To Act or Not To Act? Factors Influencing the General Public's Decision about Whether to Take Protective Action against Severe Weather

THOMAS KOX

Interdisciplinary Security Research, Institute of Computer Science, Freie Universität, Berlin, and Hans-Ertel-Centre for Weather Research, Germany

ANNEGRET H. THIEKEN

Institute of Earth and Environmental Science, University of Potsdam, Potsdam, Germany

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ABSTRACT

Research suggests that providing weather forecast end users with additional information about the forecast uncertainty of a possible event can enhance the preparation of mitigation measures. But not all users have the same threshold for taking action. This paper focuses on the question of whether there are influencing factors that determine decision thresholds for numerical weather forecast information beginning at which the general public would start to take protective action.

In spring 2014, 1342 residents of Berlin, Germany participated in a survey. Questions related to the following topics: perception of and prior experience with severe weather, trustworthiness of forecasters and confidence in weather forecasts, and sociodemographic and socioeconomic characteristics. Within the questionnaire a scenario was created in order to determine individual decision thresholds and see whether subgroups of the sample lead to different thresholds.

Results show that people's willingness to act tends to be higher and decision thresholds tend to be lower if the expected weather event is more severe or the property at risk is of higher value. Several influencing factors of risk perception have significant effects such as education, housing status, and ability to act, whereas classic socio-demographic determinants alone are often not sufficient to fully grasp risk perception and protection behavior.

1. Introduction

Weather forecasts and warnings in Germany are, with the notable exception of probability-of-rain forecasts featured on most websites, communicated deterministically to the public and professional end users, although research suggests that providing end users with additional information about the forecast uncertainty of a possible event can enhance the preparation of

mitigation measures (Hirschberg et al. 2011; LeClerc and Joslyn 2012; Murphy 1994; National Research Council 2006; Palmer 2002; Ramos et al. 2013; Richardson 2000; Roulston et al. 2006; Zhu et al. 2002). Uncertainty information can be communicated in terms of probabilities, frequencies, or confidence intervals, in the form of numbers, as verbal descriptions, or as graphical representations (Skubisz et al. 2009).

Often decisions concerning the preparation of mitigation measures must be made early, when the probability of severe weather events is low (Joslyn and LeClerc 2012). However, in a study with members of emergency services in Germany, Kox et al. (2015) showed that fewer than 10% of the participants would start to take action based on a forecast probability of 40% or lower for a violent storm to take place on the next day. No single threshold category could reach a majority consensus. The authors assumed that “beside the weather context, several other factors bias this decision making process: [...] individual expertise and

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Corresponding author e-mail: Thomas Kox, thomas.kox@fu-berlin.de

scope of action, and the overall organisational culture” (Kox et al. 2015, p. 300).

But what does a lower or higher probability threshold for taking action mean? First of all, weather forecasts per se do not possess an intrinsic value in an economic sense (Murphy 1993, 1994). They only have a specific value if a user takes action and this action saves him/her money as a result because the action avoids (higher) damage costs (Murphy 1993, 1994; Mylne 2002).¹ A lower threshold can be interpreted as taking action at an earlier stage of time when a severe weather event is indeed likely to happen but there is still uncertainty as expressed by the probability of occurrence. Accordingly, a higher threshold can mean that people will take action later when a potential event is more likely to happen. In other words, a lower threshold can be interpreted as people being more risk-averse (they tend to avoid risk) and a higher threshold can be interpreted as people being more risk-taking or risk-seeking (e.g., Morss et al. 2010; Ramos et al. 2013).²

Kox et al. (2015) noted that their specific user group of emergency services was very heterogeneous and differed with regard to requirements and needs (e.g., lead times), perceptions (e.g., of risk and uncertainty), level of weather-related knowledge and understanding (e.g., meaning of numerical forecasts), and legal and institutional constraints. Yet, if there is a diversity in capacity even within such a sophisticated group, the same—or an even larger—heterogeneity might apply for a much broader user groups such as the general public (National Research Council 2006).

In this context risk is seen as a multidimensional construct (Wiedemann and Schütz 2010, p. 799). Risk perception is dependent not only on the characteristics of the hazard (magnitude or severity, probability, duration, areal extent), but also on other factors that characterize the threat, such as the hazard source, possible consequences (i.e., damage costs), or the situation of the respective person (Burton et al. 1993). A number of different approaches have been applied in social-science risk research to address risk perception and risk-reduction behavior [for further discussion see, e.g., Bubeck et al. (2012), Renn et al. (2007), and Werg et al. (2013)]. Varying influencing factors are addressed in the

different studies. Examples are trust (e.g., Johnson and Slovic 1995; Siegrist 2001), hazard experience (e.g., Bubeck et al. 2013; Mileti and Sorensen 1990; Silver and Andrey 2014), self-efficacy (e.g., Bubeck et al. 2013; Grothmann and Reusswig 2006), or sociodemographic and socioeconomic variables such as gender, age, income, education level, or home ownership (e.g., Biernacki et al. 2008; Grothmann and Reusswig 2006; Mileti and Sorensen 1990; Siegrist and Gutscher 2006; Silver 2015).

Wachinger et al. (2013) demonstrated the complex relationship between risk perception and actual response in the case of natural hazards. Based on a review that also included multidisciplinary studies on natural hazards, they negate the general assumption that individuals with low risk perception are less likely to respond to warnings and to undertake preparedness measures than individuals with high risk perception. They derive three possible reasons for the relationship between risk perception and protective action: first, experience and motivation; second, personal ability to act, which is constrained by economic and personal conditions; and third, trust and responsibility. Likewise, Demuth et al. (2011) discuss the importance of including individual attitudes and behaviors in the analysis of people’s use and perception of weather forecasts.

Although there is a large body of literature on risk perception and protective behavior (e.g., Kahneman and Tversky 1979; Kunreuther 1996; Palm 1998; Rogers 1983), comparatively little is known about the decision thresholds that numerical weather forecasts must exceed in order to trigger protective behavior and how these are influenced [for exceptions, see Morss et al. (2010) and Joslyn and Savelli (2010)]. Therefore, this paper focuses on the question of whether there are influencing factors that determine decision thresholds for numerical weather forecast information at which the general public would start protective action. A scenario was created in a questionnaire survey (see section 2b) in order to a) determine individual decision thresholds³ and b) test whether subgroups of the sample—determined by different influencing factors such as age, gender, hazard experience, or ability to act—lead to different thresholds. The idea stems from a scenario-based study with participants of a U.S. nationwide survey published by Morss et al. (2010). They asked at which forecast probability of a temperature below freezing people would decide to cover their garden plants. They concluded that

¹ This economic perspective, however, does not apply to situations where monetary damage costs are difficult to assign, like loss of life or social or political reputation. In other situations, people might want to act but do not have the ability to do so, due to professional constraints or limited resources.

