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# Limits of Knowledge and the Limited Importance of Trust

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Perceived risk and related attitudes have been implicated as major factors in many of the difficult policy problems that face modern society (nuclear power, genetically modified food, etc). Experts often argue that no or very small risks are involved; people are still worried. Why? The standard answer is lack of trust. Data on trust and risk perception, however, point to only a weak relationship between the two (*r* approximately 0.3). It is suggested here that the reason for the surprisingly minor importance of trust is that people believe that there are clear limits to how much science and experts know. Results are presented from studies of risk perception of the public, experts, and politicians. Politicians and members of the public believe that there are many unknown effects of technology and such beliefs were strongly related to their perceived risk. Experts on nuclear waste, on the other hand, seemed to believe that little is unknown in their field of expertise. Regression analyses of risk perception showed the unknown-effects factor to be a more important explanatory factor than trust for the public and politicians.

**KEY WORDS:** Trust; risk perception; demand for risk mitigation; experts; politicians

## 1. INTRODUCTION

Trust is a concept of much interest in current social science risk research. Several ways to measure trust have been proposed. For example, Flynn, Burns, Metz, and Slovic[1] used survey questions asking about trust in the U.S. Department of Energy (DOE) in a general and global sense, trust in openness of the DOE, and its provision of "objective and scientifically sound studies." Trust in an expert, an agency, or a corporation has been assumed to be determined by perceptions of a number of attributes, among them competence and expertise.[2] Competence has two sides, however. One is knowing, the other is knowing the limits of one's knowledge. The present article is focused on that particular aspect of competence, how the limits of knowledge are perceived, and what their importance is for overall trust.

Trust is often held to be of crucial importance for the understanding of risk perception and policy attitudes.[3–6] Many papers on trust and risk perception treat the matter mostly as a theoretical problem and present no data. It seems to be simply assumed that the relationship is very strong.

Empirical data, however, do not support this commonsense notion. Examples of empirical investigations of the matter converge on the conclusion that the relationship is not strong, but rather weak to moderate. (Higher correlations might have resulted, in some cases, from the use of more reliable measures of trust and perceived risk.) Pijawka and Mushkatel[7] studied risk perception of nuclear waste and trust in the federal government, federal agencies, and state and local government. They specified trust as a belief that decisions taken will protect public safety (probably in general). The correlations with risk perception expressed a 5–10% explained variance in perceived risk on the basis of trust. The same level was reported by Bord and O'Connor[8] in a study of a hazardous waste site. Trust measures were of those in general. Hallman and Wandersman[9] investigated a hazard-

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ous waste landfill, with specific measures of trust and risk. They obtained 16% explained variance. An unusually strong relationship, about 35%, was found for specific risk and trust factors in a study of a high-level nuclear waste repository by Biel and Dahlstrand.[10] Rather strong correlations (about 35%) were also found in a study by Bord and O'Connor,[11] with specific risk and trust items concerning food irradiation.

Bord and O'Connor[11] found strong correlations, for two out of three items, between risk perception and behavioral intentions on the one hand, and distrust on the other. With only two items giving positive results, caution is called for. Furthermore, the item *not* showing a strong correlation with trust was the one related to policy attitudes; the other two were concerned with consumer behavior. Perhaps distrust is more important for individual consumer behavior than for policy attitudes.

Giddens[12] related trust (basic trust as provided by caregivers in childhood) to personality in a psychodynamic framework. While this may sound plausible, in normal populations both worry and fear have been found to be only weakly related to perceived risk.[13–15] Of course, psychodynamics may be better suited to the analysis of psychopathology and risk perception and here many possible connections to traditional theory, such as the Jungian one, remain to be explored.[16]

Trust has been mentioned as an important factor in a comparison of risk perception in France and the United States.[17] In that study trust was related to lower perceived risk within countries, but between countries a paradoxical relationship was found. The French were more trusting than Americans, yet perceived larger risks. This is a paradoxical result since one would expect higher trust to be associated with lower perceived risk. The finding can serve as a reminder that little about trust is self-evident.

