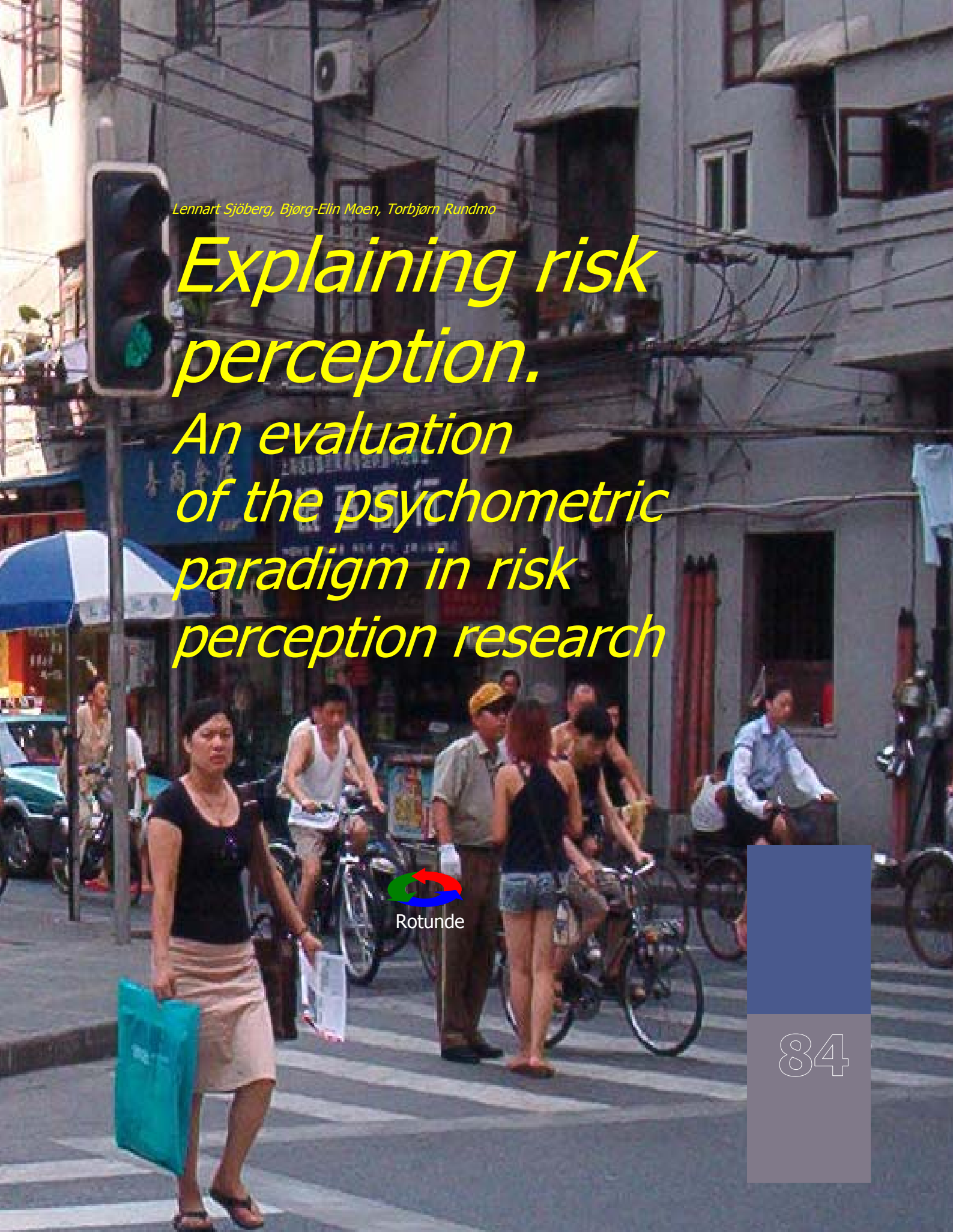
Lennart Sjöberg, Bjørg-Elin Moen, Torbjørn Rundmo

Explaining risk perception.

An evaluation of the psychometric paradigm in risk perception research



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Preface

The core aim of this report is to evaluate the relevance of the psychometric paradigm in risk perception research. Empirical tests of the theory's capability of predicting perceived risk will be presented and discussed. The report concludes that the majority of results reached in the paradigm are not sufficiently based on empirical data and appropriate analyses. Risk perception is related to conceptions of knowledge which stress the limits of science and different, ways of knowing. Finally, interest emerged as an important predictor of demand for risk mitigation. A conceptualization of the risk perceiver, based on these results, is briefly discussed. The major part of the report is written by Lennart Sjöberg and previous versions have been presented elsewhere. The report is partly financed by The Norwegian Research Council's RISIT (Risk and Safety in Transport) - program.

Trondheim, September 2004

Torbjørn Rundmo

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Abstract

Risk perception has become an important topic to politicians and policy makers concerned with transport and safety issues, and the psychological analysis of this construct has attracted much interest. Psychological research on risk perception has been dominated by the psychometric paradigm, which has been fruitful in bringing up important issues in research. Compared to cultural theory this paradigm has also been fairly successful in explaining and predicting perceived risk. Yet, most of the conclusions reached in the paradigm are not sufficiently well based on empirical data and appropriate analyses. Results are presented in the present report which show that demand for risk mitigation being related most strongly to seriousness of consequences of a hazard, not the risk of an accident or the riskiness of the activity. Risk perception is related to conceptions of knowledge which stress the limits of science and different, ways of knowing. Finally, interest emerged as an important predictor of demand for risk mitigation. A conceptualization of the risk perceiver, based on these results, is briefly discussed.

