Mobile fears? - Risk perceptions regarding RF EMF

Peter Wiedemann & Holger Schütz, Andrea Thalmann, and Markus Grutsch
Programme Group Human, Environment and Technology
Research Centre Juelich
D52425 Juelich
Germany
E-mail P.Wiedemann@fz-juelich.de

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Introduction

Electromagnetic fields (EMF) have been a hot issue in nearly all western societies since about thirty years. In the late seventies power lines became a risk topic in the United States, triggered by the studies conduced by Wertheimer and Leeper (1979). A decade later, in the eighties, microwave emission raised public interest. Nowadays, many citizens are concerned that cellular phones and base stations might adversely impact their health (Burgess 2004).

Science has tried to address these concerns by conducting risk assessments and recommending exposure limits. Nearly all risk assessments agree that there is no scientific proof of health risks below the exposure limits. However, the reports show disagreements with regard to the extent and the relevance of uncertainties in the scientific knowledge about this issue, and in particular they disagree whether precautionary measures should be implemented or not. Thus, science is not able to give a conclusive answer.

Besides the scientific controversy, the EMF issue is debated in many other arenas, i.e. in local hearing, parliaments, newspapers, TV magazines and even talk shows. In Germany, the intensive public interest in EMF was mainly triggered by the extensive media reporting on the auction of the UMTS-frequencies and the growing number – at the same time – of citizen's groups against base stations. Even in 2005, mass media coverage of the issue is still elevated and the political controversy has stabilized at high level.

Research Background

In the past, research on EMF risk perception was mainly concerned with low frequency EMF, e.g. high-voltage power lines (e.g. Slovic, Flynn, Mertz, Poumadere & Mays 2000; MacGregor et al. 1994). Currently, studies including EMF as a risk source are more often to be put on their “risk perception list”, because since early nineties the mobile telecommunication technology has been widely implemented in Europe.
Recent risk perception studies more often focus on high frequency EMF, e.g. the surveys conducted in Germany (Wiedemann, Bobis-Seidenschwanz & Schütz 1994, Schütz & Wiedemann 1998, Schroeder 2002, Zwick & Renn 2002, Büllingen et al. 2002, INFAS 2003), in Switzerland (Siegrist, Earle & Gutscher 2003, Scholz & Grasmück 2004), or Japan (Yaguchi, Nobutomo, Shingu & Miyakoshi 2000).

For instance, in the study conducted by Büllingen et al. (2002) respondents rated mobile telecommunication as a relatively modest health risk, compared to asbestos, nuclear power and road traffic, which received the highest rankings. Only TV-broadcasting stations got a lower rank. Siegrist et al. (2003) carried out a survey in Switzerland recording the perception of different EMF-related topics in terms of risk and benefit. The results show that power lines were rated to be the most risky source. Mobile phone and base stations were rated lower. In a representative survey in Germany (Schroeder 2002) smoking was rated as the highest risk in Germany, whereas mobile phones ranked on a low position compared to the other topics (cordless phone [DECT], electronic devices and radio/TV). Interestingly, base stations were rated higher than the mobile phones. Yaguchi et al. (2000), in a study with 186 undergraduate students, reported similar findings in Japan: mobile telecommunication takes a low position compared to other EMF topics (such as domestic appliances and power lines). Again,

power lines were rated as the highest EMF threat. Comparing the results of a risk perception study which included a sample (n = 140) from Poland, similar findings can be observed (Grutsch & Thalmann 2004).

Unfortunately, there is no Euro Barometer study available that addresses EMF risk perceptions in detail. Thus, we do not know whether the several European publics appraise the EMF risks differently.

Research Questions

Our interests are threefold: (1) to compare how Europeans perceive EMF risks, (2) to contribute to an understanding of the dynamics as well as resistance to persuasion of EMF risk perceptions and (3) to investigate group differences in perception of EMF risks. The main research questions are the following:

- How do different European publics perceive RF EMF risks?
- Is it possible to distinguish between different EMF-risk perception groups?
- How convincing are various warning and reassuring arguments in the debate on mobile phone technologies?
- Will new “risk information” based on science and/or personal experiences alter EMF-risk risk perceptions?