When it comes to nuclear waste, several studies carried out in the United States have shown that lack of trust in the DOE is an important predictor of perceived risk and risk acceptability.[18] Swedish data, however, show a much weaker relationship, even if it is in the expected direction.[19]

As pointed out by Drottz-Sjöberg[20] in her study of the Storuman, Sweden, referendum on siting a local high-level nuclear waste repository, trust may exist and people may still reject a siting proposal. People may well trust the technical expertise of an industry or an agency, but they may have many reasons for rejection just the same. Easterling and Kunreuther[21] argue that public acknowledgment that a facility is needed is necessary for acceptance. Of course, such acknowledgment does not necessarily lead any local community to take on the burden. In addition, there is the problem of neighboring municipalities where people may oppose the prospect of having radioactive waste transported through their communities; little social science research on that topic is available[22] but what there is shows problems similar to those arising in siting hazardous facilities in general.[23]

It is often claimed that trust can easily be lost but is hard to gain.[24] This may be true, but some empirical research on the matter is not convincing. For example, Slovic[25] asked a group of students what events they believed would lead to decreased or increased trust. Of course, the data show only what "folk psychology" has to say about trust, not necessarily how trust really would be affected.

Trust can be measured in both a specific or a more general sense. A few of the studies cited above suggest that this may be an important distinction. In a previous study, this author developed scales of general trust and found them to be weakly related to risk perception dimensions.[19] In the present study, the efficiency of specific and general trust measures is compared.

One possible reason for the limited importance of trust is that people believe that there are effects of technology that are not yet understood. One can perceive a spokesperson for nuclear technology, for example, as fully honest and competent and still not agree with his or her conclusion that risks are negligible because one may think that "they do not have the final answer." The history of technology affords several examples of technology hazards being discovered after some time of use and research; the most famous is perhaps the Chernobyl accident. Another is BSE (bovine spongiform encephalopathy), which, for many years, was denied by experts as a risk to humans until new evidence forced another conclusion. It is in the logic of things that the statement "there is no risk" really means "we have no evidence for a risk," and the latter statement can be read as "we have no evidence *yet* for a risk." Scientific knowledge is always limited; even experts make mistakes and may overestimate the extent of their knowledge.[26]

The purpose of the present article is to investigate whether people believe that there are unknown effects of nuclear technology, and if such beliefs are important for their risk perception and policy attitudes. It is hypothesized that beliefs in unknown effects will add substantially to explained variance in risk perception and related variables, above that accounted for by trust measures. As a preliminary,

which trust measures are most useful—specific or general—are investigated.

Data will be used from two studies: one where there is a comparison between the public and experts on nuclear waste (Study 1), and one where the comparison refers to the public and local health and environment politicians (Study 2).

## 2. STUDY 1: EXPERTS AND THE PUBLIC

### 2.1. Method

Questionnaires were mailed to 750 persons randomly sampled from the central Swedish population database.[2] The response rate after three reminders was 65% (444 respondents; noncitizens and respondents who stated they were not the person to whom the questionnaire had been mailed were excluded). The experts were employed by the Swedish Nuclear Power Inspectorate (SKI) and the Swedish Radiation Protection Institute (SSI), and were selected for their expertise on nuclear waste by knowledgeable informants who were research managers of the agencies. In addition, members of the National Council on Nuclear Waste (KASAM) were also included in the sample, making a total of 84 experts. The response rate in the sample of experts was 69% (58 respondents).

The questionnaire was quite extensive: 29 pages and 466 questions to the public; 24 pages and 385 questions to the experts. In the present article, results for only a selection of the data are reported. Three types of nuclear technology were selected for analysis: Swedish nuclear power, Eastern European nuclear power, and a local high-level nuclear waste repository. The data used were

- ratings of likelihood that there are unknown effects (scales using seven discrete categories),
- ratings of how good or bad such effects would be,
- ratings of overall trust in pertinent authorities, how competent, and how caring they were,
- personal and general risk of the three nuclear technologies, and
- items measuring trust in a more general sense.