1. Introduction

1.1 Definition of risk

Most humans engage in some kind of dangerous events every day and this ubiquity has prompted a substantial effort within researchers to understand how people understand risk. Everyone is seeking to manage risk, and they are all guessing because if they knew for certain, they would not be dealing with risk (Adams, 1995). In other words, in any definite situation, an adverse outcome may or may not occur and causative factors skew the probabilities of diverse outcomes (Graham and Rhomberg, 1996).

Risk has been defined in a number of ways, but is often seen as the likelihood that an individual will experience the effect of danger (Short Jr, 1984). Wherever it is discussed, it seems to be a consensus about essence of risk as being consisting of the probability of an adverse event and the magnitude of its consequences (Rayner and Cantor, 1987). According to Rayner and Cantor (1987) this definition may be adequate to define risk of engineering-type calculations, but quite misleading at a broader, more intractable, level of large-scale societal risk management. All risk concepts have one element in common; a distinction between reality and possibility. A discussion around the uncertainty of a situation has prevailed and Rosa (2003: 56) defined risk as "a situation or an event where something of human value (including humans themselves) is at stake and where the outcome is uncertain". Hence, uncertainty is closely related to risk and in many theories of behaviour, psychological uncertainty is assumed to be an important mediator of human responses in situations with unknown outcomes. Uncertainty is a psychological construct. It "exists only in the mind; if a person's knowledge was complete, that person would have no uncertainty" (Windschitl and Wells, 1996). Risk appears to mean different things to different people (see Brun, 1994, for a more extensive discussion of the term), and actions and understandings about risks are learned by socially and culturally structured conceptions and evaluations of the world, what it looks like, what it should or should not be (Boholm, 1998).

1.2 Risk perception and risk decisions

Risk perception is 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. It may also be argued that as affects related to the activity is an element of risk perception. Perception of risk goes beyond the individual, and it is a social and cultural construct reflecting values, symbols, history, and ideology (Weinstein, 1989). It follows from the specificity and variability of human social existence that it should not simply be presumed that scores and ratings on identical instruments have the same meanings in different contexts (Boholm, 1998). Adams (1995: 16) claimed that "the starting point of any theory of risk must be that everyone willingly takes risks". He concluded that this was not in fact the starting point of most of the literature on risk.

Risk perception appeared on the stage of policy as a very important concept in the 1960's. It was implicated as a main determinant of public opposition to technology, most notably to nuclear technology, but other early examples can be given as well (Martin, 1989). In Sweden and Norway, parliamentarians now devote about three times as much attention to risk issues as they did in the first half of the 60's, as reflected in their submitted private bills.

Attempts were made to handle the difficult situation that had arisen due to unexpected opposition to technology. Sowby (1965) suggested that comparisons of risk should be made. The risk of e.g. smoking, driving a car and using public transportation is very much greater than the risk of living close to a nuclear power plant. People smoke, so why not accept nuclear power? This approach had little immediate effect in making people willing to accept technology risks, perhaps not very surprisingly. Starr then investigated risks in some detail and found that society seemed to accept risks to the extent that they were associated with benefits, and were what he termed voluntary (Starr, 1969). Starr's work gave rise to much interest in risk management and an awakening of interest in the question of how people perceive, tolerate and accept risks. Risk perception came to be seen as an obstacle to rational decision making, because people tended to see risks where there were none, according to the experts. The conflict between expert and public risk perception is at the basis of the social dilemmas of risk management (Sjöberg, 1999c).

In the 1970's, a small group of cognitive psychologists with a background in the experimental study of decision making, became very interested in investigating how people react in regard to risks. One of the inputs to this work was experimental studies of lotteries and other forms of gambles, and in this field attempts have been made to define an abstract concept of risk and to measure it by means of psychological scaling procedures (Lopes, 1983; Lopes, 1995). Important work was also conducted by Langer (1975). This work says something about how people react to lotteries and similar gambles, but probably little or nothing about the risk policy questions that bother decision makers. Preferences regarding lottery gambles appear to be unrelated to just about everything else (Waerneryd, 1996).

Another part of the input to the process came from work on subjective probability by Kahneman and Tversky (1974, 1981). They found great differences between probability according to calculated probability calculus and the intuitions people had about probabilities. Assuming that risk is about probability it was tempting to conclude that this work had much to say about how people perceived and acted upon risk (Sjöberg, 1979). However, no such evidence has ever been presented. Risk perception in a policy context is probably not a question of cognitive biases (Sjöberg, 2000c).

Returning to Starr and his concept of voluntary risk, a number of authors suggested variations on the theme in the 1970's. The need to do so was obvious both because Starr seemed to have hit upon a goldmine full of interesting and important problems, and because his own solution was obviously in need of improvement. Surely, both a train passenger and a mountain climber are doing something which is "voluntary" - more or less - and more obvious distinctions would concern concepts such as control. Research in the area has found that humans tolerate substantially more risk when they engage in voluntary behaviour. This is related to a sense of controllability where less risk is perceived in situations that are under personal control. ‘Risk is sometimes defined as insufficient controllability’ (Brun, 1994). People are found to believe that they are more in control than they actually are. Overall, they view the risk of winning the lottery as higher if they pick the numbers themselves – this is known as illusion of control (Langer, 1975). Furthermore, a person that sees him or herself as being in control (driving the car vs being a passenger) perceives the risk to be smaller (McKenna, 1993).

Illusion of control has been found to be related to unrealistic optimism.

Unrealistic optimism is a general optimism about the outcome of an event (Weinstein, 1980) and exists for both men and women and across age and educational level (Weinstein, 1987). When in a group and the vast majority of people perceive their chances of a negative event to happen to them as less than average, then clearly this is just not optimistic but also unrealistic (some of them may be correct, while others are mistaken). “The best established results of risk research show that individuals have a strong but unjustified sense of subjective immunity.” (Douglas, 1985).