² Beside this interpretation a higher threshold can also mean that someone is less willing to take any action based on a probability forecast.

³ Note that we are not searching for an absolute threshold number, but rather analyzing the relation between the different scenarios.

“different individuals have different percentage-chance thresholds for decision making based on their risk tolerance, the context, and other factors” (p. 158). As in the United States, temperature forecasts in Germany are usually not accompanied by uncertainty or probability information, raising the question as to whether this has an effect on the general public’s decision to act. In the present study, the scenario was altered to incorporate the variable “value of property at risk” in order to discuss the relevance of the damage (costs) caused by the weather.

The following research questions are derived from these considerations:

Research question 1: Is people’s willingness to perform protective actions affected by a) the severity of the expected weather event and b) the value of the property at risk?

Research question 2: Is the probability threshold for taking protective action affected by a) the severity of the expected weather event and b) the value of the property at risk?

Research question 3: Do individual experience, motivation, trust, personal ability to act, and structural determinants such as socioeconomic and sociodemographic variables affect the probability thresholds?

The following sections describe the questionnaire with the scenario design, the outcome variables and factors for the analysis, and the sample characteristics of this survey (section 2). Later sections address the results (section 3), discuss the main findings and limitations of this study (section 4), and draw conclusions (section 5).

2. Methods

To investigate the probability threshold for decisions on protective action of the general public and factors that might influence such decisions, a questionnaire with a decision scenario was created and distributed among residents in Berlin, Germany, via an online-access-panel provider. The aim of the decision scenario was to identify a probabilistic threshold for forecast users to take protective action based on a hypothetical probabilistic weather forecast. In this section, the decision scenario will be outlined first, which is followed by the influencing factors addressed in the questionnaire. Finally, the data collection and sample characteristics will be outlined.

a. Weather forecast and decision to act: The “Garden Scenario”

The decision scenario consisted of four questions representing different subscenarios. The four questions were located in the middle of the questionnaire succeeding

introductory questions about media use and weather communication and preceding questions such as experience with severe weather, confidence in forecasts and sociodemographic and socioeconomic characteristics (for further discussion, see section 2b). In the present survey, participants were asked to assume that they own a garden center with some plants outside. The scenario continued with the information that a weather forecast for the coming night indicated a certain level of probability for frost. Participants had two major response options: they could either place back all plants in the greenhouse given a level of probability for frost or they could state that they would not place back the plants.⁴ If participants chose the first response option, they were asked to specify the level of probability a forecast should indicate to make them take action, if they were relying exclusively on this weather forecast. The participants were allowed to type any number between 0 and 100 in an open-space text box to specify the level of probability (for a detailed scenario design, see appendix A).

This general scenario setting was altered resulting in four subscenarios (see Table 1), which differed in the key variables of temperature and value of property at risk. All respondents received all four subscenarios in sequence and were asked the same questions. In the first scenario (baseline scenario), people were asked to make a decision about a forecast indicating slight frost (temperatures falling below 0°C). In the second scenario (severe frost scenario), the forecast was changed to severe frost (temperatures falling below −10°C).

Each of the two temperature scenarios was further altered by stating that the plants outside were of great value. Participants were asked again to make a decision on a forecast indicating slight frost (valuable scenario) or severe frost (severe/valuable scenario), respectively. Accordingly, the four subscenarios represented every possible situation within the variables of value of temperature and extent of value of property at risk (see Table 1).

The decision scenario was pretested along with the rest of the questionnaire. Several other options were tested (moving an outdoor picnic indoors, taking a bicycle to work, taking an umbrella, going for a walk in the woods, etc.). However, pretest results revealed that the

⁴ Mylne (2002) notes that, if no forecast were available, a sensible forecast user would have two options: either always protect or never protect. A third way would be to act by chance, although this does not really qualify as a sensible option. One could add that experienced people would never totally act by chance as they would also include their own observations of the current weather situation in their decisions.

TABLE 1. Garden scenario characteristics.

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Threat of frost	Slight ($<0^{\circ}\text{C}$)	Severe ($<-10^{\circ}\text{C}$)	Slight ($<0^{\circ}\text{C}$)	Severe ($<-10^{\circ}\text{C}$)
Property at risk	Unspecified	Unspecified	High value	High value
Scenario name	baseline	severe frost	valuable	severe/valuable

garden center scenario and the forecast of frost were best understood by the test groups.

b. Influencing factors

The decision thresholds as determined by the garden scenario might be influenced by several factors, which were explored by the questionnaire from different angles. Altogether 37 questions are discussed in this paper (available in the online supplemental material): socio-demographic and socioeconomic characteristics such as gender, age, education,⁵ or housing status/home ownership (9 questions); media use and prior experience with severe weather (5 questions); the ability to act, self-efficacy, or locus of control (10 questions); trustworthiness of forecasters and confidence in weather forecasts (9 questions); and desire for certainty (4 questions). They were rated with two different types of items: self-rated 5-point Likert-type items that ranged from 1 (strongly disagree) to 5 (strongly agree) and multiple-choice items using a true/false scoring procedure. Participants could also respond “I do not know.” While some items were directly taken from the literature (Bandura 1977; Rotter 1954, 1966), most items were adapted from other studies (Johnson and Slovic 1998; Kox et al. 2015; Morss et al. 2010). The reliability of scales was tested using Cronbach’s alpha, which measures internal consistency of items within a scale. The acceptable range for α was set to ≥ 0.6 . A scale has a high reliability if it produces similar results under consistent conditions (Crocker and Algina 2008).

1) HAZARD EXPERIENCE

Direct experience is linked to someone witnessing the disruptive effects of severe weather or being personally

affected. When direct personal experience of a (disastrous) event is lacking, people can learn about a hazard from many indirect sources, including the media (Biernacki et al. 2008; Silver and Andrey 2014; Smith 1992). Direct experience was measured on a scale with 5-point Likert-typed items ($\alpha = 0.8$), which represents different levels of experience related to the (both geographical and personal) distance: direct personal affliction [item 1: “How often have you personally been affected by severe weather events (heavy thunderstorms, hurricane-force gusts etc.) in Berlin over the past 12 months?”], witnessing of severe weather effects in the near neighborhood (item 2: “How often have you observed damages resulting from severe weather in your neighbourhood over the past 12 months?”) and in the city (item 3: “How often have you observed damages resulting from severe weather in Berlin over the past 12 months?”). (The items were not weighted due to missing information about people’s mobility.)