In the past – due to the dominance of the psychometric paradigm in risk perception research – variability among individuals was mostly ignored in favor of the construction of mental hazard maps reflecting the risk perception of an “averaged” person (Barnett & Breakwell 2001). So far it has not adequately considered how and why individuals differ in their judgments of risk (Sjöberg et al. 2004). However, risk communication has to be tailored to real people, therefore individual differences should be taken into account. It is important to focus on those differences among cultures, nations, groups, and individuals (Myers et al. 1997).

Inter-group differences in risk perceptions are one of the key issues. From a practical point of view it is essential to know, whether we can cluster individuals with respect to risk perceptions into groups, and whether those groups remain consistent across different kinds of risk. Assuming that risk judgments are based on a person’s beliefs, we expect that people differ in EMF risk perception based on their prior beliefs and attitudes towards the topic (see Bromiley & Curley 1992).

Research indicates that "bad" news have a larger effect than "good" news. Specially, it has been demonstrated that "negative" messages suggesting the presence of risk are trusted more and have a greater impact upon risk perceptions than "positive" messages suggesting the absence of risk (see Baumeister et al. 2001, Siegrist & Cvetkovich 2001, Poortinga & Pidgeon 2004). Following this line of research we collected risk arguments used in the German debate on mobile telephony, i.e. warning arguments expressing concerns about EMF risk, and risk-mitigating arguments indicating that EMF cause no risks. Our aim was to explore how convincing these pro- and con-arguments are. In addition, we asked whether prior attitudes towards EMF have an impact on how people evaluate these arguments.

In a pure rational world, new facts – e.g. new scientific data – should change risk perceptions provided that this information is viewed as reliable and valid. However, social psychology research indicates that prior attitudes and beliefs introduce biases in the

processing of new information. For instance, people rate the evidence that is consistent with their position as more convincing than the information that challenges their positions (see Lord et al. 1979, Kunda 1990). Therefore, we assume that the impact of new facts on risk perceptions also depends on prior risk related attitudes.

Method

We conducted in summer 2002 in Tyrol, Austria, a survey (N= 151) in order to explore the EMF risk perceptions. The EMF topic was thematically divided into two items: mobile phones and base stations. The study used questionnaires administered in face-to-face situation. The questionnaire aimed at:

- Beliefs about mobile phone related risk-issues
- Involvement and engagement in the debate on mobile phones
- Risk perceptions
- Appraisal of arguments used in the public debate on mobile phones
- Credibility of various actors
- Knowledge about mobile phone issues
- Impact of new developments in risk appraisals
- Personal traits: risk attitude and trust/distrust
- Use of mobile phones / living in the vicinity of base stations

This study was replicated in 2003 Poland and Luxembourg. In 2004 the study was also conducted in Switzerland. Further information about the different national sample is given in Table 1.

Subjects were recruited from the western part of Austria (Innsbruck and the surroundings/Tyrol), the south-east of Poland (Krakow and surroundings), the Swiss German-speaking part of Canton and Fribourg and surroundings, and Luxembourg. With the exception of 102 subjects (part of the Austrian sample), all subjects answered the questionnaire in a in a class-room setting; the Austrian subsample was interviewed at their homes. The German version of the questionnaire was translated in Polish and was retranslated to German to check the accuracy of the translation.

Table 1: Samples characteristics

Nation (acroynm)	N	Age		Sex distribution absolute (percentage)		Percentage of subjects owning a mobile phone
		Mean	Range	Male	Female	
Austria (A)	151	38	18-76	66 (44%)	85 (56%)	77%
Poland (PL)	99	21	19-28	30 (30%)	69 (70%)	93%
Switzerland (CH)	250	24	18-35	110 (44%)	139 (56%)	89%
Luxembourg (L)	210	32	14-69	103 (49%)	107 (51%)	92%
Total	710	29	14-76	309 (44%)	400 (56%)	88%

The samples do not claim representativness as the study participants were selected on an ad hoc base. They are statistical convenience samples as many others in risk perception studies.

Results

In the following we focus on cross-national differences, group differences with respect to risk perceptions, persuasiveness of arguments, and the impact of new information on risk appraisal. Only in the first section we refer to the cross national sample. In all other section we focus on the Austrian data.