Several books on risk topics, such as acceptability of risks, were published in the 1970's, suggesting different interpretations than voluntariness of the Starr findings. This work led to the development of the psychometric paradigm, which will be discussed in the present report.

Several decades of work have been devoted to psychological work on the understanding of perceived risk. Two distinct theories currently dominate the field of risk perception. One is the ‘psychometric paradigm’, rooted within the disciplines of psychology and decision sciences, whereas the other derives from ‘cultural theory’, developed by sociologists and anthropologists. One of the most important assumptions within the psychometric approach is that risk is inherently subjective. “Risk does not exist ‘out there’, independent of our minds and cultures, waiting to be measured” (Slovic, 1992). What to fear is an individual cognitive process such as the perception of threats to health or feelings of uncontrollability. In short, psychometric paradigm encompasses a theoretical framework that assumes risk to be subjectively defined by individuals who may be influenced by a wide array of psychological, social, institutional, and cultural factors. Psychometric paradigm assumes that with appropriate design of survey instruments many of these factors can be quantified (Slovic, 1992). The examination of diverse groups showed that psychometric scaling can identify and quantify similarities and differences in risk perceptions and attitudes among groups (Slovic et al., 1985).

The psychometric paradigm has gained wide credibility and popularity. But what is the recipe for success in psychology and social science? History teaches us that success seems sometimes to have only a weak relationship to actual empirical power of a model or a theory, and much more with the *apparent* power, which in turn can be created in many ways. A necessary condition is probably that there is a credible observational base. However, what is credible is in the eye of the beholder. The present report will discuss a current case of a well-known approach, or

paradigm to borrow Slovic's phrase (Slovic, 1992), in risk perception research: the psychometric paradigm[1]. We will show how apparent credibility has been created and present results that refute essential elements of the purported validity of the psychometric paradigm.

[1] We will also use the term 'the psychometric model', referring to an essential element of the paradigm, *viz.* the set of qualitative risk characteristics and their relation to perceived risk.

2. The psychometric paradigm

In 1978, an important paper was published by Fischhoff et al. (Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1978). Here, the authors had compiled 9 dimensions from the literature. The first one was whether people face this risk voluntarily, the respondents were asked to indicate on a seven point scale whether some of the risks were voluntarily undertaken and some were not (voluntary = 1, involuntary = 7). The second scale asked about the immediacy of effect and the respondents were asked to indicate whether death effected immediately or if the effect were delayed. The third asked the extent that the risks were known precisely by the person who was exposed to those risks, the scale went from risk level known precisely to risk level not known. The fourth scale asked about the chronic vs. catastrophic potential of the risk. Was this a risk that kills people one at a time (chronic risk) or a risk that kills large number of people at once (catastrophic risk). The fifth dimension went from common vs. dread. The subjects were asked to indicate whether this was a risk that people have learned to live with and can think about reasonably calmly, or is it one that people have great dread for – on the level of a gut reaction. The sixth scale asked about the severity of consequences and subjects were asked to indicate how likely it was that the consequence will be fatal if the risk from this activity was realized in the form of a mishap or illness. The seventh question concerned to what extent is the risks known to science. The subjects were asked to rate if the risk level was known precisely or not known. The eight questions were about the level of control – in terms of personal skill or diligence – the subjects perceived they had if they were exposed to the risk. The last dimension concerned the newness of the risk.

Then people were asked to rate the "risk" of a large number of activities (i.e. smoking, food colouring, nuclear power, surgery, motor vehicles, home appliances, skiing) on each of the dimensions. The authors computed mean ratings for each activity, or hazard, and then intercorrelated these means. The intercorrelations were factor analyzed and it was found that two major factors explained much of the variance: Dread and Novelty. Fischhoff et al. also showed that perceived level of risk, and risk tolerance as rated by their respondents, could be well explained by Dread and Novelty of the risks. Multiple correlations were of the order 0.8

(Slovic, Fischhoff, & Lichtenstein, 1980). Later work with larger groups of subjects and more rating scales and hazards, and by several researchers, essentially replicated these initial findings. Some of the later work has been carried out in different countries, usually with student groups, and, again, overall confirmed the findings, see Boholm (1998) for a review. Cross cultural comparisons of perceived risk has also been investigated.

Sivak, Soler, Trankle, and Spagnhol (1989) investigated differences in risk-perception among U.S., Spanish, West German, and Brazilian drivers. Hayakawa, Fischbech and Fischhoff (2000) examined the differences in this respect between Japan and the US, in the domain of traffic safety. Two studies were conducted by Teigen, Brun and Slovic (1988) to compare Norwegian, Hungarian and American students. The first study was designed to parallel the Hungarian-American study (Englander, Farago, and Slovic, 1986) as closely as possible. The second study was undertaken as a constructive replication of the first for two reasons, (a) to check the generality of the Norwegian risk profile and factor pattern against a different Norwegian sample, and (b) to investigate more closely the meaning of the risk ratings. The questionnaires originally developed to study risk perception in the US, were administered to 160 Norwegian university students. In study I, 37 first year students were given a selection of 30 potential dangerous activities, technologies or substances were judged on nine bipolar, seven point scales, intended to reflect important characteristics of risks. In addition, 35 first years students were asked to rate a larger set of 90 hazards according to how risky they were perceived to be for the Norwegian society as a whole. These subjects were also given a measure of individual differences in attitudes towards personal risks: FADIS (fear of accidental death and injury scale, developed by Dodd and Mills, 1985). In the second study risk were rated on nine dimensions, identical to those used in study I. The reported results were that the level of perceived risk in Norway was clearly below American scores for most hazards, but slightly above what has been found in Hungarians. Norwegians were more concerned than Hungarians and Americans about narcotics, less than Americans about chemicals used in food and agriculture, and less than Hungarians about a number of common, everyday hazards. Motor vehicles caused less risk perception among Norwegians compared to Hungarians and Americans (rated number 4 by Hungarians, number 17 by Americans and number 22 by Norwegians). Identical figures for motor cycles were numbers 15, 32 and 17 respectively. Jumbo jets, railroad accidents and bicycles were perceived to

