Criteria affecting people's decision to take protective measures during winter storm XAVER on 5 December 2013

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ABSTRACT

This paper discusses the impact of different dimensions of risk perception on people's decision to take protective measures against natural hazards. Initial basis of the analysis was the winter storm XAVER which affected huge parts of Northern Europe including Berlin, Germany on 5 December 2013. Preliminary results of a representative online survey within the Berlin population show that affective variables such as fear of severe weather and confidence in weather forecasts showed a significant effect on people's decision to take protective action. Contrary, high experience of natural hazards did not necessarily lead to action.

KEYWORDS

Weather warnings, risk perception, protective measures, questionnaire survey

INTRODUCTION

On 5 December 2013 a very severe winter storm known as XAVER affected several parts of Northern Europe. In Germany the highest wind speed was measured near the coasts of the North and Baltic Sea. Very strong wind force over a long term period caused a storm surge over the North Sea with up to 3.5m above mean high water, Germany's fifth highest storm surge for 100 years. In total at least 10 people died in Europe due to the storm (Deutschländer, Friedrich, Haeseler and Lefebvre, 2013; Kox, Heisterkamp and Ulbrich, 2015; Kunz, Mühr, Schröter, Bessel, Möhrle, Münzverg, Brink and Schmidt, 2013). The German Insurance Association estimated the economic losses with 100 to 200 million Euro for Germany (GDV, 2014).

Since weather models gave first evidence of the storm five days prior, the storm was not unexpected. Thus, a first severe weather alert was issued by the German Meteorological Service (DWD) on 1 December 2013. The alert was further concretized in the evening of 4 December and increased to a severe weather warning (violent storm, 103-117 km/h) on the day of the storm in the morning of 5 December. At that time the storm had already generated extensive media coverage and often comparisons with the 1962 Hamburg storm surge were drawn. Weather forecasts did not state very high wind speed for Berlin compared to the coastal regions, but due to the large scale and long duration of the storm, emergency services, the media, and the general public were in some state of excitement (Kox et al., 2015). And although in the end the maximum wind speed in the city did not reach the forecasted wind speed, it seems that the weather warnings were successful: no casualties or major losses were reported in Berlin.

It is well known that end-users of weather warning information are a very heterogeneous group and perceptions, needs and capabilities vary considerably

(Doswell, 2003, Kox, Gerhold and Ulbrich, 2014). But is it possible to identify certain criteria that influence the decision to take protective action?

SAMPLE CHARACTERISTICS AND STUDY DESIGN

In order to answer this question this paper refers to an online survey which was conducted between 28 April and 13 Mai 2014 in the context of the WEXICOM project. 1342 residents of Berlin, Germany (age 18- 90) completed the questionnaire consisting of 20 groups of questions. Topics included media use, perception of weather hazards, prior experience of severe weather, and confidence in weather forecasts.

The survey was conducted five month after the storm, but the questionnaire was already in planning when the storm occurred. The situation provided an interesting opportunity and thus, one part of the questionnaire was devoted to this event. People were asked in a closed-ended question to state if they remember the storm and if they remember taking protective action due to the weather warnings (see Table 1). In addition to answer D, the survey participants had the opportunity to state what protective measures they had taken in free text.

Using a psychometric approach (e.g. Slovic, 1987) and five-point Likert-typed questions (Likert, 1932) participants were also asked to rate the likelihood and threat of different weather phenomena (hurricane, thunderstorm, hail, snow, etc.), their confidence in weather forecasts, their prior experience with extreme weather, their 'internal locus of control' (Rotter, 1966) and their fear of severe weather. Finally, participants were asked to provide individual socio-demographic and socio-economic data.

RESULTS

Although the storm was already five months ago at the time of the survey, over 85 % of the respondents were able to remember this event. And although the majority of respondents indicated that they did not change their behaviour due to the weather warning, about a quarter of the respondents indicated that they had taken protective measures (Table 1).

Considering the free text regarding answer D, several measures can be derived (unranked): On the one hand it was stated that various measures have been taken in order to secure property (e. g. tying up objects on the balcony or closing windows). Cars were taken to safer places or placed far from trees. Several respondents indicated that they left their work place earlier than usual, or that they decided to switch from car to public transport. In addition, people report that they cancelled planned activities in the evening and generally avoided staying outdoors. A large proportion of respondents indicated that the warning has increased their attention and news and weather reports were followed with more interest. Some respondents indicated also that it has not been possible for them to change their behaviour due to professional constraints, but they would have liked to do so.

Overall, measures taken are consistent with the measures recommended by the German Federal Office of Civil Protection and Disaster Assistance as 'correct behaviour in case of severe weather' (BBK, 2013).

