Risk perception of heavy metal soil contamination by high-exposed and low-exposed inhabitants

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September 2003
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Abstract

Soil contaminated with heavy metals is a salient example of environmental risk. Consuming vegetables cultivated on contaminated soil or direct ingestion of soil by small children can cause health damage. In contrast to other kinds of pollution or risks such as air pollution or exposure to ozone, the individual risk concerning soil contamination is highly dependent on the way one is exposed to the local source of risk. An experimental study was conducted in the community of Dornach in the North West of Switzerland. The main contaminant posing a threat to human health is cadmium. The level of contamination varies mostly in dependency on the distance to the source of the contamination, i.e., a metal factory. A quasi-experimental and questionnaire-based study investigated the perception of risk of heavy metal contaminated soil by high-exposed \((N = 27)\) and low-exposed \((N = 30)\) people living in Dornach. Both groups judge the risk for oneself similarly whereas low-exposed people perceive the risk for other people living in Dornach higher than the high-exposed group. Besides this exposure effect, risk perception is mainly determined by emotional concerns. The extent of the knowledge about the risk had no influence, but the self-estimated knowledge did. On the other hand, judgments on the need for decontamination are determined by the risk perception, less application of the dissonance heuristics, and commitment to sustainability. The desire for additional information is not affected by missing knowledge but is affected by emotional concern.

Keywords: Risk perception, environmental risk, heavy metal contamination, emotional concerns

1 Introduction

The present study is part of a large project that was conducted in the Swiss Priority Program Environment (see Häberli, Gessler, Grossenbacher-Mansuy, & Lehmann Pollheimer, 2002). The project we are referring to is a case study in a community, where the inhabitants have to deal with the risk of heavy-metal contaminated soil (Hesske et al., 1998, Tietje et al., 2002). This social science part of the case study investigated the inhabitants risk perception of the soil contamination. We present a quasi experiment, i.e. a questionnaire study run with inhabitants who were differently exposed. The goal of this project was to gain a better understanding of the processes underlying risk perception and risk acceptance of exposed people. We firstly present a brief description of the case, which presents the context of the study, and then introduce the specific questions on risk perception that are dealt with in the quasi-experimental study.
1.1 The case

The problem of heavy metal contaminated soil exists at many industrial sites all over the world (Paustenbach, 2002). One example of such a contaminated site in Switzerland is the community of Dornach, which is situated near Basel in northeast Switzerland and has about 6,000 inhabitants. In Dornach, the soil is widely contaminated with heavy metals (see Schnabel, Scholz, & Tietje, in press). The primary cause for the contamination is a metal processing plant. This plant has been producing since 1895. The installation of modern filtering systems in the early 90’s inhibits a further increase of contamination. Therefore, the soil contamination in Dornach represents refuse dumps (Hesske et al., 1998, 2003).

According to the prevailing west winds in Dornach, the eastern part of the locality up to a distance of 1.2 km is partly contaminated over the legal threshold value (Wirz & Winistörfer, 1987; Schnabel & Tietje, in press). The soil is contaminated especially with cadmium, zinc and copper. Particularly, cadmium has some risk potential. In Dornach, the health risk is not great because of the medium till moderate concentrations and because of a small soluble fraction of cadmium in the soil. Thus, acute intoxication can be excluded. However, since the total content of cadmium is relatively high, a health risk cannot be excluded with long-term exposure (Scholz, May, Nothbaum, Hefer, & Lühr, 1992). Chronic cadmium poisonings can result in kidney malfunctions and cancer.

There are different paths in how the pollutants can arrive within the human organism (Geiger & Schulin, 1995). Of interest are (1) soil ingestion by infants, as they sometimes swallow larger amounts of soil material while they are playing on the soil and (2) consumption of vegetables, which were cultivated on local contaminated soil. Particularly, the consumption of tuber plants like celery should be avoided, since these types of plants accumulate a notable amount of heavy metals from the soil, and (3) consumption of the meat of animals, which grazed in the contaminated area.

