Master's thesis

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Explaining Public Disagreement over Risk

The Case of Disasters

Master's thesis in Political Science

Trondheim, June 2012

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Abstract

Citizens' perceptions of the risk associated with various kinds of disasters are important. Public opinion on these matters can both compel and constrain political, economic and social efforts to address issues related to these hazards. Starting with the observation from surveys that there appears to strong public disagreement over the risk posed by various disasters, this thesis sets out to explain these observations. Three different kinds of disasters are selected as cases: terrorist attacks, oil spills, and long-term power blackouts. Although past research has identified a number of factors which may be relevant to the understanding of risk perceptions, there has been relatively little research on variations in risk perception within the public and even less on how these variations vary across different kinds of hazards. Drawing on relevant literature, a questionnaire was designed and administered by telephone to a nationally representative sample of 901 respondents. By means of multivariate regression analyses it is demonstrated that public perceptions of the risk associated with disasters are shaped by a number of factors, including values, political orientation, trust in risk management, as well as socio-demographic characteristics such as gender and age. Importantly, however, the way in and the extent to which each of these factors influences risk perceptions is highly dependent upon the particular hazard under consideration. While this was expected with regard to the effect of values and political orientation, it is much more difficult to explain why the effect of trust in risk management as well that of socio-demographic characteristics varies across hazards. Implications of findings to both risk managers and risk perception research is discussed.

Preface

This master thesis is the result of about two years of work. It all began in 2009, when I was offered a job in the Analysis and research section at the Directorate for Civil Emergency and Preparedness Planning (DSB). Although at this point I had not even begun working on a thesis, I decided to accept the offer and to write my thesis in parallel with work. I soon started to search for research topics in DSB's portfolio that could be linked to the study of political science. DSB's annual survey about public risk perceptions stood out for a number of reasons. Not only was the subject closely related to the field of public opinion, but there were also a number of interesting research questions attached to the surveys. Moreover, I saw that by modifying the questionnaire and analyzing the data more thoroughly than had previously been done, the survey had the potential of providing useful information to disaster risk managers. Thus, a few months prior to the 2010 survey, I wrote a research proposal to DSB. The idea was well received and after some short negotiations the project was green-lighted in June 2010.

During the two years of preparation, I have learned not only about the subject under study, but also about the process of doing research, including writing research proposal, designing questionnaire, negotiating with the market research company, analyzing and interpreting the data collected and much more. Perhaps also part of the process has been much frustration and hard work. The progress of the project has suffered from the fact that I have had two "jobs" at the same time, and many evenings, weekends and even holidays have been spent at the office.

There are many people to be thanked for their support throughout the preparation of this thesis. First of all, I am very grateful to DSB for giving me the opportunity to carry out this project. Without their backing and financial support, this project had never happened. Although I am well aware of the limitations and difficulties of applying research results onto "real world" issues, I hope they will find the final product interesting and useful. I would also like to thank my adviser, Ola Listhaug, for helpful comments and valuable guidance throughout the process. Given the circumstances under which this thesis has been written, his patience has been most welcome. Finally, I would like to thank colleagues and friends who have commented on the final draft. Still, of course, any shortcomings are my responsibility alone.

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1. Introduction

1.1 Background

From time to time societies and even entire nations are exposed to large-scale events with devastating consequences. The nature of these disasters varies, in terms of both their origins and consequences. Sometimes they are caused by the forces of nature, as with the Hurricane Katrina in 2005. Other times they are results of human error or technological failure, as the massive oil spill in the Mexican Gulf in 2010. Other times still, they originate from malicious human acts – sometimes carried out by organized terrorist networks, as was the case in the 9/11 attacks in 2001, other times by solo terrorists, as in Norway in 2011. The consequences of disasters also differ. Sometimes they result in the death of hundreds or even thousands of people. Other times the cause long-term harm to the environment or to the economy. They all have in common, however, that they have devastating impacts – direct or indirect – on aspects of life that people value.

To decision-makers, who are ultimately responsible for protecting their citizens, the potential occurrence of future disasters represents a major challenge. Which threats and hazards are most dangerous? Which are most likely? How can they be avoided or managed? To decide on policies and strategies on these issues, decision-makers often turn to professional risk managers for guidance. Recently the concept of "national risk assessments" carried out by professional risk analysts has come to the forefront. By identifying potential disasters, characterizing and quantifying the probabilities as well as the consequences they may have on human health, environment and economy, these assessments provide important input to decision-makers.

Also important to decision makers, however, is public opinion. Public perceptions of the risk posed by hazards form the context within which policy makers operate, and can both compel and constrain political, economic and social efforts to address issues related to these hazards. In fact, the importance of public opinion on these matters seems to be increasingly recognized by governmental authorities and policy makers. Over the last decade a number of countries have began to map out perceptions of risk among their own citizens. While the purpose of these surveys may vary from country to country, one particular area in which the results may be useful is risk communication. By comparing public perceptions of risk with professional risk managers' assessments, these surveys

may help risk managers identify issues or hazards where there seem to be a need for bringing public and expert risk assessment closer into alignment.

1.2 Research objective

One of countries in which citizens' perceptions of risk are being mapped out is Norway. Since 2002, the Directorate for Civil Preparedness and Emergency Planning has conducted an annual survey[1] in which citizens' perceptions of risk associated with a range of different kinds of disasters have been mapped out, including terrorism, nuclear accidents, public transport accidents, pandemic flu, natural disasters, large-scale pollution, etc. While a number of things can be learned from these surveys, perhaps the most notable finding is the extent to which citizens seem to differ in their perception of risk. For example, on questions about the risk associated with accidents involving large-scale pollution, about 25 percent of the respondents consider the risk to be very *small*, while roughly 30 percent judge the risk to be very *large*. Similar variations in risk perception can be found on a number of other hazards as well. In short, these surveys seem to suggest that there is strong public disagreement over the risk these hazards pose to society.

To disaster risk managers, apart from presenting somewhat of a puzzle, these observations may also represent an opportunity, especially with regard to risk communication strategies. In cases when government risk managers seek to lower public concern over particular hazards, or alternatively, to increase public awareness, it seems that efforts to communicate risk would be much more effective if it was directed directly towards the members of the public whose perceptions of risk deviates the most from professional risk managers assessments. As the well known mantra in the field of communications goes, "knowing your audience" is the key to successful communication. Applied to risk communication, this suggests that in order for risk communication to be effective, a firm understanding of who these people are and why they perceive risk the way they do is essential.

Unfortunately, however, the surveys referred to above offer little or no such information. Thus, considering the potential value of this kind of information, this thesis sets out to address the following research question:

[1] Beredskapsbarometeret 2002, 2003, 2004, 2006, 2007, 2008

What can explain the observation that people seem to differ so substantially in their perception of the risk posed by disasters?

Implicit in this research question is the identification of the factors causing the observed variation in risk perceptions among the public. Thus, assuming these to be identified by reviewing the literature on the subject, the above research question can be broken down into at least three questions: What factors can account for the observed variation in public risk perceptions? Which factors are most important? Does the importance of the various factors depend on the particular disaster in question?

By addressing these questions, the objective of this thesis is to provide disaster risk managers with a framework of knowledge within which observations from surveys on public risk perceptions can be interpreted and, by extension, provide a basis for practical purposes, such as risk communication.

1.3 Selected hazards

Three disasters have been selected as cases. The choice of three hazards, rather than a single case, is based on methodical considerations. More specifically, by studying citizens' perceptions of risk in relation to three hazards, it will be possible to examine the extent to which the factors shaping risk perceptions vary across hazards, that is; whether the influence of various factors depend on the particular hazard under consideration. The choice of three hazards rather than, say five or ten, is mainly based on the financial constraints of the project, as collecting more data would mean increased costs. It can also be defended on methodical grounds; with a given amount of resources, more data on perceived risk (i.e. additional hazards) would necessarily have to mean either less data on explanatory factors or fewer respondents – neither of which would be desirable.

The three selected hazards are *terrorist attacks*, *large-scale oil spills*, and *long-term power blackouts*. These particular hazards were selected because they represent hazards of very different nature in terms of their origins and consequences; terrorism originates from malicious human acts and typically causes both death and social unrest; oil spills usually stem from human error or technological failure and may cause harm to nature and environment; while long-term power blackouts represent some sort of technological failure which may have wide-ranging impacts on society. So if the effect of the various factors (yet to be identified) on risk perception vary across different kinds of hazards, this design should allow me to examine that. Of course, to the extent the

literature suggests this to be the case, hypotheses will be formulated which reflect these expectations.

1.4 The structure of the thesis

I start by defining risk and related concept, including risk perceptions. In chapter 3, literature and past research on risk perceptions will be reviewed. A number of hypotheses will be formulated throughout this chapter, ending in a comprehensive table in the end chapter. In chapter 4, data collection and operationalization of theoretical variables will be presented, while analyses and results are presented in chapter 5. This chapter is split in two; First, I give a short descriptive analysis of the dependent variables, with focus on variation among the public in perceived level of risk associated with each of the three hazards studied. Next, by means of multivariate regression analysis, I examine the extent to which the variables are able to account for the observed variations. In chapter 6, I summarize the findings and draw conclusions. I also discuss the extent to which findings may be valid in relation to other kinds of hazards. Finally, implications to both risk management and risk perception research is pointed out.

2. The concept of risk

In this chapter some of the key concepts of this thesis will be defined; Risk, hazard, risk assessments, risk management and, finally, risk perception. By defining these concepts, this section will serve as background for the next chapter in which theories explaining why people perceive risk the way they do are presented.

2.1 Risk

The word "risk" seems to appear in almost all areas and levels of society; in everyday language among citizens, in media, in politics and, of course, in professional and scientific literature. Despite (or perhaps as a result of) its omnipresence, however, the way in which the word risk is used reveals that there is little consensus on the meaning and properties of the concept. As Renn and Rohrmann (2000:13) note: "Talking about risk faces the immediate danger that everybody talks about something different".

The understanding of the concept of risk differs across fields of research, and a single, commonly accepted definition of the term does not exist. According to Renn and Rohrmann (2000:13), however, most risk concepts have one thing in common, namely the distinction between reality and possibility: "If the future were either predetermined or independent of present human activities, the term 'risk' would make no sense". If this distinction is acknowledged, they argue, the term risk can be defined as "the possibility that an undesirable state of reality (adverse effects) may occur as a result of natural events or human activities" (Renn and Rohrmann 2000:13, parentheses in original), or alternatively: "the possibility that human actions, situations or events might lead to consequences that affects aspects of what humans value" (Renn and Rohrmann 2000:14).

A somewhat simpler and more concrete definition, much more commonly used by risk professionals, is risk as "the combination of the likelihood of an event occurring and the consequences of the event" (International Organization for Standardization 2009a:4). This definition is also more quantitative, in the sense that it more clearly conveys the idea that risk can vary in size or level, depending on the magnitude of the likelihood and the severity of the consequences. Conceptually, however, the two definitions are equivalent; both imply that risk

consists of two components: a) the possibility or likelihood of events and b) the adverse effects or consequences of events. Consequently, the two definitions can and will be used interchangeably throughout this thesis.

2.2 Hazard

Hazard is a key term in relation to risk. Although the term hazard is not used explicitly in any of the above definitions of risk, this is precisely what "human actions, situations and events" refer to. Hazard is a collective term referring to "a source of danger" (Kaplan and Garrick 1981:12). More specifically, it can be defined as "a situation, event or substance that can become harmful for people, nature or human-made facilities" (Renn and Rohrmann 2000:14).

In most contexts it makes little sense to talk about risk without also referring to a hazard. However, while closely linked, the distinction between them is important. While a hazard is something tangible (e.g. oil spills), risk is not. A quick glance at the risk literature reveals, however, that many researchers blur this distinction by referring to hazards (e.g. nuclear power, terrorism, financial crises, etc.) as "risks". Not only is this way of using the term *risk* inconsistent with the above definitions, but it is also confusing, since – at least in principle – it allows for statements like "the risk of risks". Thus, to avoid confusion when discussing risk in relation to various hazards, I will use the phrase "risk posed by [the hazard]", or "risk associated with [the hazard]" throughout this thesis. I deliberately avoid using the phrase "risk *of* [the hazard]", as I believe this implies an understanding of risk as synonymous to likelihood, which it is not.

2.3 Risk assessment and risk perception

Having defined both *risk* and *hazard*, as well as the relation between them, it is necessary to describe the activities and processes by which risk is evaluated, that is; the size or level of risk ascribed to hazards. In the following this will be done from both a technical point of view and from a layman's perspective.

"Risk assessments" refers to evaluations of risk by professionals and researchers. Although the practices differ between disciplines and fields of work, technical risk assessments typically involve

the following steps or activities (International Organization for Standardization (2009b); a) Identification and specification of events that may threaten people, nature or human-made facilities; b) Estimation of potential losses of the various events – a procedure which requires that losses are converted into quantifiable units, such as number of deaths, financial losses, etc.; and c) Estimation of likelihood – typically derived from historical data (frequencies) of similar events. Finally, by multiplying estimates of both likelihood and expected losses together, an estimate of risk is determined.

Risk assessments, in turn, form the basis for "risk management", which refers to activities and efforts made to reduce risk. Basically, this can be done either by reducing the likelihood of the event (i.e. preventive measures) or by mitigating the consequences if the event occurs (e.g. emergency planning).

"Risk perception" can be understood as the layman equivalent to expert risk assessment. The term was originally coined by psychologists in the 1960's to denote the subjective element in risk judgments by laymen as opposed to experts (Slovic 2000a). It refers to "people's judgments and evaluations of hazards they (or their facilities or environment) are or might get exposed to" (Renn and Rohrmann 2000:14-15). Alternatively, it can be described as "the subjective assessment of the probability of a specified type of accident happening and how concerned we are with the consequences. To perceive risk includes evaluations of the probability as well as the consequences of a negative outcome" (Sjöberg, Moen and Rundmo 2004:8).

2.4 Real versus perceived risk

In the natural sciences and technical communities "risk" is often understood as an objective entity which can be measured and calculated by means of technical risk assessments. As a result, risk estimates based on such assessments are often considered as "real", whereas layman risk judgments are seen as "perceived". The distinction between "real and "perceived" risk has been heavily criticized, however. Renn and Rohrmann (2001:15) point out that, since risk judgments are simply inference about implications of a current or future reality, "[e]pistemologists could easily show that all statements about risks, whether rough guesses or highly quantitative data-based computations, are only reflections of the 'reality' under consideration".

In fact, the idea that technical risk assessments can provide estimates of the "real" risk has been particularly strongly challenged in the context of disasters (Otway 1992). The critics argue that, in contrast to hazards such as car driving, smoking, etc., disasters have qualities and characteristics which do not lend themselves to the same method of calculation. Freudenburg (1992) points out that because disasters occur infrequently, the use of historical data and frequencies to estimate probability is not very appropriate. Also, he argues, lack of experience and knowledge about these rare events make it almost impossible to anticipate and predict adverse effects, which may be both unknown and long-lasting. Similarly, Renn (1992) argues that the adverse effects of disasters often go beyond what can be measured and quantified, and that the parameters employed in technical risk assessments, such as harm to people, are hardly sufficient to capture the adverse effects of disasters on people and society as a whole. As Jeager, Renn, Rosa and Webler (2001:88) point out: "Confining undesirable consequences to physical harm excludes other consequences that people might also consider undesirable". Additional parameters could be employed, of course, but what people perceive as undesirable, and how undesirable it is, depends on their values and preferences: "The evaluation of consequences differs considerably among groups when undesirable effects include impact on values, equities or their social interest. These effects may or may not be more relevant than physical harm to different actors" (Jeager, Renn, Rosa and Webler 2001:88).

Having defined risk and related concepts, and also the way in which risk is evaluated by both professionals and laymen, we now begin to see the outline of reasons for why people might perceive risk differently.

3. Theory and research on risk perceptions

Research on risk perceptions can be traced back to the 1960's when individuals' judgments about hazards were implicated as one of the main determinants of public opposition to technologies (Sjöberg, Moen and Rundmo 2004). During the 50 years of research on the subject, contributions have come from a wide range of disciplines, including psychology, economics, anthropology, political science sociology and geography. Broadly speaking, the literature has evolved into two streams of research; one which has sought to explain why the general public tends to see certain hazards as more dangerous than others, another which has sought to explain why citizens tend to differ in their perception of risk.

Considering the objective of the present study, this thesis will draw on theories and research within the latter stream of research. This literature, which will be presented throughout chapter 3, will form the basis for a number of hypotheses later to be tested. However, since research within the former stream of research has been highly influential in risk perception research, a brief sketch of these approaches is in order. By outlining the objectives, findings and criticism of these approaches, the following sub-chapter will also serve to justify the choice of theories and research in the present study.

3.1 Cognitive approaches to risk perception

Early research on risk perceptions focused on the cognitive processes by which people judge risk. Contributions to this research have come mostly from scholars within the field of behavioral economics and psychology. In general, much of this work has been motivated by the observation that ordinary people's perceptions of risk often differ from those of experts.

3.1.1 Heuristics

An early account of why laypeople tend deviate from experts was given by Tversky and Kahnemann (1974). These researchers demonstrated that when faced with the difficult task of assessing probability and estimating consequences (e.g. number of fatalities), people tend to rely on certain *heuristics*, that is; "orienting mechanisms that allows people to navigate quickly and

efficiently through a complex, uncertain and sometimes dangerous world (…)" (Leiserowitz 2006:48). Three heuristics were identified; 1) *representativeness*: the extent to which the hazard belongs to a group of hazards with similar characteristics; 2) *availability*: how easily a risk issue comes to mind; and 3) *anchoring and adjustment*: judgments are anchored to an initial value, and then adjusted to the present circumstance. Later, Tversky and Kahnemann (1981) identified a fourth heuristic; *framing*, which implies that different formulations of the very same risk issue may lead to different judgments of the risk. More recently, the concept of "affect heuristics" has been introduced (Poortinga and Pidgeon 2005). This research suggests that when asked to judge the risk posed by various hazards, people tend to draw on positive and negative feelings associated with the particular hazard in question. Thus, when a hazard evokes negative feelings people tend to judge the risk to be large, and vice versa.

3.1.2 The Psychometric Paradigm

Another approach in cognitive risk perception research has been the so-called *psychometric paradigm*, developed by Paul Slovic (2000) and his colleagues (Fischhoff, Slovic, Lichtenstein, Read and Combs 1978). Like Tversky and Kahnemann, these researchers also sought to explain why laymen differ from expert in their judgment of risk. More specifically, they were interested in why the public see certain hazards as more risky than other hazards. These researchers used extensive surveys in which respondents were asked to rate the risk associated with a wide range of hazards, ranging from everyday hazards such as smoking to nuclear power. Respondents were also asked to rate the extent to which the hazard possessed certain "qualitative characteristics". A number of such characteristics were identified, and by means of factor analyses Slovic (1987) reduced these to two dimensions: The first dimension, "degree of knowledge" indicates the extent to which the risk is known to those exposed, known to science, observable and whether its effects are delayed. The second dimension, "dreadfulness", denotes the extent to which the risk is dreadful, uncontrollable, involuntary, equitable, easily reduced, increasing, and whether it has fatal consequences. By analyzing respondents' scores (using sample mean) on these two dimensions, empirical studies have been able to explain a large portion of the variance in public risk perceptions, typically around 60-70 percent (Sjöberg et al. 2004).

Broadly speaking, research within the psychometric paradigm has made two important contributions. First, by identifying the influence of qualitative characteristics of hazards on people's risk judgments, this research has helped explain why the general public perceives certain hazards to be more "risky" than others. Second, it has demonstrated that ordinary people have a much richer definition of risk and that they base their risk judgment on a number of aspects other than those typically employed by experts and risk professionals (i.e. probability and fatalities). As such, this research has also helped us understand why disagreements over risk between the public and experts exist. A problem with the psychometric paradigm, however, is that it does not distinguish between individuals or groups of individuals (Marris, Langford and O'Riordan 1998). Because these researchers have been primarily interested in why "the public" consider certain hazards to be more dangerous than others, most of these studies have used average risk ratings of whole samples analyzed across different hazards. As a result, this research does not take individual differences into account (Viklund 2003). Moreover, as pointed out by Marris et al. (1998), even if individual differences *are* taken into account, the psychometric paradigm does not really help understand *why* people perceive risk the way they do. For example, that people who think of a hazard as "dreadful" also perceive the risk posed by that hazard to be large (and vice versa) should not be very surprising. The "real" question, one might argue, is why some people think of the hazard as dreadful in the first place, while others do not. On this note, Wåhlberg (2001:244) argue that the psychometric approach should not be considered a theory at all, but "models, i.e. descriptions of data, without explanatory power (…)".

Overall then, despite their important contributions to risk perception research, the cognitive approaches outlined above offer little insights into the question of why citizens seem to perceive risk differently. Obviously, to understand this observation, one needs to look for explanations not based on "the simple assumption of generalized rationality which seeks to apply to all people in the same way" (Zinn and Taylor-Gooby 2005b:37). In the following three chapters, theories and research which may account for variation in risk perceptions will be reviewed. As noted earlier, these explanations point towards various cultural, political and social factors as the key factors.

3.2 Cultural Theory

Among approaches emphasizing the influence of culture and values on perception of risk, the so-called *Cultural Theory* has been by far the most influential. Along with "the psychometric paradigm" described previously, Cultural Theory is considered to be one of the two approaches dominating the field of risk perception research (Sjöberg et al. 2004). In short, Cultural Theory holds that people's perceptions of risk are shaped by deeply held values or worldviews. According to its proponents, the theory is able to "predict and explain what kind of people will perceive which potential hazards to be how dangerous" (Dake and Wildavsky 1990:42). In the following, the underlying theory as well as empirical research will be reviewed. This provides the basis for hypotheses stated at the end of the chapter.

3.2.1 The underlying theory: Social relations and cultural biases

Cultural Theory was originally launched by social anthropologist Mary Douglas (1973 and 1978) and political scientist Aaron Wildavsky (Douglas and Wildavsky 1982), and has later been developed by others, including Michael Thompson and Richard Ellis (Thompson, Ellis and Wildavsky 1990). As most cultural theories, the basic claim of Cultural Theory is that people are culturally biased; how people perceive the world, what they believe, do or want is shaped by the culture to which they belong. From this perspective, risk is socially constructed and shaped by the "cultural lenses" of the perceiver. Disagreements and conflicts about risk must be understood as a struggle between different cultures, each culture with their own perspective on different hazards.

According to Douglas (1973), the most important thing separating different cultures from each other is the *social relations* that characterize each culture. She proposed a framework based on two basic dimensions of sociality which she believed could capture most of the variability in an individual's involvement to social life; *grid* and *group*. Thompson et al. (1990:5, emphasis in original) define the two dimensions in the following way: "*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". The two dimensions are assumed to be

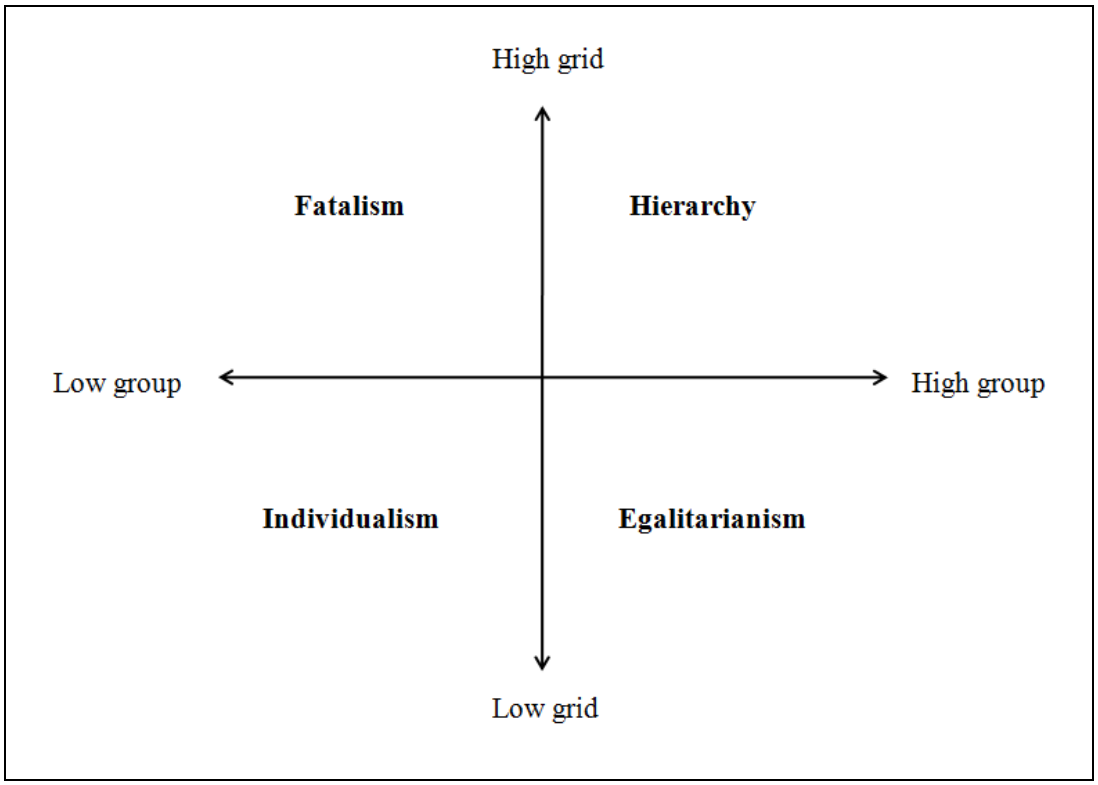
independent, and by crossing them, four types of social relations emerge: hierarchy, egalitarianism, individualism and fatalism.

For each type of social relation, Cultural Theory postulates, there is a corresponding *cultural bias*. Cultural biases are defined by Dake and Wildavsky (1990:43) as "worldviews or ideologies entailing deeply held values and beliefs defending different patterns of social relations". As implied by this definition, cultural biases are functional. Social relations and cultural biases are thought to be interacting and mutually reinforcing: "Adherence to a certain pattern of social relationship generates a distinctive way of looking at the world; adherence to a certain worldview legitimizes a corresponding type of social relations" (Thompson et al. 1990:1). Patterns of social relations and cultural biases cannot be mixed and matched, but are always found interacting together. A change in a person's worldview (e.g. views on human nature, physical nature, etc.) will be accompanied by a change in the social relations the person can justify to live in. Thus, since there are only four ways of social relations, there can only be four cultural biases or worldviews. [2] When combinations of social relations and cultural biases are mutually reinforcing they are *viable* and together they form a *culture* or a *way of life*. The typology is depicted in Figure 3-1.

Hierarchy, represented in the upper right corner, is characterized by strong group boundaries (high group) and binding prescriptions (high grid). An individual's position in society is defined by institutionalized classifications (e.g. age, gender, race). Hierarchical social relations, division of labor, role differentiation, etc. is justified on the grounds that human beings are "born sinful but can be redeemed by good institutions" (Thompson 1990:35). Institutional constraints are therefore necessary to enable people to live more harmoniously together. To hierarchists, fairness means equality before the law, and blame is put on those who deviate from established rules and procedures (Mamadouh 1999). To hierarchists nature is "tolerant"; it is robust and forgiving of most events, but may be vulnerable to occasional shocks (Thompson et al. 1990). Humans must therefore show moderation in order to attain sustainability.

[2] Actually, Thompson et al. (1990) also identify a fifth cultural type; the 'hermit'. Few cultural theorists seem to acknowledge this position however, and I will not discuss their argument here.

Figure 3-1: The typology in Cultural Theory: hierarchy, egalitarianism, individualism and fatalism



In the lower-right corner is the egalitarian culture, which is characterized by strong group boundaries (high grid) and minimal prescriptions (low grid). Underpinning support for non-coercive (low grid) and cooperative (high group) social relations is the belief that human beings are "born good but are corrupted by institutions" (Thompson et al. 1990:34). They therefore reject the role differentiation and institutional constraints favored by hierarchists. Fairness consists of equality of result, while blame is put on those in power or "the system" (Mamadouh 1999). To egalitarians nature is "ephemeral"; it is unforgiving and even minor human interference can upset the natural balance (Thompson et al. 1990). The nature must be treated with great care, and effective sanctions are required to prevent unwanted events from happening.

The individualist culture is represented in the lower-left corner. Individualists are bound neither by group incorporation (low group) nor by prescribed roles (low grid). All boundaries are provisional and subject to negotiation. To individualists, human beings are self-seeking. Human nature is extraordinary stable, and no institutional arrangement can change it (Thompson et al. 1990). Fairness consists of equality of opportunity, and blame is put on personal failure or lack of competition (Mamadouh 1999). To individualists, nature is "benign"; it is extremely forgiving and

no matter what humans do, the natural balance will eventually return to equilibrium (Thompson et al. 1990). We can therefore take a laissez-faire attitude and trial and error will generate the best outcome.

The fatalist culture is represented in the upper-left corner. Like hierarchists, individuals in the fatalist culture are subject to binding prescriptions (high grid). Unlike hierarchists, however, group incorporation is weak (low group). Fatalists feel controlled from the outside since they are "excluded from membership in the group responsible for making the decisions that rule their life" (Thompson et al. 1990:7). To fatalists, the human nature is unpredictable. Because one can never know what to expect from others, fatalists tend to distrust other people. Fairness does not exist and blame is put on faith and bad luck (Mamadouh 1999). "Nature capricious", the fatalist view, is a random world (Thompson 1990). From this perspective, all we can do is to cope with unpredictable events.

3.2.2 Cultural types and perceptions of risk

Adherence to one of the four cultures is also postulated to generate distinctive preferences and attitudes toward hazards. Following the functionalist argument, people are viewed as "active organizers of their own preferences", who "choose what to fear (and how much to fear it) in order to support their way of life" (Dake and Wildavsky 1990:43, parentheses in original).

Thus, because hierarchists favor established rules and norms, they tend to be more concerned than others about acts of social deviance such as alcoholism, AIDS, drug addiction, crime, etc. (Dake and Wildavsky 1990). They also fear hazards which may disrupt stability and social order such as war and terrorism (Douglas and Wildavsky 1982). Because hierarchists believe the nature is robust, they tend to show moderate concern for environmental hazards. They are generally optimistic towards technology, and show little concern for technological hazards, especially if it is managed and sanctioned by the authorities and experts in whom they have great trust (Thompson et al. 1990).

In contrast to hierarchists, egalitarians are not very concerned about social deviance, which is regarded as a violation of the demarcations they dislike. They tend to distrust authorities and experts and are generally skeptical towards technology which is managed and controlled by these people (Thompson et al. 1990). They distrust authorities and experts and reject a system that would impose involuntary and irreversible dangers onto people (Thompson et al. 1990). Because egalitarians

believe the nature is extremely fragile they tend to be more concerned than others about hazards which can cause environmental harm.

Individualists see risk as an opportunity (Thompson et al. 1990:61). In a world without uncertainty and potential losses there would be no prospect of personal reward and entrepreneurship. Since individualists are opportunists, they tend to be confident about technology and that new technologies will be able to mitigate unforeseen consequences to the environment (Thompson et al. 1990:63). In general, individualists show little concern for hazards unless they may threaten their personal freedom or disrupt the functioning of market, such as economic trouble and financial crises (Dake and Wildavsky 1990:46).

Fatalists see the occurrence of disasters as a matter of faith and chance (Dake and Wildavsky 1990; Thompson et al. 1990). According to Thompson et al. (1990:63), this sometimes confers onto them a "stoic dignity". In general, however, cultural theorists have made few claims about their attitude to risk, and hypotheses are seldom stated (e.g. Marris et al. 1998). Indeed, the cultural bias of fatalism is often left out of empirical analyses in research on risk perception (e.g. Dake and Wildavsky 1990)

3.2.3 Empirical applications of the theory

Quantitative studies of Cultural Theory in risk perception research have mostly relied on measurement instruments developed by Karl Dake (1991). Dake took items originally developed to measure personal attitudes (e.g. confidence in institutions, patriotism, authoritarianism, etc) and modified these in order to measure the cultural biases of Cultural Theory, i.e. hierarchy, egalitarianism, individualism and fatalism. The applications of these measures (i.e. scales) have produced mixed results.

On one hand are Dake and Wildavsky (1990) who studied public concern across a range of activities, technologies and events, broadly falling into the categories of technological and environmental hazards, war, social deviance, economic trouble. By analyzing the correlations between the measures of cultural biases and ratings of concern, these authors found a pattern of correlations largely consistent with the prediction of Cultural Theory. More specifically, hierarchy was found to correlate with high scores on issues related to social deviance. Egalitarianism

correlated with high ratings on technological and environmental hazards, while hierarchy and individualism correlated with lower scores on these hazards. Finally, individualism was found to correlate positively with economic issues. By comparing these correlations with those of other variables expected to influence perceptions of risk, they concluded that "cultural biases provide predictions of risk perceptions and risk taking preferences that are more powerful than measures of knowledge and personality, and at least as predictive as political orientation" (Dake and Wildavsky 1990:50).

On the other hand is Lennart Sjöberg (1998), one of the most outspoken critics of Cultural Theory. Sjöberg criticized Dake and Wildavsky (1990) for reporting only bivariate correlations. Thus, to examine if the same results could be obtained from multiple regression analyses, Sjöberg conducted a new survey using the same items as Dake and Wildavsky. The study successfully replicated the pattern of correlations between societal concerns and cultural biases, but the overall explanatory power was weak, and the four cultural biases were able to explain only 5-10 percent of the variation in perceived risk (see also Sjöberg 2000).

In between these two are, among others, Marris et al. (1998). These researchers criticized Sjöberg (1998) for paying too much attention to overall explanatory power of the four cultural biases taken together, averaged across different hazards. Instead, they argued, data should be analyzed with respect to *patterns* of correlations. In their own study, using some slightly modified version of Dake's items, they examined correlations between each of the four cultural biases and risk perceptions ratings for 13 hazards. Like Sjöberg, they found that the overall explanatory power was weak (5-10 %). They stressed, however, that although the correlations were weak, *a high proportion* of the correlations were statistically significant. Moreover, many of the significant correlations confirmed their hypotheses derived from Cultural Theory. They concluded that that "the correlations, though weak individually, may create a meaningful pattern if examined as a whole" (Marris et al. 1998:640).