Detailed results from other parts of the study can be found in Sjöberg, Truedsson, Frewer, and Prades[27] and Sjöberg.[28]

### 2.2. Respondents

Some background information about the respondents follows (results in parentheses are for the experts):

- 52.4% were male (81.0%)
- median age was 44 years (55 years)
- median monthly income of the household was 25,000 Swedish Crowns (only 50.4% responded to this question; not posed to experts)
- 25.5% were unmarried
- 66.7% had children (86.2%)
- 32.2% had only primary-school education, 24.7% had some college education (96.6% of the experts had college-level education)
- education beyond primary (only the most common categories are given here) includes, for the public: (1) health, biology 18.5%; (2) technology, engineering 15.0%; and (3) economics, business 16.7%; and for the experts: (1) natural science 62.1%; (2) technology, engineering 24.1%; (3) health, biology 6.9%; (4) humanistic subjects 1.7%; and (5) social science 5.2%
- Full-time or part-time employees 65.1%, unemployed 6.0%, retired 13.7%
- Public sector employer 41.8%, private 52.6%
- 46.7% stated that they often or sometimes were exposed to job risks (8.8%)
- 27.8% lived in the four largest cities (78.5%)
- 95.6% (100%) stated they answered alone, without discussing the questionnaire with someone else (as they had been instructed)
- 56.0% stated they would like to participate in further studies of this kind
- median time to complete the questionnaire was 60 min (40 min)

The respondents from the public were similar to the general population in most background data, but had a higher level of education.

Special questions put to the experts elicited the following responses:

- median of 22 years of experience in the area
- scientific orientation: (1) biology 1.8%, (2) chemistry 3.6%, (3) physics 60.7%, (4) tech-

[2] Such samples can be bought from the database, administered by the SEMA Group AB in Stockholm, and specified as to certain demographic dimensions. The author specified ages 18 to 75 years, but made no further restrictions. Citizenship is not allowable as a restriction, and since only Swedish citizens were to be studied, a question about citizenship was included in the questionnaire; all respondents who did not state that they were Swedish citizens were excluded. To estimate the response rate, the sample size was then multiplied by 0.94 because it is known that 6% of residents in the country are not citizens.

nology 12.5%, (5) ecology/environment 8.9%, (6) journalism, information 3.6%, and (7) other 8.9%
- 74.1% had published in scientific journals
- 22.4% worked with nuclear power, 20.7% with nuclear waste, 29.3% with both of these, and 27.6% with none of the above
- of those who did work in the nuclear industry, 80.5% indicated that they worked with safety, 4.9% with information, and 14.6 with other issues
- 78.2% responded that they considered themselves to be specialists in nuclear power issues
- 93.0% indicated that they were well oriented in the scientific development in their area of expertise, 91.1% indicated that they were experts in their field
- all expert respondents said they had possibilities to follow the development in their area, 94.7% that it was necessary to develop one's knowledge all the time
- they developed their competence by: (1) further education 46.6%, (2) practical experience 67.2%, (3) research 36.2%, (4) reading scientific literature 53.4%, and (5) conferences and symposia participation 67.2%
- 19.7% stated they would feel personally responsible if a nuclear accident were to happen

## 2.3. Results

### *2.3.1. Specific versus General Trust*

The questionnaire asked for ratings of trust in the pertinent authorities for each of the 22 hazards. These ratings are termed "specific trust ratings." The trust ratings were correlated with general and personal risk, for the public and for the experts (see Table I).

The overall level of correlation was thus approximately 0.3 (somewhat higher for nuclear waste), or some 10% explained variance. The experts' trust data seemed to have about the same level of correlation with risk perception as those from the public, with the exception of nuclear waste variables where the experts showed a smaller correlation. The reason is probably that their dispersions of ratings were quite small in those respects.

The public sample was also given 43 items that were used in a previous study of trust and risk perception.[19] These items measure general trust, that is, trust without reference to any specific risk or hazard. They were factor analyzed here since the present sample was much larger and also more representative