However, consequences are uncertain, and if they arise, they arise with a large temporal delay. Experts cannot tell whether, and if so, to what extent, a healthy risk has to be considered in this concrete case of Dornach. But even if the risk of contaminated soil in Dornach is hypothetical, it is certainly not a zero risk. Moreover, the heavy metals will not disappear that soon. Without decontamination, the problem of contaminated soil will be bequest to up-coming generations.
1.2 Risk perception

The risk assessment of experts is one part of the truth. The perception of concerned people is the other part. This can be considered a consequence of the discourse on risk communication (e.g. Covello & Allen, 1988, Wiedemann, 1993, Renn & Zwick, 1997). In contrast to other kinds of environmental risks such as air pollution or exposure to the ozone hole, the individual risk of soil contamination in the Dornach case is highly dependent on how a person is exposed (or not) to the local risk source. Thereby, the level of contamination varies mostly in dependency of the distance to the metal factory.

Slovic et al. (1980) already included personal exposure as a determinant of risk perception. Exposure had a positive impact on perceived risk and it was part of his first factor, dread, in the early studies of Slovic et al. In a study of Slovic, Fischhoff, and Lichtenstein (1985), personal exposure and the number of exposed people constituted an own third factor. Marks and Winterfeldt (1984) named the positive correlation of personal exposure and risk perception as the not-in-my-backyard phenomena. But these studies and results were not based on real life situations. How do real exposed people perceive the risk? A critical matter, certainly, is how long the people are exposed and how they reacted when they became aware of the exposure. If, for instance, people live on contaminated soil for years and they did not (want to) change their residence, we assume that dissonance-reduction (Festinger, 1957; Plous, 1993; Simon et al., 1995), by increasing the acceptance of the risk, is at work.

In a previous questionnaire-based study (Weber, Scholz, Bühlmann, & Grasmück, 2001), we compared 40 inhabitants of Dornach with 40 people living in comparable, but not contaminated, communities. The exposed people knew and accepted that there was a contamination problem in the area, but the risk itself, or the risk in general, was perceived lower by exposed than by non-exposed people. In the study by Weber et al., a person on the project staff was present when the people filled out the questionnaire. After they had filled them out, we collected some additional qualitative information and identified some variables, which seemed to be relevant for the risk perception, such as (1) exposure differences at Dornach itself, and individual differences in (2) the knowledge, (3) the emotional concern, and (4) the use of heuristics. The relationship between exposure and risk perception was not really clear. We suspected that people who were living in proximity of the metal factory, and were thus exposed most, rated the risk similar or even lower than people who were living some distance from the plant in an only marginally contaminated area. Contrary to the previous study, which investigated exposed versus non-exposed people from different communities, this study compares minimally exposed and highly exposed people of the same community.

In a series of studies (Scholz & Weber, 2001; Weber et. al. 2002), we observed a large variance in the knowledge people had of the contamination problem. In the Dornach case information was provided in newspaper articles, through a newsletter by the council of Dornach, and in an informational meeting, all of which were organized by the community council. Although information was available easily and for everyone in the same way, people differed considera-
bly in the knowledge about the soil contamination problem. Some people were very well in-
formed; they knew, for example, which heavy metals were included, by which paths health
damage could be caused, or which vegetables they should avoid growing in the contaminated
gardens and subsequently eat. Other people were missing some information or even had
wrong ideas about the risk. They pretended, for example, that the main problem of the soil con-
tamination is the bad quality of the ground water. Nevertheless, the self-estimated knowledge
and the desire for further information seemed to vary independently of the actual knowledge
people had. In addition, we could not realize any influence of the knowledge on risk perception.
This is in correspondence with other studies (Baird, 1986), which showed that it’s not the actual
knowledge, but rather the self-estimated knowledge that has an important influence on risk perception.