	Frequency	Percent
A) I do not remember the storm.	197	14.7
B) I do remember the storm, but I have no memory of my actions due to the warnings.	391	29.1
C) I did not take any specific action due to the warning.	428	31.9
D) I took the following protective measures…	326	24.3
	1342	100

Table 1. People's memory of the storm and about their decision based on the warning

In a next step, answers referring to no action (A, B, C) and answers referring to action (D) were cross tabulated with the answers to the Likert-typed questions elsewhere in the questionnaire (see Figure 1). No systematic deviance was found with respect to participants' age, education, income, or housing status.

I): Severe weather experience was measured by asking if someone was affected direct (injured or damaged property) or indirect (witness of an affected neighbourhood) by severe weather within the last 12 months (α = 0.8). Possible answers ranged from 1 (very low) to 5 (very high) (mean= 2.5, SD= .88). Actions due to warning were taken by 9 % of the respondents with high or very high experience of severe weather, compared to 50 % of respondents with very low and low severe weather experience.

II): Participants were asked to make a risk assessment on several different weather phenomena by stating both the likelihood and the threat separately for each phenomenon. Possible answers ranged from 1 (very unlikely/ unthreatening) to 5 (very likely/ threatening) (storm likelihood: mean= 2.9, SD= 1.23; storm threat: mean= 3.2, SD= 1.25). Generally, violent storms and hurricanes were described relatively less likely but more threatening than other phenomena of extreme weather. Of the respondents who indicated that they took action due to the storm warning, only 22 % state hurricanes and violent storms as very unthreatening or unthreatening, compared with 55 % of the respondents who state hurricanes and storms threatening or very threatening. Only 31 % state very severe storms as very unlikely or unlikely compared with 41 % who state hurricanes and storms as likely or very likely.

III): Fear of severe weather was measured using a five-point Likert-typed item ("*Severe weather (thunderstorms, hurricanes, tornadoes) scare me.*") ranging from 1 (strongly disagree) to 5 (strongly agree) (mean= 2.9, SD= 1.27). 29 % who indicated that they took action due to the storm warning state that they are not afraid of storms (strongly disagree and disagree). 50 % indicate that they fear severe weather (agree or strongly agree).

IV): Confidence in weather forecast was measured by asking the question: "*What is your general confidence in the accuracy of weather forecasts?"* Possible answers ranged from 1 (very low) to 5 (very high) (mean= 3.5, SD= .79). Of the 326 respondents who indicated that they took action due to the storm warning, 7 % have very low or low confidence in the weather forecasts. On the other hand, 64 % have a high or very high confidence in forecasts.

V): The concept of 'locus of control' measures to what degree people believe they can control events which affect them. The scale consists of two subscales (internal and external). Internal locus of control is based on two five-point Likert-typed items ("*I'm my own boss*", "*If I work hard, I will succeed*", α = 0.8, mean= 2.6, SD= 1.01) and refers to people's belief that they can control their personal life (Rotter, 1966). 4 % of the respondents who indicated that they took action have a very low or low internal locus of control In contrast, 75 % have a high or very high internal locus of control.
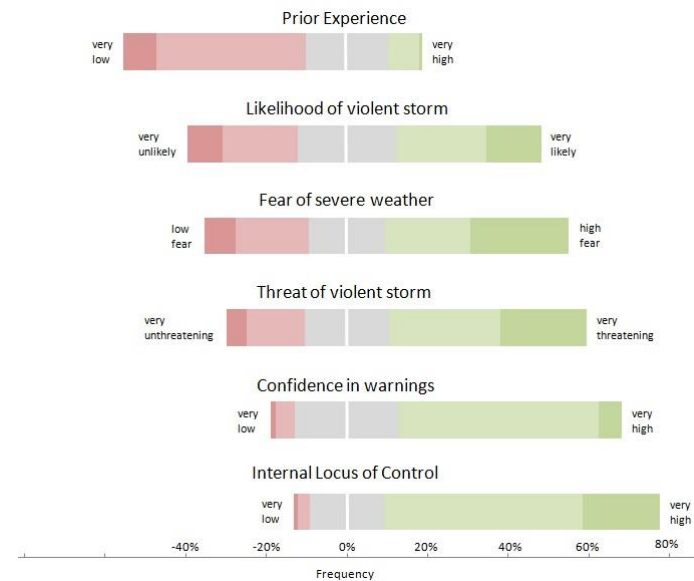

Figure 1. Diverging stacked bar chart of impact of risk perception on decision to act on the storm warning, n=326

DISCUSSION AND CONCLUSION

The preliminary results show that different dimensions of risk perception affected

people's decision to take protective measures against the upcoming winter storm. No systematic deviance was found with respect to any of the socio-demographic and socio-economic variables. Instead, affective variables such as fear and confidence showed an impact on people's decision whether to act or not to act.