Cross national Comparison of EMF risk perceptions

Facing the above mentioned problems, three research questions are raised: (1) How are various risk topics rated among respondents in different nations? (2) Placing a particular focus on the EMF of mobile telecommunication, how much attention is given to the EMF risk topics? And (3) do people differentiate in their risk perception between EMF emitting by mobile phone and EMF emitting by base stations.

The data show that risk perceptions with respect to EMF are rather low in Poland, compared with Luxembourg and the Swiss sample. The perceived EMF risk in the Austrian sample is in between. Thus, in all four samples EMF is regarded as a relatively modest risk topic. Out of 710 respondents, fewer than 8 percent, 57 individuals, itemize that EMF mobile phone is threatening them. This is a pattern that was found in other risk perception studies that included EMF as a potential risk source (compare studies listed above).

Testing whether the total of 710 respondents differ in their EMF risk perception in respect of mobile phone and base station (Figure 1), a t-test for paired samples yields a highly significant difference ($t(706) = -4.1$, $p = .000$). On the national level, significant differences in EMF risk perception are calculated for the Swiss ($t(249) = -3.38$, $p = .001$) and the Luxembourgian sample ($t(208) = -2.27$, $p = .024$). No significant differences were found in the Austrian ($t(148) = -1.49$, $p = .137$) and the Polish sample ($t(98) = -.37$, $p = .71$).

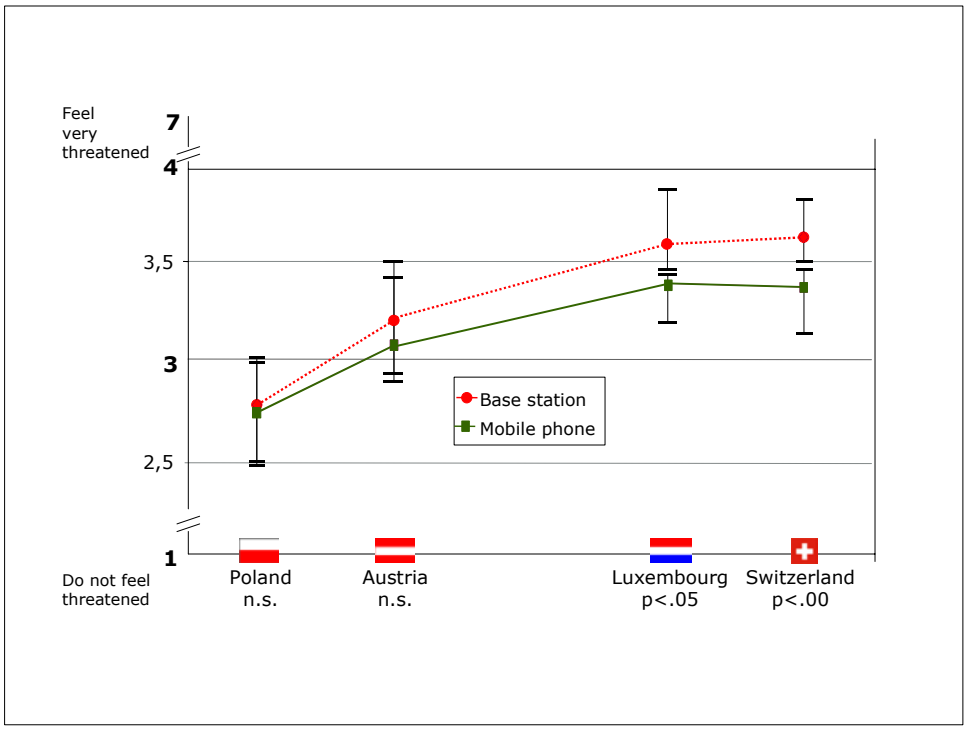

Figure 1: National differences in EMF risk perception

Group differences in risk perceptions

Following the work on risk perception and beliefs (e.g. Sjöberg & Wahlberg 2002) we assumed that prior beliefs towards EMF have an impact on how people evaluate EMF risks. With regard to differences in the evaluation of mobile phones technology, three groups of people are of particular interest:

- those who are undecided whether or not risks exist;
- those who tend to be concerned about possible risks; and
- those who tend to be unconcerned about possible risks.