Leiserowitz (2006) applied Cultural Theory to study variation in public perceptions of risk associated with global warming in the US (for a somewhat different application of Cultural Theory in the case of environmental hazards, see Steg and Sievers 2000). He found that cultural biases accounted for about 26 percent of the variance in risk perceptions. More specifically, and consistent with the predictions of Cultural Theory, egalitarianism was associated with higher levels of perceived risk, while measures of hierarchy and individualism were associated with lower level of

perceived risk. Fatalism was not associated with perceptions of risk. It should be noted, however, that Leiserowitz examined the relationships (and even tested his hypotheses) between cultural biases and risk perceptions without controlling for other relevant variables. When included in his "full model" (thus controlling for sociodemographics, politics, etc.), the correlations became substantially weaker and some even non-significant.

In summary, the results of empirical studies are mixed; the explanatory power of cultural biases on perceptions of risk is modest (typically between 5-10 percent), but the pattern of correlations between measures of cultural biases and perceptions of risk posed by various kinds of hazards are often consistent with the prediction of the theory.

There also seems to be some serious problems with the validity of the cultural bias measures based on Dake's items. Rippl (2002) points out that according to Cultural Theory an individual's cultural bias corresponds to the individual's location along the two dimensions of sociality: grid and group. People adhering to diagonally opposed cultures show differences on both dimensions, while neighboring types show similarities on one dimension, but differences on the other. As a result, Rippl argue out, one should expect measures of diagonally opposed cultures to be strongly negative, while neighboring cultures to be only weakly correlated. In empirical studies, however, the pattern of correlations between the four constructs based on Dake's items does not correspond to these expectations. Especially problematic in this respect has been the often found strong positive correlation between the two diagonally opposed cultures *hierarchy* and *individualism*.

Rippl (2002) has therefore proposed a new measurement instrument to operationalize Cultural Theory. I will return to this topic in chapter 4, and for now it suffice to say that her measurement instrument produced measures whose intercorrelations were consistent with theoretical expectations, thereby indicating much better validity than Dakes' (1991) measures. Importantly, she also demonstrated that the correlations between the four measures and perceived risk of various hazards were largely consistent with the predictions of Cultural Theory; hierarchy was negatively associated with ecological hazards, while positively associated with threats to social order; egalitarianism was positively associated with ecological hazards, unemployment and AIDS; while individualism was negatively associated with all hazards, except from of ecological hazards.

3.2.4 Hypotheses

Throughout this chapter I have outlined the predictions of Cultural Theory with regard to what kinds of hazards the four cultural types are expected to be more or less concerned about, as well as the rationale underpinning their perceptions of risk. In the present study, Cultural Theory is applied on the three hazards: Terrorism, oil spills and power blackouts. The question now, then, is the extent to which each of these hazards fall into the relatively broad categories of hazards which cultural theory claim to predict, or alternatively – if the hazards do not fall into any of these categories – the extent to which they are seen by the four cultural types as threats to their respective way of life. In the following, by drawing on the theory explicated above, I will hypothesize how the risk associated with each of the three hazards under study are likely to be seen within the hierarchic, egalitarian, individualist and fatalist worldviews, respectively.

Hierarchists

Starting with terrorism; this is a hazard about which hierarchists should be very concerned. Indeed, apart from the objective of spreading fear, terrorism represents an attack on the existing social and political order which, according to Cultural Theory, is exactly what hierarchists value and therefore wish to defend.

> *H_1: Hierarchists perceive the risk posed by terrorism to be greater than do non-hierarchists*

Turning to oil spills; this is a hazard which often stems from technological failure and which has the potential of causing harm to the environment. However, since hierarchists are technologically optimistic and because they view the nature as tolerant (Thompson et al. 1990:27), they should be expected to show less concern than others about oil spills.

> *H_2: Hierarchists perceive the risk posed by oil spill to be lower than do non-hierarchists*

To the extent long-term power blackout is considered as some kind of technological hazard, one should expect hierarchists to show little concern over this particular hazard; they are technologically optimistic, especially when the technology is sanctioned and managed by authorities and experts as in this case.

H_3: Hierarchists perceive the risk posed by power blackout to be lower than do non-hierarchists.

Egalitarians

With regard to terrorism, the relationship between egalitarians and this hazard is difficult to predict. Cultural theorists have not been explicit about this relationship. Intuitively, terrorism does not readily present itself as a hazard which threatens equality (and certainly not the environment) which is what egalitarians are most concerned about. Thus, no prediction is made for egalitarians and their perception of the risk posed by terrorism.

With regard to oil spill, this is certainly a hazard about which egalitarians should be very concerned; not only does it often originate from technological failure, but it may also cause harm to environment, which by egalitarians is seen as extremely fragile.

H_4: Egalitarians perceive the risk posed by oil spill to be greater than do non-egalitarians.

Turning to power blackout, and again assuming this hazard to be regarded as one of technological failure, one should expect egalitarians to be more concerned about power blackouts than non-egalitarians.

H_5: Egalitarians perceive the risk posed by power blackout to be greater than do non-egalitarians.

Individualists

Individualists are portrayed as opportunists and risk-takers who tend to show little concern about hazards unless they pose a threat to their personal freedom or the functioning of markets. Thus, since none of the three hazards studied here is likely to be considered as such, one should expect individualists to show low concern about these particular hazards. The following three hypotheses can be stated:

H_6: Individualists perceive the risk posed by terrorism to be smaller than do non-individualists.

H_7: Individualists perceive the risk posed by oil spill to be smaller than do non-individualists.

H_8: Individualists perceive the risk posed by power blackout to be smaller than do non-individualists.

Fatalists

Cultural theorists have not discussed fatalists' risk perceptions in much depth and predictions are seldom made. Indeed, Dake and Wildavsky did not even include the cultural bias of fatalism in their empirical study. Thus – even though Thompson et al. (1990:63) go a long way in suggesting that, because fatalists believe the occurrence of disasters is a matter of faith or (bad) luck and that there is little they can do about risk, they tend not to worry over things – no predictions are here made about fatalists' perceptions of risk. It would still be interesting to examine empirically, though, whether fatalists differ from non-fatalists in their perceptions of the risk posed by the three hazards under study.

3.3 Political orientation

While the concept of political orientation is widely used in social science to predict and explain public opinion, attitudes and behavior, the influence of political orientation has received very little attention in risk perception research. As such, political orientation does not represent a distinct "approach" in the risk perception literature. A chapter on political orientation is still included here, however, as there seems to be good reasons to expect political orientation to influence perceptions of risk in a predictable way. If so, the inclusion of political orientation to the analyses may help explain why people tend to differ in their perception of risk.

3.3.1 Political orientation in risk perception research

As noted above, despite its widespread application in the social sciences, the concept of political orientation has received very limited attention in risk perception research. Various measures of political orientation, such as left-right and liberal-conservative, are typically included in empirical models, but the findings are hardly ever discussed beyond confirming the existence (or not) of a relationship (see for instance, Fischhoff, Gonzalez, Small and Lerner 2003; Gerber and Neeley 2005; Leiserowiz 2006; Whitfield, Rosa, Dan and Dietz 2009). It seems, however, that the absence of discussions regarding the influence of political orientation is not so much about lack of associations as it is about lack of a theoretical framework within which findings can be interpreted. After all, although weak, many of the studies report associations of similar strengths as other measures (e.g. cultural biases).

Of course, a systematic review of risk perception studies employing left-right or liberal-conservative measures, such as those above, could potentially produce some interesting findings, for example some sort of pattern of correlations between left-right and perceptions of risk associated with different kinds of hazards. As it will be demonstrated below, however, the specific content of left-right is to a large extent country-specific, and without a solid understanding of the meaning of "left" and "right" (or liberal or conservative) in the particular country in which the study is conducted, these results are difficult to interpret in a meaningful way – and I will not attempt to do so. Instead, I will outline how the left-right schema may serve as a conceptual framework from which hypotheses about risk perceptions can be generated.

3.3.2 The left-right schema and its applicability to risk perceptions

As noted above, political orientation is typically measured as an individual's (self-reported) location along the left-right (or liberal-conservative) dimension. A detailed account of the properties of the left-right dimension and the way in which it influences political behavior and public opinion has been given by Fuchs and Klingemann (1990). According to these scholars, "left" and "right" can be thought of as abstract principles, that is; as basic values or ideologies. The primary function of the left-right dimension is to serve as an orienting mechanism: "a means for citizens to orient themselves in a complex political world" (Fuchs and Klingemann 1990:205). By drawing on their ideological understanding of left and right, and by evaluating and classifying political issues within that framework, the left-right dimension enables people to take a stand on a variety of political issues. This way, the use of left and right can be seen as "a form of deductive thinking in which specific attitudes are derived from abstract principles" (Fuchs and Klingemann 1990:204).

The specific content of left and right reflects long-term and basic factors of political conflict in society, or "basic structures of conflict" (Lipset and Rokkan 1967, in Fuchs and Klingemann 1990:207). By analyzing answers given by Dutch and West German respondents to open-ended questions on the meaning of left and right, Fuchs and Klingemann (1990:213-214) found that left was largely associated with concepts like "equality", "government control", "system change" and "socialism", while right was associated with "conservative", "order", "market economy", "capitalism", etc. However, although some of these meaning elements may be relatively universal, at least in western countries, the more specific contents of the left-right dimension depend on the political conflicts structures in the particular country of interest (more on this later).

Obviously, the left-right dimension and the way in which individuals' orientation towards left or right influences their attitudes toward specific political issues, has many similarities to that of cultural biases in Cultural Theory and the way in which individuals' adherence to certain cultural biases are thought to influence their perceptions of risk. Not only are both left-right and cultural biases conceived as values or ideologies which serve as orienting mechanisms from which specific attitudes are derived, but there also seem to be an overlap in terms of contents; between right and hierarchy/individualism and between left and egalitarianism (Dake and Wildavsky 1990; Grendstad 2003; Mamadouh 1999). In light of the similarities, and considering the dominant position of Cultural Theory in risk perception research, the lack of interest in political orientation as a predictor of risk perceptions seems somewhat peculiar.

Having outlined how abstract the principles of left and right may influence attitudes towards more specific political issues, the question now is why and how political orientation may influence citizens' perception of the risk posed by various hazards. Basically, if it is accepted that hazards – in this case oil spills, terrorism and power blackouts – can be regarded as "political issues", and that risk perceptions can be regarded as expressions of "attitudes" towards those issues, the very same logic should apply in this case.

The applicability of the left-right dimension as a predictor of risk perceptions is likely to be restricted, though: For left and right to function as an orienting mechanism by which people can evaluate a hazard, people need to be able to make a connection between the hazard in question and their understanding of left and right, that is; people need to be able to "classify" the hazard within the framework of left and right. Put differently, left-right may influence perceptions of risk only if the values captured by the left-right dimension are relevant to the evaluation of the specific hazard. This means that the applicability of left-right is restricted to hazards which somehow "tap into" the basic conflict structures in society as captured by the left-right dimension.

3.3.3 Hypotheses

As discussed above, one should expect individuals' orientation toward "left" and "right" to influence perceptions of risk if the hazard under consideration "taps into" political conflict structures captured by the left-right dimension. In the following, I first outline the content of left-right, then the extent to which the three hazards studied tap into these dimensions.

In Norway, where this study is carried out, left-right has traditionally reflected state – market (Aardal 1999), but the left-right dimension may also serve as indicator for other attitudes or sub-dimensions. Empirical studies have demonstrated that the left-right dimension is strongly correlated with a number of attitude-dimensions (Aardal 1999:90). At least two of these seem potentially relevant in this context: The first is "economic growth – environmental protection" (where left-oriented tend to support environmental protection while right-oriented favor economic growth), the other is "immigration – solidarity" (where right-oriented are anti-immigration).

Now, to what extent – if at all – do terrorism, oil spill and power blackout "tap into" the dimensions described above? In what way can orientation toward "left" and "right" influence the evaluation of these hazards? Of the three hazards, oil spill seems to be the hazard which most clearly taps into

one of the dimensions, namely the "growth – protection" dimension. It seems reasonable to expect that individuals who prefer environmental protection (i.e. left-oriented) perceive the risk posed by oil spill to be greater than do those who prefer economic growth (i.e. right-oriented).

H_9: Politically left-oriented individuals perceive the risk posed by oil spill to be greater than do right-oriented.

With regard to terrorism, the "immigration – solidarity" dimension seems potentially relevant. A vital question here, however, is the particular kind of terrorism, or more specifically; terrorism carried out by whom. I will return to how perceived risk of terrorism is measured later, but it is necessary to point out that, due to the way in which questions about terrorism was framed in the interview as well as the point in time at which data was collected, respondents' notion of "terrorism" in this study is likely to correspond to terrorism carried out by radical Islamists.[3] This may potentially lead the "immigration – solidarity" dimension to be relevant, since negative attitudes towards immigration often are driven by elements of xenophobia and prejudices against other ethnic groups, especially Muslims (Strabac and Listhaug 2008). It therefore seems reasonable to expect that people who tend to be xenophobic consider terrorism (by radical Islamists) as a greater threat than do those who are not. Thus, assuming levels of xenophobia to be reflected in attitudes toward immigration, which in turn is indicated by left-right orientation, the following hypothesis can be stated:

H_{10}: Politically right-oriented individuals perceive the risk posed by terrorism to be greater than do left-oriented

With regard to prolonged power blackouts, it is difficult to see how political orientation may influence perceptions of risk in a predictable way. Nothing about power blackout, neither its origins nor its effects, seems to tap into the basic structures of political conflict captured by the left-right dimension. It will still be interesting to examine empirically, of course, whether politically left- and right-oriented individuals differ in their perceptions of the risk posed by power blackout.

[3] The data was collected In 2010, i.e. prior to the terrorist attack in Norway on July 22, 2011. While this event surely has changed most Norwegians notion of "terrorism", it seems reasonable to assume that up to this event – still in the "wake" of the attacks in New York, London and Madrid – most citizens's notion of "terrorism" corresponded to terrorism carried out by radical Islamists.

3.4 Trust in risk management

The last two decades there has been a growing interest in the role of trust in relation to risk perception. More specifically, it is citizens' trust in the institutions involved in the management of risk which is at the center.

3.4.1 An institutional perspective

Questions about the potential influence of trust in risk management on citizens' perception of risk first were raised in the late 1980's, against the backdrop of increasing public concern over technological hazards (Pidgeon, Simmons and Henwood 2005). Public concern was in stark contrast to the confidence that most technical analysts and engineers had in their ability to manage hazard, and the seemingly irrational public fear gave rise to frustration among both risk managers and risk perception researchers: "during a 20-years period during which our society has grown healthier and safer on average and spent billions of dollars and immense effort to become so, the American public has become more – rather than less – concerned about risk" (Slovic 1993, in Slovic 2000:316).

An early account of these seemingly contradictory trends, as well as of the inability of risk perception research to explain them, was given by William Freudenburg (1993). Freudenburg criticized past research on risk perceptions for focusing too much on characteristics of either hazards themselves or the individuals. Instead, he argued, "there are strong reasons […] both theoretically and empirically, to broaden the focus further – asking not just about the individual perceivers, nor about the risks they perceive, but also about the larger institutional context within which the risks are managed" (Freudenburg 1993:909-910). According to Freudenburg, the explanation of the seemingly contradictory observations is to be found in the process of modernization. Modernization, he argues, has made possible an unprecedented increase in wealth, expertise, and physical health and safety. At the same time, however, the division of labor which characterizes modernization has created interdependency; the society and its citizens are increasingly dependent on other actors and institutions to carry out their responsibilities in order for the system to work. In short, any decline in "real risk" due to modernization is accompanied by an increase in vulnerability of interdependence. As a result, citizens' perception of risk has become highly dependent upon the extent to which responsible actors and institutions are trusted to properly carry out their role as risk managers.

3.4.2 Empirical work on the influence of trust

To test the hypothesis that citizens' perceptions of risk is related to their trust in risk managers or risk management institutions, Freudenburg (1993) conducted a study of public concern over nuclear and hazardous wastes in the U.S. In addition to state their level of concern over these hazards, respondents were asked to state their level of trust in the ability of a) national agencies, b) private enterprises and c) science and technology "to safely build and manage the system of nuclear wastes". The study demonstrated that measures of trust and perceived risk were strongly related: Among respondents with "no trust at all", roughly 80-90 percent expressed "extremely" or '"very high" levels of concern, while among respondents with "very high trust" only 30 percent expressed the same levels of concern. Multivariate models revealed that the trust variables accounted for as much as 25 percent of the variance in risk perception, while other factors, such as socio-demographic variables and political ideology, accounted for less than seven percent combined.

The negative association between trust in risk management and perception of risk has later been supported by a number of empirical studies (e.g. Gerber and Neeley 2005; Siegrist 2000; Siegrist, Cvetkovich and Roth 2000; Sjöberg 1999; Viklund 2003; Whitfield et al. 2009). Moreover, the relationship has been found to hold across a range of different kinds of hazards, including nuclear power (Sjöberg 1999; Viklund 2003; Whitfield et al 2009; Siegrist, Cvetkovich and Roth 2000), nuclear wastes (Freudenburg 1993), crime and air pollution (Gerber and Neeley 2005), gene technology (Siegriest 2000), pesticides and artificial sweeteners (Siegrist, Cvetkovich and Roth 2000).

However, although the direction of the association between trust and risk perception is well established, it is still not clear whether the hazard under consideration is important to the influence of trust (Zinn and Taylor-Gooby 2005c). This is partly due to the huge diversity in the way in which trust and its relationship to risk perception is studied, which makes comparison across case studies (which is the design of most studies) in different domains problematic (Earle, Siegrist and Gutscher 2007). The few comparative studies in the field – in which the relationship has been examined across different kinds of hazards – seem to indicate that, however, that the importance of trust on risk perception *does* vary across different kinds of hazards. A case in point is a study conducted by Siegrist and Cvetkovich (2000). These researchers examined the relationship between risk perceptions and trust in risk management across 20 different types of hazards, ranging from bicycles and handguns, to nuclear power and biotechnology. Consistent with previous research,

these authors found a negative association between trust and risk perception across all hazards. However, the importance of trust – as indicated by the strength of the correlations – varied substantially across the various hazards. More specifically, trust was found to be most important in relation to hazards about which people were less knowledgeable, such as biotechnology, nuclear power, food preservatives, etc., while less important in relation to everyday hazards with which people were more familiar, such as bicycles, smoking, motor vehicles, etc. The authors pointed out that this finding supports the argument of Earle and Cvetkovich (1995), namely that trust functions as a heuristic device to reduce the complexity of difficult issues people face. In the absence of sufficient knowledge about the hazard in question, risk judgments may be based on an assessment of those who are responsible for managing the risk. When knowledge is high, on the other hand, people make their own assessments and trust become less important.

3.4.3 Conceptual work

Despite the broad consensus on the importance of trust as a determinant of perceived level of risk, there seems to be little agreement on the definition, meanings and properties of trust. Indeed, the empirical studies referred to above differ considerably with regard to the way in which trust is conceptualized and measured.[4] As a result, there has been a growing body of conceptual and empirical work on the dimensions of trust (Earle et al. 2007; Johnson 1999).

Drawing on theories of trust as well as empirical research on the relationship between trust and risk perceptions, Earle et al. (2007) have proposed a conceptual framework of trust in which a distinction is made between "trust" and "confidence". Trust concerns the *motives or intentions* of the trustee (integrity, honesty, benevolence, fairness, etc) and is based on a judgment of value similarity, i.e. the extent to which the values of the trustee correspond to those of the trustor (as judged by the latter). "Confidence" on the other hand, concerns the *abilities* of the trusted party (competence, capacity, expertise, etc) and is based on experiences with past performance of the

[4] In a comprehensive review of data collection methods in research on trust in relation to risk perception, Earle et al. (2007) identify at least four aspects in which studies tend to differ: *type of judgment* (attribute versus ratings), *type of target* (agents versus objects), *tangibility of target* (abstract versus concrete) and *referent of judgment* (morality information versus performance information).

trustee. In relation to risk management, Earle et al. (2007:5) argue, "an individual expresses confidence in an entity by relying on it to properly control his/her external exposure".

3.4.4 Hypotheses

Based on empirical research as well as the conceptual framework proposed by Earle et al. (2007), two different measures of trust will be used in the present study. The first is *confidence,* which concerns citizens' trust in the ability of risk managing institutions to properly carry out their responsibilities. Since the most important institution in the context of disaster risk management is governmental authorities, confidence will be linked to this particular institution. The other measure is *trust,* which concerns the extent to which the institutions involved in risk management are deemed trustworthy, that is; that they have good intentions. In contrast to confidence, trust will be linked to several institutions (later to be specified) involved risk management. The nature of the relationship between risk perception and both confidence and trust is the same. The following hypothesis can be stated.

H_{11}: People who are confident that the government is able to properly manage risk associated with various hazards, perceive the risk posed by those hazards to be smaller than do those who are less confident

H_{12}: People who trust the institutions involved in risk management perceive risk to be smaller than those who do not

In contrast to the hypotheses about the relationships between various cultural biases/political orientation and risk perceptions, which are specific to the particular hazard under consideration, the hypothesized relationship between confidence/trust and risk perceptions are general, that is; the relationships are expected to hold across all three hazards studied.

3.5 Sociodemographics

Studies have repeatedly shown that perception of risk is related to the demographic characteristics of the perceivers. In the following, empirical findings on four key demographic characteristics are reviewed; gender, age, education and income. The relationship between each of these demographic characteristics and perception of risk will be hypothesized.

3.5.1 Gender

That perception of risk is related to gender appears to be one of the most robust findings in risk perception research; women tend to judge risks larger than do men (Brent 2004; Finucane, Slovic, Mertz, Flynn and Satterfield 2000; Flynn, Slovic and Mertz 1994; Woods, Ten Eyck, Kaplowitz and Shlapentokh 2008). This relationship has been found across a wide range of hazards, ranging from everyday hazards such as stress and sun tanning to air pollution and nuclear waste (Finucane et al. 2000; Flynn et al. 1994).

With regard to *why* women tend to judge risk higher than do men, a number of hypotheses have been put forward. An early hypothesis was that women are more worried about technological and environmental hazards because they have less *knowledge and familiarity* with science and technology. This hypothesis has later been rejected, however, by studies showing that gender differences are present even within expert communities, where women and men presumably have the same level of knowledge and familiarity (Barke, Jenkins-Smith and Slovic 1997).

Another explanation has been that gender differences are related to differences in *social roles* or *biological differences* (Gustafson 1998). This position holds that because women are socialized to nurture and maintain life, they are more concerned about threats to health as well as to the environment, or that because women are physically more vulnerable they might be more sensitive to harm.

A final explanation is *sociopolitical* and suggests that gender differences in risk perception reflect differences between men and women in terms in power, trust, values and status. An early but influential study in this respect was a study by Flynn et al. (1994), who studied individuals' perceptions of risk associated with 25 different hazards. These researchers found that the percentage of "high risk" responses were significantly larger for women than men on all the 25 hazards studied.

However, they also found that gender differences were much smaller among non-whites than among whites, indicating that gender differences in risk perceptions is not a matter of biology. A closer examination of the data revealed that a subsample of white men who had rated risk particularly low had higher education and household income, less egalitarian values, more trust in institutions and were politically more conservative than the rest of the sample. Based on these findings, Slovic (1997, in Slovic 2000:402) speculated that:

> "Perhaps males see less risk in the world because they create, manage, control and benefit from many of the major technologies and activities. Perhaps women and non-white men see the world as more dangerous because in many ways they are more vulnerable, because they benefit less from many of its activities and institutions and because they have less power and control over what happens in their communities and their lives".

The argument that gender differences in risk perception are related to factors such as trust and values seems to be supported by later research. For example, Siegrist (2000) found that when controlling for trust in the institutions responsible for managing gene technology, gender differences in perceived level of risk became significantly smaller. Similarly, in their study of nuclear risk perceptions in the U.S., Whitfield et al. (2009) found that gender had only an indirect effect on risk perception, via values, environmental beliefs and trust in nuclear institutions.

Overall, although there seems be some uncertainties about the underlying causes of gender differences in risk perceptions, the literature suggests that woman perceive risk to be greater than men. Since the relationship appears to be unrelated to the particular hazard under consideration, the following general hypothesis can be stated:

H_{10}: Women perceive risk to be greater than do men.

3.5.2 Age

A number of studies have demonstrated that perception of risk is related to age. In general, studies seem to suggest that older people perceive the risk to be greater than do younger people (Fischhoff et al. 2003, Gerber and Neeley 2005; Lai and Tao 2003).

There seem to be at least two explanations for age differences in risk perceptions. One explanation is linked to the aging process itself. Fischhoff et al. (2003) point out that age is related to physical

vulnerability and feelings of personal control over one self and one's environment. They suggest that this is related to risk perceptions, and since older people are more vulnerable and generally feel in less control than younger people, this may explain why older people tend to judge risk higher than do younger people.

Another explanation is that age differences in risk perception reflect, at least in part, age differences in values and beliefs (Whitfield et al. 2009). Since values and beliefs are shaped by experience and socialization, people of different age tend to have different values and beliefs, which in turn shape their perceptions of risk.

The argument that age differences in risk perception are related to values may in fact explain some of the anomalies reported in empirical research. Gerber and Neeley (2005) studied perceived risk associated with crime, air pollution and hazardous waste. In line with the general finding on age differences in risk perception, these researchers reported a positive relationship between age and perceived risk in the case of crime. In the case of air pollution and hazardous waste disposal, however, the association between age and risk perception was found to be negative.[5] Although the authors did not discuss these results themselves, the negative relationship may has to do with the general finding in research on environmental attitudes that older people are less likely than younger people to show environmental concern (Van Liere and Dunlap 1980). Thus, since these researchers did not control for values tapping into environmental concern, the relationship was found to be negative rather than positive.

Based on the general finding in the risk perception literature, the following hypothesis is stated:

H_{11}: Older people perceive risk to be greater than do relatively younger people

3.5.3 Education and income

Empirical studies have shown that education and income is related to risk perceptions (Brent 2004; Gerber and Neeley 2005; Whitfield et al. 2009; Woods et al. 2008). The general finding from these

[5] Note that Gerber and Neeley (2005) used three different measures of risk perception; "future risk", "personal risk" and "sociotropic risk". The correlation between age and these measures varied slightly, and not all correlations were significant. Overall, however, the pattern of correlations corresponded to that described here.

studies is that people with higher levels of education and/or income perceive risk to be smaller than do people with lower levels of education and/or income. The negative relationship has been found to hold across a wide range of hazards, from nuclear power (Whitfield et al. 2009) and ecological and environmental hazards (Brent 2004; Slimak and Dietz 2006), to terrorism (Woods et al. 2008) and crime (Gerber and Neeley 2005). The relationships are generally found to be weak, however, and in some of the studies referred to above, only one of the two variables (i.e. either education or income) has been found to be significantly associated with risk perception. Others still, such as Brody et al. (2008) in their study of climate change risk perceptions, found no significant relationship between any of the two variables and risk perception.

One explanation of why people with higher education and income tend to perceive risk as smaller than do their counterparts is linked to their social position. Based on the findings of Flynn et al. (1994), outlined earlier, where the group of men who rated risk particularly low were found to have (among other things) higher education and higher income than the rest of the respondents, Slovic (1997) suggested that wealthier and more educated people are more inclined to accept risk since they are, or at least feel, more capable of insulating themselves from the risk posed by various hazards, and because they belong to those in society who take part in the benefits from technologies and activities.

H_{12} *People with higher educational attainment perceive risk to be smaller than do people with lower educational attainments*

H_{13}: People with higher income levels perceive risk to be smaller than do people with lower income levels

3.6 Overview of hypotheses

As can be seen from Table 3-1, H_1–H_{10} are specific to the hazard, while H_{11}–H_{16} are general and are expected to hold across all hazards.

Table 3-1: Overview of hypotheses

Variables	Hypothesis	
Cultural biases	H_1	Hierarchists perceive the risk posed by terrorism to be greater than do non-hierarchists
	H_2	Hierarchists perceive the risk posed by oil spill to be smaller than do non-hierarchists
	H_3	Hierarchists perceive the risk posed by power blackout to be smaller than do non-hierarchists
	H_4	Egalitarians perceive the risk posed by oil spill to be greater than do non-egalitarians
	H_5	Egalitarians perceive the risk posed by power blackout to be greater than do non-egalitarians
	H_6	Individualists perceive the risk posed by terrorism to be smaller than do non-individualists
	H_7	Individualists perceive the risk posed by oil spill to be smaller than do non-individualists
	H_8	Individualists perceive the risk posed by power blackout to be smaller than do non-individualists
Political orientation	H_9	Politically left-oriented individuals perceive the risk posed by oil spill to be greater than do politically right-oriented
	H_{10}	Politically right-oriented individuals perceive the risk posed by terrorism to be greater than do left-oriented
Confidence and trust in risk management	H_{11}	People who are confident that the government is able to properly manage risk posed by various hazards, perceive the risk posed by those hazards to be smaller than do those who are less confident
	H_{12}	People who trust the institutions involved in risk management perceive risk to be smaller than do those who do not
Socio-demographics	H_{13}	Women perceive risk to be greater than do men
	H_{14}	Relatively older people perceive risk to be greater than do relatively younger people
	H_{15}	People with higher educational attainments perceive risk to be smaller than do people with lower educational attainment
	H_{16}	People with higher income perceive risk to be smaller than do people with lower income

4. Data and method

4.1 Data collection

A questionnaire was specifically designed to address the research question and to test the hypotheses of the thesis. The questionnaire, which will be described shortly, was submitted to the market research company Synovate Norway who was contracted to carry out the interviews on a representative sample of the Norwegian public. The data was collected in October 2010, when 901 respondents aged 18 or older was interviewed by telephone.

The sample consists of 430 (47.7 %) women and 471 (52.3 %) men. Age ranges from 18 to 95 years, with an average age of 49.4 years. Along with the data returned from the market research company was a standard weight-file. When activated, respondents' age, gender and geographic location become weighted according to known distributions in the Norwegian population. Also when activated, however, N increases from 901 to 3749. A comparison of the distributions of gender, age and geographic location in the unweighted sample with those in the weighted sample show that, except from a small overrepresentation of men, the distributions are close to identical in the two samples. Therefore, in the interest of avoiding an artificially high N, the unweighted (though still representative) sample will be used in subsequent analyses.

4.2 Operationalization of variables

Operationalization of each variable (or group of variables) is described in two steps. First, the *questions* used to tap into the various theoretical constructs are described. Quite some space is spent on justifying the choices made when designing the questionnaire. Next, construction of the *variables* is described; data handling, renaming, recoding, etc. Construction of scales, including factor analyses, reliability tests, etc will also be given as well as reflections on reliability and validity issues. At the end of the chapter, a comprehensive table will be provided in which all the variables later to be employed in multivariate analyses are listed.

4.2.1 Risk perception

Perceived risk is typically measured by asking respondent directly about the level of risk they associate with a hazard. By far the most common way to measure risk perceptions is to ask respondent to rate "the risk of [the hazard]". As noted earlier, however, since the phrase "risk of" is likely to lead respondents to think of risk purely in terms of probability, while ignoring the consequence component of the concept, the phrase "risk posed by [the hazard]" was used in the questionnaire of the present study.

Sjöberg and Drottz-Sjöberg (1994) have pointed out that a potential problem when asking about risk is that responses may vary according to whether people are thinking about risk to themselves, their family and friends, people in their country, etc. Therefore, they argue, when conducting surveys about risk perceptions, it is important to specify "risk to whom", that is; the risk subject. In the present study, the risk subject was specified as "society" and "Norway".

Equally important as to specify the risk subject, one may argue, is to specify "risk posed by what", that is; the hazard. For example, if respondent are asked to rate the risk posed by "a terrorist attack" a potential problem is that people may have very different images of the particular event in mind when responding to the question; some people might think about the 9/11 terrorist attacks, while others think of a suicide bomber. Since the risk people associate with two such substantially different events are likely to differ, this could lead to very different ratings. Therefore, in the present study, in order to create a sort of shared "mental image" among respondents with regard to the nature and severity of each hazard, interviewers were instructed to read a brief introduction to the respondents just before they were asked to rate the risk. The introduction referred to real events which respondents (presumably) were relatively familiar with. For example, in the case of terrorism, the following introduction was given: *Recent years, a number of western countries have been exposed to terrorist attacks. The attack at the London Underground in 2005 is an example of such an event* (see Appendix A for the introductions used in the case of oil spill and power blackouts). The questions used to measure level of perceived risk were asked directly after each introduction, before a new introduction was given for the second hazard, and so on.

For each hazard, three questions were used to measure perceived level of risk. The first question was formulated based on previous research: *How large of a risk do you think [the hazard] pose to*

the society? Respondent gave their answer on a scale ranging from 1 to 5, where 1 was "no risk at all" and 5 was "a very large risk".

The formulations of the second and third question were guided by the definition of risk as the combination of the *likelihood* of an event to occur and its *consequences*. To tap into these two components of risk, two separate questions were formulated. First, to measure *likelihood*, respondents were asked: "How likely do you think it is that such a [the hazard] will occur in Norway within the next 5-10 years?" Responses were given on a scale from 1 to 5, where 1 was "not likely at all" and 5 was "very likely". To measure *consequences*, respondents were asked: "If such a [the hazard] took place, how serious do you think this would be to the society[6]?" Again, respondents gave their answer on a scale ranging from 1 to 5, where 1 was "not serious at all" and 5 was "very serious".

The nine items resulting from these questions all range from 1-5, where low values indicate "no risk at all"/"not likely at all"/"not serious at all", while high scores indicate "very large risk"/"very likely"/"very serious". Don't know responses were coded into missing. Descriptive statistics of all nine items are shown in Table 4-1.

Table 4-1: Descriptive statistics of the nine risk perception items

Items	N	Min	Max	Mean	Std.Dev.
Terrorism Risk	895	1.00	5.00	2.88	1.111
Terrorism Likelihood	896	1.00	5.00	3.01	1.078
Terrorism Consequences	897	1.00	5.00	4.00	1.098
Oil spill Risk	892	1.00	5.00	3.05	1.051
Oil spill Likelihood	896	1.00	5.00	2.89	1.079
Oil spill Consequences	895	1.00	5.00	4.07	1.035
Power blackout Risk	899	1.00	5.00	2.83	1.148
Power blackout Likelihood	893	1.00	5.00	2.69	1.106
Power blackout Consequences	900	1.00	5.00	3.73	1.054

Next, to examine if three risk perception scales – one for each hazard – could be constructed from the nine risk perception items, factor analyses and reliability tests were performed. First, all items were included in a factor analysis. Using principal axis factoring, three factors with Eigenvalue above 1 were extracted, explaining 43 percent of the variance. To make the factor structure easier to

[6] In the case of oil spill, the following question was used: 'how serious do you think this would be to the environment and society in general?'

interpret, Oblique rotation (Promax) was performed. The pattern matrix from the rotated solution is shown in Table 4-2.