The extent to which people were emotionally involved in the case seemed to play an im-
portant role as well in the way they perceived the risk and did their judgments. Whereas some
people were really emotionally involved and concerned about the situation, other people did
not show any concern, and did not pay very much attention to the situation. Emotionally in-
volved people rated the risk higher than less emotionally involved people did. The importance
of considering an emotional component in risk judgments was already pointed out by other
& Wiedemann, 1998, Borcherding et al. (1986), Baron et al. (2000), Rundmo (2002), Sjöberg
(1998), and MacGregor (1991). In brief, the main results of these studies were that worry in-
creases the perceived risk. The conceptualization of the emotional influence often stays vague.

During the five-year project in Dornach, we met a lot of people who argued based on
simple heuristics, which – from an environmental science perspective – seemed to be rather
weak arguments. They sounded logical, but usually did not contain scientific reasoning. Some
people mentioned that there was an inhabitant in Dornach, who lived close to the plant, ate
vegetables from their own garden, was always very healthy, and died very old. The more fre-
quent appearance of snails on the site was another argument people used to argue that the
risk of heavy-metal contaminated soil in Dornach couldn’t be so bad. These are only two exam-
pies of such heuristics with which we were confronted. The function or the goal of these heu-
ristics could be a reduction of cognitive dissonance (Festinger, 1957; Plous, 1993; Simon et al.,
1995). Probably, the thoughts that people have in mind are along the following line: A risk exists
at the place where I live – either I change my domicile or the risk is not that bad. As far as we
know, no people moved away due to the soil contamination. Thus, we called these arguments
dissonance-reducing heuristics.

To get a better understanding of these described processes we constructed a question-
naire, which included the relevant variables. In the previous study (Weber et al., 2002), we de-
scribed the risk of soil contamination with certain characteristics taken from factor analysis
(Slovic, 1987) and compared it to other sources of risk. In the present study we try to understand
and inquire about the underlying individual processes. Beside the already mentioned variables,
the questionnaire included questions on sustainability as Weber et al. (2001) found that a
commitment towards sustainability seems to be essential with respect to votes towards soil cleanup measures. Furthermore, we wanted to improve the understanding of differences in coping with risk between high-exposed with low-exposed people.

According to the above-mentioned argumentation and theoretical considerations, the following research questions can be formulated. (1) What influence does exposure have on the risk perception of heavy metal contaminated soil and on the need for decontamination? (2) What influence does emotional concerns have on the risk perception of heavy metal contaminated soil and on the need for decontamination? (3) In how far are exposure and emotional concern related to each other? Which role do the knowledge components like (4) actual knowledge, (5) self-estimated knowledge, and (6) desire for additional information play? In which way do (7) dissonance-reducing heuristics and (8) thoughts about sustainability affect the risk judgments?
2 Method

A quasi-experimental study investigates the perception of risk of heavy metal contaminated soil by high-exposed ($N = 27$) and low-exposed ($N = 30$) people living in Dornach. We constructed a standardized questionnaire, whose questions had to be answered on an 8-point scale. Partly, we included multiple-choice questions, yes/no choices, and questions with open response possibilities (e.g., with knowledge questions). Two groups of exposure were specified on the basis of a contamination map of cadmium (see Schnabel and Tietje, in press). The people of the high-exposed group were living in close proximity of the metal factory, and the people of the low exposed group were living some distance away, where the soil was only marginally contaminated.

The emotional concern, thus, in how much a person is concerned about the situation and feels emotionally involved, was assessed by two questions ($r = .76$). The knowledge on soil contamination was divided into three facets: actual knowledge, self-estimated knowledge, and desire for further information. The actual knowledge was acquired with two multiple-choice questions and a third question with a open response possibility. Participants could achieve a minimal score of 0 and a maximal score of 14 points. For example, we asked which paths for human absorption are the most relevant ones. The self-estimated knowledge consisted of two items (“Do you feel well informed about the problem?” and “How do you estimate your knowledge in comparison to other inhabitants of your community?”), which correlated with $r = .68$. The desire for additional information was asked by a single question. The construct of dissonance-reducing heuristics consisted of 6 items ($Cronbach Alpha = .78$). These heuristics we sampled during the previous study in Dornach (see above). Thoughts about sustainability and the precautionary principle were asked with three items (e.g., “Do you think about future generations with respect to soil contamination in Dornach?”; $Cronbach Alpha = .75$).