**Table I.** Correlations between Perceived Risk and Trust in Authorities, Specific to Each Hazard

| | General risk | | Personal risk | |
|---|---|---|---|---|
| Hazard | Public | Experts | Public | Experts |
| 1. Alcohol consumption | −0.01 | 0.07 | 0.02 | 0.03 |
| 2. AIDS | −0.07 | 0.12 | 0.01 | −0.08 |
| 3. Air pollution | −0.07 | −0.30 | −0.08 | −0.36* |
| 4. High-voltage power lines | −0.19** | −0.17 | −0.14** | −0.16 |
| 5. Greenhouse effect | −0.21** | 0.04 | −0.20** | −0.02 |
| 6. Traffic accident | 0.06 | −0.29 | 0.08 | −0.45** |
| 7. Swedish nuclear power plants | −0.45** | −0.31 | −0.40** | −0.31* |
| 8. Eastern Europe nuclear power plants | −0.14** | −0.37* | −0.19** | −0.30 |
| 9. Natural background radiation | −0.06 | −0.09 | −0.05 | −0.19 |
| 10. High-level nuclear waste from Swedish nuclear power plants | −0.46** | −0.16 | −0.40** | −0.13 |
| 11. Transportation of nuclear waste | −0.41** | −0.17 | −0.39** | −0.13 |
| 12. Radiation from nuclear waste repository | −0.44** | −0.15 | −0.42** | −0.05 |
| 13. Genetic engineering | −0.39** | −0.29 | −0.33** | −0.35* |
| 14. Food contaminated by radioactive substances | −0.30** | −0.33* | −0.28** | −0.42** |
| 15. X-ray diagnostics | −0.18** | −0.20 | −0.18** | −0.21 |
| 16. Radiation therapy | −0.15** | −0.37* | −0.09 | 0.10 |
| 17. Chemical waste | −0.23** | −0.33* | −0.23** | −0.37* |
| 18. Sun rays | −0.01 | −0.02 | −0.04 | −0.08 |
| 19. Nuclear arms | −0.24** | −0.08 | −0.21** | −0.11 |
| 20. Radioactive fallout from the Chernobyl accident | −0.14** | −0.26 | −0.18** | −0.37* |
| 21. Insufficient medical care when ill | −0.39** | −0.65** | −0.43** | −0.60** |
| 22. Violence and aggression | −0.09 | −0.50** | −0.05 | −0.54** |

* $p < 0.05$; ** $p < 0.01$.

than the original one. Five factors (51.0% of the variance) could be interpreted. They were

- low trust in politicians,
- cynical suspiciousness,
- perceived high level of societal conflict,
- low level of trust in corporations, and
- lack of trust in general honesty of people.

The cynical suspiciousness factor was new to the present analysis. Tables A1 and A2 in Sjöberg[28] give the correlations between the factor scores and all the personal and general risk ratings. There was a very consistent trend for the trust dimensions to be correlated with perceived risk, but the level of correlation was low, approximately 0.2. Squared multiple correlations between the five general trust factors and the indices of pooled general and personal nuclear waste risk were both 0.08. This result, about 10% explained variance, was in good agreement with previous research on general trust and perceived risk, discussed in the introduction. Specific risk, however, was much more highly correlated with perceived nuclear waste risks. (As noted above, the high correlations were not true for many of the other hazards, even with specific trust rather than general trust.) When multiple regressions were performed on the pooled indices of perceived nuclear waste risk and trust dimensions, it was found that

- Specific risk alone accounted for 0.210 and 0.176 of the variance of perceived risk.
- This was raised, but only to 0.221 and 0.193, by the introduction of the factors of general trust.
- The only general trust factor that obtained a significant β value was lack of trust in the general honesty of people.

The present data hence show that trust may be a moderately important factor in risk perception. It is important to note that trust measures need to be made specific to the hazard under investigation since general trust adds very little to the explanatory power of trust. In the following, specific trust measures will be used.

### *2.3.2. Extent of Beliefs about Unknown Effects*

The first question to answer is whether, in the two groups of respondents, there were widespread beliefs that unknown effects existed. It is seen in Table II that beliefs about unknown effects were common in the public, but not among the experts, and that the differences were large. With regard to a nuclear waste repository, for example, only 5.4% of the experts, as opposed to 46.5% of the public, were open to the possibility of even a small probability that there might be some effects that today are unknown. Thus, the public was much more skeptical about the completeness of expert knowledge than the experts themselves were.