Following Smith (1992), indirect experience was measured by participants’ access to forecasts. Participants were asked to state which source of information (TV, radio, websites, apps, etc.) they use and how often they retrieve weather forecasts (daily, several times a week, occasionally, only in preparation for outdoor activities, rarely or never).

2) ABILITY TO ACT

There are several ways to measure people’s perception of their own ability to act: the “locus of control” scale (Rotter 1954, 1966) measures to what degree people believe they can control events which affect them. The scale consists of two subscales (internal and external) with two 5-point Likert-type items each. Internal locus of control refers to people’s belief that they can control their personal life. External locus of control refers to people’s belief that their life is controlled by fate or other external factors they cannot control. Second, self-efficacy (Bandura 1977) measures people’s individual belief that they can rely on their own competence if dealing with day-to-day difficulties (Hinz et al. 2006). For this study, an additional third scale was created to focus directly on the self-perceived ability to act on severe weather threats. Unlike the previous scales, it is not taken directly from the literature. Instead the items were developed during the pretest phase. The

⁵ As education does not necessarily have to correlate with knowledge about weather, participants were also asked multiple-choice questions (true/false) about weather-related terminology and behavior (Keul and Holzer 2013) and familiarity with severe weather alerts (Ripberger et al. 2015). Despite positive signals from the pretest phase, the reliability analyses revealed that only one out of four questions met the requirements ($\alpha > 0.6$). Therefore, this scale was not used for the further analysis. It is recommended that further studies add more questions regarding meteorological knowledge in the questionnaire in order to choose from a broader range of items.

scale includes three 5-point Likert-type items ($\alpha = 0.6$) measuring people's belief in their own capability to protect themselves against severe weather (item 1: "I personally have good options to promptly safeguard myself and my belongings against an imminent severe weather threat"), their capability to inform themselves (item 2: "I personally have good options to inform myself about imminent severe weather threats in time"), and that gathering this information is one's own duty (item 3: "It's up to me to inform myself independently and in time about imminent severe weather threats"). While items 1 and 2 also tackle the issue of self-efficacy, item 3 mainly addresses the question whether people perceive themselves as being responsible for being informed about potentially damaging events.

The scale measuring self-perceived ability to act correlates significantly with self-efficacy ($r = 0.425$, $p < 0.001$), and internal locus of control ($r = 0.348$, $p < 0.001$). In this regard and for space considerations, only the results of the more specific "ability to act" scale will be presented in the results section below.

3) CONFIDENCE, TRUSTWORTHINESS, AND DESIRE FOR CERTAINTY

In risk perception and communication research, the distinction between confidence and trust has proven to be useful (Frick and Hegg 2011; Luhmann 2000; Siegrist and Cvetkovich 2000; Siegrist 2001). While trust refers to the reliability of the information source and the informant (Frick and Hegg 2011; Ripberger et al. 2015), confidence refers to "experience or evidence that certain future events will occur as expected" (Siegrist 2001). In the latter case, any feelings of trust are nonexistent (Siegrist 2001). Here, confidence in forecasts refers to people's belief in the reliability of a weather forecast.

Confidence in weather forecasts was measured by seven 5-point Likert-type items ($\alpha = 0.9$) ranging from 1 (very low) to 5 (very high). The scale includes an item representing a statement about general confidence in weather forecasts (item 1: "How high is your general confidence in the accuracy of weather forecasts?") and correspondingly phrased statements about people's confidence in 2-day forecasts (item 2, 3, and 4; $\alpha = 0.8$) and 7-day forecasts (item 5, 6, and 7; $\alpha = 0.9$) of temperature, chance of precipitation, and amount of precipitation. The items representing different forecast lead times and content were adapted from Morss et al. (2008).

Contrary to the question about confidence in a given forecast, the questions about trustworthiness, or more precisely about integrity (Mayer et al. 1995), aimed at people's views on the source of the (uncertain) information. This might be the national or regional

meteorological service or the media in general. Uncertainty is a "fundamental characteristic of weather" (National Research Council 2006). It is assumed that being open and transparent about uncertainty will enhance trustworthiness and confidence in the quality of scientific output (Johnson and Slovic 1995). The items are loosely based on items by Johnson and Slovic (1998), who investigated lay people's views on environmental health risk assessments. They showed that the participants of their study consider the presentation of uncertainty as honest and competent. In the case of this study the question is whether or not forecasts that contain uncertainty information are seen as signaling honesty, and thus as trustworthy, and have an effect on the decision to act. The scale consists of two Likert-scale-items ($\alpha = 0.6$) related to people's belief that non-deterministic information shows that the provider of such a forecast does not fully understand the situation and is trying to hide a lack of knowledge (item 1: "If meteorologists were honest about the size of a hazard, they would not use probabilities but one unambiguous number"; item 2: "Probabilities in weather forecasts are used in order to hide lack of knowledge, because the situation could not be entirely apprehended"). Note the negative direction of the scale: the higher the values, the lower the trust.

In their study, Johnson and Slovic (1998) also found that people want to be provided with probabilistic information and do not have a desire for certainty or demand deterministic information. For this study, the items used in the study by Johnson and Slovic (1998) were adapted for weather risks. Here, the "desire for certainty" scale ($\alpha = 0.7$) included people's rejection of probabilistic information and a preference for deterministic information (item 1: "If severe weather is likely to happen, I do not want to hear assumptions or speculations. I want to know whether it will occur or not"), their preferences for expert opinions instead of self-assessments (item 2: "I want experts to tell me whether or not I am threatened by severe weather instead of having to draw my own conclusions from the information available"), and their opinion that weather forecasts have to be deterministic (item 3: "A professional and reliable weather forecast uses single and concrete numbers") and that warnings are always aligned with high risks (item 4: "Weather warnings are only issued when there is a high risk for the people affected").

c. Data collection, sample characteristics, and data analysis

The whole questionnaire was written in German and pretested with 23 scientists and students from Freie Universität Berlin in March 2014. Between 28 April and

TABLE 2. Sociodemographics of the study sample ($n = 1342$) in comparison to the Berlin census data [Sources: *Afs (2012a), **Afs (2012b), ***Destatis (2013)].