be less risky compared to motor vehicles and motor cycles. However, Hungarians clearly perceived railroads to be more unsafe compared to Norwegians and Americans. When ratings on 9 risk characteristics were factor analyzed, a two-dimensional solution was found with fatal risk and involuntary risk as the two most important dimensions. Ratings of general death risk, harm risk, and death risk for those exposed were highly correlated, but appeared to be unrelated to the number of people believed to be exposed to the hazard. The ratings were found to be comparable, yet distinguishable from the American and the Hungarian results. Logically, one should expect the magnitude of risks for the society in general to be a product of the danger for those exposed and the number of people actually exposed to the risk. They concluded that people tend to overestimate risks where everybody has the same (however small) chance of being fatally struck, as compared to risks directed towards known targets[2]. Also other studies carried out previously have found significant differences in risk perception between countries (Bastide, Moatti, Pages & Fegnani, 1989; Farago, Slovic & Fischhoff, 1986; Goszczynska, Tyszka & Slovic, 1991).

Another study, which compared cultural differences, was conducted by Keown (1989). His goal was to study the risk perceptions of Hong Kongese, people from a city state with a different hazard ecology, and different cultural and social processes from the U.S. The respondents – a convenience sample of 65 students attending The Chinese University of Hong Kong – were given a two-part questionnaire. Mean risk ratings were compared with the mean risk ratings of 175 American students from Slovic (Slovic, Fischoff, and Lichtenstein, 1982). Factor scores were also computed, and the results showed that the samples differed on some aspects, but as for other studies, the factor analysis showed *dread risk* and *unknown risk* as the two dominant factors. The author concluded that perceptions of risk were likely to vary between different countries dependent upon what the news media chose to report, what people chose to discuss, what cultural norms were viewed as important, and what technical and legal opportunities existed for control and regulation of risk. In short, risk perception was hypothesized to differ as an effect of cultural, environmental, and governmental influences.

[2] It is important to note that this study was conducted at a time where the Hungarian News media was still under censorship and thereby the Hungarians were not aware of the actual risk.

Cultural differences have also been studied within the transport area. Biases seem to affect the perception of risk and the causes of accidents (Kouabenan, 1998). If perception affects behaviour we may also be able to change people's attitude and behaviour by influencing their perception of risk. Kouabenan's (1998) article presented results of research carried out on causal attributions of traffic accidents in The Ivory Coast (West Africa) and discusses the importance of culture in risk taking and accident prevention. 553 people (18-55 yrs old), with different religions, occupations, and beliefs, were evaluated on their fatalism and their perceptions of risks and accidents. The results indicated that fatalistic beliefs and mystical practices influenced the perception of accidents and consequently incited one to take more risks and neglect safety measures. A second study conducted by Kouabenan (2002) set out to determine how hazards and accidents were perceived by persons whose relationships with road risks differed due to their profession or experience. A questionnaire was devised and consisted of the definition of an accident, information of subjects' perceptions of accidents and their causes, estimates of the prevalence of accidents, perceptions of the automobile, risk-taking behaviour, and fatalistic beliefs. Accident and risk perception was studied by means of 3 independent variables: the subjects' occupation, driving experience, and accident history. 553 subjects (aged 18-55 yrs) from the Ivory Coast Republic (West Africa) participated. They had various kinds of experience and knowledge about traffic and automobile driving. The results showed that all categories of subjects were inclined to overestimate the threat represented by the risk of a road accident. In addition, all subjects tended to make external causal attributions to defend their role in traffic safety and accident prevention. Experienced drivers, but also less experienced ones, exhibited a higher level of risk-taking than other Ss. They were also found to make more external and fatalistic causal attributions. Finally, accident history was not found to have a notable effect on accident and risk perception, but it appeared to result in more cautious behaviour.

Hence, the basic work in the psychometric paradigm has been replicated many times and it has virtually always been possible to demonstrate that the factor structure is fairly invariant and that perceived risk is well accounted for by the factors. It is probably for these reasons and their intuitively appealing contents, that the paradigm has been claimed to be "enormously successful". Many citations can be found, among them in a book published by a Justice of the U. S. Supreme Court (Breyer, 1993). These citations usually take the validity of the Psychometric Model

for granted.

There are grounds for a cautious assessment of the paradigm and the model, however. The claim that Dread and Novelty account for virtually all of the variance of perceived risk is based on analysis of means, and regressions are calculated across hazards. However, when perceived risk is regressed on the psychometric factors across *respondents*, for one hazard at a time, the level of explained variance is typically about 20%, not 70-80 per cent (Gardner and Gould, 1989; Sjöberg, 1996, 2002b). Marris et al. have published intra-individual correlations among psychometric variables, i.e. correlations computed for each respondent, across hazards. The mean of the intra-individual correlations can be related, on the basis of their published results, to the correlations between the means (Sjöberg, 2002b). When this is done, it is seen, that the mean intra-individual correlation was linearly related to the corresponding correlation between means, but only about half of it. In terms of proportion of explained variance, there would therefore be a drop to about 1/4 when changing from correlations between means to mean intra-individual correlations, from 80% to 20%. Initially the psychometric approach sought to identify attributes of risk, which were shared universally by all individuals. Except their use of 'experts' and 'lay-people' it did not attempt to distinguish between individuals or groups (Marris and Langford, 1997). Their paper concluded that the risk characteristics identified by Slovic et al. were not necessarily universal. Despite reservation concerning the difference between aggregate and individualistic analysis, the psychometric paradigm was found to be an affective tool for predicting risk perception. Even using individual scores 50% of the variance could be explained using all nine risk characteristics together.