The situation is different when it comes to whether such effects, were they true, would be bad or good (see Table III). It is clear that the unknown is expected to be bad and that good news is not expected to be around the corner. This may perhaps be very natural when it comes to nuclear waste but it is less self-evident with regard to nuclear power itself. Yet, both the public and the experts rated the unknown as negative, and they did so at about the same level. It is also interesting to note that for the public, the correlations between beliefs and values were negative and significant: −0.19, −0.15 and −0.21 for domestic nuclear power, Eastern European nuclear power, and nuclear waste, respectively. Corresponding correlations were positive for the experts: 0.23, 0.14, and 0.40, the latter being significant at the 0.01 level. Belief-value correlations have been studied extensively[29] and they do tend to reflect underlying attitudes. With something one likes, good things are likely and bad things are unlikely; the opposite is true for things one dislikes.

It is also interesting to inquire into the correlations between beliefs in unknown effects. Table IV shows

**Table II.** Study 1 Ratings of Likelihood of Effects That Are Unknown Today (Percent of Respondents)

| | Domestic nuclear power | | Eastern nuclear power | | Nuclear waste repository | |
|---|---|---|---|---|---|---|
| Likelihood | Public | Experts | Public | Experts | Public | Experts |
| Very unlikely | 1.4 | 12.1 | 4.0 | 3.6 | 3.3 | 25.0 |
| Unlikely | 5.4 | 29.3 | 4.0 | 16.4 | 6.2 | 17.9 |
| Rather unlikely | 10.0 | 29.3 | 6.4 | 16.4 | 10.2 | 28.6 |
| Neither unlikely nor likely | 29.2 | 20.7 | 28.6 | 40.0 | 33.9 | 23.2 |
| Rather likely | 15.4 | 6.9 | 13.6 | 14.5 | 15.2 | 3.6 |
| Likely | 15.7 | 1.7 | 17.4 | 9.1 | 9.7 | 1.8 |
| Very likely | 22.9 | 0.0 | 26.0 | 0.0 | 21.6 | 0.0 |

**Table III.** Ratings of Value (Good versus Bad) of Effects that Today Are Unknown, If They Were to Happen (Percent of the Respondents)

| | Domestic nuclear power | | Eastern nuclear power | | Nuclear waste repository | |
|---|---|---|---|---|---|---|
| Effect | Public | Experts | Public | Experts | Public | Experts |
| Very bad | 45.2 | 38.9 | 44.8 | 39.6 | 50.8 | 49.1 |
| Bad | 12.6 | 16.7 | 17.0 | 26.4 | 19.7 | 21.8 |
| Rather bad | 7.6 | 14.8 | 9.0 | 11.3 | 8.9 | 9.1 |
| Neither good nor bad | 28.6 | 25.9 | 24.8 | 22.6 | 18.9 | 20.0 |
| Rather good | 2.6 | 1.9 | 1.9 | 0.0 | 0.5 | 0.0 |
| Good | 2.6 | 0.0 | 0.7 | 0.0 | 1.0 | 0.0 |
| Very good | 0.7 | 1.9 | 1.7 | 0.0 | 0.2 | 0.0 |

that there were consistent trends in the public to believe in unknown effects in all three domains, and likewise to rate the value of such effects in a consistent manner. Correlations between values and beliefs, however, were lower and less consistent.

Correlations aming risk perception variables and ratings of beliefs in unknown effects are given in Table V. It is seen in Table V that there were fairly strong correlations—approximately 0.4, almost twice as much explained variance as the more common 0.3 level—between risk perception and the beliefs in unknown effects. For experts, these correlations were much lower, a fact that is associated with the smaller standard deviations of risk ratings in the group of experts.

### *2.3.3. Beliefs about Unknown Effects as Explanatory Factors in Risk Perception*

In the introduction it was stated that trust probably is a factor of limited importance in risk perception and related attitudes. It was also suggested that beliefs about unknown effects may be a factor accounting for a sizable additional share of explained variance in risk perception. To test that hypothesis, regression analyses were run with risk perception—personal and general—as dependent variables, and trust dimensions as well as beliefs about unknown effects as explanatory factors. The trust dimensions were

- overall trust in the pertinent authorities,
- trust in the authorities' knowledge about the hazards, and
- trust in the authorities' caring about protecting the public from the hazards.

