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Communication via maps in the field of radiation protection: effects of visualized information on risk perception, risk understanding and intended protective behaviours

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Abstract:

The central task of the German Federal Office for Radiation Protection (BfS) is to protect people and the environment from radiation. This concerns ionizing radiation (relevant in medicine applications, natural radioactivity from radon) and non-ionizing radiation (in the ultraviolet range (UV), electromagnetic fields). Beyond this, the BfS is tasked with providing citizens a realistic risk assessment and with motivating the adoption of appropriate protective behaviours. This is important, because e.g. individuals typically underestimate the risks of radon exposure. With regards to UV, people are generally aware of its risks, but still do not protect themselves adequately. While risk communication research has evidence on how to communicate risks effectively, the role of maps has been less studied despite the fact, that maps play an increasingly important role in risk communication. In this context, this study examines the effects of maps in radiation protection communication on risk perception, risk understanding and intended protective behaviour.

To decide on which map representations should be selected and modified for testing, a literature review was conducted to establish a status quo on good risk communication in general (e.g. Früh, 2016, Siegrist and Árvai, 2020) and by maps specifically (e.g. Lindell et al., 2011, MacPherson-Krutsky et al., 2020, Timmons and Lunn, 2023). By considering good cartographic practice as well as the knowledge gain as wished for by BfS, gaps were identified of what had not yet been tested, and the UV and radon maps identified for potential improvements. Figure 1, to the left, shows the UV map of BfS in comparison to an example for an enhanced map in the qualitative analysis. Here, a research concept was designed to gain preliminary insights on map understanding and into the hypotheses to be tested later on. The sample consisted of 30 individuals, both laypersons and people with a possible connection to radiation issues. Based on the map comparison results of the 60-min interviews, the maps were revised again for the online-experiment with a sample of N=2,000. The sample was drawn to be representative of the general population in Germany according to age, gender and region, while boosting the sample with likely recipients of the BfS maps due to their professional or personal experience. The 15-min online-experiment took the form of a randomized controlled trial that assessed the influence of the original maps and their variations. Static maps were shown as PDF files, while the interactive maps of the BfS geoportal were integrated via a permalink.

For each radiation topic a total of 16 map variants, including the status quo map, were tested. Participants were randomly allocated to the two radiation topics (UV and radon) and across map variants. They first answered introductory questions, then saw the map and answered both comprehension questions and subjective questions about the map. The former objectively assessed how well the maps were understood. The latter recorded the extent to which awareness of certain topics was raised, how risk perception changed, and which maps/map representations were more/less appreciated and why. All subjects then randomly viewed one of four possible variants of the radon map in the geoportal. Respondents again answered questions including on their map interaction. Differences in the performance of the map variants and geoportal versions were measured by comparing the answers of the independent groups of respondents.

The qualitative interviews revealed that there is potential for improving the UV map and that the proposed variations contribute positively to attractiveness, achievement of the communication objectives and credibility. However, some variations might also overwhelm some of the subjects. On the radon maps, a more specific recommendation on how to protect oneself increased the engagement with the topic, while adding other information in the map area was perceived ambivalently. Overall, based on the test results the static maps on both radiation topics were further improved. There was no consensus as to whether the geoportal was superior to the static maps in terms of perceived communication objectives due to its interactivity. However, it became clear that some people struggled with its handling.

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Finally, it was decided to work with four treatments in the quantitative experiment when varying the UV map: title & annotation, extended legend, UV index filling the entire map area, diagrams of the UV index in its daily course. In the case of radon also four treatments were tested: title, annotation, info box, uranium occurrence on map area (for status quo map and one of 15 variations see Figure 1, to the right, highlighting the treatments). Due to the demanding usability, testing of the geoportal was limited to only the one radon layer, this with two treatments: zoom, annotation.

The experiment results revealed for the UV maps that the treatments had no effect on risk understanding. Results on map comprehension were mixed but improved performance as expected. Risk perception and intended protection behaviour were sharpened – some treatments increasing others decreasing them. For the radon maps, the revised messaging with a risk description significantly improved risk understanding. Here the treatments impacted performance on map comprehension in a mixed fashion, risk perception was again sharpened while protection intentions remained mostly unchanged. Overall, the test subjects in the experiment as in the interviews appreciated the revised maps more in comparison to the status quo. The treatments tested on the geoportal had no significant effects of participant performance.

Overall, the results from the quantitative control study can be related to the fact that UV knowledge is already consolidated in society, the different maps had no effect here. However, the results indicate that some complexity on static maps can improve risk communication by means of maps. In addition, people who had previously seen the static maps and answered questions about them, performed significantly better on the geoportal implying a significant learning effect.

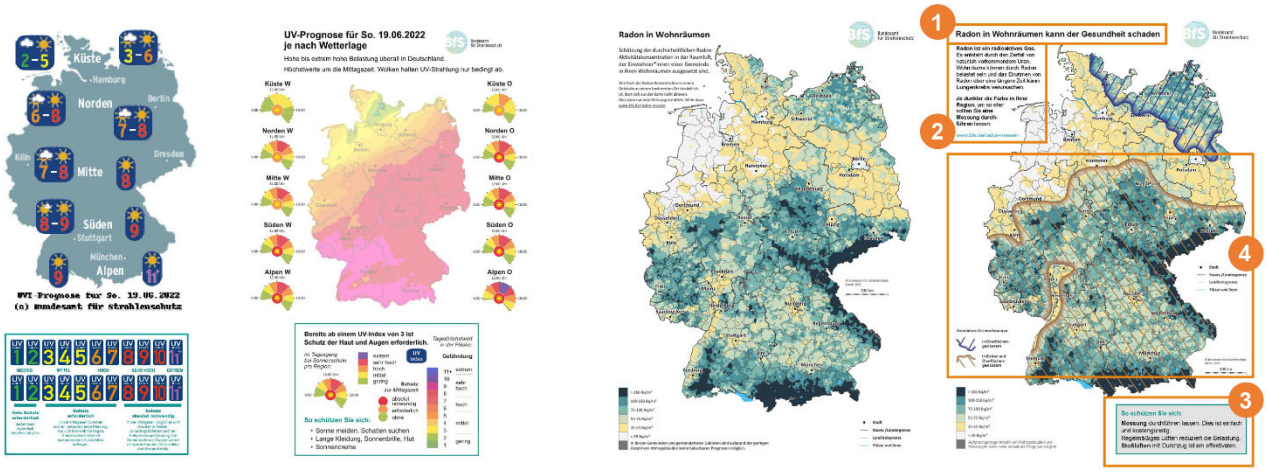

Figure 1. BfS status quo maps and examples of enhanced maps used in testing, to the left on UV and to the right on radon

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