Table 4-2: Rotated factor (pattern) matrix of risk perception items

Items	Factor 1 Oil spill	Factor 2 Power blackout	Factor 3 Terrorism
Oil spill Risk	0.63	0.15	0.02
Oil spill Likelihood	0.47	0.17	–0.05
Oil spill Consequences	0.80	–0.13	–0.03
Power blackout Risk	0.02	0.73	0.05
Power blackout Likelihood	–0.06	0.68	–0.04
Power blackout Consequences	0.17	0.35	0.06
Terror Risk	–0.02	–0.02	0.88
Terror Likelihood	–0.04	0.10	0.56
Terror Consequences	0.29	–0.12	0.31
Eigenvalue	3.014	1.256	1.160
Explained variance (%)	27.587	8.681	6.804
Cumulative exp. Variance (%)	27.587	36.268	43.072

Extraction method: Principal axis factoring
Rotation method: Oblique (Promax with Kaizer Normalization). Rotation was converged in 5 iterations

As can be seen in the table, no items have factor loadings below 0.30, which is typically considered the minimum strength of an item's loading (Costello and Osborne 2005, Bjerkan 2007, Ringdal 2001). The consequence item in the case of terrorism seems somewhat problematic, though, as its loading is only just above the minimum threshold.

Still, the factor analysis indicates that three risk perception scales may be created from these items. To examine the internal consistency of the three scales, reliability tests were performed on each "trio" of items. The results are summarized in Table 4-3.

Ringdal (2001) suggest $\alpha = 0.7$ as a lower limit for satisfactory reliability of scales. As can be seen, two of the scales have alphas below this limit. Moreover, in the case of terrorism, the correlation between the *consequence* item and the scale is only 0.31, and scale reliability would actually increase from 0.61 to 0.68 if the item was deleted.

Table 4-3: Reliability of risk perception scales

Scales and items	N	Cronbach's Alpha	Item-Total Correlation	Cronbach's alpha if deleted
Terrorism Scale	887	0.61		
Terrorism Risk			0.53	0.36
Terrorism Likelihood			0.48	0.47
Terrorism Consequence			0.31	0.68
Oil spill Scale	885	0.70		
Oil spill Risk			0.59	0.50
Oil spill Likelihood			0.48	0.64
Oil spill Consequence			0.46	0.66
Power blackout Scale	890	0. 64		
Power blackout Risk			0.54	0.41
Power blackout Likelihood			0.42	0.59
Power blackout Consequences			0.40	0.61

As pointed out earlier, the concept of risk – by definition – is a combination of both likelihood and consequences. A valid measure of risk perception should therefore tap into both these components of the concept. Therefore, one may argue, in this particular case, moderate reliability does not necessarily imply low validity. If three more similar questions about, say, "risk" had been used, reliability would almost certainly have been higher, but probably at the cost of validity. There is no assurance that one actually measures the concept of risk by simply asking respondents about the "risk". Indeed, the results here seem to suggest otherwise.

Based on the above reasoning, the reliabilities were considered acceptable and three risk perception scales were constructed. In order to obtain three identical scales – tapping into the same conceptual components of risk – the *consequence* item in the terrorism scale was retained, despite the fact that reliability would be slightly improved by removing it. As the original three items range from 1 to 5, the new additive scales range from 3 to 15. The three scales were named **TerrorRiskPerception, OilSpillRiskPerception** and **PowerBlackoutRiskPerception**. The interpretation of the scales is straightforward; low scores indicate low levels of perceived risk and high score indicates high levels of perceived risk. Descriptive statistics of the three scales are provided in Table 4-4.

Table 4-4: Descriptive statistics of the three risk perception scales

Scale	N	Min	Max	Mean	Std.Dev
TerrorRiskPerception	887	3.00	15.00	9.89	2.45
OilSpillRiskPerception	885	3.00	15.00	10.00	2.50
PowerBlackoutRiskPerception	890	3.00	15.00	9.25	2.53

Since the three risk perception scales will serve as dependent variables in subsequent analyses, their properties in terms of measurement level and frequency distribution is important. Regarding measurement level, the scales can be considered to be fairly continuous. Although adding up three variables measured at the ordinal level does not make the new scale continuous *per se*, the relatively large range of values seems to make this a reasonable assumption. Frequency distributions will be examined in chapter 5, and for now it suffices to point out that the three scales are fairly normally distributed. Thus, although later analyses of residuals will have to determine if non-normality is a problem, the three scales seem to meet the requirements of dependent variables in ordinary least square regression analyses.

4.2.2 Cultural biases

As pointed out in the theory chapter, operationalization of Cultural Theory has shown to be difficult, at least in a manner consistent with the theory. As shown, however, Rippl (2002) has proposed a new measurement instrument which produced much better construct validity. Inspired by Rippl's promising results, I chose to pursue her approach to operationalize the theoretical constructs. Thus, to examine if the results could be replicated, the same items and analysis technique was used in the present study. A few modifications were made to the items, however, and since these changes were based on theoretical and methodical considerations, it is necessary to outline Rippl's approach more carefully before presenting the specific items.

Rippl (2002) questions the validity of the scales constructed from Dake's items. She points out that according to Cultural Theory an individual's cultural bias corresponds to his or her preferences along the two dimensions of sociality: grid and group. This means that people adhering to diagonally opposed cultures (e.g. hierarchy and individualism) show differences on both dimensions, while neighboring types (e.g. hierarchy and egalitarianism) show similarities on one dimensions but differences on the other. Therefore, Rippl argues, in terms of correlations between the constructs measuring the four cultures, diagonally opposed cultures should be strongly negative, while neighboring cultures should be only weakly correlated. The strong positive correlations often found between cultural bias scales based on Dake's items, Rippl argues, violate this measurement theory.

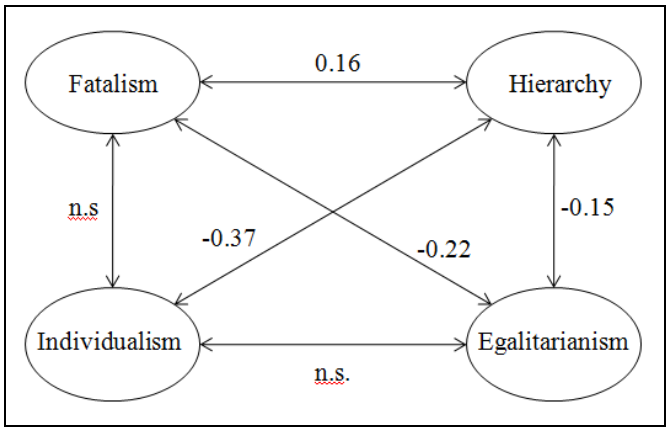
Rippl critices Dake's items for only tapping into *attitudes typical* of each of the cultures (i.e. cultural biases), while social relations are ignored. Instead, she argues, items should be used which tap into the *grid* and *group* dimensions of Cultural Theory. To measure individualism, for example, Rippl argues that the following two items could be used:

- I don't join clubs of any kind (group)
- My ideal profession would be an independent business (grid)

At the core of Rippl's approach is the argument that each grid and group item can be used to measure two cultures simultaneously: people adhering to neighboring cultures should be allowed to agree on grid items and disagree on group items, or vice versa. For example, referring to the items above, respondents who fit the fatalist type (which is next to individualism on the group dimension) could *agree* on the group item (I don't join clubs of any kind) but *disagree* on the grid item (my ideal profession would be an independent business). She points out that this way of measuring cultural biases requires methods which allow items to load on two constructs; confirmatory factor analysis (CFA). It also requires that items are identified *a priori* as either grid or group items in order to specify the model.

Based on these arguments, Rippl modified some of the items developed by Dake and designed new items which, according to her, can be identified as grid and group items. The items used by Rippl, as well as her identification of these as either grid or group items, are shown in appendix B. Then, by means of CFA, she demonstrated how this approach produced correlations between the four constructs which closely conforms to Cultural Theory. The correlations are shown in Figure 4-1.

Figure 4-1: Correlations between constructs reported by Rippl (2002)



Source: Rippl (2002). Rippl did not report significance levels.

Although promising, two issues about Rippl's approach needs to be addressed. First, Rippl identify all her items as either *grid* or *group* items. For example, the item based on the statement "I don't join clubs of any kind" is identified as a *group* item. She then states that this item is expected to load on individualism and that it should be allowed to load on fatalism since these are neighboring cultures on the group dimension. This is true, however, only because the item is a *low* group item. Not *all* group items are supposed to load on individualism (and fatalism). Therefore, I would argue, in order to correctly specify which particular construct(s) the various items are expected to load onto, each item should be identified as either *low* or *high* grid/group. Second, and perhaps more important, Rippl criticizes Dake's items for only tapping into *attitudes* typical of each of the cultures (i.e. cultural biases) and thereby ignoring social relations. However, by only including items measuring preferred social relations (she identifies all items as either grid or group items), Rippl herself seems to ignore cultural biases. Therefore, I would argue, in order to capture *both* these components in each construct, items should also be included which measure cultural biases, that is; typical attitudes *not* related to the grid/group dimension. In fact, although Rippl herself does not seem to agree, I believe a number of the items she identifies as either *grid* or *group* items should instead be identified as *cultural bias* items. For example, Rippl claims that the item based on the statement: "It is important to preserve customs and cultural heritage" is a *group* item. It is hard to see, however, in what way this statement is related to the group dimension in Cultural Theory. In my opinion, this is an ordinary cultural bias item as used by Dake and others to measure typical hierarchical attitudes, and it should also be identified as such. This is important, because while grid and group items are allowed and expected to load on two constructs, cultural bias items should load on one construct only. This may also explain (or at least provide a rationale for) why only four of the 18 items Rippl used loaded on two constructs, while theoretically – and if they were appropriate measures of grid and group – all should have loaded on two constructs.

Based on these considerations a total of 20 items were included in the present study to measure the four constructs. All items are shown in Table 4-5 (next page). 15 of the items (A22.6 - A22.20) were adopted from Rippl's study. As this is an attempt to replicate Rippl's work, it should be noted that Rippl used 18 items in her study. The three items excluded were items which in Rippl's study loaded on only one factor – thus indicating that they did not conform to the logic of double loadings underpinning this approach. The 15 items were (re)identified as either low or high grid, low or high group, or a cultural bias item.

Table 4-5: Items used to identify the four cultures of Cultural Theory. A priori identification of items.

Item	Statement	Identification				
		Grid		Group		Cultural bias [a]
		High	Low	High	Low	
A22.1	We need to drastically reduce discrimination between men and women		X			
A22.2	One of the problems with people today is that they challenge authority too often	X				
A22.3	Everybody should have an equal chance to succeed and fail without government interference		X			
A22.4	In a fair system people with more ability should earn more					I
A22.5	I would support a tax reform that put a heavier burden on companies an people with high incomes					E
A22.6	People are often best off by not trusting other than themselves					F
A22.7	It is important to me that when important decision are made at my workplace everyone is asked		X			
A22.8	We need to accept the limits in our lives, whether we like it or not	X				
A22.9	I would never participate in protest movements, action groups and things like that	X				
A22.10	There is no point in doing things for other people – one hardly ever gains from it in the long run					F
A22.11	Firms and institutions should be organized in a way so that everybody can influence important decisions		X			
A22.12	I prefer tasks where I can work out things on my own				X	
A22.13	It is important to preserve customs and our cultural heritage					H
A22.14	I prefer not to join voluntary organizations, associations, and things like that				X	
A22.15	The freedom of the individual must never be restricted, not even when fighting crime		X			
A22.16	Order and discipline is not always popular, but they are important values	X				
A22.17	My ideal job would be an independent business					I
A22.18	The police should have the right to listen to private phone calls when investigating crime	X				
A22.19	When I have problems I try to solve them on my own				X	
A22.20	Family and close communities are the basis of a functioning society			X		

[a] E=Egalitarianism, I=Individualism, F= Fatalism, H=Hierarchy

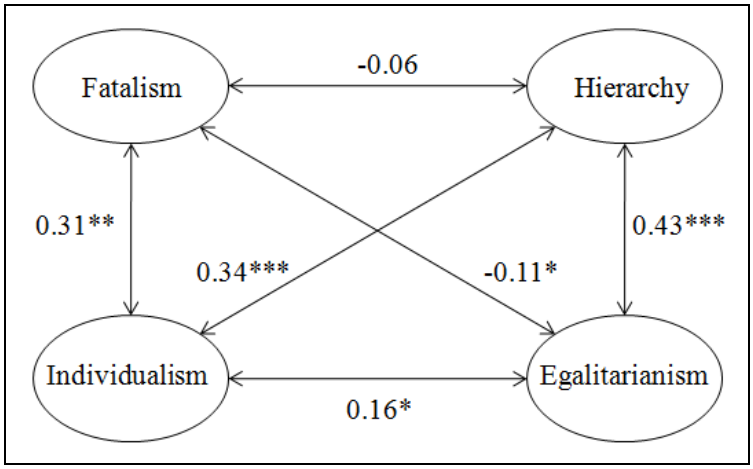
In addition to the 15 items from Rippl, five other items (A22.1 – A22.5) were included. These items were drawn from previous studies (Grendstad 2003) based on their adequacy as either *grid*, *group* or *cultural bias* items. Two of the items were selected to ensure I had at least one cultural bias item for each construct: Item A22.4 ("In a fair system people with more ability should earn more") was included as an individualism item, while item A22.5 ("I would support a tax reform that put a heavier burden on companies and people with high incomes") was included as an egalitarianism item. The last three items were selected based on their grid and group characteristics. More specifically, item A22.1 ("We need to drastically reduce discrimination between men and women") and A22.3 ("Everybody should have an equal chance to succeed and fail without government interference") were selected to tap into low grid (supposedly shared by individualism and egalitarianism) while the item A22.2 ("One of the problems with people today is that they challenge authority too often") was identified as a high grid item (supposedly shared by fatalism and hierarchy).

In order to avoid questionnaire effects, the order of the items was randomized during the interview process (i.e. between respondents). On each statement, respondents were asked to state how much they agreed or disagreed. The following five response categories were used: "completely agree" (1), '"partially agree" (2), "neither agree nor disagree" (3), "partially disagree" (4), "completely disagree" (5), and "don't know" (6).

The score on all items was reversed during recoding, so that low score indicate disagreement with the statement, while high score indicates agreement. Don't know responses were coded missing. To be able to distinguish between the original and recoded items, all items were renamed from A22.1 to B22.1 and so forth. Descriptive statistics of all 20 items are provided in Appendix C.

Next, following Rippl (2002), the items were included in confirmatory factor analysis. For this procedure Amos v.16 was used. First, a model identical to the one described by Rippl (except for the three omitted items) was specified. Model fit estimates was reasonable (Chi square = 251.2 with 80 df; GFI = 0.96 and RMSA = 0.05) and actually somewhat better than reported by Rippl. The correlations between the four cultural biases were found to be entirely different, however.

Figure 4-2: Correlations between constructs. Replication of Rippl (2002)



*** p ≤ 0.001; ** p ≤ 0.01; *p ≤ 0.05

As depicted in Figure 4-2, the constructs of individualism and hierarchy was still strongly correlated. Correlations were also strong between individualism fatalism, and between hierarchy and egalitarianism. Attempts were therefore made to improve the correlations by including the five "new" items. Each item was specified to load on to their respective constructs based on *a priori* identification. Changes were also made based on modification indices. The results were essentially the same, however, and a number of the constructs remained strongly correlated.

One can only speculate why this turned out to be the case. One possible explanation is that we used very different samples; while the present study is based on a large representative sample from Norway, Rippl used a sample of 475 German sociology students (collected during classes). As a result, differences may reflect that patterns of value orientations vary either across age groups or between countries - or both. It is also possible, of course, that these students were familiar with Cultural Theory and responded accordingly (i.e. "correct").

Because of the poor results of the CFA, the 20 items were included in exploratory factor analysis (EFA) to examine if ordinary one-dimensional scales could be constructed from the same items. Principal axis factoring extracted five factors with Eigenvalue above 1, explaining about 45 percent of the variance. The factor matrix showed that only one item (item B22.19) loaded on the fifth factor. Since the theory calls for four factors, this solution was requested in a second analysis. The resulting four factors explained about 39 percent of the variance. Oblique rotation (oblimin) was performed in order to make the factor structure easier to interpret. This produced a relatively clear

factor structure. By using the items previously identified as pure cultural bias items as references, the four factors were easily identified. Table 4-6 below shows the pattern matrix from the rotated solution.

Table 4-6: Rotated factor (pattern) matrix of cultural bias items

Item	Identification	Factor 1 Hierarchy	Factor 2 Fatalism	Factor 3 Egalitarianism	Factor 4 Individualism
B22.13	Hierarchy	.48	.00	–.05	.17
B22.16	Hierarchy	.61	.02	.05	.05
B22.18	High grid	.44	.27	–.01	–.16
B22.20	High group	.50	–.07	.11	.06
B22.8	High grid	.44	–.08	.07	–.01
B22.6	Fatalism	–.05	.47	–.01	.11
B22.10	Fatalism	–.22	.61	.07	–.06
B22.2	High grid	.15	.39	.02	–.04
B22.9	High grid	.16	.35	–.11	.11
B22.14	Low group	.00	.36	–.09	.12
B22.5	Egalitarianism	–.03	.03	.52	–.11
B22.1	Low grid	.08	–.12	.32	.08
B22.7	Low grid	.28	–.02	.45	.14
B22.11	Low grid	.04	.08	.53	.04
B22.17	Individualism	–.14	.05	–.09	.37
B22.4	Individualism	.19	.17	–.30	.31
B22.3	Low grid	.15	.06	–.01	.41
B22.12	Low group	.04	.00	.09	.34
B22.15	Low grid	–.13	.21	.21	.32
B22.19	Low group	.14	–.02	–.01	.25
Eigenvalue		2.76	2.20	1.58	1.29
Explained variance		13.84	11.09	7.90	6.45
Cumulative exp. variance		13.84	24.94	32.85	39.29

Extraction method: Principal axis factoring
Rotation method: Oblique (oblimin). Rotation was converged in 10 iterations

The table shows that all of the items identified as high/low grid and high/low group loaded on one of the two factors they were supposed to (e.g. high grid items on either fatalism or hierarchy). Moreover, to the extent grid/group items show cross loadings, most of these are consistent with expectations in the sense that they load on "neighboring" cultures. For example, the high grid item B22.18 loads on both hierarchy (0.48) and fatalism (0.27), which both are "high grid cultures". Although not very high, and with the exception of item B22.19, all factor loadings are above the critical value of 0.30.

Next, reliability tests were run to examine more closely if scales could be constructed. Item B22.19 was left out from the analyses since it loaded very weakly on all factors, thereby indicating that it did not belong to any of the constructs. The results of the reliability tests are shown in Table 4-7.

Table 4-7: Reliability of cultural bias scales

Scales and items		N	Cronbach's Alpha	Item-Total correlation	Alpha if item deleted
Hierarchy		892	.60		
A22.8	We need to accept the limits in our lives, whether we like it or not			.33	.56
A22.13	It is important to preserve customs and our cultural heritage			.37	.54
A22.16	Order and discipline is not always popular, but they are important values			.47	.50
A22.18	The police should have the right to listen to private phone calls when investigating crime			.30	.61
A22.20	Family and close communities are the basis of a functioning society			.39	.54
Egalitarianism		878	.53		
A22.1	We need to drastically reduce discrimination between men and women			.28	.49
A22.5	I would support a tax reform that put a heavier burden on companies an people with high incomes			.33	.44
A22.7	It is important to me that when important decision are made at my workplace everyone is asked			.35	.45
A22.11	Firms and institutions should be organized in a way so that everybody can influence important decisions			.33	.45
Individualism		849	.44		
A22.15	The freedom of the individual must never be restricted, not even when fighting crime			.22	.39
A22.4	In a fair system people with more ability should earn more			.20	.41
A22.12	I prefer tasks where I can work out things on my own			.22	.40
A22.3	Everybody should have an equal chance to succeed and fail without government interference			.29	.34
A22.17	My ideal job would be an independent business			.22	40
Fatalism		870	.55		
A22.6	People are often best off by not trusting other than themselves			.32	.49
A22.9	I would never participate in protest movements, action groups and things like that			.31	.49
A22.2	One of the problems with people today is that they challenge authority too often			.27	.52
A22.10	There is no point in doing things for other people – one hardly ever gains from it in the long run			.34	.49
A22.14	I prefer not to join voluntary organizations, associations, and things like that			.33	.48

Not surprisingly, the correlations between the items and their respective scales are quite weak. With one exception, all are weaker than 0.40, which is usually considered a minimum correlation for reliable scales (Ringdal 2001:360). As a result, the reliabilities of the scales are weak: Hierarchy: $\alpha = 0.61$ (after removing item B22.18); Egalitarianism: $\alpha = 0.53$; Individualism: $\alpha = 0.44$; Fatalism: $\alpha = 0.55$. As noted earlier, reliabilities below $\alpha = 0.7$ is usually considered questionable. However, Shalom Schwartz – a leading scholar on value research – argues that reliabilities even down to 0.4 can still be reasonable in cases when a) the items used tap into different conceptual components of each construct, and/or b) when the number of items are low (European Social Survey Education Net 2011). The first of these conditions is certainly present here. Indeed, the items used were designed and selected specifically to tap into different components of each construct, and very few of the items have similar wordings and meanings. Moreover, only 4 or 5 items for each scale is not a large number of items, especially not considering the heterogeneity of the items.

In light of these considerations, the reliabilities were deemed acceptable, and four scales were constructed: **hierarchy**, **egalitarianism**, **individualism** and **fatalism**. Each scale was computed by adding together their respective items (ranging from 1-5), before the scale sum was divided by the number of items comprising it. This resulted in four scales with scores ranging from 1 to 5. Descriptive statistics are provided in Table 4-9 at the end of this chapter.

Because the theory implies that people are "hierarchists", "egalitarians" and so on, an attempt was made to categorize respondents into the four cultures. This procedure was not successful, however. Very few people seem be pure hierarchists, egalitarians, and so on. Instead, most people are a "little bit of everything". This also means, rather than comparing for example hierarchists' perceptions of risk with those of egalitarians, individualists and fatalists, hypotheses will have to be tested by comparing those with high score on a scale with those with low score. Thus, to test if "hierarchists" are more or less concerned about a hazard than are "non-hierarchists", those with high score on the hierarchy scale will be compared to those with low score on this scale, irrespective of their score on other scales. This way, a positive relationship would indicate that hierarchists perceive the risk to be greater than do non-hierarchists, while a negative relationship would indicate that they perceive the risk to be smaller. Or put differently, a positive relationships would mean that the more hierarchically-oriented a person, the greater the level of perceived risk, while a negative relationship would suggest that the more hierarchically-oriented a person, the lower the level of perceived risk.

With regard to validity, despite that some of the items employed in the present study differ from those typically used in empirical studies, the cultural bias scales seem to measure cultural biases as they are described by cultural theorists; Hierarchy reflects support for authority, social order and ranked stations; Egalitarianism reflect support for equality between gender and income groups as well as popular participation; Individualism for individual freedom and prosperity as well as equal opportunity; while fatalism reflect individual inefficacy and distrust in others.

The table below shows the correlations between the four scales. To give the reader an impression of how these results compare to those reported elsewhere, a handful of other studies are also listed.

Table 4-8: Correlations between cultural bias constructs. Pearson's r.

	Individualism	Hierarchy	Egalitarianism
Hierarchy			
1. Dake (1991)	0.54***		
2. Marris et al. (1998)	0.53***		
3. Rippl (2002)	–0.37		
4. Grendstad (2003)[a]	0.36**		
5. Present study	*0.18***		
Egalitarianism			
1.	–0.30***	–0.28***	
2.	–0.42***	–0.16	
3.	n.s	–0.15	
4.	–0.11**	0.16**	
5.	*0.00*	*0.22***	
Fatalism			
1.	—	—	—
2.	0.25**	0.21	0.07
3.	n.s	0.16	n.s
4.	0.27**	0.40**	0.21**
5.	*0.32***	*0.05*	*–0.07**

Note: Rippl (2002) did not report significance levels (only whether the correlations were significant or not)
[a]: only the results from the Norwegian sample is reported here.

The correlation between hierarchy and individualism is positive, but somewhat weaker than often reported. Perhaps the most notable difference from other studies is the positive correlation between hierarchy and egalitarianism. Rather than indicating that the scales measure something "else" than those employed in other studies, however, this finding seems to reflect that patterns of value-orientations differ between the countries in which these studies have been conducted. The fact that Grendstad (2003), who also used a Norwegian sample, obtained similar results seem to support such an interpretation.

4.2.3 Political orientation

Political orientation was measured as respondents' self-reported location along the left-right dimension, based on their response to the following question: "On a scale from 1 to 10, where 1 is on the far left and 10 is on the far right, where would you locate yourself on a left-right scale?" Respondents could also answer "don't know" or "refuse to answer".

When preparing the data, "don't know" and "refuse to answer" responses (n= 38) were coded into missing, while no changes were made to the scores indicating political orientation. Thus, the resulting variable, named **left-right**, ranges from 1 to 10. The interpretation is straightforward; low score indicate being politically left-oriented, while high score correspond to being politically right-oriented. Although measured at the ordinal level, it will be used as a continuous variable in subsequent analyses. Descriptive statistics of this variable is provided in Table 4-9 at the end of this chapter.

4.2.4 Trust in risk management

The literature suggests that trust in risk management institutions is important. Earle et al point out that the empirical literature has not been entirely orderly and that a distinction should be made between measures of "trust" and "confidence". While "confidence" correspond to a judgment of the *abilities* of the trusted party to carry out its duties (e.g. competence, expertise, etc.), trust corresponds to a judgment of the *intentions* of the trusted party (e.g. integrity, honesty, etc.).

Trust

"Trust" was linked to three institutions: *Governmental authorities, scientists and experts,* and *industry and business*. In one way or another, all of these institutions are involved in management of risk. As pointed out above, trust corresponds to a judgment of the intentions of the trusted party. Thus, according to Earle et al. (2007), trust can be measured empirically as approval or disapproval of the intentions of the entity to be trusted. Intentions in turn, can be measured by a number of indicators, such as integrity, morality, fairness, compassion, etc. All of these indicators "can be taken to mean good intentions relative to those of the trusting person – shared values" (Earle et al. 2007: 6).

Thus, to measure trust in three institutions, questions were formulated which tap into judgments of the *integrity* of the target, that is; whether or not the institutions are deemed trustworthy, objective, unbiased, etc. More specifically, trust in these institutions was measured by asking: "On a scale from 1 to 5, where 1 is 'no trust' and 5 is 'very much trust', how much trust would you say you have in the following institutions, when it comes to providing trustworthy information about threats and danger in society:

- Governmental authorities
- Scientists and experts
- Industry and business"

Because the literature seems to suggest that trust in *governmental authorities* is especially important for risk attitudes, an additional question was included to measure trust in this particular institution: "In general, on a scale from 1 to 5, where 1 is 'no trust' and 5 is 'very much trust', how much trust do you have in Norwegian authorities?"

When preparing the data, "don't know" responses were coded as missing, while no changes were made to the scores indicating level of trust. Thus, low score indicate low levels of trust, while high score indicate high levels of trust. Descriptive statistics of the each of the four items are shown in Appendix C.

To examine if a scale of trust in institutions involved in the creation and management of risk could be constructed from these items, all four items were included in factor analysis (not shown). Principal axis factoring extracted one factor with Eigenvalue above 1, indicating that the items measure the same underlying dimension. The item *trust in industry and business* loaded weakly, however. This was also confirmed when testing the internal reliability of the scale; Cronbach's alpha was .69, but would increase to .75 by deleting this item. A new analysis of the remaining three items produced the similar result, but now with the item *trust in scientist and experts* being problematic; Cronbach's alpha was .75, but would increase to .80 if this item was left out. Reliability of the scale with the remaining two items tapping into *trust in governmental authorities* was good, however, with a Cronbach's alpha of .80.

Based on these results, I decided to use the items **trust in industry and business** and **trust in scientist and experts** separately (as singe-item variables) in subsequent analyses, while a two-item

scale was computed for **trust in government.** The two items were added together and then divided by two, resulting in a variable ranging from 1-5. The interpretation of this scale is identical to that of the other two variables; low score indicate low levels of trust, while high score denote high levels of trust. Descriptive statistics of the three variables are shown in Table 4-9 in the end of this chapter. Again, although strictly speaking not continuous, measures of trust in institutions will be used as such subsequent analyses.

Confidence

As pointed out earlier, confidence corresponds to a judgment of the abilities of the trusted party to carry out its duties. In this context, confidence is about (trust in) the ability of a trusted party to properly manage risk, that is; to either *prevent* disasters from occurring, or – if the disasters do occur – to *mitigate* the consequences. And since the most important institution in the context of disaster risk management is governmental authorities, confidence will be linked to this particular institution.

In contrast to measures of trust, confidence was linked to each of the three hazards specifically. Two questions were composed for each hazard. For example, in the case of terrorism, respondents were first asked: "How confident are you that the authorities – for example by way of monitoring and control – are able to prevent terrorist attacks from occurring?" Respondents gave their answer on a 5-point scale where 1 was "not confident at all", 5 was "very confident". Next respondents were asked: "If a terrorist attack *did* occur - to what extent do you think the authorities would be able to mitigate the consequences of such an event?" Again respondents gave their answer on a 5-point scale, where 1 was "not at all", and 5 was "to a very large extent". Close to identical questions were asked in relation to the other two hazards, and only some small adjustments were made to cues about preventive efforts (see questionnaire in Appendix A).

No changes were made to the original indicators during recoding, except that "don't know" responses were coded missing. Hence, low score indicate low levels of confidence, while high score indicate high levels of confidence. Descriptive statistics are shown in Appendix C.

Next, to examine if three scales of confidence in risk management – one for each hazard – could be constructed, the three pairs of items were subjected to factor analyses and reliability tests. All three factor analyses produced one factor with Eigenvalue above 1, indicating that the pairs of items

measure the same latent construct, presumably confidence in risk management of each of the hazards. To examine the internal consistency of the scales, reliability tests were performed on each pair of items. The scales obtained the following Cronbach's alphas: Terrorism: $\alpha = .64$; Oil spill $\alpha = .63$; Power blackout $\alpha = .74$. As each scale consists of only two items, these reliabilities were considered to be acceptable.

Three scales were computed. Each of the three pairs of items were added together and then divided by two, so that each scale ranges from 1 – 5. The scales were named **Confidence[Hazard]RiskManagement**. The interpretation of these scales is the same as for the original items; low score indicate low confidence, while high score indicate high confidence. Descriptive statistics of the three scales are shown in Table 4-9.

4.2.5 Socio-demographic variables

Variables of four socio-demographic characteristics were constructed: Age, gender, level of education and income. **Age** is measured in years, while **gender** is dummy coded (men = 0, women = 1).

Level of education was obtained by asking respondents about their "highest educational attainment". Answers were categorized by the interviewers into four categories: "elementary school" (1), "lower secondary" (2), "upper secondary or high school" (3), and "college or university" (4). Dummy variables were constructed for respondents in each of these categories. However, because of the low number of respondents in the category of "lower primary school" (n = 30) and "upper primary school" (n = 54), these categories were combined into one category, labeled "compulsory". Thus, educational attainment will be represented by three dummy variables, named **compulsory school**, **high school** and **university**.

To measure income, respondents were asked to estimate their "household's total gross income". Answers were categorized by interviews into eleven categories: Less than 100.000 kr. (1), 100.000 – 199.000 kr. (2), 200.000 – 299.000 kr. (3), 300.000 – 399.000 kr. (4), 400.000 – 499.000 kr. (5), 500.000 – 599.000 kr. (6), 600.000 – 799.000 kr. (7), 800.000 – 1 million kr. (8), More than 1 million kr. (9), "Refuse to answer" (10) and "Don't know" (11). When preparing the data, "refuse to answer" and 'don't know' responses were coded missing. The nine categories of income levels

were coded into dummy variables. Bivariate analyses of the relationship between household income and risk perceptions were performed to assess if there were some "natural" cut-off values for the categories (see Appendix H). Based on these analyses, the variable was recoded into the following three categories: **up to ½ million**, **½ to 1 million** and more than **1 million**.

Descriptive statistics of all socio-demographic variables are shown in Table 4-9.

4.2.6 Geographic location

Finally, to control for potential influence of geographic location, two variables of respondents' geographic location were constructed based on the number of the municipality in which the respondent was living. First, to control for the potential influence of living in particular geographic regions, six dummy variables of different regions in Norway were computed: **east**, **south**, **west**, **mid**, **north** and **Oslo**.[7] Next, to control for the potential influence of living in urban or non-urban areas, a dichotomous variable for whether the respondent was a "**city resident**" or "**non-city resident**" was computed. A respondent was categorized as a city resident if the municipality in which he or she lived met both of the following two criteria: a) more than 50.000 inhabitants and b) more than 90 percent of the inhabitants live in "densely populated areas" (as defined by Statistics Norway).[8]

4.2.7 Data imputation

As shown above, all "don't know" and "refuse to answer" responses were coded as missing during data preparation. Missing value analysis demonstrated, however, that only 653 otut of 901 cases were valid listwise (See Appendix C, last column). Two variables in particular contributed to this; *income* (missing = 119) and *political orientation* (missing = 41), but also other variables had missing values (typically between 5 and 20).

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[7] East = Vestfold, Oppland, Hedemark, Akershus, and Østfold; South = Vest-Agder, Øst-Agder, Telemark, and Buskerud; West = Rogaland, Hordaland, and Sogn and Fjordane; Mid = Møre and Romsdal, Sør-Trøndelag, and Nord-Trønderlag; North = Nordland, Troms and Finnmark.

[8] The following eleven municipalities fulfilled these criteria: Oslo, Bergen, Trondheim, Stavanger, Kristiansand, Fredrikstad, Drammen, Sarpsborg, Bærum, Asker and Sandnes.

Since the default method for dealing with missing values in SPSS –which is my choice of software – is listwise deletion, this means that 248 respondents, or 27.5 % of the sample, would be excluded from the multivariate analyses. This, of course, would involve loss of both data and statistical power. I therefore decided to follow the recommendations of Byrne (2010), who argue that, although listwise deletion is by far the most common method for dealing with incomplete data, imputation methods may be appropriate to avoid the problems outlined above.