The explanatory factors were entered in two blocks: first the three trust dimensions and then the ratings of unknown effects, both beliefs and values. The values of $R^2_{adj}$ for the two blocks and the three nuclear hazards are given in Table VI. The table shows that there was a substantial increase in explained variance from adding the two variables of ratings of unknown effects, on the average from 0.123 to 0.202, or almost 65%. Beliefs in unknown effects had the largest weight in the regression equations in five of the six cases, and its β values were statistically significant throughout all analyses. Hence, beliefs in unknown effects emerged as the most important determinant of perceived risk of the nuclear technologies studied, more important than trust, and contributing a sizable amount of explained variance.

## 3. STUDY 2: POLITICIANS AND THE PUBLIC

The results of Study 1 show clearly that specific trust is a more powerful construct than general trust for explaining risk perception and that beliefs in the

**Table IV.** Intercorrelations among Ratings of Unknown Effects, Data from Public

| | NP beliefs | NP value | East beliefs | East value | Waste beliefs | Waste value |
|---|---|---|---|---|---|---|
| NP beliefs | | 0.23 | 0.46** | 0.22 | 0.42** | 0.23 |
| NP value | 0.23 | | −0.01 | 0.55** | 0.31* | 0.58** |
| East beliefs | 0.46** | −0.01 | | 0.14 | 0.46** | 0.09 |
| East value | 0.22 | 0.55** | 0.14 | | 0.22 | 0.60** |
| Waste beliefs | 0.42** | 0.31* | 0.46** | 0.22 | | 0.40** |
| Waste value | 0.23 | 0.58** | 0.09 | 0.60** | 0.40** | |

*Note:* NP = Domestic nuclear power; East = Eastern European nuclear power; Waste = nuclear waste repository. * $p < 0.05$; ** $p < 0.01$.

**Table V.** Correlations between Risk Ratings and Ratings of Beliefs in Unknown Effects

| | Personal risks | | | General risks | | |
|---|---|---|---|---|---|---|
| | NP | East | Waste | NP | East | Waste |
| NP beliefs | 0.42** | 0.24** | 0.41** | 0.47** | 0.28** | 0.44** |
| NP value | −0.18** | −0.17** | −0.18** | −0.18** | −0.17** | −0.21** |
| East beliefs | 0.24** | 0.31** | 0.23** | 0.24** | 0.32** | 0.24** |
| East value | −0.13** | −0.11* | −0.13* | −0.12* | −0.16** | −0.17** |
| Waste beliefs | 0.36** | 0.28** | 0.39** | 0.42** | 0.31** | 0.38** |
| Waste value | −0.18** | −0.17** | −0.17** | −0.15** | −0.16** | −0.20** |

*Note:* NP = Domestic nuclear power; East = Eastern European nuclear power; Waste = nuclear waste repository. * $p < 0.05$; ** $p < 0.01$.

existence of unknown factors seem to play an important role, beyond the effects of trust on risk perception. Study 1 included a group of topical experts. A group with an important role in societal risk management is that of politicians who specialize in health and the environment. In Study 2, the design is extended to include politicians.

## 3.1. Method

### *3.1.1. Samples*

A random sample, $N = 1{,}000$, of the Swedish population aged 18–74 was approached with a mailed questionnaire. At the same time, all members and their deputies of Health and Environment boards (HEBs) of 27 municipalities received the same questionnaire. There were 15–20 persons in each municipality approached in this manner, for a total of 550. The 27 communities were selected on the following basis:

- the four largest cities (Stockholm, Göteborg, Malmö, and Uppsala)
- a few especially interesting communities where siting a nuclear waste repository was contemplated (Malå, Storuman; these are very small communities)
- a wide sampling covering Sweden geographically and in terms of size of the community

**Table VI.** Values of $R^2_{adj}$ for Regression Analyses Using Three Trust Dimensions and with the Addition of Ratings of Unkown Effects (Beliefs and Values)

| Risk type | Block 1, trust dimensions only | Block 1 + block 2, unknown effects added |
|---|---|---|
| Personal Risk | | |
| Domestic nuclear power | 0.142 | 0.238 |
| Eastern European nuclear power | 0.035 | 0.096 |
| Nuclear waste repository | 0.145 | 0.210 |
| General risk | | |
| Domestic nuclear power | 0.192 | 0.302 |
| Eastern European nuclear power | 0.025 | 0.110 |
| Nuclear waste repository | 0.196 | 0.256 |
| Mean | 0.123 | 0.202 |

### *3.1.2. Questionnaire*

The questionnaire was quite extensive, consisting of 31 pages (see Sjöberg[30] for a full description). Used in the present article are

- ratings of risk,
- ratings of demand for risk mitigation,
- trust in the competence of risk managers,
- trust in the risk assessment made by risk managers, and
- ratings of unknown effects of nuclear power and nuclear waste.