Strong confidence in weather forecasts and a high level of internal locus of control seems to be an important driver for protective action. This can be linked to the fact that most stated protection measures (tying up objects on the balcony, moving cars, avoiding staying outdoors) are clearly individual in nature and generally refer to protecting oneself or to protecting moveable objects. (Note that tower houses and apartment buildings in an urban environment like Berlin are much more difficult to secure against weather events than rural houses.) This corresponds with findings from other studies: For example a study in Poland by Biernacki, Działek, Janas and Padło (2008) found that a majority sees themselves responsible for storm protection of their houses, just one-fifth expected local government to do it for them. Unlike e. g. flood protection measures, most wind protection measures were seen as much more individual.

Some sense of storm threat (and fear of severe weather) seems to have an impact on taking protective actions, while the likelihood of the storm seems to be less influential. Considering that violent storms in general are described by survey participants as relatively less likely but more threatening than other phenomena of extreme weather, the magnitude – and thus the potential damage – of a storm might have a bigger influence on the decisions than its actual likelihood.

Additionally, high experience of natural hazards does not necessarily have to lead to action. Contrary, in this sample most people who could recall the storm and their actions stated that they do not have much severe weather experience.

However, the results should be seen contextual: The storm was finally not so severe and all reactions described must be related to this situation. If the storm would have been more severe, reactions might have been different.

When trying to enhance weather warning system, further work should focus not only on improving the technical aspect, but also on the communication aspect of a warning system. This should likewise include behaviouristic and sociological approaches, because the results stated above suggest influences of socio-scientific

variables on protective measures. The determination of the criteria influencing people's decision to take protective action might help to reveal the different dimensions of risk perception in the heterogeneous group of end-users, and might finally lead to a more effective warning system.

It is recommended to tailor warnings according to end-user needs and constraints in order to address individual risk tolerances (Joslyn and Savelli, 2010). Since most measures stated by the respondents and recommended by the government (BBK, 2013) request people to act on their own, self-responsibility is an important driver for protective action. However, the question remains how to address specific subgroups of the population, such as the elderly or disabled people, who might depend on others to prepare and are therefore limited in their actions.

REFERENCES

1. BBK (German Federal Office of Civil Protection and Disaster Assistance) (2013) Ratgeber für Notfallvorsorge und richtiges Handeln in Notsituationen, Bonn.

2. Biernacki, W., Działek J., Janas K. and Padło, T. (2008) Community attitudes towards extreme phenomena relative to place of residence and previous experience, in: Liszewski, S. (Ed.) The influence of extreme phenomena on the natural environment and human living conditions. Łódzkie Towarzystwo Naukowe, Łódź, 207–238.

3. Deutschländer, T., Friedrich, K., Haeseler, S. and Lefebvre, C. (2013) Orkantief XAVER über Nordeuropa vom 5. bis 7. Dezember 2013, http://www.dwd.de/jb/2013/pdf/Kapitel_3_2013_XAVER_europa.pdf [13.01.2015].

4. Doswell, C. (2003) Societal impacts of severe thunderstorms and tornadoes: lessons learned and implications for Europe. *Atmospheric. Research,* 67–68, 135–152.

5. GDV (German Insurance Association) (2014) Insurers paid 7 billion euro for floods, storms and hail, http://www.en.gdv.de/2014/01/insurers-paid-7-billion-euro-for-floods-storms-and-hail/ [13.01.2015]

6. Joslyn, S. and Savelli, S. (2010) Communicating forecast uncertainty: public perception of weather forecast uncertainty. *Meteorological Applications,* 17, 180–195.

7. Kox, T., Heisterkamp, T. and Ulbrich, T. (2015) Viel Wind um nichts? Orkan XAVER über Berlin, in: Gerhold, L., Jäckel, H., Schiller, J. and Steiger S. (Eds) Ergebnisse interdisziplinärer Risiko- und Sicherheitsforschung. Eine Zwischenbilanz des Forschungsforum Öffentliche Sicherheit (Schriftenreihe Sicherheit 17), 73-94.

8. Kox, T., Gerhold, L. and Ulbrich, U. (2014) Perception and use of uncertainty in severe weather warnings by emergency services in Germany, *Atmospheric. Research*. http://dx.doi.org/10.1016/j.atmosres.2014.02.024

9. Kunz, M., Mühr, B., Schröter, K., Bessel, T., Möhrle, S., Münzverg, T., Brink, S. and Schmidt, H.-M. (2013): CEDIM Forensic Disaster Analysis Group (FDA): Winterstorm Xaver–Report, http://www.wettergefahren-fruehwarnung.de/Ereignis/20131206_cedim.pdf [13.01.2015].

10. Likert, R. (1932) A technique for the measurement of attitudes. *Archives of Psychology*, 22 (140), 1–55.

11. Rotter, J. B. (1966) Generalized Expectations for Internal versus External Control of Reinforcement. *Psychological Monographs*, 80, 1–28.

12. Slovic, P. (1987). Perception of Risk. *Science* 236 (4799), 280–285.