	Study sample	Census data Berlin
Gender (% , women)	48	51*
Age (median)	35–44	35–44*
Household income (median, monthly)	1000–2000 €	1500–2000 €*
Education (% , college entrance qualification)	56	35.2*
Mobility status (% , resident > 10 yr in Berlin)	77.4	40.9**
Housing status (% , tenancy)	82.1	84.4***

13 May 2014 a total of 1405 residents of Berlin, Germany (aged 18 to 90) were recruited through an online-access-panel provider to participate in an online survey. Of these, 63 “speeders” (people answering the questionnaire in less than 1/3 of the overall median time of approximately 15 min) were excluded, leaving a total of 1342 completed questionnaires.

A summary of the sample (Table 2) reveals broad similarities to the Berlin census data (Afs 2012a,b; Destatis 2013), with the exception that the study sample has a higher number of participants that have been resident in Berlin for more than 10 years and shows slightly higher levels of education. The sample has a very high percentage of tenants, which is typical for Germany, especially for Berlin. Although most people live in multifamily houses (30.5%) or in apartment buildings (41.6%), a majority state that they have a balcony (66.5%) or a garden (29.5%). This issue will be discussed in more detail at a later point of this paper.

The weather conditions during the survey period were calm and temperatures were unremarkable for the season. No frost occurred. However, the participants should be used to frost, as Berlin usually experiences temperatures below 0°C on half of the winter days. No extraordinary low temperatures occurred during the winter of 2013/14 before the survey.

The data analysis was performed using SPSS 22, software used for statistical analysis in social science. The analysis included calculations of relative frequencies, cross tabulations, and comparisons of means. Statistical significance was determined using ANOVA as well as a Kruskal–Wallis test and Friedman test among repeated measures as nonparametric models. Post hoc tests were performed using Dunn–Bonferroni pairwise comparisons. For a binary response Cochran’s Q test was used. Nonparametric tests were used if the sample was not normally distributed and thus did not meet the necessary assumptions for parametric tests. Normality of the sample was tested via visual inspection of the histograms and measuring skewness and kurtosis of the distribution. If either score divided by its standard error is greater than ± 1.96 , it suggests that the sample is not normally distributed (Cramer 1998; Doane and Seward

2011). The analysis of the decision scenario was split into two parts. First, frequencies of the two major response options of each scenario as stated above were calculated in order to determine people’s willingness to act. Second, the mean probability thresholds for each scenario were calculated for people who were willing to act.

3. Results

With regard to the three research questions posed in the introduction, the results of the survey will be presented as follows: First, we look at willingness to act and general decision thresholds as addressed in the research questions 1 and 2. Finally, we look at the influence of the factors (as described in section 2b) on the probability thresholds as addressed in research question 3.

a. Willingness to act and general decision thresholds

Results show that 306 out of 1342 people (22.8%) stated that they would not act based on the slight frost forecast in the described situation of the “baseline scenario” (see Fig. 1). The mean threshold of the remaining 1036 is 46.4% probability for frost [standard deviation (SD) = 24.4]. The number of people not willing to act is reduced to 160 (11.9%) if severe frost is forecasted (scenario 2). Here the mean threshold of the remaining 1182 participants is 38.8% (SD = 29.7). 310 (23.1%) would not act if the forecast indicates slight frost but the plants at risk are of higher value (scenario 3). The mean decision threshold for this scenario is 39.9% (SD = 26.6, $n = 1032$). The number of nonaction is again reduced in the “severe/valuable scenario” to 169 (12.6%) if severe frost is forecasted and valuable plants are endangered. Here, the mean decision threshold is 35.7% (SD = 30.5, $n = 1173$). Across all scenarios 128 participants (9.5%) chose not to act in any of the four scenarios, while 98 participants (7.3%) chose not to act in scenarios 1 and 3 (less severe events) and only 4 participants (0.3%) chose not to act in scenarios 2 and 4 (more severe events).

Concerning research question 1, it is striking that more people decided to act in the scenarios involving a more severe weather threat (scenarios 2 and 4) than in the other. A Cochran’s Q test determined that there

FIG. 1. Number of participants choosing not to act and probability threshold for action with 95% confidence interval (CI) for each scenario (scenario 1: slight frost; scenario 2: severe frost; scenario 3: slight frost, high value; scenario 4: severe frost, high value; see Table 2).

was a significant difference among the four subscenarios ($\chi^2 = 268.93$, $df = 3$, $p < 0.001$). With regard to research question 2, mean thresholds are lower in all scenarios involving either severe weather or property of special value (scenarios 2, 3, and 4) compared to the initial baseline scenario. A nonparametric Friedman test of differences among repeated measures was conducted and rendered a chi-square value of 712.5, which was significant ($p < 0.001$). Additionally, probabilities in scenarios involving severe frost (scenarios 2 and 4) scatter slightly more (i.e., have higher standard deviations), indicating that people answered less consistently in these scenarios. The implications will be further discussed in section 4. The following subsection show the results with regard to research question 3.

b. Influence of sociodemographic and socioeconomic variables on the decision threshold

Education was measured by people's highest degree level and grouped following the German school system into low education level (no secondary school graduation and lower secondary education), middle education level (secondary education without college entry qualification), and high education level (upper secondary education with college entry qualification). Results show that people with higher education are more likely to state a lower threshold of probability that makes them to take protective measures than people with lower education. Education had a significant effect on thresholds involving severe frost in scenarios 2 and 4

(Kruskal–Wallis test, scenario 2: $\chi^2 = 32.205$, $df = 2$, $p < 0.001$; scenario 4: $\chi^2 = 41.659$, $df = 2$, $p < 0.001$),⁶ but no significant effects on the two other. A post hoc test using Dunn–Bonferroni pairwise comparisons revealed significant differences between high education and middle education ($p < 0.001$) and high education and low education ($p < 0.001$) for the severe frost scenarios (2 and 4), and significant differences between middle education and low education ($p = 0.043$) for scenario 4. Please note that education is slightly correlated with other sociodemographic and socioeconomic variables, namely income ($r = 0.218$, $p < 0.001$), age ($r = 0.161$, $p < 0.001$), and housing status ($r = -0.167$, $p < 0.001$, meaning more educated people tend to own a house rather than rent it).

A one-way ANOVA yielded no significant effect of gender on the mean thresholds in the four scenarios. Generally, the relationship between gender and protective action is highly context dependent and often unclear [for further discussion see, e.g., Silver and Andrey (2014) and Werg et al. (2013)].