### *3.1.3. Respondents*

Respondents were deleted if they stated they were not the person initially addressed, or if they were not Swedish citizens. They were also deleted from the public sample if they stated they were members of the local HEB. (A clean sample of nonpoliticians was needed to compare with the politicians.) The net response rate in the public was 53.2%; among the politicians, 63.0%.

Comparing the respondents from the public sample with national data, it was found that they were quite close in terms of demographics. On the other hand, the politicians diverged. They were dom-

**Table VII.** Ratings of Likelihood of Effects That Are Today Unknown (Percent of Respondents)

| | Domestic nuclear power | | Nuclear waste repository | |
|---|---|---|---|---|
| Likelihood | Public | Politicians | Public | Politicians |
| Very unlikely | 3.7 | 2.4 | 3.8 | 4.3 |
| Unlikely | 5.6 | 6.7 | 6.7 | 10.5 |
| Rather unlikely | 5.7 | 6.1 | 7.1 | 8.0 |
| Neither unlikely nor likely | 17.0 | 20.8 | 16.2 | 16.4 |
| Rather likely | 26.4 | 22.0 | 16.8 | 20.4 |
| Likely | 16.6 | 17.4 | 18.7 | 14.6 |
| Very likely | 24.9 | 24.5 | 30.7 | 25.7 |

**Table VIII.** Ratings of Value of Effects That Are Today Unknown (Percent of the Respondents)

| | Domestic nuclear power | | Nuclear waste repository | |
|---|---|---|---|---|
| Likelihood | Public | Experts | Public | Experts |
| Very bad | 62.3 | 67.1 | 64.9 | 64.3 |
| Bad | 15.6 | 11.1 | 14.2 | 15.3 |
| Rather bad | 4.8 | 5.4 | 5.3 | 5.1 |
| Neither good nor bad | 12.2 | 13.0 | 12.1 | 12.7 |
| Rather good | 0.8 | 1.3 | 0.6 | 0.6 |
| Good | 2.5 | 1.3 | 1.4 | 1.0 |
| Very good | 1.9 | 0.9 | 1.6 | 1.0 |

inated by highly educated males—65.4% males as compared to 48.6% in the public sample (49.5% in the national population), about 40% university educated as compared to 19% in the national population. The mean age of the national population was 41.3 years; in the sample of respondents from the public 44.7 years, politicians 46.7 years.

The sample from the general public resembled national data in almost all respects quite well (see Sjöberg[30] for details). One exception is civil status: there were too few singles among the respondents. On the other hand, the national data appear to be questionable in this respect in that reports to the authorities about such a matter can have undesired tax consequences, rental leases can be challenged, and so forth. A quota sample of the population could hardly have done a better job in approximating the nation than the present sample of respondents.

### 3.2. Results

Table VII gives the distributions of ratings of unknown effects. The politicians and the public had similar views about the possibility of unknown effects of the two nuclear hazards. Value distributions are given in Table VIII.

These data resemble those in Study 1. Both groups saw the unknown effects as likely and potentially quite negative. To proceed to regression analysis, two indices measuring trust were formed. Nine items were available for ratings of competence of various groups and authorities; eight were pooled to an index with a coefficient $\alpha$ of 0.81. These eight items showed strong and consistent positive intercorrelations. One item measuring trust in "deviating" experts who had denounced nuclear power was retained as a separate predictor variable. Similar analyses were made for the eight items measuring trust in the risk assessment published by various groups and authorities. The $\alpha$ value for seven of these was 0.82. They were strongly and positively intercorrelated. The "deviant" experts were retained as a separate predictor variable.

The trust variables were entered in Block 1, and the two variables pertaining to beliefs and values of unknown effects were entered in Block 2. See Table IX for the values of $R^2_{adj}$ in the public sample. The improvement from adding beliefs about unknown effects was, on the average, 27%. For the politicians, the corresponding results can be seen in Table X. The average improvement here was 42%. The beta weights of the variable measuring beliefs in unknown effects (likelihood) was largest in six of the eight analyses, and at all times statistically significant. For the politicians, it was largest in all four analyses, for the public in two out of four.