The dependent variable risk perception or perceived risk magnitude was split into the risk for oneself and the risk for other inhabitants of Dornach with one item each. A third dependent variable was the need for decontamination, again one item.
3 Findings

3.1 Participants

The investigation included 57 residents (33 male and 24 female) of Dornach. Depending on the level of contamination at their place of residence, participants were divided into either a low-exposed or high-exposed group. The classification was made based on a cadmium contamination map. As the cadmium load decreases with the distance from the metal factory and as people were strongly informed about this, people should know the differential degree of objective exposure.

The average age of the participants was $M = 50.5$ ($min = 18, max = 80$). 45% (78.9%) of the residents questioned had children. The average time spent in the contaminated village was $M = 26.8$ years ($SD = 20.9$ years). 55 (96.5%) of the participants owned a garden and 40 (70.2%) consumed fruit or vegetables from their own garden or from local producers. There were no significant statistical differences in these data between the high-exposed and the low-exposed group.

3.2 Procedure

The investigation took place in Dornach. Only people who were living in houses with gardens were included. The participants filled out a questionnaire, with one person on the project staff present to help in case of questions. After filling out the questionnaire, the participants got a small box of chocolates for their efforts.
4 Results

We analyzed the variables perception of risk for oneself and risk to other persons in dependency on exposure and emotional concern by an ANOVA with repeated measurement (see Table 1). Emotional concern was categorized into three groups: high, medium, and low concern by people. Exposure did not have a direct influence on the risk judgment ($F = .01, p = .92$). In contrast, emotional concern had a direct influence ($F = 15.9, p < .001$). People also distinguished between risk for oneself and risk for others ($F = 30.8, p < .001$). The risk for others was generally rated higher than the risk for oneself ($M_{\text{risk for oneself}} = 3.8, M_{\text{risk for others}} = 5.1$). Emotional concern did not interact significantly with either exposure ($F = .721, p = .49$) or with the risk judgment ($F = 1.3, p = .27$). There is an interaction between exposure and risk ($F = 7.3, p < .01$). Whereas the low-exposed group perceives the risk for other people higher than the high-exposed group as expected, the high-exposed group did not rate the risk for oneself higher than the low-exposed group (see Figure 1). Both groups perceived the risk for oneself similarly. No gender effects were found.

<table>
<thead>
<tr>
<th>Source</th>
<th>Df</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure</td>
<td>1</td>
<td>.01</td>
<td>.921</td>
</tr>
<tr>
<td>Emotional Concern</td>
<td>2</td>
<td>15.9</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Risk (risk for oneself vs. risk for others)</td>
<td>1</td>
<td>30.8</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Exposure* Emotional Concern</td>
<td>2</td>
<td>.721</td>
<td>.491</td>
</tr>
<tr>
<td>Exposure* Risk</td>
<td>1</td>
<td>7.3</td>
<td>.009</td>
</tr>
<tr>
<td>Emotional Concern* Risk</td>
<td>2</td>
<td>1.3</td>
<td>.273</td>
</tr>
<tr>
<td>Exposure* Emotional Concern* Risk</td>
<td>2</td>
<td>.44</td>
<td>.648</td>
</tr>
</tbody>
</table>

Table 1: ANOVA table with repeated measurement with exposure and emotional concern as independent variables and the perceived risk as repeated measurement (N_{high-exposed} = 27, N_{low-exposed} = 30)

Figure 1: Mean risk judgments for oneself and for other persons of low-exposed and high-exposed people. Both groups rated their own personal risk at the place of their residence similarly, whereas low-exposed people perceived the risk for other people living in Dornach higher than high-exposed people.
In correspondence with the analysis of variance, emotional concern was a direct influence on risk perception (see Table 1), but it did not depend significantly on the exposure group ($M_{\text{high-exposed}} = 3.7$, $M_{\text{low-exposed}} = 4.6$) or interact significantly with the different risk statements. However, using a point-biserial correlation analysis exposure correlates significantly with emotional concern ($r = .27, p < .05$). Tests for exposure and other variables were not significant.