The psychometric paradigm leaves several important questions unanswered. It has not adequately considered how and why individuals differ in their judgments of risk (Kraus and Slovic, 1988). Vlec and Stallen (1981) concluded that the use of group mean ratings tells only part of the story about risk perception and suggested that aggregate analyses of mean risk scores across a whole sample may misrepresent the spectrum of opinions shown by individuals making up that sample. Marris and Langford (1997) found that some of the strong intercorrelations observed between risk characteristics at the aggregate level are not supported when the same data are analyzed at the level of individuals. Despite these findings, the relationship between risk characteristics and risk perceptions inferred by the psychometric paradigm were found to hold true at the level of individuals, for

most, but not all of the characteristics. In particular, the relationship between lack of knowledge to those exposed and risk perceptions appears to be a complex one.

One can debate which the most appropriate level of analysis is. If, however, we are interested in the processes of individual perception or in individual differences it is clear that the appropriate analyses are those that give the lower levels of explained variance. The correlation between means may be high, but that says nothing about how well we can account for individual differences or the individual risk perception process. When the latter are in focus, the psychometric paradigm clearly leaves most of the variance unexplained. This is true for level of perceived risk, and even more so for more policy-related variables such as demand for risk mitigation or risk tolerance. Misleading conclusions from analyses at the aggregated level have long been discussed in the social sciences and are termed the "ecological fallacy" (Robinson, 1950).

The fact that the factor analyses of the psychometric model show that the two major factors account for about 70 per cent of the variance is of course no evidence for those factors accounting for a large share of the variance of perceived risk. This misunderstanding occurs in the literature, however. Also, the fact that the factors are replicated (and that they are so few) is probably mostly due to shared semantics of these words, and to the fact that relatively few words are used, and sampled from a very restricted domain. Even cross-cultural validation with mostly highly educated samples of respondents does not prove that these are very important factors of perceived risk. Overlapping semantics of basic vocabulary is commonly found.

In other papers, it was claimed that the model explained only lay people's risk perception, not the risk perception of experts (Slovic, Fischhoff and Lictenstein, 1979). The latter were said to take into account only the facts, annual fatalities and the like. This, too, is a finding which is quite attractive and matches the preconceptions of many, perhaps especially of experts. However, there are several problems with the statement (Rowe and Wright, 2002a). The finding is based on a very small sample of expert respondents, only 15, and they made judgments of a very broad range of hazards, much broader than anyone can be a topical expert in. At any rate, the concept of expert usually refers to someone who has advanced topical knowledge in a given field, and it is clear that the group studied by Slovic et al. did not qualify in this sense.

Data from a fairly large group of nuclear waste experts were recently re-

analyzed. It was found that, in this group, risk perception *was* related to qualitative risk characteristics. The correlations were lower than for the public, probably due to the much smaller standard deviations of experts' data (Sjöberg, 2002a).

A further development was that of introducing trust as yet another determinant of risk perception, said to be very powerful (Slovic, 1993; Slovic, Layman and Flynn, 1993). But trust correlates only about 0.3 with perceived risk (Sjöberg, 1999b). Only a few studies, out of about 20 published, have provided higher levels of explanation. Siegrist has claimed that there are strong correlations between trust and perceived risk (Siegrist, 1999, 2000) but the claim is only supported by data where both risk and trust are measured by means of Likert type attitude scale items, not by the usual ratings of both constructs (Sjöberg, 2002c). Hence, a methodological factor seems to be the explanation for his result.

A well-known study by Slovic involved asking people how their trust would be affected by various events (Slovic, Flynn and Layman, 1991). The conclusion was that it is easy to destroy trust, hard to re-establish it. This may be true, but the data say little since they merely reflect the beliefs that people had about how their trust would change. Such beliefs are notoriously invalid as indicators of what psychological event would in fact take place, cp. Nisbett and Ross (Nisbett and Wilson, 1977).

Additional critical remarks are relevant. The first one was put forth by Wåhlberg (2001: 245) who claimed that "the criteria of falsibility and general testable hypothesis are not met" by the psychometric paradigm. He concludes that the psychometric approach is a model, i.e. description of data, without explanatory power. The psychometric approach does not even make predictions, and therefore its usefulness is very limited. Its validity, however, is not questioned.

Another criticism is the use of numeric measures of uncertainty. It may lead people toward a more deliberate and rule-based thinking. However, often, people's preferences, decisions, and behaviours are predominantly influences by the more associative intuitive system (Windschitl and Wells, 1996). This can provide a skewed reflection of how people think about uncertainty in some situations.

Risk perception data are presumably collected because there is a belief that perceived risks are, and should be, of importance to policy makers. The larger the risk, the more should people demand that the risk be mitigated. That assumption sounds very likely to be true. However, many other factors enter the picture and it has been found in several studies that demand for risk mitigation, when rated

separately, is most strongly related to severity of consequences of a hazard, not to its “risk”. Perceived risk is most strongly related to probability of an accident or some other type of unwanted outcome (Sjöberg, 1998a, 1999a, 2000a). These results go against a central tenet of the Psychometric Paradigm which is centered on “risk” as people perceive it.

Risk is usually also undifferentiated with regard to target, but it has been found in many investigations that personal and general risk differ (Drottz-Sjöberg, 1993). In relation to risk policy, personal and general risk have different implications depending on what kind of risk is under consideration. Results from a study by Sjöberg (2000b) show that general risk is more important than personal risk with regard to risk policy attitude when there is a large protection possibility. These are lifestyle risks such as risk from alcohol consumption. It is the risk to *others* which is driving policy attitude. In the other extreme, personal risk is more important. These are hazards people feel they cannot protect themselves from, such as nuclear risks.