The questionnaires included a number of items – which were to be scored on 7-point Likert-type rating scales with verbal endpoints – that are aimed at identifying these groups on the basis of their beliefs about risks of mobile phone technology:

1. I belief, that the risks of mobile phone technology are exaggerated. I do not see any risk.
2. Discussions about many things including mobile phones are often highly agitated. However, I do not care because there are more serious problems.
3. Even though the media exaggerate every now and again, I think there could be something real about mobile phone risks. However, I know too little to make a proper judgment.
4. Somehow, this does not feel right. You constantly hear that there are risks associated with mobile phones.
5. I'm convinced that mobile phones damage health.
6. I'm convinced that many of my health problems are caused by mobile phone masts.

From a theoretical point of view, unconcerned subjects should give high ratings on items 1 and 2 and not on the other scales, uncertain subjects should give high ratings only on item 3, and concerned subjects should rate high only on items 4, 5 and 6. These conceptual differences could be confirmed empirically. Based on the intercorrelations among the items a principal component analysis was conducted, yielding 2 factors (according to the eigenvalue > 1 criterion), which in total explained 57 percent of the variance. Figure 2 shows the location of the six items in the factor space. Three clusters of items can be identified: The first cluster consists of items 1 and 2, the second of item 3, and the third of the remaining items 4, 5 and 6.

To assign subjects to the three groups, the following classification rules were used: Subjects who scored > 4 for at least two of the items 4, 5, and 6, and who are not a member of the group „unconcerned people", were assigned to the "concerned" group. Subjects with scores > 4 for items 1 and 2 and who are not members of the group "concerned" were assigned to the "unconcerned" group. Finally subjects with scores > 4 for item 3, who are not members of the groups "concerned" and "unconcerned", were assigned to the "undecided" group.

With this classification, 112 of the 151 subjects (74 %) of the can be assigned to one of the three groups. The "concerned" group comprises 44 subjects, the "unconcerned" 25 subjects and the "undecided" 43 subjects. Subsequent analyses will refer solely to these 112 subjects, if not noted otherwise.

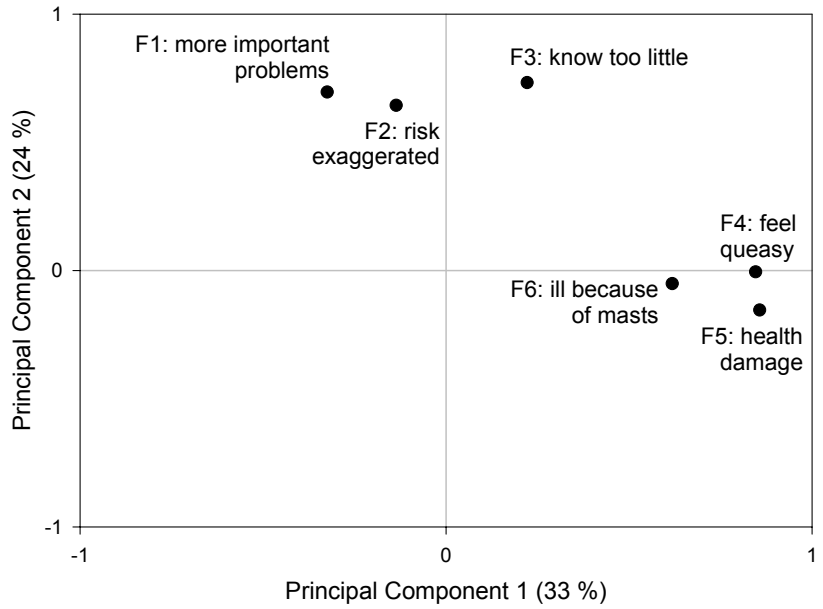

Figure 2: Results of the principal component analysis (Austrian sample).