Age had a significant effect on thresholds in the severe frost scenario (Kruskal–Wallis test, scenario 2: $\chi^2 = 16.784$, $df = 5$, $p = 0.005$) but no significant effects on the other scenarios. A post hoc test revealed significant differences between the age group 18 to 24 years and 55 to 64 ($p = 0.007$) for scenario 2, but no significant differences between the other age groups in this scenario. In the severe frost scenario thresholds drop to 30.9% in the group aged 18 to 24 years, and increases to 44% in the group aged 55 to 64.

Housing status had a significant effect on thresholds in all but the “valuable scenario,” scenario 3. (Kruskal–Wallis test, scenario 1: $\chi^2 = 3.974$, $df = 1$, $p = 0.046$; scenario 2: $\chi^2 = 4.89$, $df = 1$, $p = 0.027$; scenario 4: $\chi^2 = 4.524$, $df = 1$, $p = 0.033$). Tenants are more likely to state a higher threshold in these scenarios than homeowners. Participants were also asked if they have a garden or a balcony. Results show a significant effect of having one or none of them on the mean thresholds in all but the baseline scenario (ANOVA, scenario 2: $F_{1,1180} = 9.049$, $p = 0.003$; scenario 3: $F_{1,1030} = 3.888$, $p = 0.049$; scenario 4: $F_{1,1171} = 6.669$, $p = 0.01$). Having either a garden or balcony leads to higher decision thresholds (Fig. 2).

The effect of urban settings, like housing status or housing type, on risk perception and protective action has been widely discussed in the literature (Biernacki et al. 2008; Burton et al. 1993; Wachinger et al. 2013).

⁶ All means and standard deviations for all four scenario thresholds are presented in appendix B.

FIG. 2. Mean threshold of sociodemographic and socioeconomic variables for all four scenario thresholds: (a) education, (b) gender, (c) age, (d) possession of garden and/or balcony, (e) tenancy/housing status, and (f) direct experience (95% CI).

In contrast to most privately owned rural houses, urban houses such as apartment buildings and tower blocks are much more difficult to individually secure against weather events as the owner's permission

is often required to make adjustments. Therefore, homeowners are more sensitive to natural hazards than tenants, and rural dwellers are more likely to protect their homes than their urban counterparts

(Biernacki et al. 2008; Burton et al. 1993; Grothmann and Reusswig 2006). This is consistent with findings in the present study as results show that tenants stated higher thresholds in the scenarios involving more severe frost (scenarios 2 and 4) than people who own their houses.

c. Influence of hazard experience on the decision threshold

Results show that the participants in general stated low to medium direct experience with severe weather (personal affliction, item 1: mean = 2.17, SD = 0.88; neighborhood, item 2: mean = 2.13, SD = 0.91; within city, item 3: mean = 2.54, SD = 0.92). Statements have been grouped in two bins (low experience, high experience) separated by using the median of the data (low experience: $n = 655$, 48.8%; high experience: $n = 447$, 33.3%; missing: $n = 240$). Direct experience had significant effects on thresholds in scenarios 2 and 4 involving severe frost (Kruskal–Wallis test, scenario 2: $\chi^2 = 4.859$, $df = 1$, $p = 0.028$; scenario 4: $\chi^2 = 10.133$, $df = 1$, $p = 0.001$). Results show that the higher the level of direct experience, the higher is the decision threshold in all scenarios (Fig. 2).

With respect to media use, 69.4% of the participants stated that they use weather forecasts daily and further 23.3% use them several times a week. Also, 80.6% of survey participants stated that they use TV as one source of information, followed by radio (61%), Internet websites (60.9%), apps (58.1%), and daily newspapers (23.5%). Only 5.3% use Short Message Service (SMS) or e-mail notifications. Hence, traditional mass media are still the primary source of weather information, a matter noted as well in other studies (Biernacki et al. 2008; DWD 2006). However, in contrast to direct experience, results show no significant effect of indirect experience on decision thresholds: neither frequency of media use nor usage of different media sources alters decision thresholds significantly.

Hazard exposure of property and direct experience of severe weather events (either first-hand or passed on by family or neighbors) can lead to an increased awareness and improve general protective behavior (Biernacki et al. 2008; Bubeck et al. 2013). However, there are also examples for the opposite effect: “low severity and seldom experienced events can produce a false sense of security/misjudgement of ability to cope. [...] individuals who had previous experience with a hazard event and who did not experience personal damages are more likely to believe that a future event will unlikely affect them and, therefore, their risk perception decreases” (Wachinger et al. 2013, p. 1052). In addition, awareness does not necessarily have to be translated

into behavior that would otherwise be anticipated (Biernacki et al. 2008).

Indirect experience (media use) had no significant effect on any decision threshold in this study. This is consistent with findings from other studies (Biernacki et al. 2008). In this case, it might partly be due to non-differentiating results: nearly 70% of the participants use weather forecasts daily and over 90% use them more than once a week. Furthermore, people use all kinds of media sources and only few rely on TV or radio, or on websites and phone apps, as a sole source. As Siegrist and Gutscher (2006) pointed out, media coverage is not that important if someone has had direct experience with the hazard in the past. Since frost is not an unusual weather event in the study area, it can be assumed that people are familiar with the hazard to a certain extent. Of course this would change if someone faced an unfamiliar hazard.

d. Influence of self-perceived ability to act on the decision threshold

For the analysis, the continuous self-perceived ability to act scale has been grouped into four bins (width: one standard deviation): very low (relative frequency of values: 14.5%), low (34.4%), high (32%), and very high (19%). People's self-perceived ability to act had a significant effect on the decision thresholds in all but the baseline scenario (Kruskal–Wallis test, scenario 2: $\chi^2 = 8.719$, $df = 3$, $p = 0.033$; scenario 3: $\chi^2 = 8.612$, $df = 3$, $p = 0.035$; scenario 4: $\chi^2 = 12.035$, $df = 3$, $p = 0.007$). The higher the self-perceived ability to act the lower is the decision threshold (Fig. 3). A post hoc test revealed significant differences between very low and very high levels of ability to act for scenario 2 ($p = 0.035$), scenario 3 ($p = 0.043$), and scenario 4 ($p = 0.004$) and significant differences between very low and low in scenario 4 ($p = 0.049$). That there are no significant differences for the baseline scenario suggests that ability to act does not matter much in everyday situations, but becomes important when event severity and value of the property at risk increase. In these situations (scenarios 2–4), people with a very low level of self-perceived ability to act report consistently higher thresholds for action, reflecting their lack of efficacy. In contrast, people with higher levels of self-perceived ability to act report consistently lower thresholds for action, reflecting their efficacy when a risk of any level is posed. This becomes most explicit in scenario 4, where all but the people with very low level of ability to act report lower thresholds for action, suggesting that most groups would act in the riskiest of situations.