The psychometric paradigm work usually operates with an undifferentiated concept of risk without a specified target. It has been found that such non-specific risk ratings most closely resemble ratings of general risk (Sjöberg, 2000b), thus making them more relevant for lifestyle risk policy than for environment and technology policy attitudes. This is unfortunate since the paradigm has been motivated foremost by the need to inform the latter type of policy making.

Another thesis of the psychometric paradigm is that media have strong effects on the public's risk perception, see af Wåhlberg and Sjöberg (2000a) for a review. The media are the main scapegoat in experts' debates of risk policy dilemmas and it is frequently asserted that media have a very large effect on risk perception, see e.g. Okrent (1998). The media are often seen as irresponsible and only interested in disseminating negative information, with a special inclination to cover low probability/high consequence risk (Cohen, 1985). But typically, few references are given to support such statements. A classical study is the one by Combs and Slovic published over 20 years ago (Combs and Slovic, 1979). This was a preliminary study of very limited scope and oriented towards accidents and illnesses rather than risks proper. Okrent also cites Kone and Mullet (Kone and Mullet, 1994) as support for the thesis of media effects. However, that paper describes a study of risk perception in Africa, finds it similar to Western risk perception, and concludes that media must be the reason. This is clearly only indirect evidence for a media

effect.

Combs and Slovic reported that perceived causes of death correlated more strongly with media report frequency than with actual mortality statistics. As they pointed out, this is no proof of a causal effect, of course. Many alternative explanations are possible. Perhaps more important, the study pertained to illnesses and accidents rather than technologies, which are the usual topic of risk policy issues. Suppose the study would have relied on data from, e.g. nuclear waste and genetically modified food. No deaths have been reported in media, and no are known in statistical data bases. Yet, people have strong views about these hazards and perceive risks of varying intensity. Why? Perhaps because media cover them. But there are no data showing strong relations between perceived risk and amount of media coverage.

In a project concerned with risk perception and media in five countries in Western Europe (project RISKPERCOM, with partners in Sweden, Norway, France, the UK and Spain) we found no support for the simple media image common in the debate. The results showed that perceived risk correlated only weakly (across hazards) with media coverage, whereas self-rated knowledge about the risks correlated more strongly. The former correlations were only of the size 0.2, the latter about 0.6 (Sjöberg et al., 2000). Demand for risk mitigation was not correlated with media coverage.

Media has given a fairly balanced picture of risks and accidents (Nilsson, Sjöberg and Wåhlberg, 1997). It was also found that it was not true that media gave priority to risks of the type small probability/large consequence. The media reported, for example, many traffic accidents, which are fairly common and typically do not have catastrophic consequences; only few people are involved in any accident.

Media seem often to be the only channel of information seriously considered when risk perception is to be accounted for. However, there are several alternatives worthy of considerations. One is movies[3] and television dramas, another is rumor (Kapferer, 1989), or personal contacts (Sjöberg, 1994). It is also possible that the mere connotations of the terms carry strong suggestive power for eliciting risk

[3] For example, the movie "The China Syndrome" which was released shortly before the TMI accident in 1979.

perceptions[4].

The psychometric paradigm is also open to the possibility that Cultural Theory (Douglas and Wildavsky, 1982) carries important explanatory power with regard to perceived risk (Peters and Slovic, 1996). This theory is discussed elsewhere and will not be treated here in detail. In a quantitative form, as operationalised by Dake and Wildavsky (Dake, 1990; Wildavsky and Dake, 1990), it has been found to explain only some 5 per cent of the variance of perceived risk in European studies, somewhat more in US data (Sjöberg, 1998b).

Peters and Slovic, with results fully in accordance with such a very modest level of explanatory power, still claimed that Cultural Theory dimensions were powerful determinants of perceived risk. They investigated correlations between Cultural Theory scales and various risk judgments and found a number of, mostly very weak, but often statistically significant correlations, which they describe in the text in a somewhat optimistic manner. For example, the correlations between the egalitarian subscale and technology concerns were -0.22, -0.10, -0.01 and 0.02, a not very impressive set of correlations. Nonetheless the authors wrote that "these data confirm the hypothesis that the Egalitarian factor will be *strongly* related to concerns about technology... " (p. 1439, emphasis added). Other examples of optimistic bias in interpretations could be given (see Sjöberg, 1997a).

Slovic and Peters have responded to this criticism with arguments pertaining to the use of squared correlations as measures of explanatory power (Slovic & Peters, 1998). Although this is an interesting debate, they did not succeed in demonstrating the futility of correlations in the current contexts. They cited authors who had shown that correlations between independent and dependent variables in an *experimental* context may be quite misleading as to the practical value of the experimental interventions. However, the present discussion is about the explanatory value of a dimension as an indicator of the value of a theory (Sjöberg, in press-a). The squared correlation is the first statistic suggested in the APA manual as a measure of effect size (American Psychological Association, 1994). It seems strange to see this standard statistical measure be written off as misleading and even obsolete (Sjöberg, in press-a).

Finally, what is driving policy attitudes and demand for risk mitigation?

[4] E.g. "Nuclear waste" *sounds* very unpleasant even if you know nothing more about it than the verbal label and have only a vague idea about the concepts of waste and nuclear.