## 4. DISCUSSION

The present results agree well with previous work in two aspects. First, specific trust was more powerful than general trust in accounting for risk perception and related variables. Second, the level of explanation that trust measures achieved was weak to moderate, leaving, in fact, most of the variance of risk perception unexplained. It is interesting to note that trust in "deviant" experts constituted a second trust factor. Further research on trust might profit from extending the analysis to different groups, some of which may not at all agree with others in their risk assessment. Trust may be important, but may refer to those deviating sources rather than the official risk managers.

The introduction of data on beliefs about unknown effects of the technologies under study added a

**Table IX.** Values of $R^2_{adj}$ for Regression Analyses Using Four Trust Variables and with the Addition of Ratings of Unknown Effects (Beliefs and Values) for the Public Sample

| Dependent variable | Hazard | Block 1, trust dimensions only | Block 1 + block 2, unknown effects added |
|---|---|---|---|
| Risk | Domestic nuclear power | 0.217 | 0.239 |
| | Nuclear waste repository | 0.195 | 0.245 |
| Demand for risk mitigation | Domestic nuclear power | 0.119 | 0.167 |
| | Nuclear waste repository | 0.120 | 0.175 |
| Mean | | 0.163 | 0.207 |

substantial amount of explained variance, on the average an increase of about 40–50%. In addition, in most analyses the most important predictor of perceived risk turned out to be beliefs about the likelihood that there might be effects that are as yet unknown.

It is interesting to see that such beliefs were very common among nonexperts, including politicians specializing in health and environmental issues. In addition, such effects were usually believed to be quite negative. On the other hand, experts rarely agreed that there could be effects not yet known, although they, too, believed that such effects would be negative.

The expert or authority wishing to communicate a reassuring message may find it hard to establish full credibility because of the prevalence of judgments in the public about the limits of scientific knowledge. Members of the public judge that the expert does not know all there may be to the hazard. Such judgments are not always entirely unreasonable or merely uninformed since science never really can claim to have the final answer to anything. Hence, science cannot claim to have the final answer to risk questions. The expert can only appeal to a "reasonable" assessment that there is nothing speaking strongly in favor of risk factors not having been taken fully into account. How reasonable is such a judgment? How can one communicate it and be believed?

History gives examples where experts have had to retract a previous reassuring message: Chernobyl had such aspects, and so had the case of BSE. The assessment of the risks of ionizing radiation have changed over time since World War II, and are now believed by experts to be larger than was believed by experts 50 years ago.[31] There seem to be relatively few examples of the opposite trend. Perhaps it is in the logic of the issue that if things change, they get worse. This is because risks tend to be routinely denied or ignored unless or until they have been proven to exist. This may be a necessary risk management strategy, but it still exposes the risk managers to the danger of being caught later as having been negligent of a risk that turned out in fact to exist.

Can risk communication counteract the beliefs that there are unknown effects? Should it? How does one persuade a skeptical audience that research and theory together are so complete that they can reasonably exclude the suspicion that important aspects have perhaps not yet been covered? Or, how can people be expected to accept a risk in the face of uncertainty about its size? It would be interesting to study in more detail how beliefs about the limits of scientific and technological knowledge are established and what the detailed contents of such beliefs are. No matter what the practical implications of such re-

**Table X.** Values of $R^2_{adj}$ for Regression Analyses Using Four Trust Variables and with the Addition of Ratings of Unknown Effects (Beliefs and Values) for the Politicians Sample

| Dependent variable | Hazard | Block 1, trust dimensions only | Block 1 + block 2, unknown effects added |
|---|---|---|---|
| Risk | Domestic nuclear power | 0.256 | 0.350 |
| | Nuclear waste repository | 0.258 | 0.361 |
| Demand for risk mitigation | Domestic nuclear power | 0.140 | 0.200 |
| | Nuclear waste repository | 0.136 | 0.216 |
| Mean | | 0.198 | 0.282 |

search would be, it is an important topic to pursue since these beliefs appear to play such an important role in risk perception and related dimensions.

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