Of available imputations methods, I chose to use regression based imputation which can be performed in SPSS. This means that missing values are estimated by using the incomplete data as dependent variables, while the complete data serve as the predictors. Constraints (i.e. max and min of the estimated value) were set to correspond to the minimum and maximum values on the original variable, and rounding was set to 1. This procedure was performed on all variables in the data set.

4.3 Overview of variables for analyses

All the variables to be included in multivariate analyses are listed in Table 4-9. Preliminary analyses (see Appendix E, specification) revealed that none of the geographic location variables (neither region nor city resident) contributed to the models. In the interest of parsimony, these variables have been excluded from the final regression models and they are therefore not included in the table.

Table 4-9: Descriptive statistics of variables to be used in multivariate analyses

Variables	N	Min	Max	Mean	Std.Dev.	Cronbach's alpha
Dependent variables						
TerrorRiskPerception	901	3.00	15.00	9.89	2.47	.61
OilSpillRiskPerception	901	3.00	15.00	10.00	2.50	.70
PowerBlackoutRiskPerception	901	3.00	15.00	9.26	2.53	.64
Independent variables						
Cultural biases						
Hierarchy	901	1.00	5.00	4.50	.59	.61
Egalitarianism	901	1.00	5.00	3.89	.83	.53
Individualism	901	1.20	5.00	3.35	.75	.44
Fatalism	901	1.00	5.00	2.36	.83	.55
Political orientation						
Left (1) - right (10)	901	1.00	10.00	5.39	1.94	
Confidence and trust						
ConfidenceTerrorRiskManagement	901	1.00	5.00	3.11	.78	.64
ConfidenceOilSpillRiskManagement	901	1.00	5.00	2.97	.78	.63
ConfidencePowerBlackoutRiskManagement	901	1.00	5.00	3.16	.81	.74
TrustGovernment	901	1.00	5.00	3.31	.87	.80
TrustScientist&experts	901	1.00	5.00	3.32	.92	
TrustIndustry&business	901	1.00	5.00	2.76	.86	
Socio-demographics						
Age	901	18.00	95.00	49.39	15.97	
Gender	901					
Men	471	.00	1.00	.52	.50	
Women	430	.00	1.00	.48	.50	
Education	901					
University	505	.00	1.00	.56	.50	
High school	312	.00	1.00	.35	.48	
Compulsory	84	.00	1.00	.09	.29	
Income	901					
More than 1 million	176	.00	1.00	.20	.40	
½ to 1 mill.	391	.00	1.00	.43	.50	
less than ½ mill	334	.00	1.00	.37	.48	
Valid N (listwise)	901					

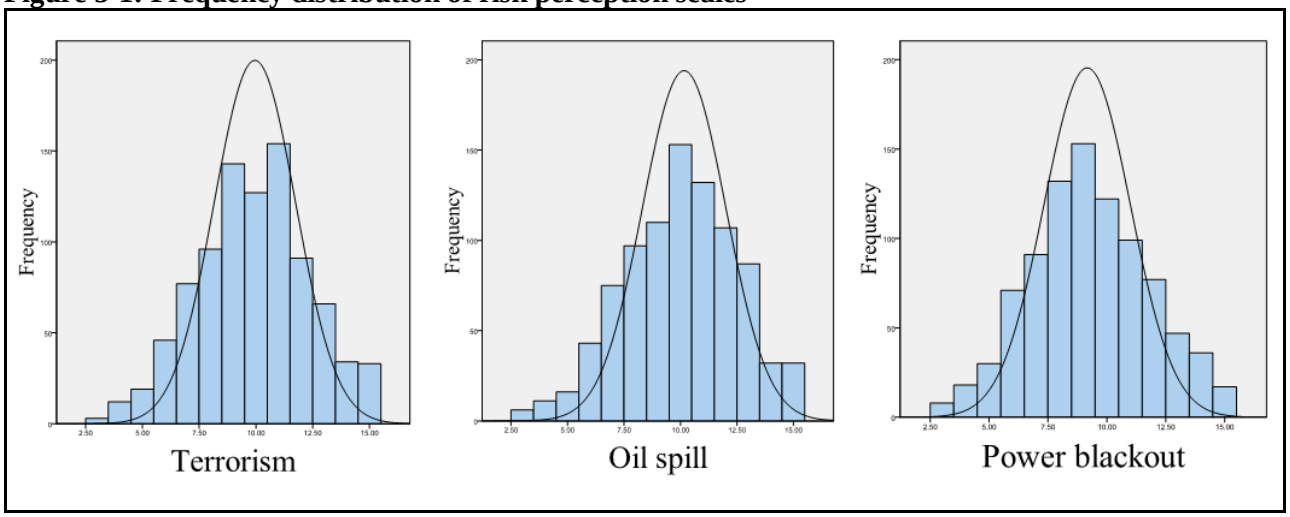
5. Analysis and results

As this thesis seeks to explain variation in the level of perceived risk among members of the public, most of this chapter is devoted to examining the extent to which the variables outlined in the previous chapter are able to account for these variations. Before turning to these analyses, however, a brief look at the variation itself is in order.

5.1 Variation in public risk perceptions

As shown in the previous chapter, three risk perception scales – one for each hazard – were constructed to measure respondents' perceptions of the level of risk associated with the three hazards. The three scales, which will serve as dependent variables in subsequent regression analyses, range from 3-15. The frequency distributions of the three scales are displayed in Figure 5-1.

Figure 5-1: Frequency distribution of risk perception scales

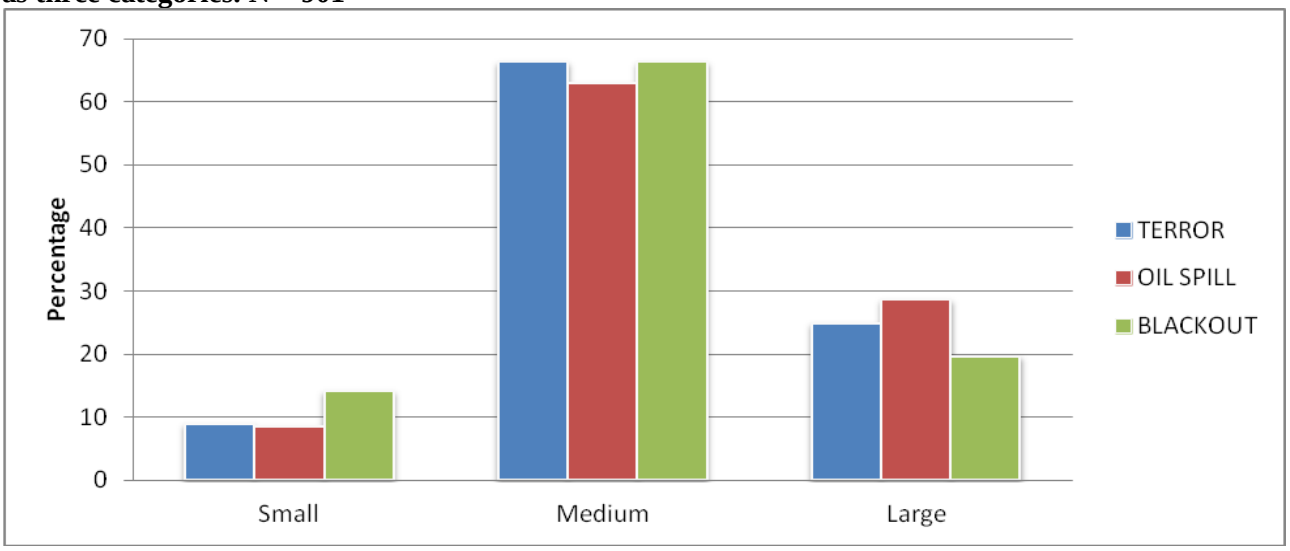


As noted earlier, responses on the three risk perception scales are fairly normally distributed. This it also implies, of course, that there is considerable variation among respondents with regard to the level of risk ascribed to these hazards.

In order to make variations among the public clearer, in Figure 5-2 the responses have been administered into three (provisional) categories: "small risk" (3-6), "medium risk" (7-11) and "large

risk" (12-15). Consequently, since the "medium" category consists of five units, while "small" and "large" only three, the latter two categories can be regarded as representing relatively "extreme" positions.

Figure 5-2: Frequency distribution (in percentage) of the three risk perception scales when presented as three categories. N = 901



The figure demonstrates that there are large variations among the respondents regarding the perceived level of risk associated with the three hazards. Since the variation is very similar for the three hazards, the variation can be described jointly; the majority of the respondents – about 65 percent – are located in the medium risk category (7-11); roughly 10 percent in the small risk category (3-7); while in between 20 and 30 percent is located in the large risk category (12-15).

Overall, these figures reflect observations from past surveys, referred to in the introduction, about public disagreement over risk. In short, they suggest that there is considerable disagreement between members or groups of the public over the risk these hazards are considered to pose to society. With that observation (re)established, I now turn to the multivariate analyses where I examine the extent to which the explanatory variables are able to account for these observations.

5.2 Explaining variation in risk perceptions

5.2.1 The multivariate regression models

Variation in risk perception is analyzed by means of Ordinary Least Squares (OLS) regression analysis. Three models are analyzed – one for each hazard. However, OLS regression rests on a number of assumptions (Eikemo og Høyvarde 2007; Hamilton 1992; Ringdal 2001). To verify that the regression model(s) meet these assumptions, a number of steps were taken. In order to save space, the most of these analyses are moved to Appendix E, and in the following only the most important procedures and results are presented.

First, to examine that the models were correctly specified, bivariate regression analyses were run; each of the independent variables was regressed onto the three dependent variables. F-tests and t-tests were used to assess whether variables significantly contributed to the model. Also, to examine if any of the relationships between the independent and dependent variables were non-linear, scatter plots with *loess fit line* was requested in the process. This procedure revealed no non-linear relationships between the dependent variables and the continuous variables. As noted earlier, however, the analyses suggested that education and income were best represented by three categories each (see Table 4-9). The bivariate regressions also demonstrated that most variables were significantly associated with all the three dependent variables at the $\alpha = 0.05$ level. A few variables, however, were significantly associated with only one or two (but not all three) of the dependent variables.

As a further test to determine if variables should be left out, multiple regression models were built stepwise (in blocks). Again, the t-test and F-test were used to assess whether the inclusion of the variables or group of variables contributed significantly to the models. This procedure revealed that a number of the correlations which were found to be significant in the bivariate regressions became non-significant when controlling for the other variables. More specifically, none of the two geographic location variables (**region** and **city resident**) contributed to any of the three models. As these variables were primarily included as controls with no theoretical foundation, they were – in the interest of parsimony – excluded from the models. The analyses also revealed that neither **education** nor the cultural bias **individualism** contributed to any of the full regression models. However, since these findings are theoretically interesting, they were retained in the final models. For the same reason as describe above, as well as in the interest of comparison across models (i.e.

hazards), all variables which were found to contribute significantly to *at least one model* were retained in all three models. Consequently, all three regression models are identical with regard to the independent variables.

To be confident in the multivariate results, the full regression models were finally subjected to various tests in order to verify that they meet the rest of the assumptions of OLS regression (Appendix E). The tests confirmed that errors are normally distributed and have fairly constant variance (i.e. they are homoscedastistic), and that neither autocorrelation nor multicollinearity is a problem. Finally, no cases were found to influence the regression results in any substantial way, so none were removed from the sample.

The multivariate regression results are shown in Table 5-1. The results from the three models are presented in a single table rather than separately. Discussions of the results are organized accordingly; for each variable its association to each of the three dependent variables will be presented and discussed, before turning to the next variable, and so forth. This way of structuring the results and discussions seems favorable to other alternatives as it facilitates comparison across models, that is; the extent to which the effect of the independent variables on risk perception varies across different hazards.

Also, since the units of measurement of both the dependent variables and many of the independent variables are not very intuitive or meaningful at a practical level, only standardized coefficients (β) and their significance level are reported and discussed. These will suffice to assess both direction and strength of correlations, which is the primary concern of this study. Full models with both unstandardized and standardized coefficients, as well as standard errors, t-values and significance levels, are reported in Appendix F, however. When necessary, especially in relation to dummy variables, unstandardized coefficients (b) will be reported.

Table 5-1: Standardized coefficients from three OLS regression analyses of the perceived level of risk associated with terrorism, oil spills and power blackouts

	Terrorism	Oil spills	Power blackouts
Cultural biases			
Hierarchy	**0.10****	0.00	0.01
Egalitarianism	0.06	**0.17*****	**0.09****
Individualism	0.01	–0.01	–0.02
Fatalism	**0.09****	–0.03	**0.09***
Political orientation			
Left (1) – right (10)	**0.11*****	0.00	0.06
Trust and confidence			
ConfidenceRiskManagement [a]	–0.06	–**0.16*****	–**0.25*****
TrustGovernment	–**0.13*****	–0.06	–0.01
TrustScientists &Experts	–0.03	**0.13*****	**0.08***
TrustIndustry&Business	**0.10****	–0.04	**0.08***
Sociodemographics			
Women [b]	**0.26*****	**0.30*****	**0.14*****
Age	**0.12*****	–0.02	**0.15*****
Education [c]			
High school	0.02	–0.03	–0.02
University	–0.05	–0.05	–0.09
Income [d]			
½ to 1 mill.	0.04	–**0.07***	–0.00
more than 1 mill	0.03	–**0.12****	–0.00
F	14.489***	16.490***	11.089***
R^2 adjusted	0.184	0.205	0.144
N	901	901	901

Bold entries denote coefficients significant at $\alpha = 0.05$.
*$p \leq 0.05$; **$p \leq 0.01$; *** $p \leq 0.001$
[a] specific to the hazard (i.e. model)
[b] reference category = men
[c] reference category = compulsory
[d] reference category = less than ½ million

Table 5-1 shows that all three models are significant at the $\alpha = 0.001$. The amount of explained variance in perceived level of risk is modest, however; in the case of terrorism, the independent variables account for roughly 18 percent of the variance; in the oil spill model about 20 percent; while in the power blackout model approximately 14 percent of the variance is explained.

There may be several reasons for the relatively low explanatory power of the model. One possibility is that respondents have interpreted the hazards differently (cf. earlier discussion about different "mental images" of the particular hazards in question) and that the level of risk assigned to the hazards varies accordingly. Thus, unless these differences in interpretation are related to gender, age, or any of the other variables employed, this variation is not captured by the model. Similarly, it may be that respondents have interpreted the scales differently, that is; that they have different notions of what "1" or "5" corresponds to. This could potentially also lead to variation not captured by the model. Finally, of course, there is the possibility that relevant variables are omitted. This issue will be discusses later, as certain findings seem to point in this direction.

Leaving aside the unexplained variance, the following subchapters will discuss the variation actually explained by the variables in the models, including whether or not the data support the hypotheses stated throughout chapter 3.

5.2.2 Cultural biases

Regression models with only the four cultural biases scales included (not shown) demonstrate that these variables account for roughly 6, 7 and 3 percent of the variation in perceived level of risk associated with terror, oil spills, and electrical blackout, respectively. While a moderate amount of explained variance, these results are similar to those reported elsewhere (Sjöberg 1998 and 2000; Marris et al. 1998).

More interesting than the overall explanatory power of the four cultural biases together, are the individual associations between each of the four cultural biases and perceptions of risk. Starting with *hierarchy*, I earlier hypothesized that hierarchists perceive the risk posed by terrorism to be greater than do non-hierarchists (H_1). This hypothesis is supported by the data. Hierarchy shows a significant and positive correlation to perceived risk of terrorism ($\beta = 0.10$, $p < 0.01$), indicating that

hierarchists perceive the risk posed by terrorism to be greater than do non-hierarchists. Turning to perceived risk of oil spill and power blackout, I earlier hypothesized that hierarchists perceive the risk posed by both these hazards to be smaller than do non-hierarchists (H_2 and H_3). In the oil spill model the coefficient of hierarchy is virtually zero ($\beta = 0.00$, $p > 0.05$), indicating that hierarchists perceive the level of risk posed by oil spills similar to non-hierarchists, or put differently; the extent to which people are hierarchically-oriented has no implications for their perceived level of risk associated with oil spills. Similarly, I find no significant correlation between hierarchy and perceived risk of power blackout ($\beta = 0.01$, $p > 0.05$). Thus, the hypotheses that hierarchists perceive the risk posed by oil spill (H_2) and power blackout (H_3) to be smaller than do non-hierarchists are not supported. Overall, then, while I find support for the argument of Cultural Theory that one of hierarchists' main worries are hazards which may threaten order and stability, I find no support for the claim that hierarchists tend to show less concern for technological failure and environmental hazards than do non-hierarchists (Douglas and Wildavsky 1982; Dake and Wildavsky 1990).

Turning to *egalitarianism*, I earlier hypothesized that egalitarians perceive the risk posed by oil spill (H_4) and power blackout (H_5) to be greater than do non-egalitarians. The data support both of these expectations; egalitarianism shows a positive and significant correlation to perceived risk associated with both oil spills ($\beta = 0.17$, $p < 0.001$) and power blackout ($\beta = 0.09$, $p < 0.01$). Although both are positive, the correlation between egalitarianism and oil spill risk perception is close to twice as strong as between egalitarianism and power blackout risk perceptions. This finding is consistent with Cultural Theory which holds that, although worried about both technological and environmental hazards, the latter is their chief worry (Douglas and Wildavsky, 1982; Thompson et al., 1990). Finally, with regard to terrorism, no predictions were made about the relationship between egalitarianism and risk perceptions. I find no significant correlation between egalitarianism and perceived risk associated with terrorism, indicating that terrorism is not a hazard for which egalitarian values are relevant in terms of risk perception. Overall, the results with regard to egalitarianism are largely consistent with the predictions of Cultural Theory.

With regard to *individualism*, I hypothesized that individualists perceive the risk posed by all three hazards to be smaller than do non-individualists (H_6, H_7 and H_8). The data provide little support for these expectations. I find no significant association between individualism and perceived level of risk posed by any of the three hazards. The coefficients are close to zero in all models, and although

negative in the case of oil spills and power blackout, they are not even close to approaching significant levels. Overall, these results provide little support for Cultural Theory which view individualists as "risk takers" who tend to see risk as an opportunity for reward rather than losses and therefore tend to show little concern for hazards unless they are likely to infringe their personal freedom or interrupt the functioning of markets (Dake and Wildavsky 1990). A potential objection to such a conclusion, however, could be that since the hazards studied here are disasters (e.g. oil spill) with seemingly no benefits or potential reward, the risk taking attitude of individualists does not apply in the same way as if the hazards were objects (e.g. "oil drill") or activities (e.g. "oil drilling"). Also, the weak internal consistency of the individualism scale warrant some caution, as this tends to generate weaker correlations.

Finally, with regard to *fatalism*, no predictions were made prior to the analyses about the relationship between this cultural bias and perception of risk. Still, some significant associations were found. I find fatalism to be positively and significantly correlated with both terrorism risk perception ($\beta = 0.09$, $p < 0.01$) and power blackout risk perception ($\beta = 0.09$, $p < 0.01$), suggesting that people with a fatalistic worldview consider the risk posed by these hazards to be greater than to those less fatalistic. According to Cultural Theory fatalists view risk and danger as a matter of faith and (bad) luck which – at least according to some cultural theorists – sometimes confers onto them a "stoic dignity" (Thompson et al. 1990:63). These results lend little support to such characterizations.

On the whole, the support for the predictions of Cultural Theory is, at best, mixed. On the one hand, the most clear-cut predictions of the theory about the relationship between cultural types and risk perceptions seem to correct, namely that hierarchists are most concerned about threats to social order and stability, and that egalitarians are most worried about technological failure and environmental hazards. Moreover, none of the hypothesized relationships were in the opposite direction. On the other hand, only three out of eight hypotheses derived from the theory are supported.

5.2.3 Political orientation

First, with regard to terrorism, I earlier hypothesized that politically right-oriented individuals perceive the risk posed by terrorism to be greater than do politically left-oriented (H_9). The data support this hypothesis. The left-right variable is significantly and positively associated with perceived risk of terrorism ($\beta = 0.11$, $p < 0.001$), indicating that the more politically right-oriented, the greater the concern for terrorism. Importantly, however, since the effect of right-orientation is assumed to be linked to xenophobia and prejudices against other ethnicities, and particularly Muslims, this finding cannot be assumed to be valid in relation to all kinds of terrorism.

Turning to perceived risk associated with spills, I earlier hypothesized that politically left-oriented individuals perceive the risk posed by oil spills to be greater than do right-oriented (H_{10}). The oil spill risk perception model shows, however, that the correlation between the left-right variable and risk perception is not significant. Indeed, the coefficient of the left-right variable in this model is close to zero. Thus, H_{10} is not supported. Considering the seemingly close link between oil spill risk perception and attitudes toward environmental protection and economic growth – which is one of the underlying dimensions of the left-right dimension – this result was quite unexpected. It is worth noting, however, that the bivariate correlation is negative and significant.

With regard to power blackouts, no prediction was made about the relationship between political orientation and risk perceptions. It is therefore not surprising to find that the left-right variable is not significantly associated with power blackout risk perception ($\beta = 0.06$, $p > 0.05$). Obviously, this particular hazard is not easily interpreted within the left-right schema.

5.2.4 Confidence and trust

By first regressing the dependent variables onto the four trust variables (not shown), I find that these account for roughly 7, 5 and 7 percent of the variance in perceived risk associated with terrorism, oil spill and power blackout, respectively. This is about the same explanatory power as the four cultural bias scales. Next I discuss the individual associations between each of the trust variables and the three dependent variables.

Starting with *confidence in risk management*, I earlier I hypothesized that people who have confidence in the ability of authorities to properly manage the risk posed by a hazard perceive the risk posed by that hazard to be smaller than do those who have less confidence (H_{11}). Thus, in contrast to the hypotheses about the effect of cultural biases and political orientation, this relationship was expected to hold across all hazards. The analyses show that the correlation between confidence in risk management and perception of risk is negative and significant in the case of oil spill ($\beta = -0.16$, $p < 0.01$) and power blackout ($\beta = -0.25$, $p < 0.01$), indicating that the more confident a person is that the authorities can properly manage the risk posed by a hazard, the smaller the perceived level of risk. The correlation is negative in the case of terrorism as well, but it is weaker and not significant at the 0.05 level ($\beta = -0.06$, $p = 0.57$). Overall then, H_{11} is partly supported.

The strength of the correlations, as indicated by the size of the standardized regression coefficients, varies considerably across the models. The finding that the effect of risk management on risk perception varies across hazards is consistent with previous studies (Siegrist and Cvetkovich 2000). As discussed earlier, past research suggests that familiarity and knowledge about the hazard might be an important contextual factor; trust in risk management is most important when people's knowledge about the hazard is weak (Earle and Cvetkovich, 1995). Unfortunately, levels of knowledge or familiarity are not measured in this study. However, if the results of the present study were to be interpreted along this line of reasoning, it would have to mean that citizens's knowledge and familiarity with power blackout is weaker than their knowledge about oil spills, which in turn is lower than their knowledge and familiarity with terrorism. Intuitively, considering the history of these kinds of events in a Norwegian context, this seems very unlikely.[9] Quite to the contrary, of the three hazards under study, it seems more reasonable to assume that the general public is most (rather than least) familiar with power blackouts. Although no conclusions can be drawn without actually measuring levels of knowledge and familiarity, the knowledge hypothesis seems to be of little help for explaining this finding.

Trust in institutions

Turning to trust in institutions, I earlier hypothesized that the more trust a person have in institutions responsible for the creation and management of risk, the lower the perceived level of

[9] The history up to 2010, that is; before the terrorist attacks in 2011.

risk (H_{12}). Three institutions were selected: government, scientists and experts, and industry and business. Starting with *trust in government*, I find this variable to be negatively correlated with terror risk perception ($\beta = -0.13$, $p < 0.001$), indicating that people who find the government to be trustworthy are less concerned about terrorism. A negative association is also found in the case of oil spill, but the correlation it is weaker and it does not reach the 0.05 significance level ($\beta = -0.06$, $p = 0.131$). Trust in government is not associated with power blackout risk perception.

Turning to *trust in scientists and experts*, the results are very different from expectations. I find no significant correlation between this variable and perceived level of risk associated with terrorism ($\beta = -0.03$, $p > 0.05$). In the case of oil spill and power blackout, significant correlations are found, but contrary to expectations, both are positive ($\beta = 0.13$, $p < 0.001$ and $\beta = 0.08$, $p < 0.05$, respectively). These results seem to suggest that people who trust scientists and experts are more, rather than less, concerned over these two hazards than those who do not trust this institution.

The variable of *trust in industry and business* show a significant correlation to perceived level of risk associated with both terrorism and power blackout. Again, however, both correlations are positive ($\beta = 0.10$, $p < 0.01$ and $\beta = 0.08$, $p < 0.05$, respectively), indicating that people who trust industry and business are more concerned about terrorism and power blackout than are people who do not trust this institution. In relation to perceived risk of oil spill, the correlation is negative, but not significant ($\beta = -0.04$, $p > 0.05$).

Overall, with the exception of government, these results were contrary to expectations and the general hypothesis that people who have trust in various institutions involved in risk management perceive risk to be smaller than those who do not (H_{12}) is not supported. This also raises the question of why. A closer look at the pattern of correlations leads me to suspect, however, that these should not be interpreted as effects of trust in these institutions' involvement in risk management *per se*. Indeed, the mere fact that trust in *industry and business* is associated with perceived risk of *terrorism* seems to suggest otherwise. Instead, it seems that these correlations to a large extent reflect political attitudes and values. This is also indicated by the correlation matrix which shows that trust in the various institutions is associated with both political orientation and cultural biases. To illustrate this point, trust in industry and business and political orientation can serve as an example. The correlation matrix shows that having trust in industry and business is quite strongly associated with being politically right oriented ($r = 0.20$). And although these correlations are controlled for in the multivariate regressions, the similarities in the pattern of correlations between

these two variables and risk perception is conspicuous; both variables show positive correlations to perceived risk of terrorism and power blackout, while they are unrelated to perceived risk of oil spill. These two variables are used here as examples because the similarities in the pattern of correlations are especially evident for these two, but it seems reasonable to assume that this also holds for trust in other institutions as well cultural biases. In fact, such an interpretation is also consistent with the argument made by Earle et al. (2007) that the basis of trust – measured as a judgment of trustworthiness – is a feeling of shared values with those to be trusted.

These results may also explain the finding in risk perception research that measures of "general trust", that is; measures constructed from items of trust in various social institutions, tend to show weak correlations to risk perception (e.g. Sjöberg 1999). Basically, such measures may conceal variation in direction and strength of correlations across institutions and hazards. Perhaps more importantly, this finding also suggests that the interpretation of associations between risk perception and trust in institutions (as distinct from confidence) is not as straightforward as often assumed.

5.2.5 Socio-demographics

Regression models with only socio-demographic variables included (not shown) demonstrate that these variables alone explain about 10 percent of the variance in perceived risk associated with terrorism, 14 percent in the case of oil spills, while 7 percent of power blackout risk perception. This is actually more than any of the other groups of variables. In the following the individual associations between each socio-demographic characteristic and perceived risk of the three hazards is presented and discussed.

Gender

With regard to gender differences in risk perception I hypothesized that women perceive risk to be greater than do men, and that this relationship would hold across all the three hazards under study (H_{13}). This hypothesis is strongly supported by the data. The coefficient of the dummy *women* is positive and significant in all models, indicating that women perceive risk to be greater than men. The results also indicate, however, that gender differences in risk perception vary across hazards. The difference is largest in relation to oil spill ($b = 1.486$, $\beta = 0.26$, $p < 0.001$) and terrorism ($b =$

1.258, $\beta = 0.25$, $p < 0.001$), while considerably smaller in the case of power blackout (b= 0.720, $\beta = 0.13$, $p < 0.001$).

Compared to the other variables in the models, gender appears to be a very strong predictor of risk perception; the standardized coefficient of *women* is the largest of all coefficients in both the terrorism model and the oil spill model, while third largest in the case of power blackout. The relatively large gender differences, even when controlling for factors such as values, trust, education, etc., is somewhat surprising. As shown earlier, some has suggested that gender differences in risk perception reflect differences in power, trust, values and status (Slovic 1997; Whitfield et al. 2009). The explanation is supported by studies in which these factors are controlled for, and where gender differences become very small and even non-significant (Siegrist 2000; Whitfield et al. 2009). This is obviously not the case here. In fact, compared to the bivariate correlation (see Appendix D), the coefficient of women (both unstandardized and standardized) in the multivariate regression models are basically unchanged. Thus, to the extent the variables employed in the present model are able to capture relevant values and power relations, these results seem to suggest that something else is causing gender differences in risk perception. Although these analyses provide no conclusive results, there seems to be some room for explanations pointing toward the influence of biological and physical differences (Gustafson 1998).

Age

With regard to age differences in risk perception, I earlier hypothesized that older people perceive risk to be greater than do younger people (H_{14}). The correlation between age and risk perception is positive and significant in both the terrorism model ($\beta = 0.12$, $p < 0.001$) and the power blackout model ($\beta = 0.15$, $p < 0.001$), indicating that older people perceive the risk associated with these hazards to be greater than do younger people. The standardized coefficients of age in both these models are relatively large compared to those of other variables (third and second largest, respectively). In the oil spill model, however, the correlation is weak and not significant ($\beta = –0.02$, $p = 0.505$). Overall, the hypothesis that older people perceive risk to be greater than do relatively younger people (H_{14}) is only partly supported by the data.

Although not expected, the absence of a positive relationship between age and perceived risk associated with environmental hazards echoes past research (Gerber and Neeley 2005). As noted earlier, this may has to do with the general finding in studies of environmental attitudes, namely that

older people tend to show less environmental concern than do younger people (Van Liere and Dunlap 1980). And although a few variables in the present study presumably tap into environmental concern, such as egalitarianism and left-right, it seems rather unlikely that these variables are able to capture *all* variation in environmental attitudes. Consequently, one possible explanation for the absence of a relationship might be that the general tendency of older people to perceive risk to be large (i.e. the hypothesized positive effect of age) is somehow "offset" by their lesser concern about environmental harm (i.e. the negative effect of environmental attitudes not captured by the variables in the model), resulting in no age differences in oil spill risk perceptions.

Education and income

On education and income, I earlier hypothesized that people with higher levels of educational attainment perceive risk to be smaller than do people with lower levels of educational attainment (H_{15}) and, similarly, that people with higher levels of income perceive risk to be smaller than do people with lower levels income (H_{16}). Again, this relationship was expected to hold across all hazards.

First, with regard to education, F-tests show that the contribution of the dummy variables representing educational attainment is not significant at the 0.05 level in any of the three models. H_{15} is therefore rejected. However, although none of the differences between the reference category (compulsory school) and the two dummy variables representing higher levels of education (high school and university) are statistically significant in any of the three models, as much as five out of six coefficients are negative. Moreover, the size of the coefficients (both standardized and unstandardized) increases with levels of education. The consistency in this pattern arguably lends some support to the hypothesis; it seems very unlikely that these results are due to chance. At any rate, however, the effect of education is only marginal.

Turning to income, expectations are not quite met. As shown in Table 5-1, there are no significant differences in risk perception between respondents with different levels of income in relation to neither terrorism nor power blackout. Only in the case of oil spill significant differences are found; the unstandardized coefficients of both the dummies representing higher levels of income ("½ to 1 mill" and "more than 1 mill") are negative ($b = –0.34$, $p = 0.049$ and $b = –0.75$, $p = 0.001$, respectively), indicating that risk is perceived to be smaller among these groups than in the

reference category. Also, the size of the coefficients indicates that the level of perceived risk increases relatively proportionately with levels of income.

Overall, to the extent levels of education and income reflect individuals' social location, the findings here offer little support for explanations pointing toward the importance social location or status (Slovic 1997). It may be, however, that because the hazards studied here are disasters with wide-ranging impacts of which all people are potential victims, social location is less relevant than in the case of everyday hazards such as crime, car driving, smoking, etc. Consequently, it would be wrong to blatantly reject the relevance of social location as a predictor of risk perceptions based on the findings in this study.

5.2.6 General attitude toward risk?

The three hazards analyzed in this study were initially selected as cases because they represent very different types of hazards in terms of their origins and consequences. Indeed, the finding that very few variables show consistency across the hazards in terms of their correlation with risk perceptions seems to suggest that they are conceived as different as well. The correlation matrix (Appendix D) shows, however, that the three risk perception scales are strongly correlated. All correlations are positive, with Pearson's r varying from 0.31 to 0.37. Considering the very different nature of the three hazards, this seems to indicate an inclination among people to perceive risk to be *either* large *or* small – irrespective of the hazard under consideration.

An objection to this reasoning could be that the correlation between the three risk perception scales is, at least partly, caused by other variables either positively or negatively associated with risk perception across the three hazards. Not many variables do that, however. To examine this more closely, regression analyses were run in which each risk perception scale was regressed onto the "other two" risk perception scales (in separate analyses) and where all the independent variables from the original regression models served as controls. In order to save space, the regressions are not shown, but the results are summarized in Table 5-2. To demonstrate change (or lack thereof) when controlling for other variables, the bivariate correlations between the scales are also listed.

Table 5-2: Correlations between the three risk perception scales.

Risk perception scale	Terrorism		Oil spill		Power blackout	
	Bivariate (r)	Regression (β)	Bivariate (r)	Regression (β)	Bivariate (r)	Regression (β)
Terrorism	–	–	.31	0.30	.35	0.27
Oil Spill	.31	0.29	–	–	.37	0.36
Power Blackout	.35	0.24	.37	0.32	–	–

Note 1: The left columns show the bivariate correlations (Pearson's r), while the columns to the right show regression estimates (standardized coefficient) when controlling for other variables
Note2: All correlations are significant at the .001 level.

As can be seen in the table, the correlations between the three risk perception scales become only slightly weaker when controlling for the other variables in the model. In fact, of all the variables in the full regression models, the three risk perception scales have the largest standardized regression coefficients. In other words; the strongest predictor of the perceived level of risk associated with a hazard is the perceived level of risk associated with other – even completely different – hazards.

These results seem to demonstrate that some people, cutting across socio-demographics and other factors, tend to judge risk as large, while others tend to judge risk as small – seemingly irrespective of the particular hazard in question. While it is beyond the reach of this thesis to explain this finding, one possibility would be that that this reflects individual differences in a more general "attitude towards risk", in the sense that some people are "risk averse" and tend to be concerned about all kinds of hazards, while other are "risk takers" who are not concerned about anything.