Several studies, including the present one, have shown that it is seriousness of consequences, not risk *per se* (Sjöberg, 2000a). Here, it was also found that the risk inducing activity was important in the sense of commonness, or frequency. This makes sense. If people are often exposed to a risk, it would be more important to mitigate it. On the other hand, the riskiness of the activity had little importance for demand for mitigation, and accident risk also turned out to be less powerful as an explanatory variable. The psychometric paradigm is based on the assumption that risk of an activity is the most important variable to investigate; a wealth of data has by now shown this belief to be false, and that it does make a difference which risk variable is selected for study. It has also been found, in a very consistent set of analyses, that interest in a risk was a relatively powerful predictor of demand for risk mitigation, clearly more so than perceived risk (Sjöberg, 1999, July). The risk perceiver seems to be willing to pursue risk themes in a positive mood, perhaps because such an active attitude creates a feeling of empowerment and heightened self esteem. The results were surprising because we had earlier found that risk perception was negatively related to interest in groups of adolescents (Drottz-Sjöberg & Sjöberg, 1991). Risk perception should clearly not be analyzed only with reference to negative thoughts and feelings.

The psychometric paradigm is an interesting and fruitful pioneering effort and it has without doubt done much to create an interest in important issues. Yet, as so many pioneering efforts, it has raised more questions than it has been able to provide well founded answers to.

3. Discussion

3.1 The psychometric paradigm: conclusions

McDaniels et al. (1995) found the psychometric paradigm to be an approach for identifying the characteristics influencing people's perception of risk. The approach assumes that risk is inherently multidimensional, with many characteristics other than the probability of harm affecting individual judgments. Applying the method to human health risk perception includes:

- Developing a list of hazard items of risky events, technologies, and practices that include a broad domain of potential hazards.
- Developing a number of psychometric scales that reflect characteristics of risks that are important in shaping human perception of, and response to, different hazards.
- Asking people to evaluate the list of items on each of the scales.
- Using multivariate statistical methods to identify and interpret a set of underlying factors that capture the variation in the individual and group responses.

As pointed out in the introduction, the shortcomings of the psychometric paradigm are not hard to see (Sjöberg, 1996a). When data are analyzed in an appropriate manner, it is clear that the model accounts for, at the most, 20-25% of the variance of perceived risk and risk tolerance. The strong explanatory power claimed for the model is based on misleading data analysis using means. The same method that was used in the 1978 paper is still used for current claims about the powerful properties of a similar model of ecological risk (McDaniels, Axelrod, Cavanagh & Slovic, 1997). .

The explanatory power of the psychometric model is largely due to the inclusion of Dread items among the explanatory variables. However, Dread is probably a consequence of perceived risk, not a cause of it, and therefore it should not be used as an explanatory variable. It seems unlikely that we first feel fear, then perceive a risk - at least the assumption must be substantiated in some way. The risk characteristics form a logically coherent group of variables denoting properties of the hazard, not how the respondent reacts emotionally to the hazard.

Loewenstein, Weber, Hsee and Welch (2001) proposed a risk-as-feelings hypothesis, that highlights the affect experiences at the moment of decision making. They showed that the emotional reactions to risky situations often diverge from cognitive assessments of those risks. “The risk-as-feelings hypothesis postulates that responses to risky situations (including decisison making) result in part form direct emotional influences, including feelings such as worry, fear, dread, or anxiety” (Loewenstein et al, 2001: 272). The fact that there is a moderately strong and consistent relationship between emotional reactions and risk perception is documented in our work as reported elsewhere (Drottz-Sjöberg & Sjöberg, 1990; Sjöberg, 1998c). It can be added that Dread was a misnomer for the set of items summarized under that heading (Sjöberg, in press-b); they denote severity of consequences in various respects (Graham, 2001). One or two items which do attempt to measure emotional reactions appear not to carry any explanatory power.

The data on experts cited so frequently turn out, on examination, to be very weak as evidence. Only 15 experts were studied, and their claim to expertise is most dubious. When real experts in a chosen field were analyzed, as Sjöberg (2002a) recently did for the case of nuclear waste, they turned out to give risk ratings which were explicable by the psychometric model dimensions in a manner similar to those of other respondents. The present study gave similar results. Experts' risk perception was correlated with risk characteristics in a similar manner when compared to the public. This was true also for policy attitudes, but that aspect of risk attitudes needs to be developed beyond what was done in the present study. Another explanation for the alleged difference between lay-people and experts that experts feel that they are more in control with the danger and thereby perceive less risk.

Trust is a fairly weak explanatory variable with regard to perceived risk. The present results support that statement and suggest that trust measures should be made specific, not general. A specific risk measure turned out to give moderately important contributions to the explanation of perceived risk.

The psychometric paradigm misses out by neglecting important distinctions and variables. People make quite different judgments of personal and general risk, for example (Drottz-Sjöberg, 1993). Personal and general risk differ both in level (personal risk is usually much lower than general risk) and in correlates. General risk is a better predictor of policy attitudes for lifestyle risks such as alcohol while

personal risk is more or equally important for technology and environment risks perceived as being outside of our individual control, such as nuclear power (Sjöberg, 2000b). Two things will have an affect here, unrealistic optimism and "law of numbers" that is number of people in the reference group (Price, 2001).

The model does not take into account the powerful dimension Sjöberg (1997b) entitled Tampering with Nature, nor does it account for the rather loose relationship between rated "risk" and policy attitudes, such as demand for risk mitigation. The latter dimension is hard to explain with risk data but so far it has been found to be most strongly related to expected *consequences* rather than probabilities or risks (Sjöberg, 1993, 1998a, 1999a). The latter finding is true whether hazards are defined as activities or consequences, as shown in the present paper and elsewhere (Sjöberg, 1999d). The psychometric paradigm is founded on the presumption that *activities* are important for risk policy attitudes. The present data, and data in the cited references, strongly support the notion that *consequences* are much more important.