Table 2: Correlation Matrix (N = 57): Correlation with ** is significant at the 0.01 level (2-tailed). Correlation with * is significant at the 0.05 level (2-tailed).

<table>
<thead>
<tr>
<th></th>
<th>Emotional concern</th>
<th>Heuristics</th>
<th>Precaution</th>
<th>Knowledge</th>
<th>Self-estimated knowledge</th>
<th>Desire for information</th>
<th>Risk for oneself</th>
<th>Risk for others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotional concern</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heuristics</td>
<td>-.37**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precaution</td>
<td>.38**</td>
<td>-.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge</td>
<td>-.16</td>
<td>.11</td>
<td>-.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-estimated</td>
<td>-.31*</td>
<td>.43**</td>
<td>-.20</td>
<td>.36**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desire for</td>
<td>-.34*</td>
<td>-.28*</td>
<td>-.34**</td>
<td>-.11</td>
<td>-.35**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk for oneself</td>
<td>.63**</td>
<td>-.21</td>
<td>.22</td>
<td>-.14</td>
<td>-.33*</td>
<td>.45**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk for others</td>
<td>.56**</td>
<td>-.34**</td>
<td>-.33*</td>
<td>-.03</td>
<td>-.36**</td>
<td>.37**</td>
<td>.68**</td>
<td></td>
</tr>
<tr>
<td>Need for decontamination</td>
<td>.51**</td>
<td>-.57**</td>
<td>.52**</td>
<td>-.09</td>
<td>-.42**</td>
<td>.51**</td>
<td>.38**</td>
<td>.51**</td>
</tr>
</tbody>
</table>

Table 2 shows the correlation between the different variables. Emotional concern correlates positively with desire for additional information ($r = .34, p < .05$), with thoughts about sustainability ($r = .38, p < .05$), with risk for oneself ($r = .62, p < .01$) as well as risk for others ($r = .56, p < .01$), and with need for decontamination ($r = .51, p < .01$). It correlates negatively with dissonance-reducing heuristics ($r = -.37, p < .05$). Thus, emotional concern seems to be very central in the process of risk perception.
The knowledge scores varied in the whole range between 0 and 14 (see Figure 2) and are showing a bimodal distribution. There were two notable peaks. Either people are well informed or they are badly informed. The knowledge correlated with self-estimated knowledge ($r = .36$, $p < .01$), but it did not have any other significant relations to other variables (see Table 2). On the other hand, the self estimated knowledge correlated negatively with the perceived risk ($r = -.33$, $p < .01$ and $r = -.38$, $p < .01$), with need of decontamination ($r = -.42$, $p < .01$), and other variables. It correlated positively only with the use of dissonance-reducing heuristics ($r = .43$, $p < .01$). Desire for additional information correlated most with need for decontamination ($r = .51$, $p < .01$) but it also correlated significantly with all the other variables, except knowledge.

Multiple linear regression analysis for the three dependent variables - risk for oneself, risk for others, and need for decontamination - showed the following results: Not significant independent variables were excluded stepwise. Risk perception for oneself is exclusively determined by the emotional concern ($t = 5.9$, $p < .001$). The risk for others as presented in Table 3 is determined by emotional concern ($t = 4.4$, $p < .001$), the self-estimated knowledge ($t = 2.4$, $p < .05$), and by exposure ($t = 2.1$, $p < .05$). With $R^2_{\text{adjusted}} = .39$, only a small part of the variance can be explained by the independent variables. The need for decontamination on the other side (see Table 4) is determined by the risk perceived for oneself ($t = 2.2$, $p < .05$), a lower use of dissonance-reducing heuristics ($t = -5.1$, $p < .001$), and thoughts about sustainability ($t = 4.6$, $p < .001$). With these three predictors, 57% of the variance can be explained.
Table 3: Multiple linear regression model with emotional concern, self-estimated knowledge, and exposure as independent variables and perceived risk for others as the dependent variable; $R^2_{\text{adjusted}} = .388$