FIG. 3. Mean decision thresholds for self-perceived ability to act on all four scenario thresholds (95% CI).

High self-perceived ability to act and self-efficacy seem to be important drivers for protective action. This can be linked to the fact that protection measures in case of meteorological hazards are mostly individual in nature and generally refer to protecting oneself or to protecting moveable items, such as securing objects on the balcony or moving them indoors, moving cars to safer places, or avoiding staying outdoors (Kox 2015). Likewise, Biernacki et al. (2008) found that people see storm protection measures, in contrast to flood protection, as their own responsibility rather than that of the government, as most wind protection measures were seen as much more of individual nature. To develop adequate warnings it is of great importance whether people see the responsibility for protection as lying in their own hands or in the hands of others such as the government (Wachinger et al. 2013).

e. Influence of confidence, trustworthiness, and desire for certainty on the decision threshold

In general survey participants correctly expressed more confidence in 2-day temperature forecasts (mean = 3.83, SD = 0.78) than in 2-day forecasts of chance of precipitation (mean = 3.43, SD = 0.82) or amount of precipitation (mean = 3.08, SD = 0.86), as “precipitation tends to be more challenging to forecast than temperature due to its greater spatial and temporal variability” (Morss et al. 2008, p. 979). Likewise, they correctly judged 2-day forecasts as more accurate (or more skillful) than 7-day forecasts (Balzer 1994; Murphy and Brown 1984) by expressing less confidence in longer-lead-time forecasts (7-day temperature forecasts, mean = 2.86, SD = 0.93; 7-day chance of precipitation

forecasts, mean = 2.5, SD = 0.91, 7-day amount of precipitation forecasts, mean = 2.33, SD = 0.94). However, people’s confidence in forecasts had no significant effect on decision thresholds in all four scenarios. Neither the overall confidence in forecast scale nor the general confidence in the weather forecast item (item 1) nor confidence in 2-day forecasts (items 2, 3, and 4) revealed significant effects. In contrast, trustworthiness (related to the use of nondeterministic information) had a significant effect on thresholds in all four scenarios (Kruskal–Wallis test, scenario 1: $\chi^2 = 22.174$, $df = 4$, $p < 0.001$; scenario 2: $\chi^2 = 44.502$, $df = 4$, $p < 0.001$; scenario 3: $\chi^2 = 26.425$, $df = 4$, $p < 0.001$; scenario 4: $\chi^2 = 58.130$, $df = 4$, $p < 0.001$). The higher the trustworthiness, the lower the decision thresholds in all four scenarios (Fig. 4). A post hoc test revealed significant differences in scenario 2 between mid and low trustworthiness ($p = 0.003$) and mid and very low ($p = 0.001$) and in scenario 3 between mid and low ($p = 0.02$) and mid and very low ($p = 0.015$), and in scenario 4 between very high and very low ($p = 0.021$), high and very low ($p = 0.005$), mid and low ($p = 0.005$), and mid and very low ($p < 0.001$). Additionally, there is a significant correlation between trustworthiness and education ($r = -0.343$, $p < 0.001$; higher education, less distrust⁷). Although the expression of confidence in weather forecasts is not directly related to the level of knowledge about forecast uncertainty, it can give an idea about people’s perception of weather forecasts and their understanding of the inherent uncertainty (National Research Council 2006). It can be assumed that there is also a link between trust and the level of knowledge about risks: most people do not have the knowledge needed for a rational risk assessment associated with most complex situations (like weather conditions). They therefore rely on expert assessments (such as weather forecasts and warnings). However, if self-knowledge is perceived as being adequate to assess the risks, people will make their own judgments (Siegrist and Cvetkovich 2000). The less knowledge someone has about a risk (and its embedded uncertainty), the less he/she trusts in his/her own personal judgment and the more he/she trusts the advice of authorities and their appraisals of the situation (Luhmann 2000; Siegrist and Cvetkovich 2000).

Similarly, people’s desire for certainty had a significant effect on thresholds in all four scenarios (Kruskal–Wallis test, scenario 1: $\chi^2 = 16.268$, $df = 4$, $p < 0.005$; scenario 2: $\chi^2 = 17.8$, $df = 4$, $p < 0.005$;

⁷Please keep in mind the negative direction of the trustworthiness scale.

FIG. 4. Mean decision thresholds for (a) trustworthiness and (b) desire for certainty on all four scenario thresholds (95% CI).

scenario 3: $\chi^2 = 12.995$, $df = 4$, $p < 0.05$; scenario 4: $\chi^2 = 16.289$, $df = 4$, $p < 0.005$). The higher the desire for certainty is, the higher the decision thresholds are (Fig. 4). A post hoc test revealed significant differences in scenario 1 between very high and very low ($p = 0.001$), very high and low ($p = 0.007$), and high and very low ($p = 0.019$); in scenario 2 between very high and high ($p = 0.04$), very high and low ($p < 0.001$), very high and very low ($p < 0.001$), high and low ($p = 0.039$), and high and very low ($p < 0.001$); in scenario 3 between very high and low ($p < 0.001$), very high and very low ($p < 0.001$), high and low ($p = 0.039$), and high and very low ($p = 0.023$); and in scenario 4 between very high and high ($p = 0.015$), very high and low ($p < 0.001$), very high and very low ($p < 0.001$), high and low ($p = 0.02$), and high and very low ($p < 0.001$). One possible explanation is that some people may prefer being told what to do and whether a situation is safe or unsafe, as uncertainty may disturb them (Johnson and Slovic 1995). Therefore, it is not surprising that people who have a strong desire for certainty act when the weather forecast is comparatively more unambiguous and clearer in their opinion.