Despite its important shortcomings, the psychometric paradigm has become an attractive basis for most current work on risk perception, both research and consulting (Sandman, 1993). The question we pose here is why. A few suggestions are offered as answers:

- The model is very simple. It is very easy to understand and is close to "common sense".
- The model provides answers which are politically desirable. The public is depicted as emotional and ignorant, just as policy makers have always suspected. In contrast, experts are said to make the objectively correct risk judgments.
- The model seems to supply a final answer. As we have seen above, the model has been popularized with the help of a kind of data analysis which can hardly fail to provide the impression that risk perception is explained. Furthermore, it gives replicable data, probably because it profits from common semantics of risk and related concepts in various groups and even nations or cultures. Similar semantic overlap has been noted before, e.g. with Osgood's semantic differential (Osgood, Suci, & Tannenbaum, 1957).

Perhaps other aspects also are involved, but those mentioned above appear to carry

the Psychometric paradigm a long way.

3.2 A conception of the risk perceiver

Myths based on the psychometric paradigm have indeed penetrated very far. Jasanoff (Jasanoff, 1998) puts the matter quite well in the following citation:

> "The psychometric paradigm, in particular, has been instrumental in preserving a sharp dualism between lay and expert perceptions of risk, together with an asymmetrical emphasis on investigating and correcting distortions in lay people's assessments of environmental and health hazards. In policy settings, psychometric research has provided the scientific basis for a realist model of decision making that seeks to insulate supposedly rational expert judgments from contamination by irrational public fears". (p. 98).

The simple diagram, reproduced many times, of the factors Dread and Novelty, seemed to show convincingly that people oppose nuclear power because they were emotional and ignorant. Moreover, as Jasanoff points out, experts were widely held to be rational and objective in their risk perceptions. The widespread notion that policy decisions should ignore the publics' perceived risk probably has some of its roots and at least considerable support in these conclusions from the psychometric model. It disregards the simple fact that the views of the public cannot and should not be ignored in a democracy (Sjöberg, 2001b, 2001c). Public opinion is becoming a more salient factor also in sociological theory (Weakliem, in press).

In our research we have found a quite different picture of the risk perceiver, be he or she an expert or not. The dominating factors in risk perception are of an ideological character. The belief that the development of technology involves unknown dangers is very important, and it seems no less rational than not believing that such is the case. Science does develop all the time and risks we do not know about today will be discovered tomorrow. If experts say "there is no risk" this usually means "no risks have yet been discovered". In studies especially oriented towards New Age beliefs and world views, it was found that such beliefs account for some 10-15 per cent of the variance of risk perception (Sjöberg, 2002d, in press-a).

Maybe we have here a clue as to the relatively moderate importance of trust. I may trust that experts tell the truth, as they know it, but still believe that they do

not know the whole truth, that nobody does (Sjöberg, 2001a).

Initially the psychometric approach "sought to identify attributes of risk which were shared universally by all individuals. Except their use of 'experts' and 'lay-people' it did not attempt to distinguish between individuals or groups" (Marris et al, 1997: 304). During the development of the psychometric paradigm, cultural factors have been taken into consideration. The psychometric paradigm has been developed to include factors like gender, ethnicity, nationality, affect, and worldviews (Rohrman, 1994; Slovic, 1999), but their early studies continues to be very influential among both academic researchers and policy-makers (Marris et al, 1997). Risk perception varies between respondents, dependent on the particular issue being evaluated and the definition of risk used to elicit responses. Again, this suggests a coalition between psychometric paradigm and cultural theory. They also found that 'personality profiles' of hazards defined by the qualitative risk characteristics of the psychometric paradigm were not necessarily universal: different individuals will attribute different characteristics to the same risk issue. We suggest a further investigation between the cultural paradigm and psychometric paradigm. Since the statistical analysis in early studies were made on mean scores for whole samples, and provided no information about how individuals might differ in their perception of risk (Marris et al, 1997) it might be useful to combine it with cultural theory. The psychometric paradigm assumed that risks have 'personality profiles'. This implies that all individuals assess hazard in the same manner. The approach treated risk, activities, and products as 'external objects with a set predefined qualities and drawbacks, and ignored the possibility that social, cultural and institutional factors might affect the way in which risks are understood and evaluated by individual members of the public" (Marris et al., 1997: 304, ref from Turner and Wynne, 1992)

Safety systems should be designed to reduce the amount of risk in different areas. Expressing and evaluating the tolerable amount of risk is very difficult. It will also vary among individuals. Objective risk estimates are average values, based on summary statistics. As shown by Finn and Bragg (1986) and Matthews and Moran (1986) the majority of drivers tend not to equate their own traffic risk with that of the average person, because they believe themselves to be more skilful and safer than average. Therefore objective risk estimates will tend to be viewed as somewhat irrelevant for most drivers, when assessing their own behaviour, except as confirmation of their own superiority.

Why should risk be so important? In data presented in the present paper we have seen risk to be a dominating factor in accounting for attitude, benefits being much less important. In related work, we found that people are more easily sensitized to risk than to safety (Sjöberg & Drottz-Sjöberg, 1993). Mood states have been found to be more influenced by negative expectations than by positive ones (Sjöberg, 1989). People seem to be more eager to avoid risks than to pursue chances. Maybe biological factors are responsible for human risk aversiveness.

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Explaining risk perception. An evaluation of the psychometric paradigm in risk perception research

The core aim of this report is to evaluate the relevance of the psychometric paradigm in risk perception research. Empirical tests of the theory's capability of predicting perceived risk will be presented and discussed. The report concludes that the majority of results reached in the paradigm are not sufficiently well based on empirical data and appropriate analyses. The major part of the report is written by Lennart Sjöberg and previous versions have been presented elsewhere. The report is financed by The Norwegian Research Council's RISIT (Risk and Safety in Transport) – program.

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