Since the groups are formed with regard to beliefs about potential risks of mobile phone technology, they should appraise EMF risks differently. Our analysis shows that this is actually the case. As one would expect, for both mobile phones and base stations "concerned" subjects give the highest average risk ratings and the "unconcerned" the lowest risk ratings while the ratings of the "undecided" is between these two groups. The differences between the groups are statistically significant (mobile phones: $F(2,109) = 26.926$, $p < 0.001$; base stations: $F(2,109) = 37.561$, $p < 0.001$). However, a closer inspection with a *post hoc* Scheffé test reveals that the statistically significant difference is between the "concerned" on one side and the "unconcerned" and "undecided" on the other side (the latter two not differing statistically significantly).

Persuasiveness of pro- and con-arguments

White et al. (2003) have analyzed the role of prior attitudes in processing risk information. They suggest that both the negativity bias and the conformation bias might occur.

The subjects were asked to appraise the persuasiveness of a number of pro- and con-arguments taken from the recent debate on the risk of mobile phones. The selected arguments represent the main topics of the discussion about mobile phone risks in Germany. The following Table 2 gives an overview of the chosen pro- and con arguments.

Table 2: Pro- and con-arguments

▪ Because no long term studies are available, we must be very cautious with mobile phone technology
▪ Sometimes outsiders have made proper assessments. That might be also the case with EMF.
▪ The permanent EMF exposure might cause health risks. Therefore mobile phone masts are a risk.

▪ Humans might be compared with a barrel that is slowly filled up with toxins including electrosmog. Eventually the barrel will overflow. Therefore EMF is a risk
▪ In the past, people have believed that phones pose a risk to human health. This belief turned out to be wrong. Therefore something new is not automatically a reason for concern.
▪ Only internationally recognised experts who collaborate in expert commissions are able to assess EMF risks. These experts do not see a risk. Therefore there is no reason to be afraid.
▪ Dose is decisive in risk assessment. If the dose is very low there is usually no risk. Expositions from base stations are very low. Therefore base stations do not pose any risk to health.
▪ There are about 30.000 studies on the biological effects of EMF. Therefore it is valid to say that EMF is well researched.

Figure 3 provides the results of the appraisal of the persuasiveness of the various arguments. The three belief groups differ in their evaluation of EMF-arguments. It seems that the two extreme groups – the concerned and the unconcerned people – appraise those arguments as most persuasive that are consistent with their prior belief. For instance, the concerned people downplay contra risk arguments and highlight the pro risk arguments. The opposite is true for the unconcerned people. Only the undecided group is – to a certain degree – open to both kinds of arguments. This indicates how difficult it will be to change risk perceptions by providing information and educating people.

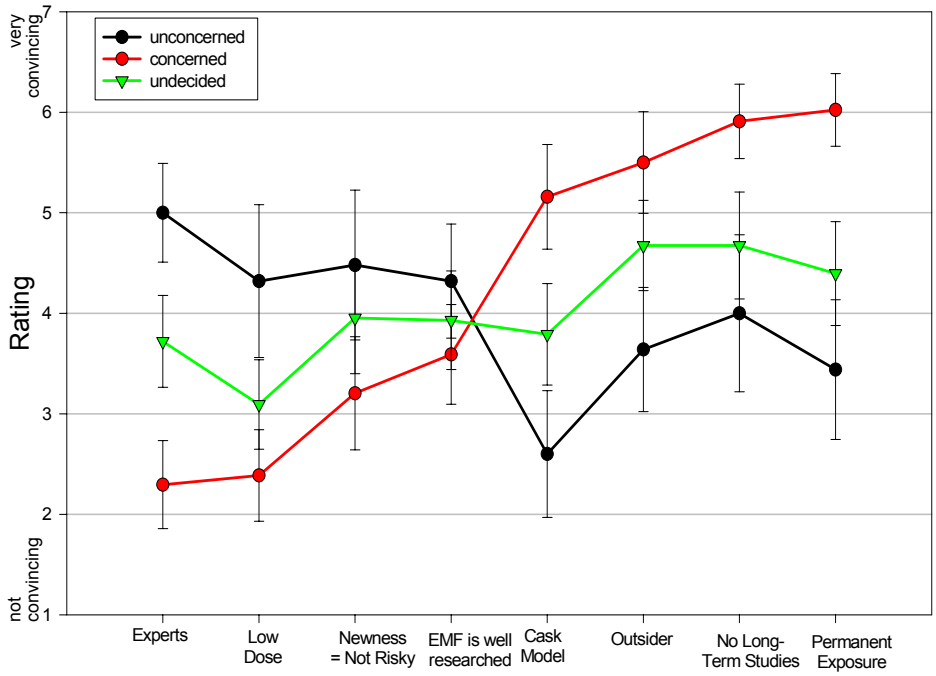

Figure 3: Appraisal of the preference for pro- and con-arguments by the three groups (Austrian sample)

