Risk perception, experience and objective risk: A cross-national study with European emergency survivors.

Abstract

Understanding public risk perceptions and their underlying processes is important in order to learn more about the way people interpret and respond to hazardous emergency events. Direct experience with an involuntary hazard has been found to heighten the perceived risk of experiencing the same hazard and its consequences in the future but it remains unclear if cross-over effects are possible (i.e. experience with one hazard influencing perceived risk for other hazards also). Furthermore, the impact of objective risk and country of residence on perceived risk is not well understood. As part of the BeSeCu (Behaviour, Security and Culture) project a sample of 1045 survivors of emergencies from seven European countries (i.e. Germany, Czech Republic, Poland, Sweden, Spain, Turkey and Italy) was drawn. Results revealed heightened perceived risk for emergency events (i.e. domestic and public fires, earthquakes, floods and terrorist attacks) when the event had been experienced previously plus some evidence of cross-over effects, although these effects were not so strong. The largest country differences in perceived risk were observed for earthquakes, but this effect was significantly reduced by taking into account the objective earthquake risk. For fires, floods, terrorist attacks and traffic accidents, only small country differences in perceived risk were found. Further studies including a larger number of countries are welcomed.

Keywords: risk perception, hazard experience, objective risk

1. INTRODUCTION

Emergency events such as building fires, terrorist bombings, floods and earthquakes are hazards which pose a threat to lives and property. Insurers and public sector professionals concerned with safety and security will be interested in the actual occurrence of such events in their own geographic regions and the harm/damage incurred consequently. However, they will also be interested in the "objective risk" calculated from this, i.e. the likelihood of these events and their negative consequences occurring to the average person, in order to better inform their work and protect the public. Yet the public's own perception of the risk connected to such events might also, in part, influence how well they are protected. Risk perception as a psychological construct is defined as a subjective judgment made by people when characterizing and evaluating hazards [(1, 2)]. Perceived risk, in turn, may be defined as the perceived likelihood of personally encountering a hazard[(3)] and the possibility of incurring negative consequences. Several studies have investigated a relationship between risk perception and preparedness and some have revealed that the greater the perceived risk associated with an emergency event, the better prepared people were for experiencing that event; i.e., with a flood they were more likely to raise heating, ventilation and electrical systems above flood level and add waterproof veneer to exterior walls[(4)]; plan their own escape in the event of a domestic fire and practice this plan [(5)]; and in the case of a terrorist attack, establish an emergency plan, have an emergency supply kit to hand and learn about public evacuation plans [(6)]. Although a direct positive relationship between perceived risk and emergency preparedness actions has been questioned [(7)], and has not been found for all emergency events that threaten lives and property (see for example Tekeli-Yesil et al.'s study involving earthquakes [(4)]), risk perception is still one factor (among others) which can increase the likelihood for the adoption of mitigation measures [(7)] and therefore help lessen the chances of suffering severe injury or property damage in an emergency.

How are public risk perceptions formed? The social amplification of risk framework (SARF)[8] states that psychological, social and cultural processes interact with hazard events, and this can either in- or decrease perceived risk and, in turn, influence behavior regarding these events. The SARF further emphasizes the importance of both direct personal experience with an event and indirect exposure through information about the event [8]. In this regard, the availability heuristic [9] might also be important in that people's probability estimations may be mediated by the possibility to recall events and similar cases in one's own environment [9]. Thus, for an emergency event, people's risk perceptions will likely be influenced by their own personal experience with that type of hazard. However, it is not clear whether this experience would also affect risk perceptions for other hazards. If this were true, it is possible that direct exposure to one emergency event might help prepare the public more widely for emergencies than first thought. It is also feasible that information about the objective risk, provided by insurers, emergency services' safety campaigns, health and safety notices and so forth, might have an influence, as well as media stories. The present study investigated the impact of hazard experience and objective risk on risk perception in a sample of European survivors of the following emergency events: A fire (in their home or a public building), a flood, an earthquake or a terrorist attack. Recognizing that the survivor data were nested within countries sampled, this study conducted multilevel modeling. This allowed analysis of the effect of hazard experience (at the individual-level) on risk perception plus the effect of objective risk (calculated based on geographic region and therefore a variable at the group, i.e. country-level). It further allowed for cultural aspects to be considered.