5.3 Review of hypotheses

	Hypotheses	Results
H_1	Hierarchists perceive risk posed by terrorism to be greater than non-hierarchists	Supported
H_2	Hierarchists perceive the risk posed by oil spills to be smaller than do non-hierarchists	Not supported
H_3	Hierarchists perceive the risk posed by power blackout to be smaller than do non-hierarchists	Not supported
H_4	Egalitarians perceive the risk posed by oil spill to be greater than do non-egalitarians	Supported
H_5	Egalitarians perceive the risk posed by power blackouts to be greater than do non-egalitarians	Supported
H_6	Individualists perceive the risk posed by terrorism to be smaller than do non-hierarchists	Not supported
H_7	Individualists perceive the risk posed by oil spills to be smaller than do non-hierarchists	Not supported
H_8	Individualists perceive the risk posed by power blackout to be smaller than do non-hierarchists	Not supported
H_9	Politically left-oriented individuals perceive the risk posed by oil spill to be greater than do politically right-oriented	Not supported (only in bivariate analyses)
H_{10}	Politically right-oriented individuals perceive the risk posed by terrorism to be greater than do left-oriented	Supported
H_{11}	People who are confident that the government is able to properly manage risk posed by various hazards, perceive the risk posed by those hazards to be smaller than do those who are less confident	Partly supported (rejected in the case of terrorism)
H_{12}	People who have trust in the institutions involved in risk management perceive risk to be smaller than do those who have less trust	Not supported/Inconclusive
H_{13}	Women perceive risk to be greater than do men	Supported
H_{14}	Relatively older people perceive risk to be greater than do relatively younger people	Partly supported (rejected in the case of oil spill)
H_{15}	People with higher levels of educational attainment perceive risk to be smaller than do people with lower levels of educational attainment	Not supported
H_{16}	People with higher levels of income perceive risk to be smaller than do people with lower levels income	Partly supported (rejected in the case of terrorism and power blackout)

6. Conclusions

6.1 Addressing the research question

The starting point of this thesis was an annual survey showing that there is considerable variation within the public regarding the level of risk ascribed to various hazards. Based on these observations, the following research question was formulated: *What can explain the observation that people differ so substantially in their perception of the risk posed by disasters?* In addition, the following questions were raised; which factors are most important in explaining variation in risk perception? Does their importance depend on the hazard in question? Since the answers to these questions are closely linked, they will be discussed in parallel.

A range of different approaches in risk perception research have been reviewed throughout this thesis. One of these has been Cultural Theory, which holds that citizens' perceptions of the risk posed by various hazards correspond to deeply held values or worldviews, so-called cultural biases: hierarchy, egalitarianism, individualism and fatalism (Dake and Wildavsky 1990; Douglas and Wildavsky 1982, Thompson et al. 1990). Consistent with predictions derived from the theory, I find that hierarchically-oriented people perceive the risk posed by terrorism to be greater than do those who are not. Also in line with expectations, I find that people with egalitarian values perceive the risk posed by oil spills and power blackouts to be greater than those not holding such values. Contrary to expectations, however, I find that people holding individualist values do *not* judge the risk to be smaller (nor larger) than people less individualistic-oriented. Finally, although cultural theorists have made few statements about fatalists' perceptions of risk, I find that people with a fatalistic worldview perceive the risk posed by both terrorism and power blackout to be greater than those less fatalistic.

To the extent Cultural Theory has been put to a test in the present study, the results seem to provide rather weak support. First of all, operationalization of the four cultural biases was problematic, at least in a manner consistent with the theory. While this may be due to the specific measures or method used in the present study, the problems echo past research. As such, they seem to reflect an inherent problem in empirical research on Cultural Theory. Moreover, as much as five out of eight hypotheses derived from the theory were rejected. Three of the correlations *were* consistent with

expectations, but as others have pointed out; demonstrating correlations between cultural biases and perceptions of risk – even if in a pattern consistent with the theory – does by no means verify Cultural Theory (Marris et al. 1998). Cultural Theory makes a number of claims beyond postulating a pattern of correlations between cultural biases and risk perceptions – claims not put to a test in this study. On the other hand, even if Cultural Theory is not verified, or for the sake of argument – even if it was proved to be wrong – the results of this study *do* demonstrate that values influences perceptions of risk. As such, these findings help understand the observation that citizens tend to differ in their perceptions of the risk posed by various disasters. They also suggest that future research on risk perceptions may gain from broadening its horizon from Cultural Theory to also explore the influence of others types of values used in social sciences, such as Schwartz's basic human values and Inglehart's post-materialist values.

Related to this is the influence of political orientation, as captured by the left-right dimension. Although largely ignored in risk perception research, "left" and "right" – much like cultural biases – also reflect values or ideology (Fuchs and Klingemann 1990; Aardal 1999). As a result, the relatively simple left-right scheme may also serve as a framework from which hypotheses about citizens' perceptions of risk posed by various disasters can be generated. Thus, consistent with expectations, I find that politically right-oriented citizens perceive risk posed by terrorism to be greater than do left-oriented. Importantly, however, the xenophobic attitudes assumed to underlie this relationship cannot be expected to be relevant to all kinds of terrorism, and the validity of this finding is likely to be restricted to terrorism carried out by radical Islamists. People's political orientation is not predictive of perceived level of risk associated with neither oil spill nor power blackout, however. Most surprising is the finding that left-oriented, who (at least in Norway) tend to be more concerned about environment (Aardal 1999), do not perceive the risk posed by oil spill to be greater than do right-oriented.

The study also demonstrates that citizens' perceptions of the risk posed by disasters are closely linked to their trust in risk management and risk management institutions. By drawing a distinction between confidence in risk management on one hand, and trust in the institutions involved in risk management on the other, I find that citizens who have confidence in risk management perceive risk to be smaller than those who are not. The importance of confidence varies considerably across the three hazards studied, however. While being one of the most important factors in relation to power blackout, its effect is much weaker and not even significant in the case of terrorism. That the

importance of confidence in risk management varies across hazards is, in itself, not a new finding (Siegrist and Cvetkovich 2000), but the finding in the present study is not easily explained based on existing knowledge about the causes of these variations.

As regards trust in various institutions involved in risk management, including government, scientists and experts, and industry and business, I also find these to be related to risk perceptions. However, few correlations are consistent with predictions from the literature. People who have more trust in government show less concern for terrorism than those with less trust; People who have more trust in scientists and experts perceive the risk posed by oil spill and power blackouts to be greater than those with less trust; while people who have trust in industry and business is more concerned about terrorism and power blackout. The pattern of associations seems to be best explained when trust in an institution is conceived as reflecting a feeling of shared values. Hence, these associations cannot be interpreted as effects of people's trust in these institutions' involvement in the creation and management of risk *per se.*

The study also demonstrates that the perceived level of risk associated with the hazards under study differ between people with different socio-demographic characteristics. In particular, I find gender to be a strong predictor of risk perceptions. Women perceive risk to be greater than do men in relation to all three hazards. In fact, gender stands out as one of the most important variables for explaining variation in risk perception. While this finding is consistent with previous research (e.g. Finucane et al. 2000; Flynn et al. 1994), the relatively strong effect of gender even when controlling for differences in values, trust, etc., contrasts some previous studies (Siegrist 2000; Whitfield et al. 2009). I also find age differences in perceptions of risk. Relatively older people consider the risk posed by terrorism and power blackout to be greater than do relatively younger people. I find no age differences in risk perception in the case of oil spill, however. The may be related to the finding in past research that older people tend to show less concern for the environment than do younger people (Van Liere and Dunlap 1980). With regard to education, the results seem to indicate that more highly educated people perceive risk to be lower than do less educated. However, although this relationship appears to be fairly consistent across all hazards studied, the differences are very small and not even significant. Income appears to be relevant, but only in relation to oil spills, where I find that people with higher income are less concerned than people with lower income. Overall, the findings suggest that education and income have only marginal effect on perceived risk of the hazards studied.

Finally, and somewhat unexpected, I find that people – across variables such as age and gender – tend to perceive the risk of all three hazards as *either* high *or* low. Considering the different nature of the three hazards, this finding may be interpreted as to suggest the existence of more general "attitude towards risk"; some people are risk averse and tend to reject danger, while other are "risk takers" and tend to accept danger. This may help explain the large amount of variance in risk perception not accounted for by the variables used in present study, and it suggests that other explanations may also be relevant to the understanding of risk perceptions. As such, it also shows the complexity of the subject.

In summary, perhaps the most notable finding in this study has the extent to which the influence of the various factors on risk perceptions vary across the three hazards selected as cases. As shown, while this was expected with regard to the effect the four cultural biases as well as political left-right orientation, these variations were quite unexpected with regard to the rest of the variables. Not only is this finding at odds with many of the hypotheses generated from literature – as discussed above – but it also has implications to risk managers.

6.2 Implications for risk managers

In short, this study has demonstrated how cultural biases, political orientation, trust in risk management as well as socio-demographic characteristic influences citizens' perceptions of risk associated with terrorism, oil spills and power blackout. Simply put, the study sheds light on what kind of people are more or less likely to be concerned about these hazards, including why they tend to perceive risk the way they do. To disaster risk managers, this kind of information may be very useful when developing risk communication strategies. More specifically, when seeking to lower public concern – or alternatively, to increase public awareness – about these hazards, these finding can be used not only to identify the target of communication, that is; groups or segments of the public more or less likely to be concerned, but also to provide clues as to how the message should be formulated and framed in order for it to be accepted. A message more attuned to the values of the receiver seems much more likely to be accepted. Moreover, depending on the target of communication, the results may also provide clues as to what kinds of institutional channels or platforms of communications which are most likely to be effective. In short, these findings may help disaster risk managers to "customize" risk communication strategies for the particular hazard in question.

If the kind of application described above is feasible, the findings in this study could be very useful to risk managers seeking to communicate risk associated with terrorism, oil spills or power blackout. However, these three hazards are far from the only hazards of interest to disaster risk managers and policy planners. Public transport accidents, nuclear accidents, pandemic influenzas and other diseases, natural disasters such as storms and flooding, financial crises, etc. are only a few examples of other possible disasters. Thus, to risk managers and policy planners with responsibilities beyond the three hazards studied here, the value of the findings in this study may be limited in the sense that – "next time" risk communication is needed – they may turn out not to be relevant. This is true unless, of course, the findings on each of these hazards are valid also in other cases. This is an issue which needs to be addressed.

6.3 Can the findings be generalized to other hazards?

As shown in this thesis, citizens' perceptions of the risk posed by terrorism, oil spill and power blackout are influenced by a number of factors. As also shown, however, the effect these variables have on risk perception seems to be very much dependent upon the particular hazard in question. Both the direction and strength of the correlations vary considerably across the three hazards studied. Obviously, the relationships between these variables and risk perception cannot be generalized to all hazards. The question is: can they reasonably be assumed to be valid in relation to any other hazards at all beyond the three particular hazards studied here?

To address this issue, the following question may serve as a starting point: what is it about these particular disasters that cause the strength and direction of the associations between the various variables and risk perception to vary? What are the key characteristics or properties of each of these disasters? If these could be identified, I would argue, generalizing the findings from each of the particular cases to other cases with similar characteristics or properties would seem reasonable.

This is not a straightforward task, however, since what exactly is the "key" characteristic of a disaster may depend on the particular relationship in question. For example, the characteristics of importance for the influence of values are not necessarily the same as the characteristics of importance for the effect of age. As a result, one cannot simply generalize all the relationships found in one particular case (i.e. hazard) to other hazards with similar characteristics. Instead, it seems that careful attention has to be paid to each and one of the variables and the rationale

underpinning its effect on risk perception in relation to different hazards. Guided by theory and reasoning, however, I believe the variables employed in this thesis can be divided into two groups of variables; "value variables" and "non-value variables".

As shown earlier, all of the hypotheses about the influence of values (i.e. cultural biases and political orientation) on risk perceptions were "specific" to the hazard in question, that is; the hypothesized relationships were based on the characteristics of the disasters – in terms of their origins and consequences – and the extent to which these were assumed to conflict with different types of values. As for these relationships, I would argue – at least when found to be consistent with the hypotheses – it might be reasonable to generalize the findings to hazards with similar characteristics. Thus, in the case of oil spill, which arguably is characterized by causing harm to nature and environment, it seems reasonable to assume that the positive relationship between egalitarianism and risk perception may also hold true in the case of other hazards possibly causing harm to the environment. CO_2 emissions, hazardous waste, releases of chemical substances, and other kinds of pollution are possible cases.

This kind of generalization is much more problematic in the case of terrorism and power blackout, however. In contrast to oil spill, which first and foremost is characterized by its consequences (i.e. harm to nature), terrorism and power blackout may be characterized by both their causes and consequences. As shown earlier, in the case of terrorism, the hypothesized effect of political orientation on risk perception was based on the *origins* of terrorism (in this case radical Islamists), while the hypothesized effect of hierarchy on risk perception was based on the *consequences* of terrorism (i.e. "social disorder"). Consequently, it would be a fallacy to generalize the effect of political orientation on risk perception to hazards with similar consequences as terrorism (e.g. crime, war, etc.). Likewise, it would make little sense to generalize the effect of hierarchy on risk perception to hazards with similar origins.

The same problem applies to power blackouts; throughout this thesis I have characterized this kind of disaster as a technological hazard, due to its origins in technological failure. Indeed, the hypothesized effect of egalitarianism on power blackout risk perception was based precisely on this notion. Thus, considering the fact that this hypothesis was supported by the empirical analyses, it could be argued that this relationship also may hold true in relation to other hazards involving some sort of technological failure. It is also possible, however, that the effect of egalitarianism, as well as that of fatalism and political orientation (no hypotheses were stated about the effect of the latter

two), is actually related to the *consequences* of power blackout rather than the origins. This uncertainty, about what exactly it is about power blackout that underlies the effect of the value-variables on risk perception, makes generalization of these relationships to other hazards highly problematic.

With regard to the "non-value variables", all of the hypotheses about the relationship between these and risk perceptions were "general", that is; they were expected to hold across all hazards. Basically, the rationale underpinning these hypotheses was not related to the characteristics of the hazards at all. Thus, if these relationships had been found to be consistent with the hypotheses, then it would seem reasonable to argue that they also could be valid in relations to other types of hazards – especially considering the very different nature of the hazard studied. As shown, however, with the notable exception of gender, none of these relationships were found to hold across all hazards (and even gender differences varied across hazards). Obviously, then, they cannot be generalized to all kinds of hazards. In fact, I would argue, since these relationships (presumably) are unrelated to the characteristics of the hazards, they cannot reasonably be generalized even to hazards with similar characteristics. This logic simply does not apply. For example, why should the origins or the consequences of a disaster be relevant to the influence of confidence in risk management on risk perception? It seems more likely that some other, unknown characteristics or contextual factor causes the effect of these variables to vary across the three hazards. As a result, generalizing these findings to other hazards with similar origins or consequences would be a fallacy.

6.4 A suggestion for future research

As shown above, the findings on the relationships between the various independent variables and risk perception in the case of terrorism, oil spill and power blackout are not easily generalized to other hazards. Thus, to disaster risk managers with interest and responsibilities beyond these three particular hazards, the applicability of the findings of this study to practical purposes remains restricted. Considering the potential value of knowledge about these relationships in relation to other kinds of hazards, a track for future research could therefore be to map out empirically how risk perception relationships vary across different kinds of hazards.

In fact, at least to my knowledge, there have been few – if any – genuine attempts to systematically map out how risk perception relationships vary across different kinds of hazards. Of course, a number of studies with comparative designs have been conducted in which risk perceptions are studied in relation to multiple hazards. However, most of these studies have been carried out within the psychometric paradigm described in chapter 3. And because the main objective of this research has been to explain why "the public" perceive certain hazards to be more dangerous than other hazards, the variables employed in these models are not very useful to the understanding of why citizens tend to differ in their perception of the risk. In contrast, among studies with this particular research objective, by far the most common approach is case studies in which a relatively large number of variables are used to explain variation in public perceptions of the risk associated with certain hazards of interest to the researchers (e.g. nuclear power, global warming, etc). Of course, to the extent these case studies combined cover all hazards of interest to risk managers, systematic reviews or meta-analyses of these studies could possibly provide some insights into variation across hazards. However, although these studies do have in common that they employ a relatively large number of explanatory variables, they still differ considerably in their design, both in terms of the specific variables employed and also in the way in which key concepts (including risk perceptions) are operationalized. For this reason, reviews or meta-analyses of case studies do not seem like an appropriate approach.

What seem to be needed are studies combining the design of studies within the psychometric paradigm with that of case studies. In other words: a comparative study in which the relationships between relevant explanatory variables and risk perceptions are examined across "all" hazards/disasters of interest to risk managers. But which variables should be employed and which hazards should be selected? As regards the variables, the findings in this thesis suggest that similar variables would be reasonable. With regard to the hazards, the selection should be guided mainly by the needs of the disaster risk managers. Still, in order to examine closer the domain validity of findings in this study, hazards could be selected which are similar to those already analyzed. A case in point is different kinds of terrorism (i.e. terrorism carried out by different political and/or ethnic groups). Similarly, to examine the extent to which oil spill model are representative of "environmental" hazards, other hazards with may cause harm to the environment should be selected. Finally, to examine the extent to which, if at all, the findings in the power blackout model are representative of "technological" hazards, other hazards involving some sort of technological failure could be included. In addition, of course, hazards with seemingly different characteristics

should be selected, including for example economic trouble such as financial crises, natural disasters such as storms, flooding, etc.

A study like the one outlined above could be useful to risk managers both "directly" and "indirectly". Directly, by empirically mapping out risk perception relationships in relation to different kinds of hazards. While this kind of contribution would be similar to that of the present study, the applicability of the results would most certainly increase by increasing the number of hazards studied. The study could also contribute more "indirectly". If patterns of relationships could be demonstrated empirically – between explanatory variables and the level of risk associated with hazards of similar characteristics – this would provide a stronger basis for generalizing findings to other kinds of hazards. In fact, considering the "unlimited" number and types of potential hazards in the real world, the latter use could potentially be very helpful to risk managers and policy planners. Based on the characteristics of the hazard at hand, it would enable them – at least with greater certainty than at present – to anticipate what kinds of people are more or less likely to be concerned and why.

6.5 Concluding remarks

By addressing the research question of why people seem to differ so substantially in their perception of the risk associated with the very same disasters, the main objective of this thesis has been to provide disaster risk managers with a framework of knowledge within which survey observations on public risk perceptions can be interpreted, and – by extension – applied to practical purposes, such as risk communication strategies. With regard to the first part of the objective, the literature review and the empirical analyses in this thesis may hopefully help risk managers understand why public disagreement over risk exists. This study has demonstrated that how people judge the risk posed by various hazards varies systematically between people or groups of people with different values and political leanings, levels of trust in risk management as well as socio-demographic characteristics. With regard to the latter part of the objective, applications of the findings to risk communication strategies seems possible in the case of terrorism, oil spill, and power blackout, but questions about the validity of findings in domains beyond these three particular hazards place some serious restrictions on the range of applicability. A track for future research has been pointed out which may help close this gap.

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Appendix A: Questionnaire

English version

Note: Questions are listed in the order they were asked. Statements A22.1 – A22.20 were randomized during interviews.

Nr	Name	Question/statement
		First I would like to ask you some questions about three different types of threats and dangers facing society. The first one is terrorism. Recent years several western countries have been exposed to terrorist attacks. The attack on the London Underground in 2005 is an example of such an event.
1	**A2**	How likely do you think it is that a terrorist attack will occur in Norway within the next 5-10 years? On a scale ranging from 1 to 5, where 1 is *not likely at all* and 5 is *very likely*, what do you think?
2	**A3**	If such a terrorist attack took place, how serious do you think this would be to the society? Give your answer on a scale ranging from 1 to 5, where 1 is *not serious at all* and 5 is *very serious*.
3	**A4**	How large of a risk do you think terrorist attacks pose to society?" Give your answer on a scale ranging from 1 to 5, where 1 is *no risk* and 5 is a *very large risk*.
		The next topic is large oil spills. The oil spills in the Gulf of Mexico this spring is an example of such an event.
4	**A5**	How likely do you think it is that such an oil spill will occur in Norway within the next 5-10 years? On a scale ranging from 1 to 5, where 1 is *not likely at all* and 5 is *very likely*, what do you think?
5	**A6**	If such an oil spill occurred, how serious do you think this would be to the environment and society in general? Respond on a scale from 1-5, where 1 is *not serious at all* and 5 is *very serious*.
6	**A7**	How large of a risk do you think large oil spills pose to society? Give your answer on a scale ranging from 1 to 5, where 1 is *no risk* and 5 is a *very large risk*.
		Next is a question about long-term power blackouts. An example of such an event was

		Sweeden in 2005, when large parts of Southern-Sweden were without electricity for several days – some places for weeks.
7	**A8**	How likely do you think it is that such power blackouts will occur in Norway within the next 5-10 years? On a scale ranging from 1 to 5, where 1 is *not likely at all* and 5 is *very likely*, what do you think?
8	**A9**	If such a power blackout occurred, how serious do you think this would be to the society? Give your answer on a scale from 1-5, where 1 is *not serious at all* and 5 is *very serious*.
9	**A10**	How large of a risk do you think long-term power blackouts pose to society? Give your answer on a scale ranging from 1 to 5, where 1 is *no risk* and 5 is a *very large risk.*
10	**A11**	First, in general, on a scale ranging from 1 to 5 where 1 is "no trust" and 5 is "very much trust", how much trust do you have in Norwegian authorities?
		On a scale from 1 to 5, where 1 is "no trust" and 5 is "very much trust", how much do you trust the following institutions to provide trustworthy information about threats and dangers in society:
11	**A12.1**	Scientists and experts?
12	**A12.2**	Industry and business?
13	**A12.3**	Governmental authorities?
14	**A13**	How confident are you that the authorities – for example by way of monitoring and control – are able to *prevent* terrorist attacks from occurring? Give your answer on a scale from 1 to 5, where 1 is "not confident at all" and 5 is "very confident".
15	**A14**	If a terrorist attack does occur – to what extent do you think the authorities will be able to mitigate the consequences from such an event? On a scale from 1 to 5, where 1 is "not at all" and 5 is "to a very large extent" – what would you say?
16	**A15**	How confident are you that the authorities – for example through regulations and demands on the oil industry – are able to *prevent* huge oil spills from occurring? Give your answer on a scale from 1 to 5, where 1 is "not confident at all" and 5 is "very confident"
17	**A16**	If a huge oil spill *does* occur – to what extent do you think the authorities will be able to *mitigate* the consequences from such an event? Give your answer on a scale from 1 to 5, where 1 is "not at all" and 5 is "to a very large extent"
18	**A17**	How confident are you that the authorities – for example through regulations and demands on the power sector – are able to prevent prolonged electrical blackouts from occurring? You may give your answer on a scale from 1 to 5, where 1 is "not confident at all" and 5 is "very confident".
19	**A18**	If a prolonged electrical blackout *do* occur, to what extent do you think the authorities are able to mitigate the consequences from such an event? Give your answer on a scale from 1 to

		5, where 1 is “not at all” and 5 is “to a large very extent”.
		Now I am going to read to you a number of statements representing different values and attitudes among people. I want you to tell me how much you agree or disagree with each statement. **1**: Completely agree **2**: Partially agree **3**: Neither agree nor disagree **4**: Partially disagree **5**: Completely disagree **6**: Don’t know
20	**A22.1**	We need to drastically reduce discrimination between men and women
21	**A22.2**	One of the problems with people today is that they challenge authority too often
	A22.3	Everyone should have an equal chance to succeed and fail without government interference
22	**A22.4**	In a fair system, people with more ability should earn more.
23	**A22.5**	I would support a tax shift that put a heavier burden on companies and people with high incomes.
24	**A22.6**	People are often best off by not trusting other than themselves.
25	**A22.7**	It is important to me that when important decisions are made at my workplace everybody is asked.
26	**A22.8**	We need to accept the limits in our lives whether we like it or not.
27	**A22.9**	I would never participate in protest movements, action groups and things like that.
28	**A22.10**	There is no point in doing things for other people. One hardly ever gains from it in the long run.
29	**A22.11**	Firms and institutions should be organized in a way so that everybody can influence important decisions.
30	**A22.12**	I prefer tasks where I can work out things on my own.
31	**A22.13**	It’s important to preserve customs and our cultural heritage.
32	**A22.14**	I prefer not to join voluntary organizations, associations, and things like that
33	**A22.15**	The freedom of the individual must never be restricted, not even when fighting crime
34	**A22.16**	Order and discipline is not always popular, but it is important values
35	**A22.17**	My ideal job would be an independent business
36	**A22.18**	The police should have the right to listen to private phone calls when investigating crime
37	**A22.19**	When I have problems I try to solve them on my own
38	**A22.20**	Family and close communities are the basis of a functioning society
39	**A23.1**	Year of birth?
40	**A24**	Gender?
41	**A25**	On a scale from 1 to 10, where 1 is very far to the left and 10 is very far to the right, where

		would you place yourself on a left-right scale?
42	**A26**	What is your highest educational attainment? **1**: Elementary school **2**: Lower secondary/high school **3**: High school/college **4**: University
43	**A27**	What would you estimate your household's annual total gross income to be? **1**: Up to kr. 100.000 **2**: Kr. 100.-199.000 **3**: Kr. 200.-299.000 **4**: Kr. 300.-399.000 **5**: Kr. 400.-499.000 **6**: Kr. 500.-599.000 **7**: Kr. 600.-799.000 **8**: Kr. 800.000 to less than 1 mill. **9**: Kr. 1 mill. or more **10** : Refuse to answer **11** : Don't know

Norwegian version

Nr	**Name**	Question/statement
		Først vil jeg stille deg noen spørsmål knyttet til tre ulike typer trusler og farer samfunnet står ovenfor. Den første er *terrorisme*. De siste årene har flere vestlige land blitt utsatt for terroraksjoner. Angrepet mot undergrunnsbanen i London i 2005 er et eksempel på en slik hendelse.
1	**A2**	Hvor sannsynlig tror du det er at slike terroraksjoner vil kunne inntreffe her i Norge løpet av de nærmeste 5-10 årene? På en skala fra 1 til 5, der 1 er "helt usannsynlig" og 5 er "svært sannsynlig" - hva tror du?
2	**A3**	Hvis en slik terroraksjon skulle inntreffe, hvor alvorlig mener du dette ville være for samfunnet? Svar på en skala fra 1 til 5, der 1 er "ikke alvorlig i det hele tatt" og 5 er "svært alvorlig"
3	**A4**	Hvor stor risiko mener du at terroraksjoner utgjør i dagens samfunn? Du skal svare på en skala fra 1 til 5, der 1 er "ingen risiko" og 5 er "svært stor risiko".
		Det neste temaet er *store oljeutslipp*. Utslippene i Mexico-gulfen i våres er et eksempel på en slik hendelse.
4	**A5**	Hvor sannsynlig tror du det er at slike oljeutslipp vil kunne inntreffe her i Norge i løpet av de

		nærmeste 5-10 årene? På en skala fra 1 til 5, der 1 er "helt usannsynlig" og 5 er "svært sannsynlig " - hva tror du?
5	**A6**	Hvis et slikt oljeutslipp skulle inntreffe, hvor alvorlig mener du dette ville være for naturen og samfunnet forøvrig? Du skal svare på en skala fra 1 til 5, der 1 er "ikke alvorlig i det hele tatt" og 5 er "svært alvorlig".
6	**A7**	Hvor stor risiko mener du at store oljeutslipp utgjør i dagens samfunn? Du skal svare på en skala fra 1 til 5, der 1 er "ingen risiko" og 5 er "svært stor risiko".
		Så et spørsmål om *langvarige strømutfall*. Et eksempel på en slik hendelse var i 2005, da store deler av Syd-Sverige mistet strømmen i flere dager - noen steder i ukesvis.
7	**A8**	Hvor sannsynlig tror du det er at slike strømutfall vil kunne skje her i Norge løpet av de nærmeste 5-10 årene? På en skala fra 1 til 5, der 1 er "helt usannsynlig" og 5 er "svært sannsynlig" - hva tror du?
8	**A9**	Hvis et slikt strømutfall skulle inntreffe, hvor alvorlig mener du dette ville være for samfunnet? På en skala fra 1 til 5, der 1 er "ikke alvorlig i det hele tatt" og 5 er "svært alvorlig" - hva mener du?
9	**A10**	Hvor stor risiko mener du at langvarige strømutfall utgjør i dagens samfunn? Nå skal du svare på en skala fra 1 til 5, der 1 er "ingen risiko" og 5 er "svært stor risiko".
10	**A11**	Først helt generelt: på en skala fra 1 til 5, hvor 1 er "ingen tillit" og 5 er "svært stor tillit", hvilken tillit vil du si at du har til norske myndigheter?
		På en skala fra 1 til 5, hvor 1 er "ingen tillit" og 5 er "svært stor tillit", hvilken tillit vil du si at du har til følgende aktører når det gjelder å gi pålitelig informasjon om trusler og farer i samfunnet?
11	**A12.1**	Forskere og eksperter
12	**A12.2**	Industri og næringsliv
13	**A12.3**	Myndighetene
14	**A13**	Hvor stor tiltro har du til at myndighetene - gjennom f.eks. overvåking og kontroll - er i stand til å *forhindre* terroraksjoner fra å inntreffe? Svar på en skala fra 1 til 5, der 1 er "ingen tiltro" og 5 er "svært stor tiltro".
15	**A14**	Hvis et terrorangrep inntreffer, i hvilken grad tror du myndighetene vil klare å *begrense* konsekvensene av en slik hendelse? På en skala fra 1 til 5, der 1 er "ikke i det hele tatt" og 5 er "i svært stor grad" - hva svarer du?
16	**A15**	Hvor stor tiltro har du til at myndighetene - gjennom f.eks. regulering og krav til oljebransjen - er i stand til å *forhindre* store oljeutslipp fra å inntreffe? Svar på en skala fra 1 til 5, der 1 er "ingen tiltro" og 5 er "svært stor tiltro".

17	**A16**	Hvis et stort oljeutslipp inntreffer, i hvilken grad tror du myndighetene vil klare å *begrense* konsekvensene av en slik hendelse? Svar på en skala fra 1 til 5, der 1 er "ikke i det hele tatt" og 5 er "i svært stor grad".
18	**A17**	Hvor stor tiltro har du til at myndighetene â` gjennom f.eks. regulering og krav til strømbransjen - er i stand til å *forhindre* langvarige strømutfall? Her skal du svare på en skala fra 1 til 5, der 1 er "ingen tiltro" og 5 er "svært stor tiltro".
19	**A18**	Hvis et langvarig strømutfall inntreffer, i hvilken grad tror du myndighetene vil klare å *begrense* konsekvensene av en slik hendelse? Du skal svare på en skala fra 1 til 5, der 1 er "ikke i det hele tatt" og 5 er "i svært stor grad".
		Nå skal jeg lese opp noen påstander som representerer ulike verdier og holdninger blant folk. Jeg vil her at du skal si hvor enig eller uenig du er i påstandene. **1**: Helt enig **2**: Delvis enig **3**: Verken enig eller uenig **4**: Delvis uenig **5**: Helt uenig **6**: Vet ikke
20	**A22.1**	Vi må drastisk redusere forskjellsbehandlingen av menn og kvinner
21	**A22.2**	Et av problemene med folk i dag er at de alt for ofte setter seg opp mot autoriteter
	A22.3	Alle burde ha like muligheter til å lykkes eller feile uten at myndighetene blander seg inn
22	**A22.4**	I et rettferdig system vil de som er flinkest tjene mest penger
23	**A22.5**	Jeg ville støttet en skattereform som la en større belastning på selskaper og personer med høye inntekter
24	**A22.6**	Folk er ofte best tjent med ikke å stole på andre enn seg selv
25	**A22.7**	Når viktige beslutninger skal tas på jobben er det viktig for meg at alle involverte blir spurt
26	**A22.8**	Vi må akseptere at det finns begrensninger i livet, enten vi vil det eller ei
27	**A22.9**	Jeg kunne aldri tenke meg å delta i protestbevegelser, aksjonsgrupper eller lignende
28	**A22.10**	Det er ikke noe vits å gjøre ting for andre mennesker - man tjener sjelden på det i det lange løp
29	**A22.11**	Bedrifter og institusjoner burde være organisert slik at alle kan påvirke viktige beslutninger
30	**A22.12**	Jeg foretrekker oppgaver hvor jeg kan finne ut av ting selv
31	**A22.13**	Det er viktig å bevare tradisjoner og vår kulturelle arv
32	**A22.14**	Jeg melder meg helst ikke inn i frivillige organisasjoner, foreninger eller lignende
33	**A22.15**	Individets frihet må aldri begrenses, selv ikke når man bekjemper kriminalitet
34	**A22.16**	Orden og disiplin er ikke alltid så populært, men det er en viktig verdi
35	**A22.17**	Min ideelle jobb ville være å arbeide som selvstendig næringsdrivende
36	**A22.18**	Politiet bør ha lov til å lytte på private samtaler når man etterforsker kriminalitet

37	**A22.19**	Når jeg har problemer prøver jeg helst å løse dem på egenhånd
38	**A22.20**	Familien og nære felleskap er grunnleggende for et velfungerende samfunn
39	**A23.1**	Hva er ditt fødselsår?
40	**A24**	Kjønn?
41	**A25**	På en skala fra 1-10, hvor 1 er svært langt til venstre og 10 er langt til høyre, hvor vil du si du befinner deg på en høyre-venstre-skala?
42	**A26**	Hva er din høyeste avsluttede utdannelse? **1**: Folkeskolenivå **2**: Ungdomsskole/ realskolenivå **3**: Videregående skole/ gymnasnivå **4**: Universitetsnivå
43	**A27**	Hva vil du anslå husstandens samlede brutto inntekt til pr. år? **1**: Inntil kr. 100.000 **2**: Kr. 100.-199.000 **3**: Kr. 200.-299.000 **4**: Kr. 300.-399.000 **5**: Kr. 400.-499.000 **6**: Kr. 500.-599.000 **7**: Kr. 600.-799.000 **8**: Kr. 800.000 til under 1 mill. **9**: Kr. 1 mill. eller mer **10**: Vil ikke svare **11**: Vet ikke

Appendix B: Cultural Theory items used by Rippl

	A priori identification	
Statement	**Grid**	**Group**
People are best off not trusting other than themselves		x
It is important to me that when important decision are made at my workplace everyone is asked	x	
We need to accept the limits of our lives, either we like it or not	x	
I would never joined protest, demonstrations and things like that	x	
There is no point in doing things for other people – one hardly ever gains on it in the long run anyway		x
Companies and firms should be organized so that everybody have an influence on important decisions	x	
I prefer tasks where I can work out things on my own		x
It is important to preserve customs and cultural heritage		x
I prefer not to join voluntary organizations, associations, and things like that		x
The freedom of the individual must never be restricted, even when fighting crime	x	
Order and discipline is not always popular, but it is important virtues	x	
My ideal job would be an independent business		x
The police should have the right to listen to private phone calls when investigating crime	x	
When I have problems I try to solve them on my own		x
Family and close communities are the basis of a functioning society		x

Appendix C: Descriptive statistics of items from questionnaire

Note: The items listed below correspond to the items in the questionnaire (A2 = B2 and so on), except that "don't know" and "refuse to answer" responses are coded missing, and the scores on item B22.1 – B22.20 are reversed (1 = disagree, 5 = agree). Scales constructed from the items below are presented separately in the main text.