4. Discussion and limitations

This paper focuses on whether it is possible to identify thresholds of numerical weather forecasts at which the public would start protective action, and whether the decision to act is influenced by the severity of the event, the value of property at risk, or other influencing factors. First, the results show that people's willingness to act tends to be higher the more severe the forecasted weather event is. This supports the first part of the first research question stated in the

introduction. Most people seem to have a good sense for threat of frost and it is therefore not surprising that they are more likely to act in severe frost scenarios, as the likelihood for potential damage to the plants rises the lower the temperatures drop. This general outcome illustrates that the surveyed people understood the scenario, created valid data, and thus enabled the consequent investigations on what factor influence the decision threshold. Second, mean decision thresholds tend to be lower in scenarios involving either severe weather or property of higher value (scenarios 2 to 4) compared to the low threat/low value baseline scenario (scenario 1). These findings support the second research question. A lower threshold can be interpreted as taking action at an earlier stage when a severe weather event is indeed likely to happen but there is still uncertainty as expressed by the probability of occurrence. On the other hand, a higher threshold can mean that people will take action later when a potential event is more likely to happen. In other words, a lower threshold can be interpreted as people being more risk-averse (i.e., they tend to avoid risk), and a higher threshold can be interpreted as people being more risk-taking or risk-seeking (e.g., Morss et al. 2010; Ramos et al. 2013).

Several of the presented factors have a significant effect on the mean decision thresholds, thus, supporting parts of research question 3. While some socioeconomic or sociodemographic determinants such as gender had less or no effects, education and housing status on the other hand had strong effects on scenarios involving more severe frost. Homeowners tend to be more risk-averse than people who rent their homes. These findings are in accordance with the relevant

literature as homeowners generally tend to be more sensitive to natural hazards than tenants and show more self-protective behavior (e.g., [Biernacki et al. 2008](#); [Burton et al. 1993](#); [Grothmann and Reusswig 2006](#)), whereas tenants might tend to choose moving to a safer place as risk-avoiding behavior, as indicated by [Thieken et al. \(2007\)](#) for flooding. As the survey took place solely in the urban settings of Berlin, differences in risk perception between rural and urban dwellers could not be addressed.

In the scenarios involving more severe frost, people with higher levels of education tend to be more risk-averse than people with less education. It might be that they are more aware of the potential consequences of a frost hazard. But this argument misses the possibility that graduation from school does not necessarily have to correlate with general meteorological knowledge or numeracy skills. Further work should address these issues separately (e.g., with individual items or scales) in order to get a more detailed picture.

In addition, people who have the experience of regularly exposing property to weather hazards (since they have access to a garden, a balcony, or both) and people who stated higher experience with severe weather tend to be more risk-seeking. At a first glance, this result comes as a surprise. One possible explanation might be that hazard experience and ownership of a garden or balcony led to the implementation of precaution measures, which leads to a more risk-seeking behavior as people feel more secure. Furthermore, constant confrontation with the consequences of frost might contribute to a better familiarity with the hazard and people think that they are more competent and therefore act more risk-seeking. However, it has to be noted that experience was measured with more general disruptive weather events such as thunderstorms and hurricane-force gusts, which does not necessarily have to match with experience of frost.

Overall, a high level of self-perceived ability to act and/or self-efficacy seem to be important drivers for protective action. But some questions remain: What are the reasons for low self-efficacy in this domain, and how can weather warnings better be addressed to these people?

A further interesting result is the allocated level of honesty or integrity⁸ of the provider of weather information regarding forecast uncertainty. Although stating uncertainty information is generally not

perceived as dishonest by the majority, some people see it as such. Those people tend to be more risk-taking (stating higher decision thresholds). This is consistent with the findings that low probability is often seen as preliminary rather than complete information and lower risk numbers are seen as either less accurate or less honest ([Johnson and Slovic 1995](#)). Or, as [Patt and Schrag \(2003\)](#) state, some people might believe that forecasts for extreme events are exaggerated in both probability and severity. This can lead to the problem that the perceived urgency for protective action is reduced when it is most important ([Joslyn and Savelli 2010](#)).

Individual risk perception is not solely tied to objective criteria such as the magnitude and frequency of a hazardous event; instead it is also based on individual experience, sensation, motivation, socialization, and cultural background ([Renn et al. 2007](#)). Therefore, laypeople's understanding of the role of uncertainty in "good science" might lead them think differently about risks than experts ([Johnson 2003](#)). When communicating forecast uncertainty, it is important to understand that the forecasts users do not appear as a homogeneous group ([Demuth et al. 2011](#); [Kox et al. 2015](#); [Silver and Conrad 2010](#)) and "no single representation suits all members of an audience" ([Spiegelhalter et al. 2011](#), p. 1399). It is therefore recommended to use uncertainty information in weather forecasts, as it allows "users to tailor the forecast to individual risk tolerances" ([Joslyn and Savelli 2010](#), p. 181).

Still, there are some common limitations when using such a scenario in a questionnaire survey. All respondents were asked the same questions and received all four subscenarios in sequence. The questions were not randomized to control for order effects. Note that the scenario describes a fictional situation and the participants had only the choice whether or not to relocate the plants, but could not choose an adjustment measure such as purchasing insurance, using heating equipment, or providing shelter. Furthermore, the hypothetical scenario suffers from a lack of real consequences (e.g., losses) for the decisions and people might be less risk-seeking in real-life decisions. Such aspects may best be addressed using a real-life environment and studying real-life decision making (resulting in real-life consequences) using ethnographic research approaches such as observations. Professional users of weather information such as road maintenance crews, renewable energy operators, or emergency services might be appropriate target groups for such an investigation.

⁸ Note that there are more dimensions of trust that are not addressed here. For further discussion see, e.g., [Mayer et al. \(1995\)](#).

5. Conclusions

This paper showed that when making decisions on protective behavior the severity of an event and the value of the property at risk, or in other words the consequences of not taking actions, alter the decision thresholds significantly. The results show that people's willingness to act tends to be higher and mean decision thresholds tend to be lower (indicating risk-averse behavior) in scenarios involving more severe weather or high value property. Additionally, the thresholds are influenced by different factors based on socialization and cultural background such as individual experience, education, housing status, and ability to act, whereas classic sociodemographic determinants alone are often not sufficient to fully grasp risk perception and protection behavior. Please note that the factors discussed here are not meant to provide an exhaustive list of the many other factors that may affect protective action. Such an analysis would be beyond the scope of this work.

Weather services should recognize that the public is not a homogeneous group of end users. It is therefore recommended to communicate the uncertainty inherent in weather information so that users can tailor the forecast to individual risk tolerances. Wherever possible this should be an integrative and transdisciplinary process involving provider and user of the information, as it might be difficult to assess such risk tolerances. Furthermore, such a discussion would enable the weather services to recognize specific regional weather features and individual capabilities, and, overall, might contribute to a deeper understanding of numerical weather information.