<table>
<thead>
<tr>
<th></th>
<th>Standardized Beta</th>
<th>T</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotional concern</td>
<td>.499</td>
<td>4.4</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Self-estimated knowledge</td>
<td>-.274</td>
<td>-2.4</td>
<td>.019</td>
</tr>
<tr>
<td>Exposure</td>
<td>-.235</td>
<td>2.1</td>
<td>.041</td>
</tr>
</tbody>
</table>

Table 4: Multiple linear regression model with risk for others, thoughts about sustainability, and use of dissonance-reducing as independent variables and need for decontamination as the dependent variable; $R^2_{\text{adjusted}} = .573$

<table>
<thead>
<tr>
<th></th>
<th>Standardized Beta</th>
<th>T</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainability</td>
<td>.425</td>
<td>4.6</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Heuristics</td>
<td>-.470</td>
<td>-5.1</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Risk for others</td>
<td>.214</td>
<td>2.2</td>
<td>.034</td>
</tr>
</tbody>
</table>

The control-variables of age and gender did not have any influence on the other variables. The only exception was the duration of living in Dornach, which correlated significantly with the use of dissonance-reducing heuristics ($r = .34, p < .05$) and the need of decontamination ($r = -.46, p < .01$).
5 Discussion

An interesting finding is that the high-exposure group and the low-exposure group do not differ in the risk judgments for themselves, but low-exposed people rated the risk for others higher. This finding obviously indicates that the two exposure groups differ in their risk judgments. Fischhoff, Bostrom, & Jacobs Quadrel (1997) already pointed out that “asking people about risks to other people like themselves is not the same as asking them about their personal risk” (p. 994). The difference of the judgments on others can be best explained by the following argumentation: Those who are in the low-exposure group cognize a group of others who are more exposed, whereas those who live close to the metal factory do not. Nevertheless, this instance is noteworthy because the participants of the study did not know about their group membership, and the distance to the risk source was rather small (less than 2 km). The fact that both exposure groups rated the risk for oneself on the same level could indicate a kind of self-regulation. People could accept a certain upper risk level for oneself. Above this level, people are no longer comfortable. Of course, this level varies individually, but because the two groups were comparable in regard to the socio-demographical variables, they achieved the same average.

As the results show, emotional concern plays a very central role in personal risk perception. This is in line with other studies, which found that emotional components (Harding & Eiser, 1984) and personal concern (Karger & Wiedemann, 1998) are very essential in risk judgments. Emotional concern had an influence on both risk measures and on the judgments on the need for decontamination. As the link between the (objective) level of exposure and the (subjective) emotional concern is rather weak (see also Maderthaner, et al., 1978), the likelihood of emotional concern seems to depend on other intervening variables. Emotional concern correlates positively with thoughts about sustainability, desire for additional information and negatively with self-estimated knowledge and the use of dissonance-reducing heuristics. Emotional concern thus seems to have some linkage with societal responsibility, emotionally concerned people do not overweight them knowledge, and they use less simple (and not reasonable) heuristics. Obviously, these heuristics seem to be a strategy for reducing emotional concern. People who cannot deal with negative emotions like worry or insecurity are more prone to using dissonance-reducing heuristics. Because exposed people cannot escape or reduce the objective risk as long as they live in Dornach, this dissonance is likely to be reduced by a cognitive strategy. Thus, the use of some heuristics in such a situation is in line with the theory of cognitive dissonance (Festinger, 1957; Simon et al., 1995).