Item	Description	N	Min	Max	Mean	S.D.	Miss.
B2	Likelihood of terrorist attacks	896	1.00	5.00	3.01	1.078	5
B3	Consequences of terrorist attacks	897	1.00	5.00	4.00	1.098	4
B4	Risk posed by terrorist attacks	895	1.00	5.00	2.88	1.111	6
B5	Likelihood of large oil spills	896	1.00	5.00	2.89	1.079	5
B6	Consequences of large oil spills	895	1.00	5.00	4.07	1.035	6
B7	Risk posed by oil spills	892	1.00	5.00	3.05	1.051	9
B8	Likelihood of long-term power blackouts	893	1.00	5.00	2.69	1.106	8
B9	Consequences of long-term power blackouts	900	1.00	5.00	3.73	1.054	1
B10	Risk posed by long-term power blackouts	899	1.00	5.00	2.83	1.148	2
B11	Trust in government in general	899	1.00	5.00	3.36	.934	2
B12.1	Trust in information provided by scientists and experts	898	1.00	5.00	3.32	.921	3
B12.2	Trust in information provided by industry and business	897	1.00	5.00	2.76	.860	4
B12.3	Trust in information provided by government authorities	901	1.00	5.00	3.26	.967	0
B13	Confidence in ability to prevent terrorist attacks from occurring	898	1.00	5.00	3.20	.905	3
B14	Confidence in ability to mitigate consequences of terrorist attacks	899	1.00	5.00	3.01	.915	2
B15	Confidence in ability to prevent oil spills from occurring	896	1.00	5.00	3.10	.928	5
B16	Confidence in ability to mitigate consequences of oil spills	895	1.00	5.00	2.84	.897	6
B17	Confidence in ability to prevent power blackouts from occurring	896	1.00	5.00	3.22	.904	5
B18	Confidence in ability to mitigate consequences of power blackouts	898	1.00	5.00	3.10	.909	6
B22.1	We need to drastically reduce discrimination between men and women	894	1.00	5.00	3.93	1.322	7
B22.2	One of the problems with people today is that they challenge authority too often	880	1.00	5.00	2.67	1.358	21

B22.3	Everybody should have an equal chance to succeed and fail without government interference	883	1.00	5.00	3.76	1.285	18
B22.4	In a fair system people with more ability should earn more	889	1.00	5.00	3.38	1.408	12
B22.5	I would support a tax reform that put a heavier burden on companies an people with high incomes	894	1.00	5.00	3.61	1.402	7
B22.6	People are often best off by not trusting other than themselves	895	1.00	5.00	2.27	1.342	6
B22.7	It is important to me that when important decision are made at my workplace everyone is asked	894	1.00	5.00	4.44	1.018	7
B22.8	We need to accept the limits in our lives, whether we like it or not	897	1.00	5.00	4.48	.954	4
B22.9	I would never participate in protest movements, action groups and things like that	895	1.00	5.00	2.88	1.570	6
B22.10	There is no point in doing things for other people – one hardly ever gains from it in the long run	895	1.00	5.00	1.46	1.041	6
B22.11	Firms should be organized in a way so that everybody can influence important decisions	894	1.00	5.00	3.60	1.350	7
B22.12	I prefer tasks where I can work out things on my own	894	1.00	5.00	4.01	1.051	7
B22.13	It is important to preserve customs and our cultural heritage	898	1.00	5.00	4.46	.871	3
B22.14	I prefer not to join voluntary organizations, associations, and things like that	900	1.00	5.00	2.48	1.543	1
B22.15	The freedom of the individual must never be restricted, not even when fighting crime	881	1.00	5.00	2.97	1.448	20
B22.16	Order and discipline is not always popular, but they are important values	899	1.00	5.00	4.48	.870	2
B22.17	My ideal job would be an independent business	889	1.00	5.00	2.62	1.520	12
B22.18	The police should have the right to listen to private phone calls when investigating crime	897	1.00	5.00	3.95	1.293	4
B22.19	When I have problems I try to solve them on my own	898	1.00	5.00	3.91	1.211	3
B22.20	Family and close communities are the basis of a functioning society	900	1.00	5.00	4.61	.767	1
B23.1	Age	901	18.00	95.00	49.39	15.965	0
B24	Gender	901					0
	Women	430					
	Men	471					
B25	Left-right	860	1.00	10.00	5.38	1.946	41
B26	Highest educational attainment	897					4
	University	501					
	High school	312					
	Upper secondary	54					
	Lower secondary	30					

B27	Household income	782					119
	Less than 100.000	17					
	100.000 – 199.999	39					
	200.000 – 299.999	54					
	300.000 – 399-999	75					
	400.000 – 499.999	94					
	500.000 – 599.999	69					
	600.000 – 799.999	142					
	800.000 – 999.999	129					
	1.000.000 or more	163					
B1.1	Region	901					0
	Oslo	119					
	North	85					
	Mid-Norway	102					
	West	174					
	South	144					
	East	277					
B1.1	Residential environment	901					0
	City resident	315					
	Non-city resident	586					
	Valid N (listwise)	652					

Appendix D: Correlation matrix

Table: Correlations (Pearson's r) between the variables used in multivariate regression analyses

	Income	Education	Women	Age	TrustIndustry& Business	TrustExperts& Scientists	Trust Government	Confidence BlackoutRiskMgm	Confidence OilRiskMgm	Confidence TerrorRiskMgm	Left–right	Fatalism	Individualism	Egalitarianism	Hierarchy	PowerBlackout RiskPerception	OilSpill RiskPerception
TerrorRiskPerception	**–.026**	**–.111**	**.241**	**.186**	**.127**	**–.102**	**–.187**	**–.084**	.007	**–.105**	**.190**	**.172**	**.081**	**.088**	**.191**	**.347**	**.314**
OilSpillRiskPerception	**–.152**	–.029	**.358**	.020	–.049	**.114**	–.041	–.023	**–.170**	–.004	**–.109**	**–.080**	**–.074**	**.265**	.027	**.369**	
PowerBlackoutRiskPerception	–.021	**–.125**	**.154**	**.207**	**.113**	.006	**–.093**	**–.245**	**–.105**	**–.106**	**.078**	**.117**	.021	**.105**	**.079**		
Hierarchy	**–.034**	**–.074**	.009	**.231**	**.148**	**–.089**	–.028	.047	.012	.053	**.197**	.052	**.171**	**.216**			
Egalitarianism	**–.142**	**–.076**	**.216**	**.076**	–.006	.063	**.085**	**.084**	–.031	**.098**	**–.274**	**–.068**	.005				
Individualism	**–.066**	**–.175**	**–.215**	.015	**.103**	**–.068**	**–.157**	–.038	.005	**–.144**	**.257**	**.308**					
Fatalism	**–.117**	**–.266**	**–.083**	**.079**	**.104**	**–.206**	**–.192**	–.057	.043	**–.109**	**.259**						
Left–right (left=1, right=10)	**.115**	**–.083**	**–.088**	.016	**.199**	**–.107**	**–.217**	–.068	.041	**–.084**							
ConfidenceTerrorRiskMgmt.	–.018	.015	.034	–.013	**.172**	**.225**	**.383**	**.458**	**.349**								
ConfidenceOilSpillMgmt.	.000	.011	–.005	**–.136**	**.197**	**.134**	**.318**	**.469**									
ConfidenceBlackoutRiskMgmt.	–.037	.057	.048	**–.122**	**.116**	**.219**	**.389**										
TrustGovernment	**.119**	**.156**	.028	**–.077**	**.235**	**.432**											
TrustExperts&Scientists	**.107**	**.130**	**.103**	**–.095**	**.203**												
TrustIndustry&Business	.002	**–.103**	.032	**.129**													
Age	–.039	**–.115**	.033														
Women	–.095	.051															
Education	**.345**																

Note 1: Bold entries denote coefficients significant at the .05 level (two-tailed).
Note 2: Education and income are represented as “continuous” variables rather than dummies.

Appendix E: OLS regression diagnostics

OLS regression models rests on the following assumptions:

- Specification: All relevant variables are included, and irrelevant variables excluded.
- Linearity: The relationship between the independent variables and the dependent variable is linear
- Normality: The error terms are normally distributed, i.e. the error term has zero mean (t-test, not necessarily coefficients)
- Homoscedastisity: The error term has constant variance
- Independence: The errors are uncorrelated, i.e. the errors associated with one observation are not correlated with the errors of any other observation

All of these assumptions are tested in this Appendix. In addition, influential cases are examined.

Specification and normality

Tests of the assumptions of linearity and normality were conducted in two steps. First, to examine if irrelevant variables are included (specification) and if the relationships between the independent variables and the dependent variables are non-linear (linearity), bivariate regressions and scatterplots were produced. As a further test of specification, multiviariate regressions built stepwise were run.

Bivariate regressions and scatter plots

To test these assumptions, bivariate regression analyses were run in which each independent variable was regressed on to each of the three dependent variables. Variables not significantly correlated with the dependent variables are irrelevant and should therefore be removed. To check for non-linearity, scatter plots with "loess fit line" was produced (see Jacob 2000).

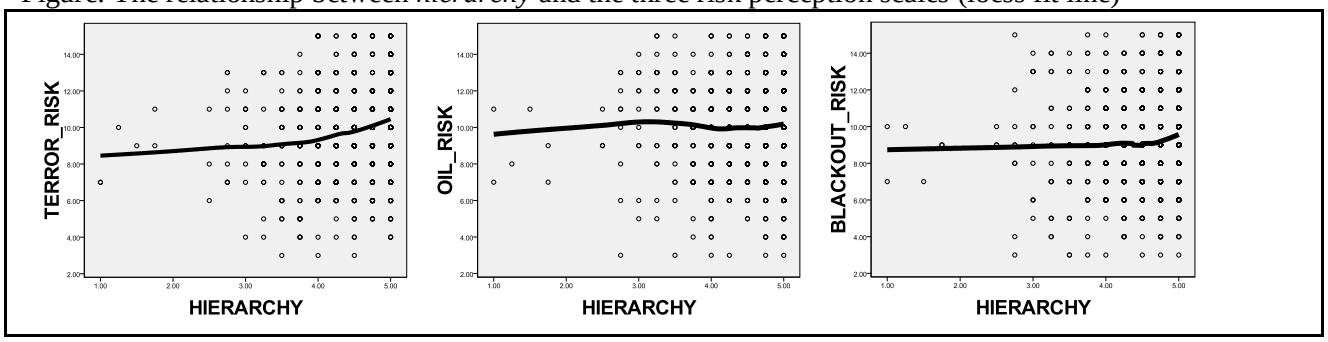
Hierarchy

Bivariate correlations between *hierarchy* and the three risk perception scales (standardized regression coefficients)

Variable	Terrorism	Oil spills	Power blackout
Hierarchy	0.19***	0.03	0.08*

*p ≤ 0.05; **p ≤ 0.01; *** p ≤ 0.001

Figure: The relationship between *hierarchy* and the three risk perception scales (loess fit line)



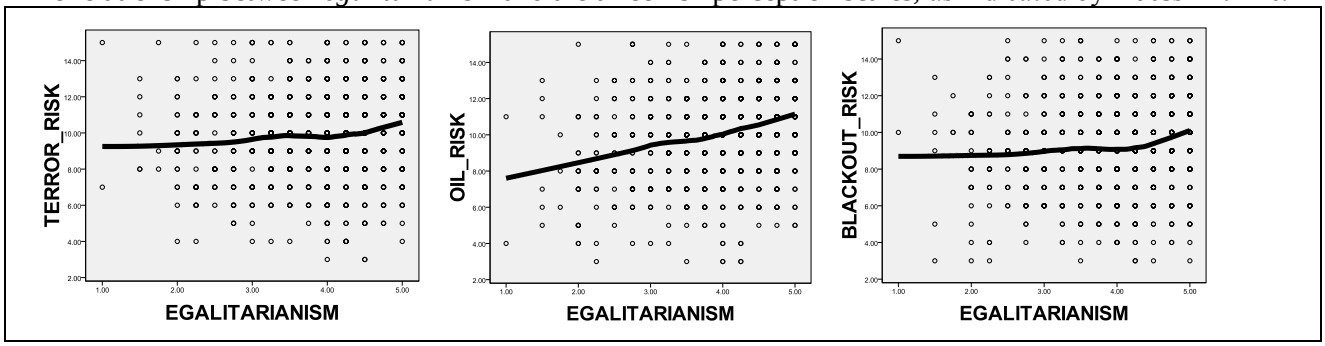
Egalitarianism

Table: Bivariate correlations between *egalitarianism* and risk (standardized regression coefficients)

Variable	Terrorism	Oil spills	Power blackout
Egalitarianism	0.09**	0.27***	0.11**

*p ≤ 0.05; **p ≤ 0.01; *** p ≤ 0.001

The relationship between *egalitarianism* and the three risk perception scales, as indicated by "loess" fit line.



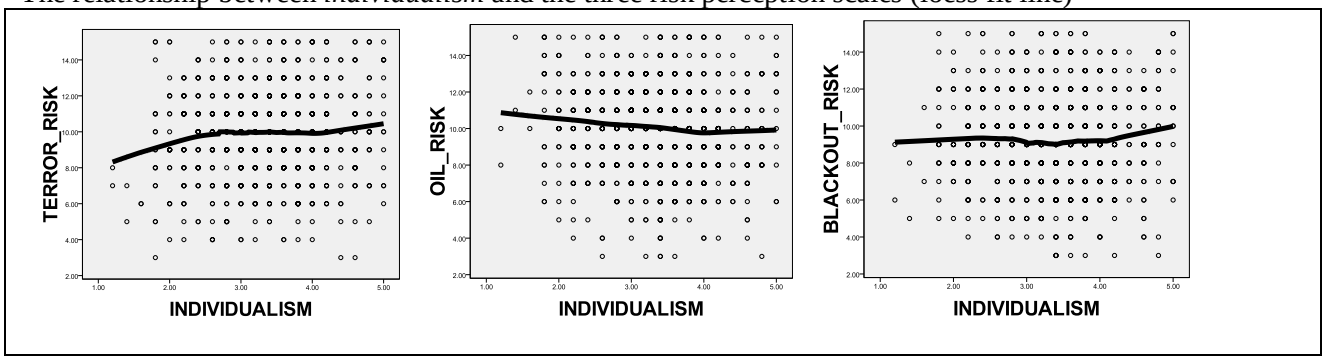
Individualism

Bivariate correlations between individualism and risk perceptions (standardized regression coefficients)

Variable	Terrorism	Oil spills	Power blackout
Individualism	0.08*	-0.07*	0.02

*p ≤ 0.05; **p ≤ 0.01; *** p ≤ 0.001

The relationship between *individualism* and the three risk perception scales (loess fit line)



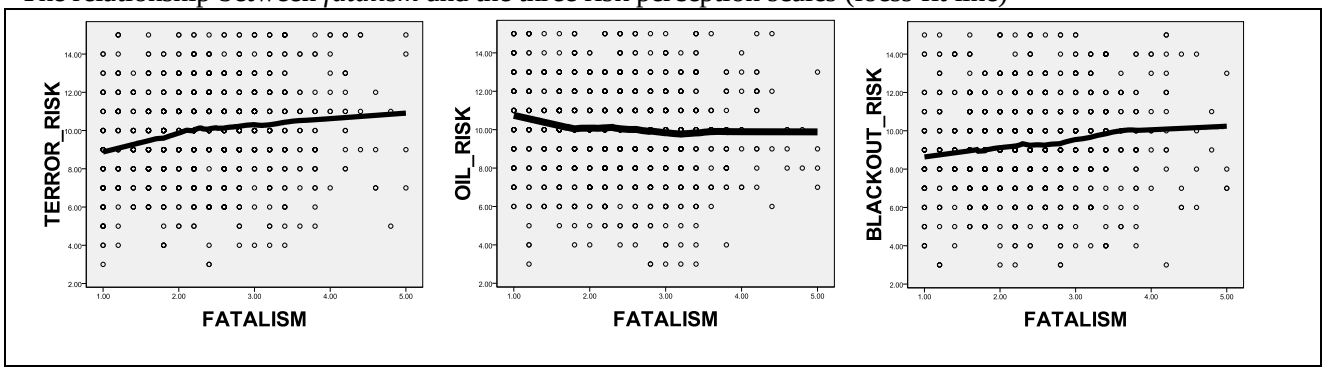
Fatalism

Bivariate correlations between fatalism and risk perceptions (standardized regression coefficients)

Variable	Terrorism	Oil spills	Power blackout
Fatalism	0.17***	-0.08*	0.12***

*p ≤ 0.05; **p ≤ 0.01; *** p ≤ 0.001

The relationship between *fatalism* and the three risk perception scales (loess fit line)



ConfidenceRiskManagement

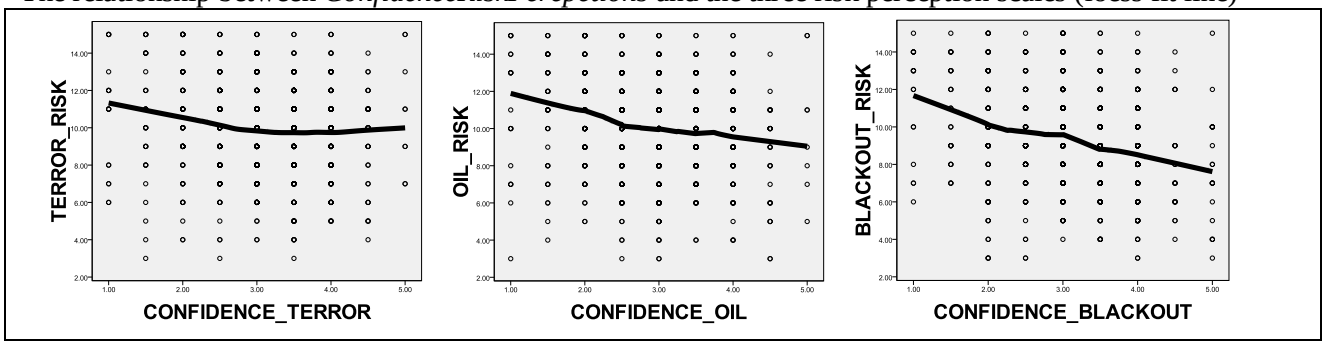
Bivariate correlations between *ConfidenceRiskManagment* and the three risk perception scales (standardized regression coefficients)

Variable	Terrorism	Oil spills	Power blackout
ConfidenceRiskManagment[a]	-0.11**	-0.17***	-0.25***

[a] specific to the hazard

*p ≤ 0.05; **p ≤ 0.01; *** p ≤ 0.001

The relationship between *ConfidenceRiskPercpetions* and the three risk perception scales (loess fit line)



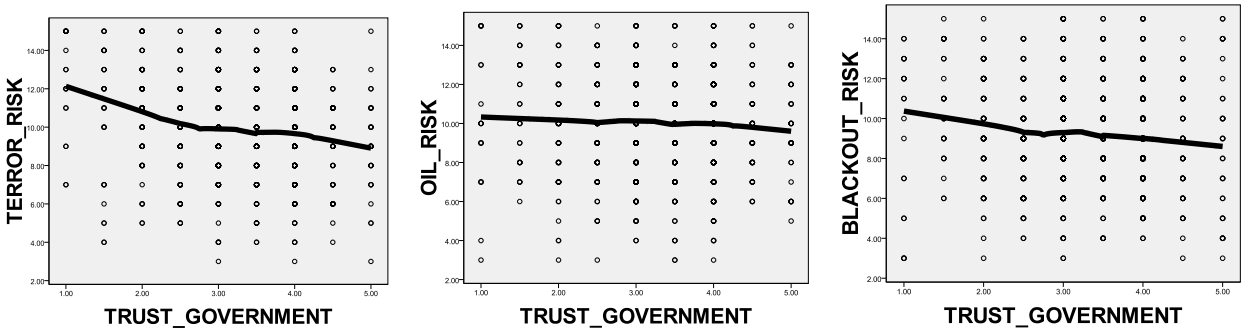
TrustGovernment

Bivariate correlations between *TrustGovernment* and the three risk perception scales (standardized regression coefficients)

Variable	Terrorism	Oil spills	Power blackout
TrustGovernment	-0.19***	-0.05	-0.10**

*p ≤ 0.05; **p ≤ 0.01; *** p ≤ 0.001

The relationship between *TrustGovernment* and the three risk perception scales (loess fit line)



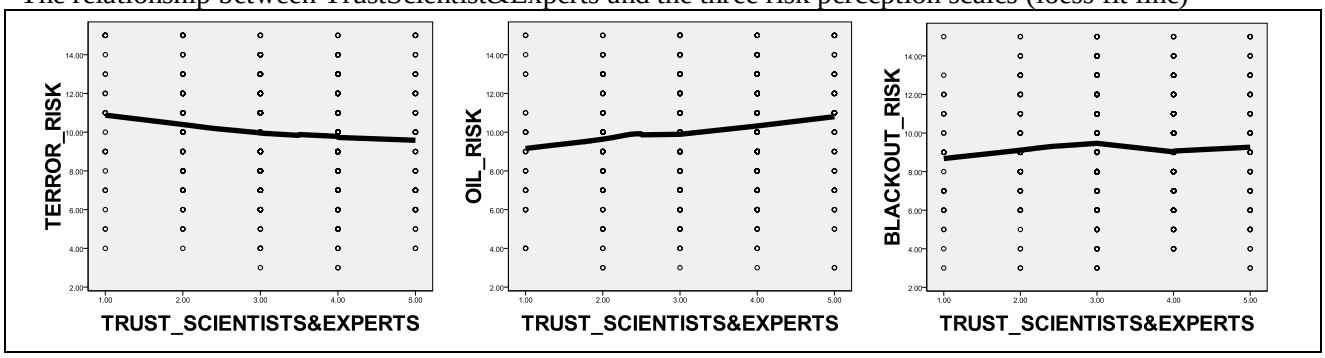
TrustScientists&Experts

Bivariate correlations between TrustScientist&Experts and risk perceptions (standardized regression coefficients)

Variable	Terrorism	Oil spills	Power blackout
TrustScientists&Experts	-0.10*	0.11**	0.01

*p ≤ 0.05; **p ≤ 0.01; *** p ≤ 0.001

The relationship between TrustScientist&Experts and the three risk perception scales (loess fit line)



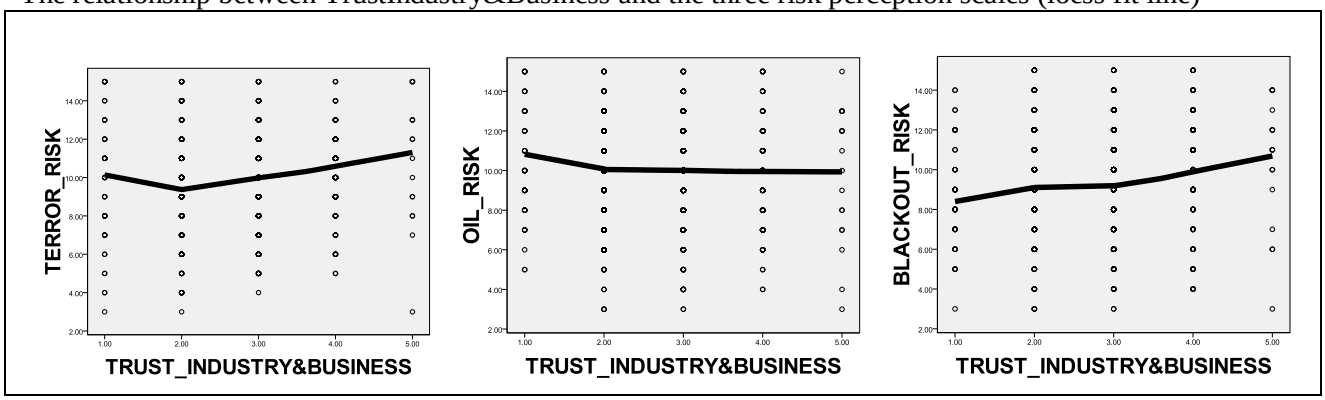
TrustIndustry&Business

Bivariate correlations between TrustIndustry&Business and the three risk perception scales (standardized regression coefficients)

Variable	Terrorism	Oil spills	Power blackout
TrustIndustry&business	0.12***	-0.06	0.11***

*p ≤ 0.05; **p ≤ 0.01; *** p ≤ 0.001

The relationship between TrustIndustry&Business and the three risk perception scales (loess fit line)



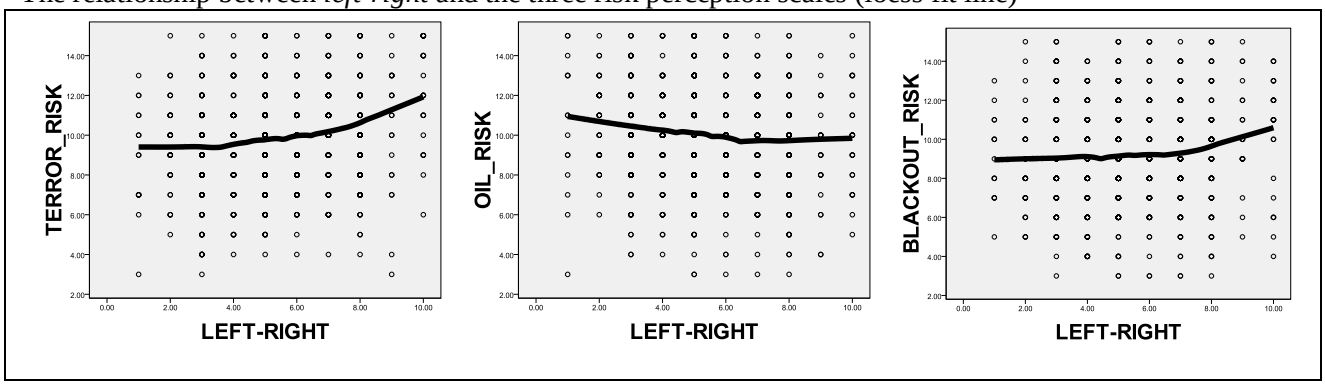
Left-right

Bivariate correlations between Left-right and risk perceptions (standardized regression coefficients)

Variable	Terrorism	Oil spills	Power blackout
Left-right	0.19***	-0.11***	0.08*

*p ≤ 0.05; **p ≤ 0.01; *** p ≤ 0.001

The relationship between *left-right* and the three risk perception scales (loess fit line)



Notes: As can be seen, the relationship is not perfectly linear. Three dummy variables were tested, but the amount of explained variance was actually reduced. I therefore decided to use the left-right variable in its original form, i.e. as show above.

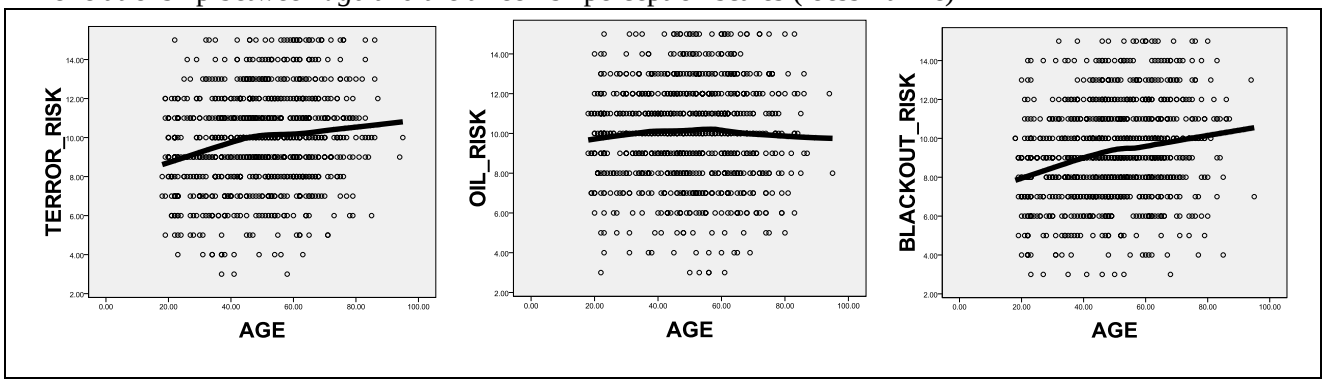
Age

Bivariate correlations between *age* and the three risk perception scales (standardized regression coefficients)

Variable	Terrorism	Oil spills	Power blackout
Age	0.19***	0.02	0.21***

*p ≤ 0.05; **p ≤ 0.01; *** p ≤ 0.001

The relationship between *age* and the three risk perception scales (loess fit line)



Notes: The plots show that the relationships are fairly linear, although there appear to be some slight curve linearity in all models. Age squared was not significant in any of these models, however. Thus, age will be used in its original form.

Women

Bivariate correlations between *women* and the three risk perception scales. Standardized regression coefficients.

Variable	Terrorism	Oil spills	Power blackout
Women	0.24***	0.36***	0.15***

*p ≤ 0.05; **p ≤ 0.01; *** p ≤ 0.001

Education

Dependent variables regressed onto level of educational attainment (four categories)

	Terror				Oil spills				Blackout			
	b	S.E.	t	Sig	b	S.E.	t	Sig	b	S.E.	t	Sig
Constant	9.638	.109	88.234	.000	9.935	.111	89.423	.000	9.040	.112	80.814	.000
Education[a]												
Upper sec.	.516	.177	2.921	.004	.129	.180	.720	.472	.393	.181	2.172	.030
Lower sec.	.677	.351	1.927	.054	.510	.357	1.426	.154	.534	.360	1.485	.138
Elementary	.862	.461	1.870	.062	-.101	.469	-.216	.829	1.627	.472	3.445	.001
R^2 adjusted				0,010				0,000				0,014
Sig (F)				0,006				0,496				0,001
N				901				901				901

[a] ref = university

Notes:

The F-tests show that the effect of education on perceived risk is significant in two of three models. However, the differences between university (reference category) and lower secondary and elementary school are not statistical significant despite the differences between these two categories and university is greater than the difference between university and high school and (which *is* statistically significant). This is probably due to the low number of respondent in both of these categories (n = 30 and n = 54, respectively). With so few observations it is difficult to demonstrate significant differences. Therefore, to make predictions more robust, the lower two categories were combined into one category, labeled *compulsory*. The bivariate regression results with the new variable are shown below.

Dependent variables regressed onto education (three categories)

	Terror				Oil spills				Power blackout			
	b	S.E.	t	Sig	B	S.E.	t	Sig	B	S.E.	t	Sig
Constant	9.638	.109	88.278	.000	9.935	.111	89.415	.000	9.040	.112	80.696	.000
Education[a]												
High school	.516	.177	2.922	.004	.129	.180	.720	.472	.393	.181	2.168	.030
Compulsory	.743	.289	2.571	.010	.292	.294	.991	.322	.925	.297	3.117	.002
R^2 adjusted				0.011				0.000				0.011
Sig (F)				0.002				0.540				0.003
N				901				901				901

[a] ref = university

Income

Dependent variables regressed onto income (nine categories)

	Terror				Oil spills				Power blackout			
	b	S.E.	t	Sig	B	S.E.	t	Sig	B	S.E.	t	Sig
Constant	9.682	.186	52.140	.000	9.324	.186	50.088	.000	9.102	.191	47.752	.000
Income[a]												
800 - 999	.227	.278	.816	.415	.535	.279	1.922	.055	.278	.285	.975	.330
600 – 799	.174	.270	.644	.520	.745	.270	2.758	.006	.030	.277	.108	.914
500 – 599	.318	.319	.997	.319	.432	.320	1.349	.178	.031	.328	.095	.925
400 – 499	.055	.299	.182	.855	1.022	.300	3.404	.001	.325	.307	1.057	.291
300 – 399	.699	.317	2.204	.028	1.187	.318	3.736	.000	.289	.325	.888	.375
200 – 299	.548	.366	1.496	.135	1.283	.367	3.496	.000	.717	.376	1.909	.057
100 - 199	.184	.389	.472	.637	1.215	.390	3.116	.002	.205	.399	.515	.607
0 - 99	-.945	.595	-1.589	.113	.992	.596	1.663	.097	-1.050	.611	-1.719	.086
R^2 adjusted				0.003				0.021				0.002
Sig (F)				0.211				0.001				0.288
N				901				901				901

A ref = more than 1000

Notes:

The F-tests show that income is relevant only in the case of oil spills. A number of the coefficients in this model are not statistically significant, despite their values are greater than others (which *are* significant). Again, this seems to be due to the low number of respondents in these categories. Therefore, I decided to recode the variable. The coefficients in the case of oil spills (where income

significantly correlated to risk perception) suggest that three new categories with cutoff at 500.000 and 1 million are reasonable. Thus, three new categories were computed.

Dependent variables regressed onto income (three categories)

	Terror				Oil spills				Power blackout			
	b	S.E.	t	Sig	B	S.E.	t	Sig	B	S.E.	t	Sig
Constant												
Income[a]												
½ to 1 mill	.226	.224	1.009	.313	.597	.224	2.669	.008	.120	.230	.523	.601
Less ½ mill	.285	.230	1.241	.215	1.143	.229	4.982	.000	.290	.236	1.230	.219
R^2 adjusted				0.000				0.026				0.000
Sig (F)				0.451				0.000				0.432
N				901				901				901

[a] ref = More than 1 mill.

Residence

Dependent variables regressed onto residence

	Terror				Oil spills				Power blackout			
	b	S.E.	t	Sig	B	S.E.	t	Sig	B	S.E.	t	Sig
Constant	10.009	.102	98.366	.000	10.123	.103	98.330	.000	9.343	.105	89.389	.000
Residence[a]												
City	-.351	.172	-2.042	.041	-.332	.174	1.909	.057	-.232	.177	-1.312	.190
R^2 adjusted				0.004				0.003				0.001
N				901				901				901

a ref = non-city resident

Notes:

The table shows that residence (whether one lives in cities or elsewhere) is significantly correlated with perceived risk only in the case of terrorism. I will let results from multivariate (test) models determine whether this variable should be included or not.