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APPENDIX A

Design Garden Scenario

The "Garden Scenario" discussed in this paper is presented below. Please note that the original questionnaire was in German. The formatting has been altered for space considerations. The scenario was placed half way through the questionnaire and split on two pages.

Imagine you own a garden center. For a long planned garden show in spring, some plants have been placed outside some days before. Some of the plants are *sensitive to frost*.

A day prior to the garden show you listen to the weather forecast for the coming night. The forecast indicates a probability for frost. Starting from which level of probability for frost would you take action, if you relied exclusively on this weather forecast?

1. Scenario

The forecast for the coming night predicts *slight frost* (temperature below 0°C). Which probability for slight frost would motivate you to place all plants back into the greenhouses for the night?

- a) I'd place all plants back if forecasts indicate a probability of. . .
- b) I would under no circumstances place back the plants.

2. Scenario

severe frost (temperature below -10°C)

- a) I'd place all plants back if forecasts indicate a probability of. . .
 - b) I would under no circumstances place back the plants.
- **next page**

The Botanic Garden decided to place some additional, *especially valuable plants* outside which are also sensitive to frost.

3. Scenario

slight frost (temperature below 0°C)

- a) I'd place all plants back if forecasts indicate a probability of. . .
- b) I would under no circumstances place back the plants.

4. Scenario

severe frost (temperature below -10°C)

- a) I'd place all plants back if forecasts indicate a probability of. . .
- b) I would under no circumstances place back the plants.

APPENDIX B

Outcome Variables for Scenario Thresholds

The means and standard deviations of the outcome variables for the four scenario thresholds described in [Appendix A](#) are presented in [Table B1](#) in order of appearance in the paper.

TABLE B1. Means (in %) and standard deviations of the outcome variables for all four scenario thresholds in order of appearance in the paper.

			Scenario 1	Scenario 2	Scenario 3	Scenario 4
Level of education	Low	Mean	51.41	49.51	42.99	50.68
		Std dev	24.39	32.22	27.07	33.93
		N	76	83	71	81
	Mid	Mean	47.77	43.84	41.97	40.91
		Std dev	25.85	31.17	28.22	32.38
		N	325	390	322	386
	High	Mean	44.89	34.44	38.4	30.68
		Std dev	23.47	27.62	25.83	27.8
		N	608	677	610	673
Gender	Men	Mean	46.35	38.68	40.97	36.13
		Std dev	24.33	30.46	26.7	31.21
		N	488	547	490	543
	Women	Mean	46.38	38.9	39.11	35.35
		Std dev	24.32	29.03	26.46	30.04
		N	544	631	538	626
Age	18–24	Mean	44.33	30.9	38.91	27.37
		Std dev	20.76	24.06	24.31	23.14
		N	118	126	111	125
	25–34	Mean	45.09	34.12	37.58	32.08
		Std dev	20.87	24.6	23.71	26.18
		N	232	248	236	253
	35–44	Mean	45.72	37.08	38.04	34.07
		Std dev	25.52	27.55	25.91	27.96
		N	186	225	190	223
	45–54	Mean	47.63	41.43	41.87	38.73
		Std dev	25.14	32.36	27.51	33.81
		N	264	295	260	287
	55–64	Mean	49.42	44.07	43.91	39.53
		Std dev	27.05	31.80	29.98	33.15
		N	189	228	186	225
	65–90	Mean	39.95	46.88	34.26	45.1
		Std dev	28.23	39.1	26.21	39.44
		N	39	49	42	49
Housing status	Owner	Mean	43.15	35.47	37.57	32.42
		Std dev	25.81	30.13	27.66	30.83
		N	184	216	188	210
	Tenant	Mean	47.11	39.57	40.5	36.42
		Std dev	23.99	29.58	26.3	30.45
		N	852	966	844	963
Household with garden and/or balcony	No	Mean	44.91	32.87	36.38	30.49
		Std dev	22.81	26.3	25.64	28.37
		N	170	188	176	191
	Yes	Mean	46.7	39.95	40.7	36.71
		Std dev	24.65	30.19	26.71	30.86
		N	866	994	856	982
Direct experience	Low	Mean	45.89	37.49	39.01	33.7
		Std dev	24.52	29.08	26.3	29.56
		N	506	592	512	587
	High	Mean	47.01	42.13	42.95	40.32
		Std dev	23.86	30.82	27.53	31.55
		N	339	374	329	373
Self-perceived ability to act	Very low	Mean	47.25	44.78	43.86	42.54
		Std dev	24.73	31.18	28.16	32.32
		N	142	170	134	166
	Low	Mean	46.6	36.73	41.13	34.31
		Std dev	23.72	27.26	26.96	28.52
		N	336	383	334	382

TABLE B1. (Continued)

			Scenario 1	Scenario 2	Scenario 3	Scenario 4
Trustworthiness	High	Mean	46.72	39.11	39.87	35.52
		Std dev	42.21	29.79	25.53	30.27
		N	343	394	353	391
	Very high	Mean	45.06	37.45	35.81	33.43
		Std dev	25.44	31.84	26.23	32.36
		N	215	235	211	234
	1	Mean	42.15	29.66	33.72	25.22
		Std dev	22.75	25.16	24.94	26.53
		N	150	157	150	156
	2	Mean	41.54	32.34	35.04	29.02
		Std dev	21.8	27.39	24.83	28.03
		N	242	277	255	277
	3	Mean	47.89	40.35	41.9	37.07
		Std dev	24.21	29.29	25.8	30.09
		N	324	387	325	385
Desire for certainty	4	Mean	51.06	44.35	44.57	41.43
		Std dev	25.59	30.91	27.55	30.76
		N	216	244	207	237
	5	Mean	48.05	48.34	45.37	48.04
		Std dev	28.14	33	31.23	34.96
		N	88	99	82	100
	1	Mean	34.33	27.45	25.35	24.33
		Std dev	18.16	28.3	19.16	32.71
		N	21	22	20	21
	2	Mean	41.52	29.48	33.95	27.53
		Std dev	23.47	23.54	24.83	25.91
		N	77	86	79	88
	3	Mean	43.78	36.69	39.62	34.47
		Std dev	22.37	28.24	25.65	29.54
		N	244	284	250	283
	4	Mean	46.83	38.95	39.39	35.2
		Std dev	23.51	29.06	25.31	29.46
		N	398	456	402	451
	5	Mean	49.79	43.4	43.55	40.1
		Std dev	26.92	32.37	29.28	33.22
		N	292	330	278	326

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