The extent of actual knowledge does not show significant effects. But the self-estimated knowledge correlates negatively with the risk judgments. Other authors found this missing link between actual knowledge and risk perception as well (e.g. Baird, 1986). Whereas the negative correlation that we found is in correspondence with some studies (e.g. Slovic et al., 1980), other studies are reporting a positive correlation between effective and self-estimated knowledge (e.g. MacGregor, Slovic & Morgan, 1994). This effect of opposite correlation possibly depends on the type of risk and whether the risk is new or not. If the risk is known, a high self-estimated
knowledge may improve a feeling of control over the risk and reduce the risk perception (Langer, 1975; Mc Daniels et al., 1995; Slovic, 1992). Thus Frewer et al. (1998) found a positive correlation between perceived knowledge and perceived control.

On the other hand, if the risk is new, a high self-estimated knowledge could stand for a better awareness of the risk. This could be explained by the availability heuristic (Kahnemann & Tversky, 1982; Tversky & Kahnemann, 1973). Another explanation would be that the increase of knowledge by being given new information increases subjects’ risk ratings (Scholz & Weber, 2001). The logic or the mechanism behind these differences could be similar to the ones described above with the dissonance-reducing heuristics. The high correlation between the use of dissonance-reducing heuristics and self-estimated knowledge could be a hint that people see these heuristics as a type of knowledge. Moreover, the actual knowledge does not correlate with the desire for additional information. In fact, the desire for additional information is not determined by missing knowledge, but by the self-estimated knowledge and the emotional concern.

The need for decontamination is related to risk perception, particularly to the risk people see for others, thoughts about sustainability, and negatively with dissonance-reducing heuristics. The need for decontamination can be understood as a kind of risk acceptance or willingness to act. The correlation to risk perception is quite high. This influence of risk perception on peoples’ desire for risk reduction is empirically validated by many studies (e.g., Borcherding et al., 1986; Burns et al. 1993; Fischhoff et al, 1978), but is sometimes also doubted and critically discussed (see Sjöberg, 1999; Slovic, 1999; Weinstein & Nicolich, 1993). From an environmental risk management point of view, it is interesting that people who are including thoughts about sustainability and precaution issues in their judgments have a stronger need for decontamination. This influence of thoughts about sustainability is in line with our previous study (Weber et al., 2001) and the findings of other authors (Karger & Wiedemann, 1998; McDaniels, Axelrod & Slovic, 1995). On the other hand, the use of dissonance-reducing heuristics decreases the need for decontamination. The influence of dissonance-reducing heuristics on the need to do something about the risk has to be considered in the context of risk communication or prevention of risk-taking behavior. Dissonance-reducing heuristics may make people ‘cognitively immune’ for risk reducing arguments. Of course, the need for decontamination correlates with emotional concern as well. But in the regression analysis, emotional concern was not a significant predictor. Its influence seems to be rather moderated by the risk perception.

The present study is a good example of combining environmental case study with basic psychological research using a quasi-experimental design. In contrast to rather descriptive and static approaches such as the psychometric paradigm (Slovic, 1987, 1993), we focused on the process of individual risk perception. We were able to identify some important variables. The correlation we found between our variables and the risk measurements are in accordance with other studies and in so far is not a new finding. However, our study investigates the integration of these variables to observe the relative importance of each variable and their interaction. As
we did that in a real-world case study, this suggests that the results could have a high ecological validity (Scholz, R.W. & Tietje, O., 2002).

The effect of exposure or how people deal with being exposed seems to be a complex topic. Based on the findings of our study, dissonance-reducing heuristics seem to be an important issue in risk communication. Furthermore, a dissemination of information on the risk is no guarantee that the perceived risk will be judged appropriately. In this context, we consider the emotional impact as very central for risk perception. We further think that emotional concern will go beyond a simple affect heuristic (Finucane et al., 2000). We thus suggest that the emotional concern and its relation to risk perception and risk management, in particular to the willingness to act or to support soil remediation programs, should be stressed in future research.
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