Region

Dependent variables regressed onto region

	Terror				Oil spills				Blackout			
	b	S.E.	t	Sig	b	S.E.	t	Sig	b	S.E.	t	Sig
Constant	9.538	.226	42.159	.000	10.042	.229	43.854	.000	9.210	.231	39.888	.000
Region[a]												
North	.497	.350	1.419	.156	.334	.355	.943	.346	.084	.358	.235	.814
Mid	.227	.333	.681	.496	-.013	.337	-.037	.970	.692	.340	2.036	.042
West	.250	.294	.850	.396	-.122	.297	-.412	.680	-.319	.300	-1.066	.287
South	.539	.306	1.762	.078	.090	.309	.291	.771	.373	.312	1.196	.232
East	.459	.270	1.695	.090	-.183	.274	-.668	.504	-.105	.276	-.382	.703
R2 adjusted				0.000				-0.002				0.010
Sig (F)				0.465				0.633				0.017
N				901				901				901

[a] Ref = Oslo

Notes:

Variables of region significantly contributes to the model only in the case of power blackout, where respondents living in Mid-Norway are slightly more concerned about this kind of hazard than are respondents living in Oslo. Setting Mid-Norway as reference category (not shown) indicate that people living in this region perceive risk associated with electrical blackout to be significantly ($p < 0,05$) higher than do people living Oslo, West and East. The differences are small, however. Again, multivariate regression results will determine whether these variables should be excluded or not.

Multivariate regression models built stepwise

The bivariate regressions shown above demonstrate that all of the independent variables contribute to at least one of the three models (i.e. hazards). To examine closer the contribution of each variable, multivariate regression models were build stepwise. In the first block (model 1) all continuous variables, as well as gender, were included. For these variables the t-test was used to examine their respective contribution to the model. In the next blocks (model 2-5) dummy variables for *education*, *income*, *residence* and *region* were included. For these variables the F-test was used to assess whether their contribution were statistically significant or not.

Terrorism

Regression models of perceived level of risk associated with terrorism, built stepwise (unstandardized coefficients)

Variable	Mod. 1	Mod. 2	Mod. 3	Mod. 4	Mod. 5
Constant	**5.409**	**5.638**	**5.582**	**5.660**	**5.442**
Hierarchy	**.418**	**.413**	**.411**	**.408**	**.415**
Egalitarianism	.190	.171	.175	.168	.176
Individualism	.037	.022	.022	.028	.025
Fatalism	**.298**	**.273**	**.281**	**.280**	**.279**
Left - Right	**.156**	**.153**	**.145**	**.144**	**.144**
Confidence risk management [a]	-.200	**-.211**	-.201	**-.209**	-.208
TrustGovernment	**-.361**	**-.348**	**-.359**	**-.357**	**-.362**
TrustScientists&Experts	-.077	-.071	-.076	-.074	-.074
TrustIndustry&Business	**.289**	**.280**	**.280**	**.282**	**.286**
Woman	**1.231**	**1.237**	**1.258**	**1.260**	**1.251**
Age	**.018**	**.018**	**.019**	**.018**	**.018**
Education [b]					
High school		.113	.075	.079	.089
University		-.158	-.230	-.208	-.197
Income [c]					
½ - 1 mill			.204	.203	.203
More than ½ mill			.198	.229	.222
City resident				-.149	-.047
Region [d]					
East					.246
South					.214
West					.097
Mid					.015
North					.235
R^2 adjusted	0.183	0.184	0.184	0.183	0.180
F	**19.379**	**16.611**	**14.489**	**13.633**	**10.407**
F Change	**18.167**	1.314	0.785	0.827	0.264
N	901	901	901	901	901

Bold entries are significant at the 0.05 level.
[a] specific to the hazard
[b] reference category = compulsory
[c] reference category = less than 1 million
[d] reference category = Oslo

Oil spills

Table: Regression models of perceived level of risk associated with oil spill, built stepwise (unstandardized coefficients)

Variable	**Mod. 1**	**Mod. 2**	**Mod. 3**	**Mod. 4**	**Mod. 5**
Constant	**8.544**	**9.039**	**9.263**	**9.303**	**9.582**
Hierarchy	.029	.030	.018	.016	.010
Egalitarianism	**.563**	**.543**	**.512**	**.508**	**.509**
Individualism	.000	-.015	-.027	-.023	-.006
Fatalism	-.045	-.078	-.089	-.090	-.088
Left - Right	-.023	-.023	.001	.001	-.008
Confidence risk management [a]	**-.481**	**-.484**	**-.496**	**-.496**	**-.492**
TrustGovernment	-.204	-.184	-.159	-.160	-.155
TrustScientists&Experts	.330	.341	.359	.360	**.366**
TrustIndustry&Business	-.087	-.103	-.102	-.101	-.100
Woman	**1.525**	**1.538**	**1.486**	**1.487**	**1.505**
Age	-.002	-.002	-.003	-.004	-.003
Education [b]					
High school		-.243	-.159	-.157	-.170
University		-.453	-.250	-.236	-.250
Income [c]					
½ - 1 mill			**-.340**	**-.340**	**-.362**
More than ½ mill			**-.745**	**-.725**	**-.722**
City resident				-.092	-.229
Region [d]					
East					-.420
South					-.078
West					-.219
Mid					-.406
North					-.485
R^2 adjusted	0.196	0.197	0.205	0.205	0.204
F	**20.906**	**17.979**	**16.490**	**15.468**	**11.990**
F Change	**20.906**	1.700	**5.602**	0.320	0.890
N	901	901	901	901	901

Bold entries are significant at the 0.05 level.
[a] specific to the hazard
[b] reference category = compulsory
[c] reference category = less than 1 million
[d] reference category = Oslo

Power blackouts

Table: Regression models of perceived level of risk associated with power blackouts, built stepwise (unstandardized coefficients)

Variable	Mod. 1	Mod. 2	Mod. 3	Mod. 4	Mod. 5
Constant	**6.663**	**7.181**	**7.182**	**7.172**	**7.410**
Hierarchy	.050	.046	.046	.047	.024
Egalitarianism	**.318**	**.289**	**.289**	**.290**	**.286**
Individualism	-.058	-.079	-.079	-.080	-.057
Fatalism	**.308**	**.266**	**.266**	**.266**	**.272**
Left - Right	.081	.078	.079	.079	.076
Confidence risk management [a]	**-.794**	**-.798**	**-.799**	**-.799**	**-.781**
TrustGovernment	-.048	-.025	-.024	-.024	-.021
TrustScientists&Experts	**.194**	**.206**	**.206**	**.206**	**.208**
TrustIndustry&Business	**.255**	**.237**	**.237**	**.237**	**.239**
Woman	**.706**	**.721**	**.720**	**.720**	**.720**
Age	**.023**	**.024**	**.024**	**.024**	**.023**
Education [b]					
High school		-.097	-.095	-.096	-.128
University		-.446	-.444	-.448	-.487
Income [c]					
½ - 1 mill			-.007	-.007	-.025
More than ½ mill			-.007	-.012	.000
City resident				.025	-.080
Region [d]					
East					-.350
South					.093
West					-.433
Mid					.318
North					-.451
R^2 adjusted	0.143	0.146	0.144	0.143	0.149
F	**14.646**	**12.824**	**11.089**	**10.386**	**8.515**
F Change	**14.646**	2.526	0.001	0.021	2.286
N	901	901	901	901	901

Bold entries are significant at the 0.05 level.
[a] specific to the hazard
[b] reference category = compulsory
[c] reference category = less than 1 million
[d] reference category = Oslo

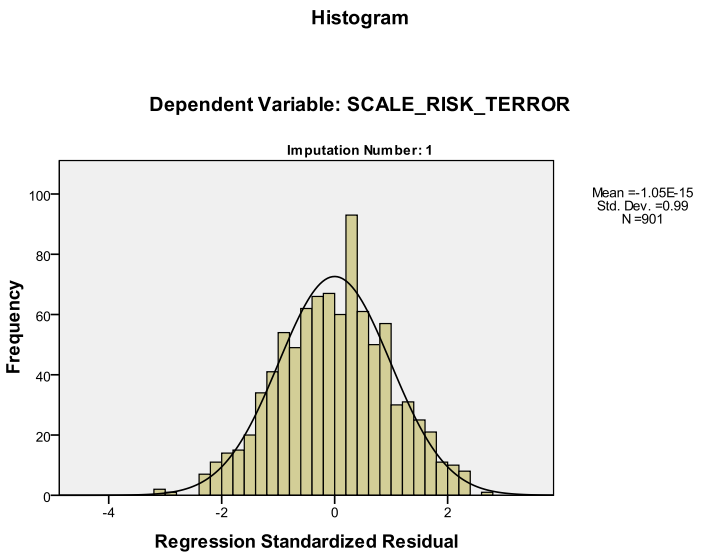
Notes:

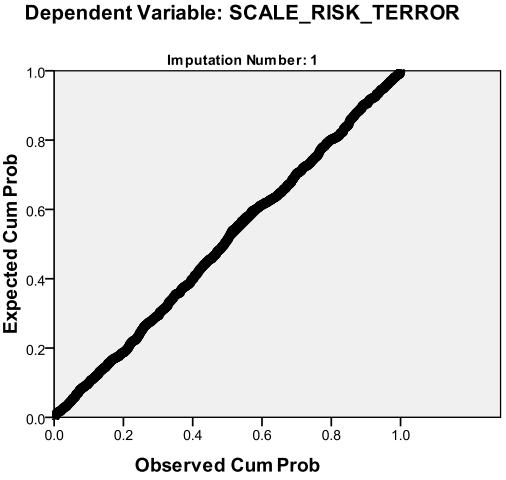
As can be seen from the three models, a number of the correlations which were significant in bivariate regressions become non-significant when controlling for the other variables. Most variables are significantly correlated with perceived risk in relation to only one or two of the hazards. Some variables, however, do not contribute to *any* of the models. This is *individualism*, *education*, *residence* and *region*. However, since most of these non-findings are theoretical interesting (i.e. they contradict theory or previous studies) they were retained in the final models. The exception was geographic location variables for which I had no theoretical basis for including in the first place.

Normality

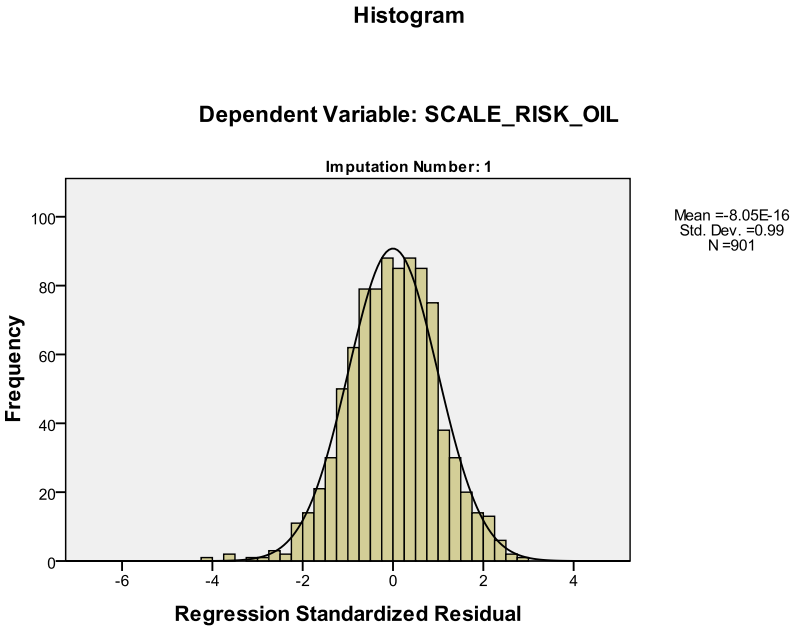
In order for t- and F-tests to be justified, the error terms need to be normally distributed. To examine this assumption, frequency distributions and Normal P-P plot of standardized residuals were produced.

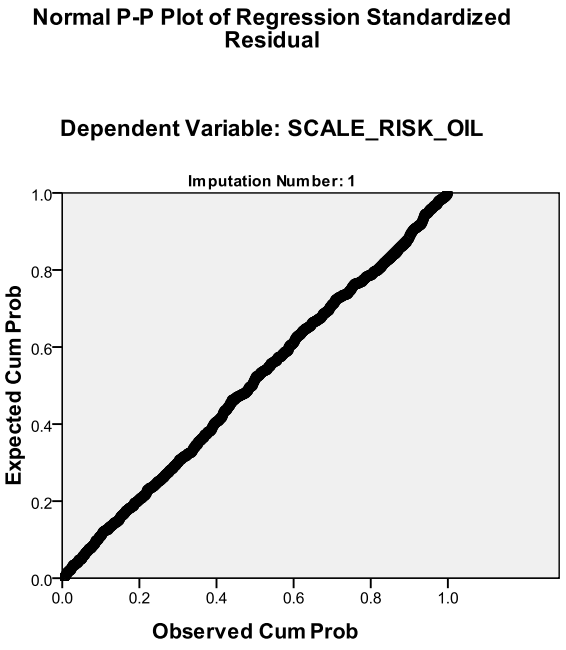
Terrorism model



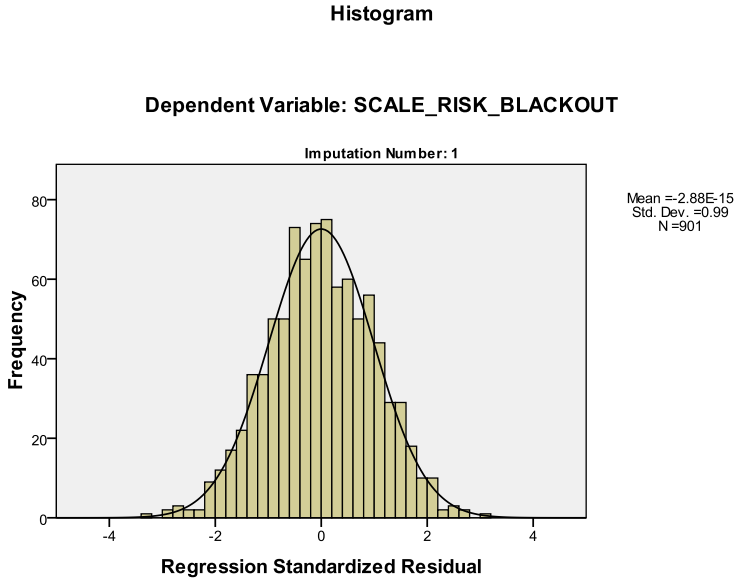


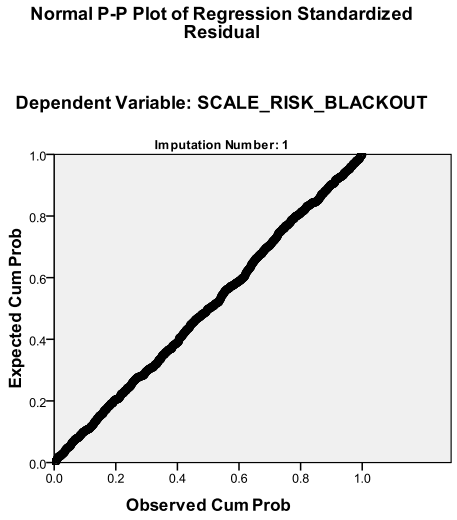
Oil spill model





Power blackout model





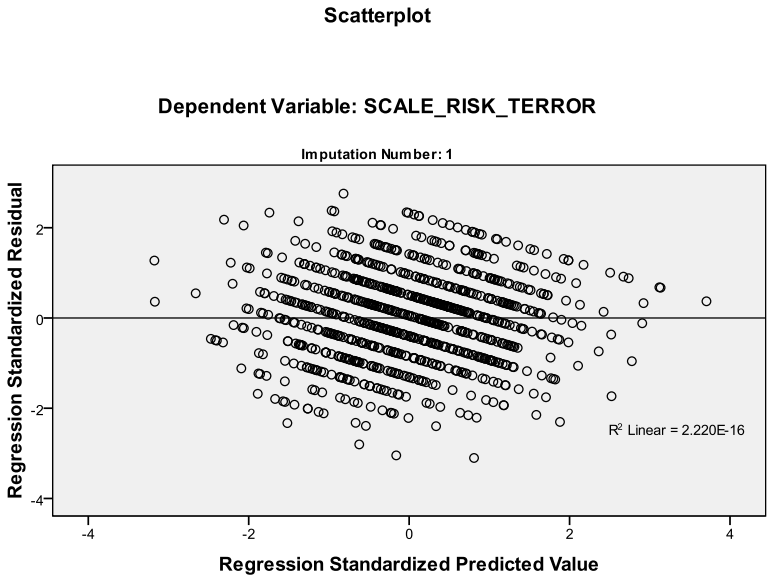
Notes:

Error terms are very close to normally distributed, and no transformations are required.

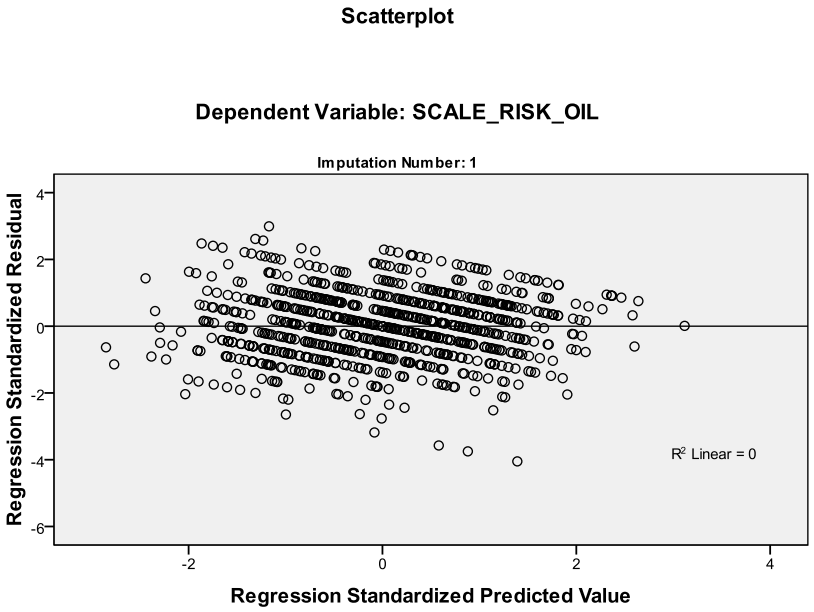
Homoscedastisity

To examine if the error terms has constant variance, plots of the residuals versus predicted y was produced.

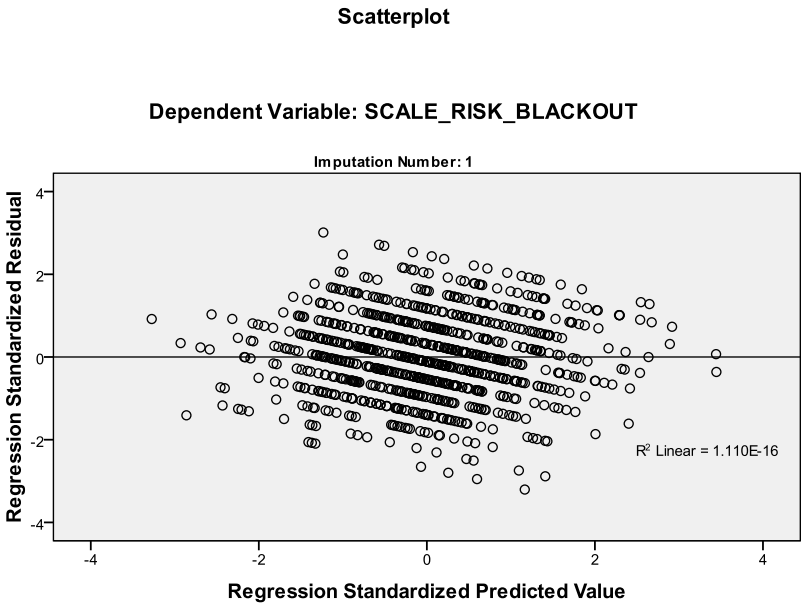
Terrorism model



Oil spill model



Power blackout model



Notes:

The scatter plots show that the data points get narrower towards both ends in all three models, indicating a mild heteroscedasticity. This means that the model(s) predicts lower and higher values of perceived risk better than values closer to the mean. However, the heteroscedasticity is very mild and does not represent a problem.

Independence/autocorrelation

Although autocorrelations seldom is a problem in cross sectional samples as in my case, the Durbin-Watson test was performed.

The three regression models obtained the following Durbin-Watson statistics:

- Terrorism: d = 1.936
- Oil spill: d = 2.158
- Power blackout: d = 2.037

As can be seen, Durbin-Watson statistics, d is very close to 2, indicating that autocorrelation is not a problem.

Colliniarity

The correlation matrix strongly suggest that multicollinearity is not a problem in these models (the strongest correlation is Pearson's r = 0.47). This is also confirmed by collinearity statistics (tolerance and VIF). In order to save space, these are not shown.

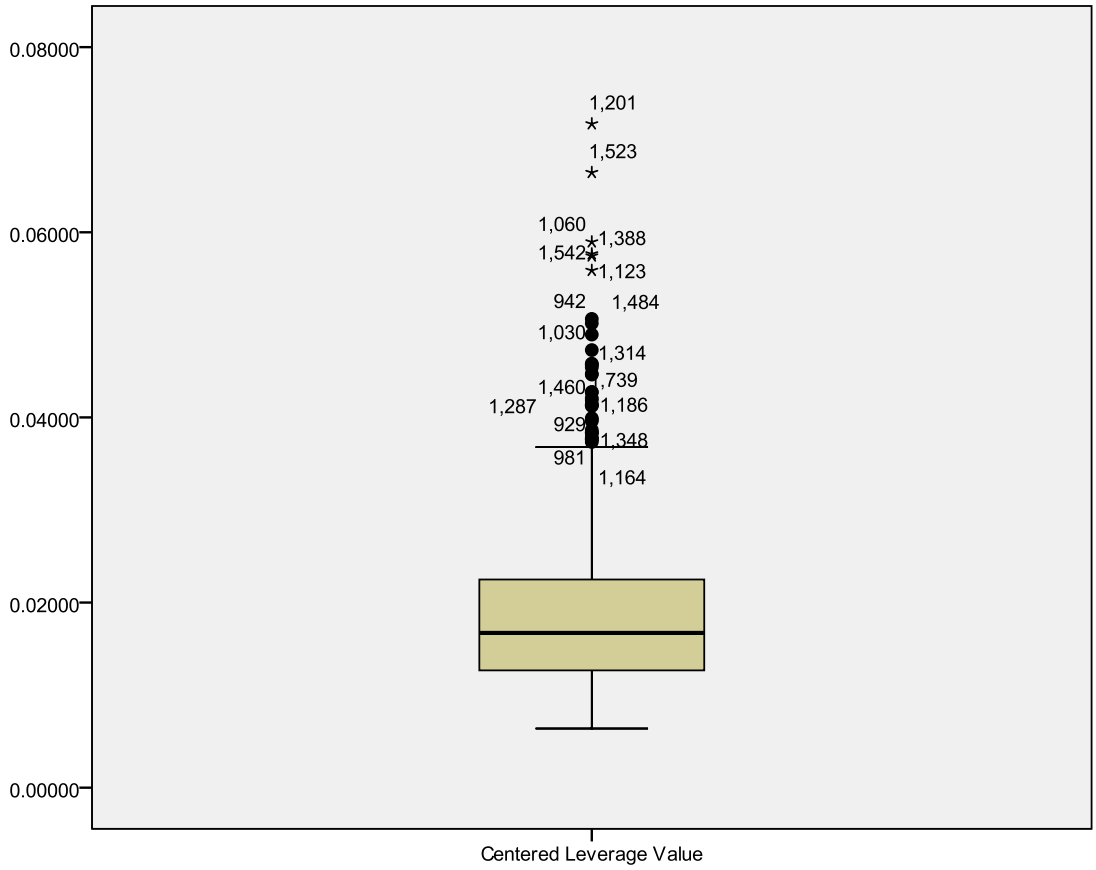
Influence

Three different measures were used to identify and assess potentially influential cases:

- *DFBETAS*: how much a case influence the regression coefficients in the model based on unusually *high* or *low* values on one or more of the independent variables. According to Hamilton (1991:136), DFBETAS > 1 is an absolute cutoff, although some suggest a size-adjusted cutoff at DFBETAS > 2/√n. The size-adjusted cutoff in this study equals (2/√901 = 2/30 =) 0.067.
- *Leverage*: How much an individual case influence the regression coefficients based on unusual *combinations* of X values, which separately are not necessarily unusual. According to Hamilton (1991:130) cases with leverage < 0.2 are considered safe, although some suggest a size-adjusted cutoff at H > 2K/n – which in this study equals (2x15/901 =) 0.033.
- *Cock's D*: How much a case influence the model as a whole. Can detect cases that have rather small influence on many variables, rather than huge influence on one or a few variables. Hamilton (1991:132) suggest that the absolute cutoff is D > 1, while size-adjusted cutoff is D > 4/n – which in this study equals (4/901=) 0.004

Terrorism model

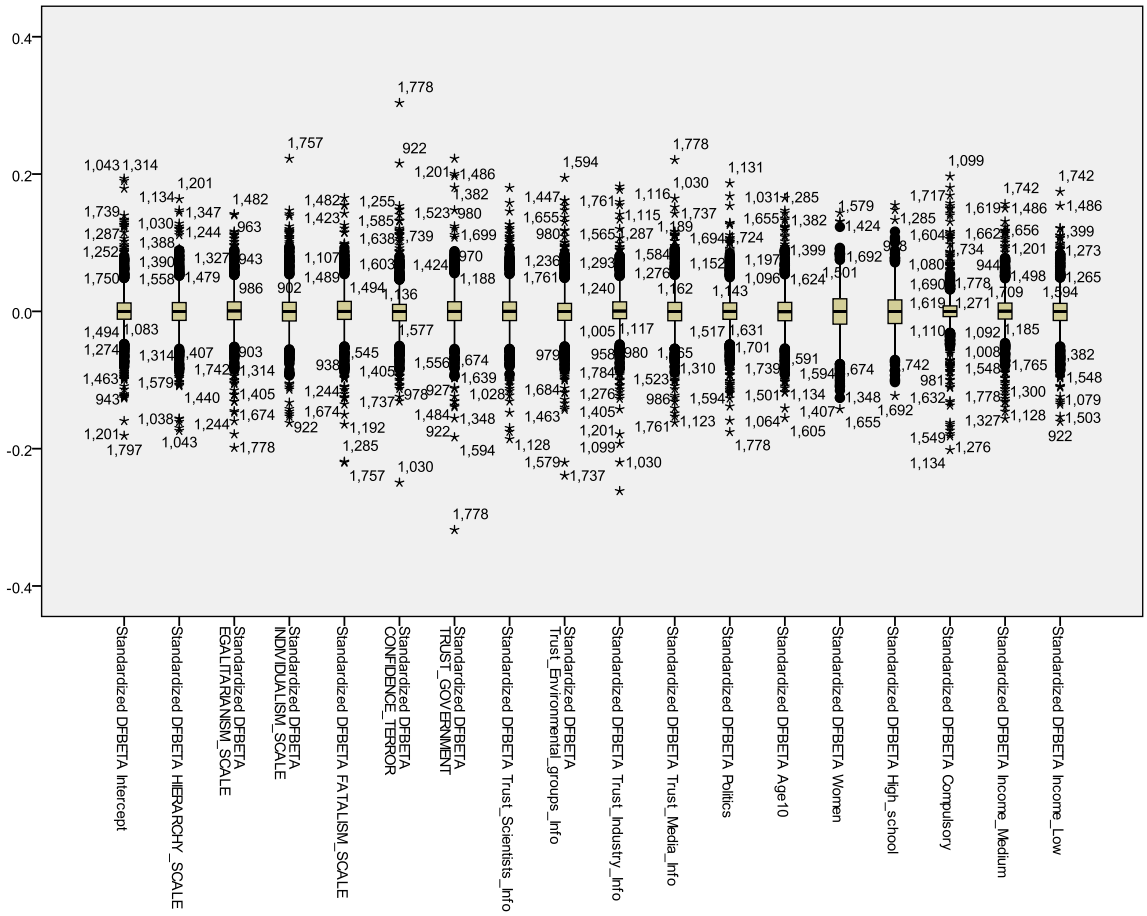
Leverage



Notes:

All cases are well below the absolute cutoff value (0.2), but not below size-adjusted cutoff (0.033). Conspicuous cases are 1201, 1523, 1060, 1388, 1542, and 1123.

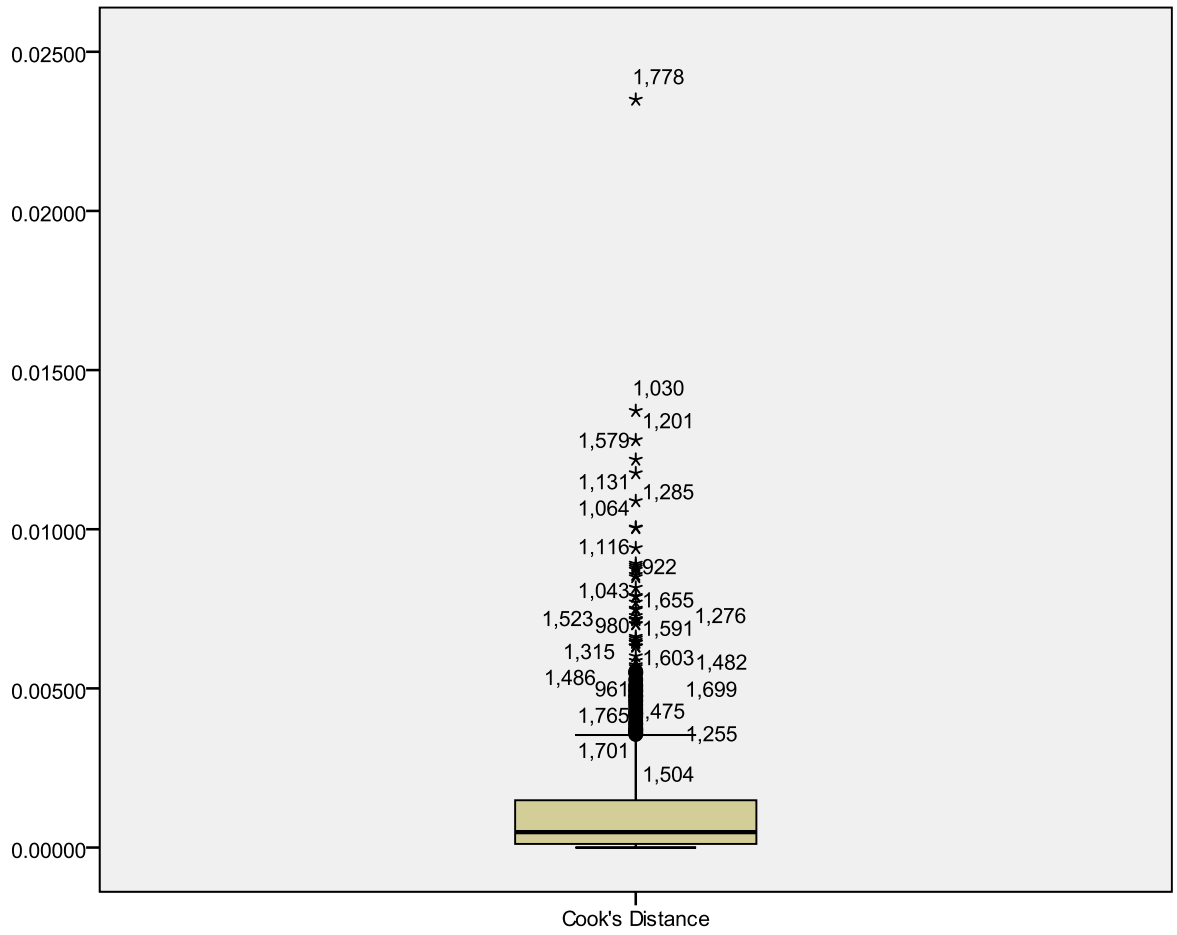
DfBetas



Notes:

All cases are below absolute cutoff value (2), but not below size-adjusted cutoff (0.067). Cases with high DFBETAS are: 1778, but also 1757, 922, 1030, 157 and 1737.

Cook's Distance



Notes:

All cases have Cook's distance values below absolute cutoff value (D>1). However, case 1778 stands out. Other cases which seem to be relatively influential to the model are 1030, 1201, 1579, 1131, 1285, 1064, 1116. Most of these have been identified earlier.

Case summary of the most influential cases in the terrorism model

Case Number	Terror risk	Hierarchy	Egalitarianism	Individualism	Fatalism	Confidence	Trust government	Trust Scientists	Trust Industry	Left-right	Age	Women	Standardized Residual	Cook's Distance	Centered Leverage Value
922	15.00	4.75	4.50	1.50	2.00	5.00	2.50	2.00	3.00	5.00	62.0	.00	2.222	.009	.031
1030	15.00	5.00	4.00	4.00	3.40	1.00	3.50	5.00	1.00	7.00	22.0	.00	2.150	.014	.047
1043	13.00	2.50	4.50	2.75	1.20	2.00	3.50	3.00	1.00	2.00	25.0	1.00	2.180	.007	.026
1060	7.00	2.00	2.00	4.25	5.00	2.50	4.50	5.00	2.00	5.00	48.0	.00	-.059	.000	.059
1064	6.00	5.00	4.00	5.00	3.40	1.00	1.50	1.00	2.00	4.00	79.0	.00	-2.322	.010	.030
1116	15.00	4.00	4.75	3.75	2.00	4.00	3.00	1.00	5.00	7.00	57.0	.00	1.872	.010	.046
1123	9.00	3.50	2.00	3.50	4.20	1.50	1.00	1.00	1.00	3.00	23.0	1.00	-1.054	.004	.058
1131	15.00	3.75	4.00	4.75	3.40	1.00	1.00	1.00	1.00	10.00	32.0	.00	2.105	.011	.040
1201	7.00	2.25	2.25	5.00	1.20	1.00	1.00	5.00	5.00	6.00	53.0	.00	-1.650	.013	.072
1285	5.00	5.00	5.00	4.75	4.80	2.50	1.50	1.00	1.00	3.00	28.0	.00	-2.102	.012	.043
1388	7.00	1.00	1.00	3.00	2.80	2.50	3.00	4.00	3.00	5.00	45.0	1.00	-.761	.002	.057
1486	5.00	4.50	4.50	2.00	2.00	3.50	2.50	4.00	3.00	3.00	30.0	1.00	-2.299	.006	.019
1523	11.00	3.75	3.50	2.75	2.00	5.00	4.50	1.00	1.00	5.00	19.0	1.00	1.290	.007	.066
1542	15.00	4.75	3.50	3.75	4.00	1.00	1.00	5.00	5.00	10.00	62.0	1.00	.397	.001	.056
1579	4.00	5.00	3.00	3.25	3.20	3.00	1.50	3.00	2.00	9.00	54.0	.00	-3.061	.012	.021
1737	5.00	3.50	2.75	3.75	3.20	3.50	2.00	2.00	2.00	5.00	23.0	1.00	-2.199	.009	.030
1742	7.00	4.00	5.00	4.00	3.40	3.00	3.00	3.00	3.00	5.00	62.0	1.00	-1.903	.004	.020
1757	7.00	4.25	3.50	1.00	4.60	3.50	2.50	2.00	3.00	9.00	43.0	1.00	-1.907	.008	.036
1778	3.00	5.00	4.50	4.75	2.40	1.50	5.00	3.00	5.00	9.00	37.0	.00	-2.994	.024	.042
1797	4.00	3.25	4.25	2.25	1.80	3.50	1.50	1.00	1.00	3.00	63.0	.00	-2.017	.009	.034
N	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20

Notes:

The case summary shows that many of the cases (1778, 1757, 922, 1030, 1579, 1737, 1043) have high values on one or several of the variables, thereby producing high DFBetas. However, since most variables were scored on a scale (with defined lower and upper values) none of these are "extreme". For instance, the value 10 on political orientation (case 1131 and 1542) must be regarded as a valid score. Other cases (1201, 1523, 1060, 1388, 1542 and 1123) have combinations of answers which contradict the predictions of the model and hence generate high leverage values.