Thus, people favor the arguments that are consistent with their views that they have already formed about EMF risks. People are biased in favor of confirming their views. Depending on their existing attitudes towards EMF they devalue non-matching, disproving information. This is especially applicable to people who are concerned about the risks possibly caused by cell phone technology. Undecided individuals seem to be most open to "factual" EMF information. To conclude, risk perception depends on personal beliefs and attitudes towards the risk source, which work as a "filter" that determines the perceived persuasiveness of arguments.

Impact of new facts on the willingness to change risk perceptions:

It seems rational to change one's own position in the light of new and valid risk information, and irrational to deny it. However, two biases might occur. First, researchers have observed a negativity bias, i.e. the preference for negative information (see Ito et al. 1998), and it has been indicated that negative information elicit more rapid and more prominent responses than non-negative information (Taylor 1991). Furthermore, is has been shown that the context, e.g. prior beliefs and attitudes play a significant role in evaluating new information. Studies have typically found that people are more likely to seek out and attend to data which are consistent rather than data which are inconsistent with their initial beliefs (Evans 1990).

To analyze this question we constructed different scenarios outlining possible critical developments or changes in the debate on risks from cellular phones/base stations, and where possible, matched them with contrasting events (see Table 3)

Table 3: Administered scenarios

If the radiation protection board would release a warning message about EMF, then my personal appraisal of EMF risks will increase	If the radiation protection board would release a reassurance message about EMF then my personal appraisal of EMF risks will decrease
If a base station will be sited close to my house, my personal appraisal of EMF risks will increase.	If a base station will be sited far away from my house, my personal appraisal of EMF risks will decrease.
If the WHO would release warning message about EMF, then my personal appraisal of EMF risks will increase	IF the WHO would release a reassurance message about EMF then my personal appraisal of EMF risks will decrease
If one of my friends would attribute her health problems to base stations, then my personal appraisal of EMF risks will increase	If none of my friends would attribute her health problems to base stations my personal appraisal of EMF risks would decrease.
If I would suspect a link between base stations and my personal health status, then my personal appraisal of EMF risks will increase	If I don't suspect as link between base stations and my personal health status then my personal appraisal of EMF risks will decrease
If the media would more and more publish stories about health damages caused by mobile phones technology, then my personal appraisal of EMF risks will increase.	If the media would less and less publish stories about health damages caused by mobile phones technology then my personal appraisal of EMF risks will decrease.
If my fellow citizens would organize a grass root group against base stations, then my personal appraisal of EMF risks will increase.	(not applicable)
If my doctors would warn about the health risks of EMF, then my personal appraisal of EMF risks will increase.	If my doctors would assure me that there is no link between EMF and health risks then my personal appraisal of EMF risks will decrease.
If a link would be detected between health of farm animals and EMF exposure, then my personal appraisal of EMF risks will increase.	If no link would be detected between health of farm animals and EMF exposure, then my personal appraisal of EMF risks will decrease.

Half of the scenarios describe warnings, i.e. risk confirming news. The other half of the scenarios consists of reassuring messages, i.e. risk disconfirming news. The scenarios are outlined above in Table 3. The subjects are asked to indicate their willingness to change their own risk perception in the light of each of these several scenarios on a 7-point-rating scale.

Our findings reveal a asymmetry between warnings and reassuring scenarios with respect to the impact on one's willingness to alter risk perceptions. In average, warning scenarios turned out to be much more influential than of reassuring scenarios (see Figure 4). Most interestingly, this effect is stronger for the concerned compared to the undecided and unconcerned people. This indicates clearly that concerned people show the largest confirmation bias.