Regression without influential cases

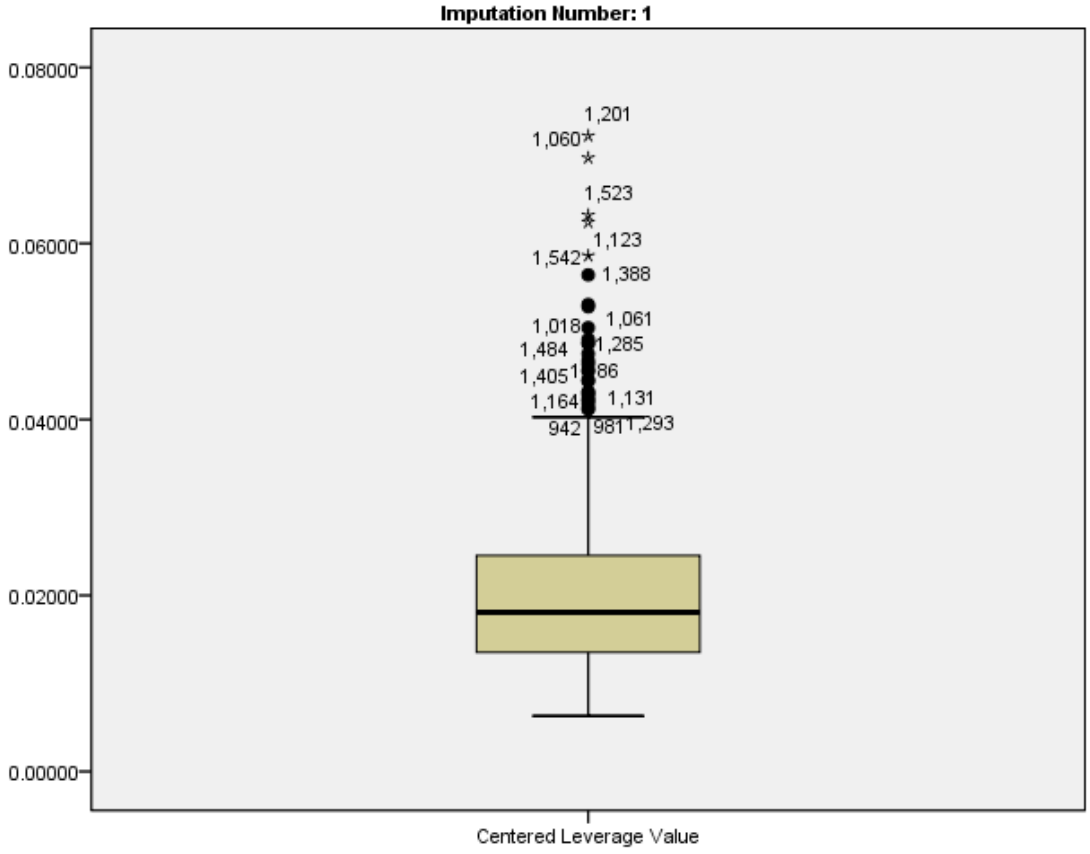
Regression of perceived level of risk associated with terrorism, without the 20 most influential cases

	B	Std. Error	Beta	t	Sig
Intercept	5.796	.894		6.486	.000
Cultural biases					
Hierarchy	.368	.142	.086	2.584	.010
Egalitarianism	.149	.100	.051	1.490	.137
Individualism	.032	.110	.010	.290	.772
Fatalism	.353	.100	.119	3.513	.000
Political orientation					
Left (1) – right (10)	.124	.045	.099	2.765	.006
Trust and confidence					
ConfidenceRiskManagement [a]	-.208	.105	-.066	-1.975	.049
TrustGovernment	-.435	.106	-.153	-4.117	.000
TrustScientists &Experts	-.086	.093	-.032	-.924	.356
TrustIndustry&Business	.321	.096	.112	3.347	.001
Sociodemographics					
Women [b]	1.284	.155	.267	8.303	.000
Age	.019	.005	.127	3.953	.000
Education [c]					
High school	.204	.281	.040	.727	.467
University	-.061	.280	-.013	-.217	.828
Income [d]					
½ to 1 mill.	.282	.168	.058	1.681	.093
more than 1 mill	.221	.221	.036	1.003	.316
F					16.097
R^2 adjusted					0.205
N					880

*p ≤ 0.05; **p ≤ 0.01; *** p ≤ 0.001
[a] specific to the hazard (i.e. model)
[b] reference category = men
[c] reference category = compulsory
[d] reference category = less than ½ million

Oil spill model

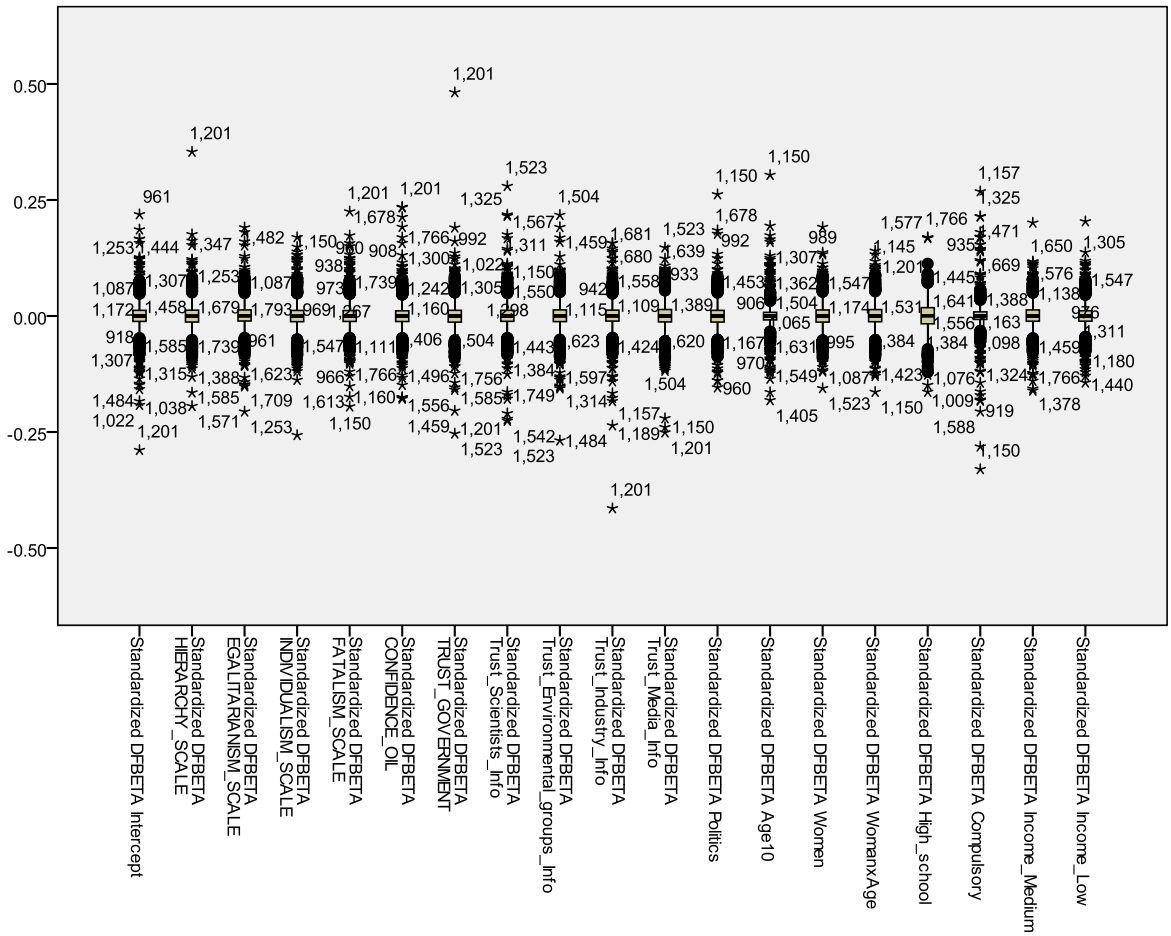
Leverage



Notes:

All cases have leverage below recommended absolute cutoff value (0.2), but not below the size-adjusted cutoff (0.04). Case 1201, 1060, 1523, 1123, 1542, 1388 are most conspicuous.

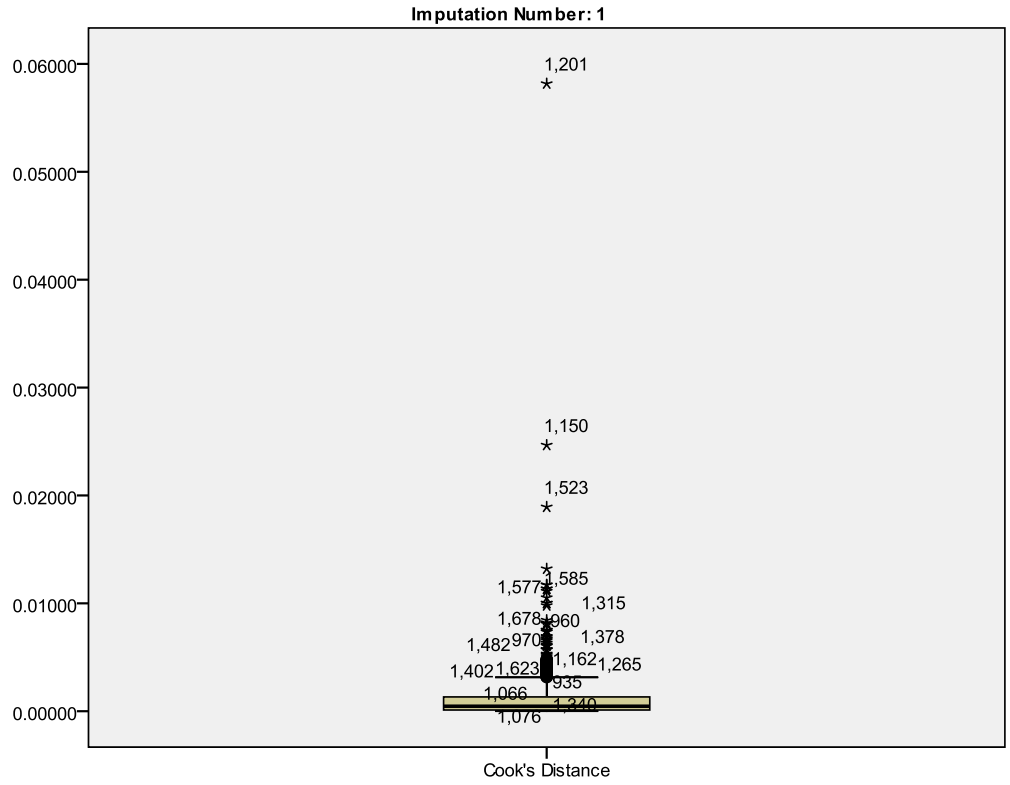
DfBetas



Notes:

All are below absolute cutoff of 2, but not below size-adjusted cutoff of 0,067. Case 1201, 1150 stands out, but also1523, 1459, 1484 and 1189 are relatively high.

Cook's Distance



Notes:

All cases have Cook d's below absolute cutoff value (D>1), but not below size-adjusted cutoff (0.004). Case 1201 stands out. Also case 1150 and 1523. All these cases have appeared in the plots above.

The cases identified as potentially problematic above are show in the summary.

Case summary of the most influential cases in the oil spill model

Case Number	Oil spill risk	Hierarchy	Egalitarianism	Individualism	Fatalism	Confidence	Trust government	Trust Scientists	Trust Industry	Left-right	Age	Women	Standardized Residual	Cook's Distance	Centered Leverage Value
1060	7.00	2.00	2.00	4.25	5.00	1.00	4.50	5.00	2.00	5.00	48.0	.00	-.39819	.00068	.06973
1123	7.00	3.50	2.00	3.50	4.20	3.50	1.00	1.00	1.00	3.00	23.0	1.00	-.66555	.00169	.06241
1150	3.00	3.75	4.00	2.75	3.40	3.00	4.00	5.00	3.00	1.00	22.0	.00	-3.33614	.02634	.04021
1189	3.00	4.50	3.50	3.00	2.80	4.50	3.50	3.00	2.00	7.00	56.0	.00	-2.57027	.00791	.02067
1201	3.00	2.25	2.25	5.00	1.20	1.00	1.00	5.00	5.00	6.00	53.0	.00	-3.47272	.05421	.07223
1388	11.00	1.00	1.00	3.00	2.80	3.50	3.00	4.00	3.00	5.00	45.0	1.00	.62560	.00139	.05860
1449	9.00	4.50	3.75	2.25	3.20	3.00	4.00	3.00	2.00	7.00	42.0	.00	-.15781	.00002	.01682
1484	4.00	4.50	2.00	3.50	1.20	3.50	1.00	1.00	5.00	9.00	31.0	.00	-1.71669	.00889	.05042
1523	7.00	3.75	3.50	2.75	2.00	3.00	4.50	1.00	1.00	5.00	19.0	1.00	-2.10887	.01720	.06322
1542	7.00	4.75	3.50	3.75	4.00	1.00	1.00	5.00	5.00	10.00	62.0	1.00	-1.78594	.01087	.05642
N	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Regression without influential cases

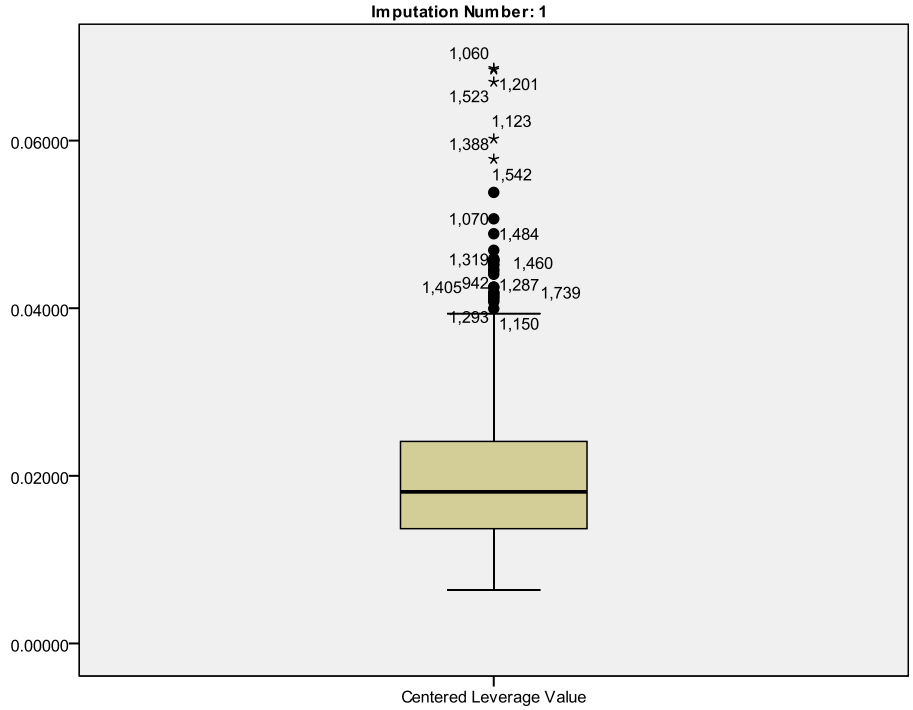
Regression of perceived level of risk associated with oil spill, without the 10 most influential cases

	B	Std. Error	Beta	t	Sig
Intercept	9.795	.899		10.890	.000
Cultural biases					
Hierarchy	-.030	.144	-.007	-.208	.835
Egalitarianism	.470	.101	.156	4.649	.000
Individualism	-.002	.110	.000	-.016	.987
Fatalism	-.075	.102	-.025	-.737	.462
Political orientation					
Left (1) – right (10)	-.011	.045	-.009	-.241	.810
Trust and confidence					
ConfidenceRiskManagement [a]	-.530	.103	-.167	-5.146	.000
TrustGovernment	-.223	.107	-.078	-2.081	.038
TrustScientists &Experts	.398	.093	.147	4.263	.000
TrustIndustry&Business	-.045	.097	-.016	-.463	.644
Sociodemographics					
Women [b]	1.475	.157	.300	9.409	.000
Age	-.005	.005	-.032	-1.005	.315
Education [c]					
High school	-.239	.284	-.046	-.841	.400
University	-.328	.283	-.066	-1.160	.246
Income [d]					
½ to 1 mill.	-.314	.170	-.063	-1.847	.065
more than 1 mill	-.722	.222	-.117	-3.261	.001
F					16.622
R^2 adjusted					0.208
N					890

*p ≤ 0.05; **p ≤ 0.01; *** p ≤ 0.001
[a] specific to the hazard (i.e. model)
[b] reference category = men
[c] reference category = compulsory
[d] reference category = less than ½ million

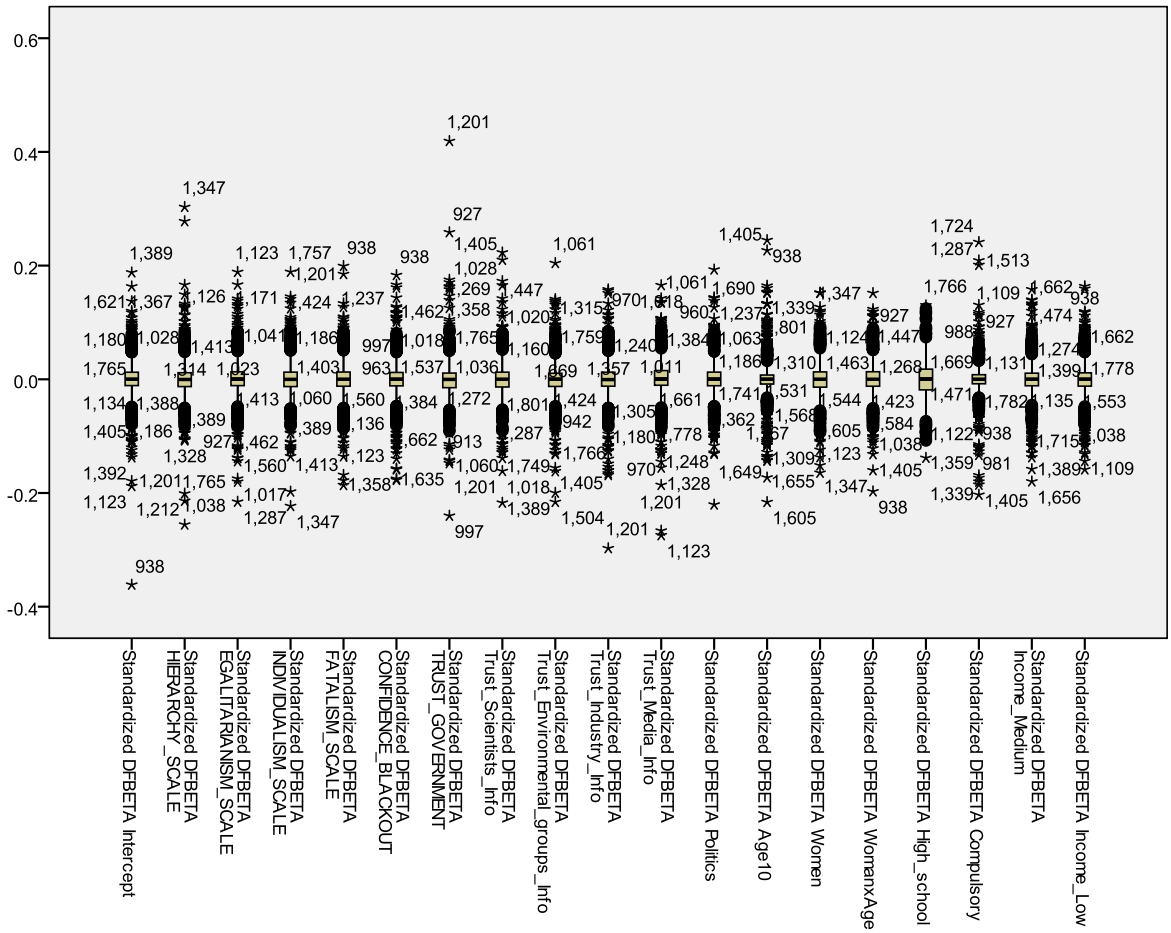
Power blackout model

Leverage



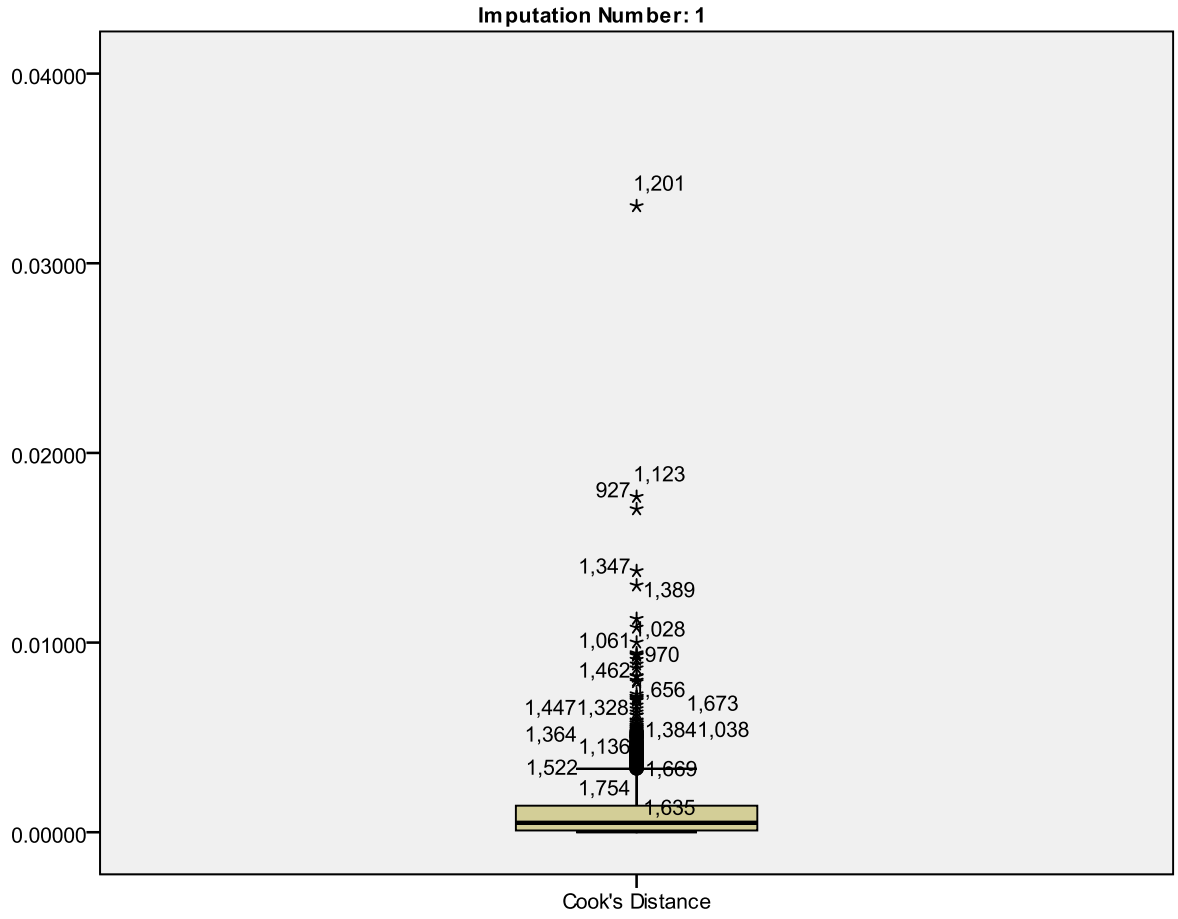
All cases are below absolute cutoff (> 0.2), but not below the size-adjusted cutoff (0.04). Cases that stands out are: 1060, 1201, 1523, 1123, 1388 and 1542.

DfBetas



None cases above absolute cutoff (>2), but many above size-adjusted cutoff (0.067). Cases which stand out are: 1201 and 1347, but also 938, 927, 997, 1061, 1123, 1405, 1212, 1765, 1038, 970 and1605.

Cook's Distance



All cases have D's below absolute cutoff value (D>1), but not below size-adjusted cutoff (0.004). Case 1201 stands out. Also high (in relative terms) are case 1123 and 927. All of these have been identified earlier as cases with high leverage and/or DFBetas.

The 14 most conspicuous cases are summarized below.

Case summary of the most influential cases in the power blackout model

Case Number	Blackout risk	Hierarchy	Egalitarianism	Individualism	Fatalism	Confidence	Trust government	Trust Scientists	Trust Industry	Left-right	Age	Women	Standardized Residual	Cook's Distance	Centered Leverage Value
927	3.00	5.00	5.00	3.25	2.80	2.50	1.00	2.00	2.00	7.00	6.80	.00	-2.91421	.01583	.03201
938	15.00	5.00	4.00	5.00	4.20	5.00	4.00	5.00	4.00	7.00	7.60	.00	2.69366	.01475	.03478
970	6.00	5.00	2.50	3.00	2.60	1.00	2.50	5.00	2.00	8.00	7.50	.00	-1.95832	.00835	.03715
1038	13.00	2.25	3.50	2.75	3.00	3.00	3.00	2.00	3.00	7.00	7.00	.00	1.72426	.00657	.03769
1060	7.00	2.00	2.00	4.25	5.00	1.00	4.50	5.00	2.00	5.00	4.80	.00	-1.34067	.00762	.06864
1061	14.00	4.25	3.25	2.75	3.40	3.00	2.00	4.00	1.00	9.00	2.20	.00	1.88817	.00806	.03850
1123	3.00	3.50	2.00	3.50	4.20	2.00	1.00	1.00	1.00	3.00	2.30	1.00	-2.05079	.01540	.06021
1201	3.00	2.25	2.25	5.00	1.20	2.50	1.00	5.00	5.00	6.00	5.30	.00	-2.66455	.03002	.06844
1212	13.00	2.50	4.75	3.75	3.60	3.50	2.50	3.00	2.00	8.00	2.20	.00	1.75652	.00577	.03211
1347	4.00	2.75	4.00	4.75	2.20	3.50	4.50	5.00	3.00	5.00	7.70	1.00	-2.76707	.01545	.03455
1388	10.00	1.00	1.00	3.00	2.80	3.00	3.00	4.00	3.00	5.00	4.50	1.00	.44554	.00069	.05779
1523	7.00	3.75	3.50	2.75	2.00	5.00	4.50	1.00	1.00	5.00	1.90	1.00	.06197	.00002	.06699
1605	4.00	4.75	3.50	4.00	3.40	4.50	3.50	4.00	4.00	7.00	8.50	.00	-1.98332	.00563	.02472
1765	13.00	2.50	4.25	4.75	2.20	2.50	4.00	3.00	3.00	7.00	5.00	.00	1.66873	.00569	.03495
	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14

Regression without influential cases

Regression of perceived level of risk associated with power blackout, without the 14 most influential cases

	B	Std. Error	Beta	t	Sig
Intercept	7.429	.935		7.942	.000
Cultural biases					
Hierarchy	.005	.154	.001	.033	.973
Egalitarianism	.231	.106	.076	2.178	.030
Individualism	-.020	.116	-.006	-.174	.862
Fatalism	.266	.105	.088	2.535	.011
Political orientation					
Left (1) – right (10)	.053	.047	.042	1.132	.258
Trust and confidence					
ConfidenceRiskManagement [a]	-.837	.106	-.269	-7.907	.000
TrustGovernment	-.093	.112	-.032	-.826	.409
TrustScientists &Experts	.246	.097	.090	2.528	.012
TrustIndustry&Business	.264	.100	.091	2.651	.008
Sociodemographics					
Women [b]	.761	.164	.153	4.653	.000
Age	.026	.005	.167	5.042	.000
Education [c]					
High school	-.082	.294	-.016	-.279	.780
University	-.343	.294	-.069	-1.167	.243
Income [d]					
½ to 1 mill.	.091	.178	.018	.511	.610
more than 1 mill	.025	.233	.004	.109	.913
F					12.384
R^2 adjusted					0.162
N					886

*p ≤ 0.05; **p ≤ 0.01; *** p ≤ 0.001
[a] specific to the hazard (i.e. model)
[b] reference category = men
[c] reference category = compulsory
[d] reference category = less than ½ million

Notes:

In all the three models, the explanatory power of the models increases when the most influential cases are removed. None of the regression coefficients are substantially changed, however. Moreover, the case summaries do not indicate that the information is wrong (e.g. coding error). Therefore, no cases are removed.

Appendix F: Full regression models

Terrorism model

Full OLS regression model of perceived level of risk associated with terrorism

	B	Std. Error	Beta	t	Sig
Intercept	5.582	.892		6.261	.000
Cultural biases					
Hierarchy	.411	.140	.098	2.931	.003
Egalitarianism	.175	.102	.058	1.714	.087
Individualism	.022	.112	.007	.194	.846
Fatalism	.281	.101	.094	2.779	.006
Political orientation					
Left (1) – right (10)	.145	.045	.114	3.192	.001
Trust and confidence					
ConfidenceRiskManagement [a]	-.201	.106	-.064	-1.907	.057
TrustGovernment	-.359	.106	-.126	-3.389	.001
TrustScientists &Experts	-.076	.093	-.028	-.815	.415
TrustIndustry&Business	.280	.096	.098	2.909	.004
Sociodemographics					
Women [b]	1.258	.158	.255	7.941	.000
Age	.019	.005	.121	3.765	.000
Education [c]					
High school	.075	.284	.015	.265	.791
University	-.230	.283	-.046	-.812	.417
Income [d]					
½ to 1 mill.	.204	.173	.041	1.177	.239
more than 1 mill	.198	.226	.032	.877	.381
F					14.489
R^2 adjusted					0.184
N					901

*p ≤ 0.05; **p ≤ 0.01; *** p ≤ 0.001
[a] specific to the hazard (i.e. model)
[b] reference category = men
[c] reference category = compulsory
[d] reference category = less than ½ million

Oil Spill model

Full regression model of perceived level of risk associated with oil spill

	B	Std. Error	Beta	t	Sig
Intercept	9.263	.889		10.425	.000
Cultural biases					
Hierarchy	.018	.140	.004	.127	.899
Egalitarianism	.512	.102	.169	5.035	.000
Individualism	-.027	.111	-.008	-.247	.805
Fatalism	-.089	.101	-.029	-.883	.378
Political orientation					
Left (1) – right (10)	.001	.045	.001	.031	.975
Trust and confidence					
ConfidenceRiskManagement [a]	-.496	.103	-.155	-4.818	.000
TrustGovernment	-.159	.106	-.055	-1.510	.131
TrustScientists &Experts	.359	.093	.132	3.868	.000
TrustIndustry&Business	-.102	.096	-.035	-1.059	.290
Sociodemographics					
Women [b]	1.486	.158	.298	9.400	.000
Age	-.003	.005	-.021	-.668	.505
Education [c]					
High school	-.159	.284	-.030	-.561	.575
University	-.250	.282	-.050	-.885	.376
Income [d]					
½ to 1 mill.	-.340	.172	-.068	-1.974	.049
more than 1 mill	-.745	.225	-.118	-3.316	.001
F					16.490
R^2 adjusted					0.205
N					901

*p ≤ 0.05; **p ≤ 0.01; *** p ≤ 0.001

[a] specific to the hazard (i.e. model)

[b] reference category = men

[c] reference category = compulsory

[d] reference category = less than ½ million

Power blackout model

Full regression model of perceived level of risk associated with power blackout

	B	Std. Error	Beta	t	Sig
Intercept	7.182	.928		7.737	.000
Cultural biases					
Hierarchy	.046	.147	.011	.314	.753
Egalitarianism	.289	.107	.094	2.697	.007
Individualism	-.079	.117	-.023	-.677	.498
Fatalism	.266	.106	.087	2.507	.012
Political orientation					
Left (1) – right (10)	.079	.048	.060	1.647	.100
Trust and confidence					
ConfidenceRiskManagement [a]	-.799	.107	-.254	-7.452	.000
TrustGovernment	-.024	.113	-.008	-.217	.828
TrustScientists &Experts	.206	.098	.075	2.107	.035
TrustIndustry&Business	.237	.101	.080	2.349	.019
Sociodemographics					
Women [b]	.720	.166	.142	4.326	.000
Age	.024	.005	.149	4.501	.000
Education [c]					
High school	-.095	.299	-.018	-.319	.750
University	-.444	.297	-.087	-1.493	.136
Income [d]					
½ to 1 mill.	-.007	.182	-.001	-.040	.968
more than 1 mill	-.007	.238	-.001	-.029	.977
F					11.089
R^2 adjusted					0.144
N					901

*p ≤ 0.05; **p ≤ 0.01; *** p ≤ 0.001
[a] specific to the hazard (i.e. model)
[b] reference category = men
[c] reference category = compulsory
[d] reference category = less than ½ million