Furthermore it seems that the "experiential mode" indicated in the scenarios plays also a role in determining the response. For instance, the direct experience of health problems is viewed as most influential scenario. The WHO – scenario is second followed by the "living in vicinity of base stations" – scenario.

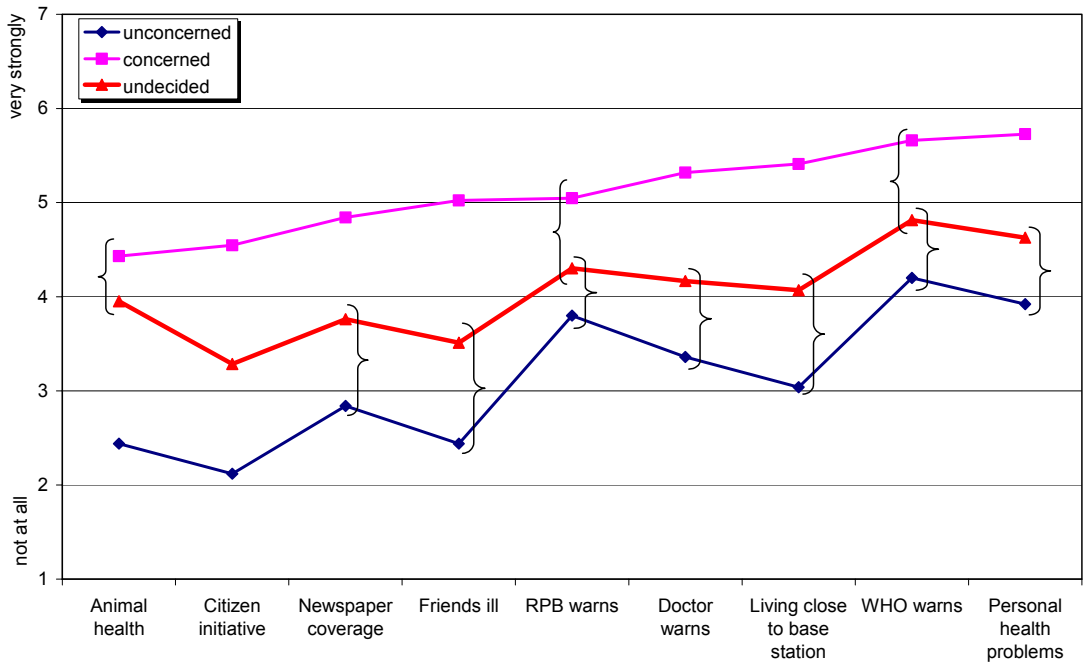

Figure 4: Impact of risk-confirming scenarios on the willingness to change risk perception. Brackets indicate non-significant differences (Austrian sample).

Conclusions

Our preliminary comparison of risk perception in Austria, Germany, Luxembourg, and Switzerland suggest that EMF risk perception might vary across Europe. Therefore it seems to make sense to conduct an Euro-Barometer study, especially focusing on EMF issues. Such a study should focus in particular on the pro- and con-risk arguments we analyzed in this paper in order to learn which arguments have an impact on public opinion and which are neglected.

The effects of risk communication depend upon a complex interaction between the characteristics of the audience, the source of the message, and its content (see Breakwell 2000). Our data suggest an interaction between the negativity and the confirmation bias. The impact of negative information (warning news) on the willingness to change one's own risk perception seems to be larger if people are concerned than the impact of positive information (assuring news) on people who are unconcerned.

The research presented here suggests that effects of risk communications depend strongly on the prior beliefs of the recipients and the message content. Once a risk attitude has been developed, it appears to be extremely difficult to change people's risk perception, even by providing rational arguments or facts. It might be that other factors – especially emotions – might have a stronger impact and could change risk perception. However, a better understanding of that variables´ influence on risk perceptions is obviously needed.

In conclusion, we are still convinced that the scientific community as well as governmental and industrial organizations should continue to increase their risk communication efforts. However, risk communication is not a magic tool. We should avoid wishful thinking and unrealistic optimism, i.e. to overestimate the impact of risk communication.

Only realistic expectations about the impact of risk communication together with careful planning and continuous evaluation of the results will help to improve risk communication and thus to provide a solid basis for further development of effective risk communication tools.

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