1.1 Hazard experience

Previous, direct experience with a hazard has been found to influence risk perception [10-18]. For instance, Ho et al. [12] compared risk perception for different types of hazardous event (i.e. earthquakes, floods, landslides, fires, environmental pollution and contagious diseases) and found that, out of the six events, floods and landslides were rated as most risky when participants had personally experienced such events. Furthermore, they found that the frequency of disaster experience was positively associated with the perceived likelihood of those disasters occurring again and the perceived threat to the participants' lives [(12)]. Other researchers who have looked at a single type of event have demonstrated that direct experience with that event (usually a natural hazard like a flood [(14, 17)], a hurricane[(19)], an earthquake [(13)], [(20)] but also bushfires [(21)]) can result in heightened perceived risk for that hazard. SARF theory proposes that heightened perceived risk arises because personal experience with events leads to those events being more memorable and easier to imagine [(8)]. However, other factors might also influence the effect of experience on risk perception. For example, a positive effect might only result if the hazard is considered "involuntary", i.e. an event that people would not normally choose to experience. Barnett and Breakwell [(10)] found a positive relationship between the frequency of directly experiencing an involuntary hazard (e.g. being in a hurricane, being in a motorway pileup) and concern about the risk the event poses. In contrast, the relationship was negative when the events were voluntary hazards (e.g. skiing, smoking). A recent review [(22)] which concluded that experience with natural disasters leads to an elevation of risk in most cases would be in line with this. As the current study was interested in what could be considered involuntary, memorable events, the following hypothesis was derived:

(1) Experience with a particular hazard will lead to elevated perceived risk for this hazard.

If experienced hazards are indeed more easily pictured in one's mind then should not other, similar forms of hazard also be easier to picture? Consequently, should not risk perception for other types of event also be influenced by hazard experience? From prior research the answer remains unclear. For example, one investigation, of residents' perception of a coastal flood risk [(14)], revealed higher perceived risk when participants had previously experienced floods but not when participants had experienced a storm surge. Also, in a study on the optimistic bias (i.e. the tendency to believe that the risk of experiencing a negative event is lower for one's self than for other people), Helweg-Larsen [(11)] found no evidence of this bias in a sample of earthquake survivors when the event was an earthquake but did find an optimistic bias for other events like fires and floods. Results like these would suggest that hazard experience only affects risk perception for the particular type of event experienced. On the other hand, other research [(15)] has demonstrated that flood experience may not only be positively correlated with perceived risk for floods but also with risk for hurricanes and chemical hazards. Thus it might be premature to make such a conclusion.

It is probably too simplistic to assume different hazards will be pictured and evaluated in a similar fashion because they may all be labeled as "negative" or "emergency events/ disasters". It may be that experience makes specific aspects of an event more marked in people's minds and it is those aspects that people consider when evaluating other hazards, although it is not clear what those aspects might be. The research examples above would argue against it being the physical or sensory aspects (e.g. floods and storm surges both involve raised water levels yet were not perceived in the same way [(14)]. Also floods, hurricanes and chemical hazards are very different in this respect yet risk perceptions for all were affected [(15)]). It is also unlikely to be the type and scale of the harm as the aforementioned events all posed the risk of serious injury/death, and to many as opposed to just a single occupant. Perhaps it is not so much a question of being able to picture certain aspects of the event but being able to picture one's self in the given context. Self-relevance is an issue in risk research as the questions often do not ask participants either explicitly or solely about the risk to themselves/their lives which might prevent or dilute attempts to recall related incidents/information and imagine going through such an experience. In the present study, the risk perception question was more clearly worded in this respect. Therefore the following second hypothesis was investigated:

(2) Experience with a particular hazard will affect perceived risk for at least some other hazards (i.e. *cross-over effect*).

1.2 Objective risk

Public risk perceptions have been compared to objective risk estimations based on hazard occurrence statistics [23] or expert judgments [14]. The results have been inconsistent but, in general, perceived risk for a given event has tended not to perfectly match the objective risk for that event [24, 23, 25-27]. Nonetheless, this does not mean there is no relationship between perceived and objective risk. For example, positive correlations between perceived and objective risk estimations have been found for floods [28, 14, 17], different causes of death [23] and problems like unemployment, inflation and crime [29]. It would stand to reason that if events occur less frequently, and would therefore be objectively rated as lower risk, this could also then lead to lower perceived risk: less frequent occurrences would mean that not only would an individual be less likely to directly experience the event, but so would other reference points (e.g. family, friends, colleagues). There would also likely be less indirect exposure from other sources too (e.g. information from emergency services, governments) as they would not view such events as a priority. Thus, rare events would be less available, less easy to picture, and therefore perceived as posing less risk. Of course, other sources of information, specifically the media, might behave differently with regards to rare events, lending disproportionate attention to such occurrences when they did happen[8].

However, it might be expected that governments and other protection agencies would react to this by releasing information about the objective risk to reassure the public that the incident was not a common event. Research [30] has hinted that people's risk perceptions can be manipulated by helping raise their awareness of the (low) incidence of a hazardous event. Swedish participants were first encouraged to think about the 2004 Tsunami – an event with which they had no direct experience – then engaged in an ease-of-thought generation task before rating perceived risk for different life events (e.g. having a heart attack before the age of 50, not finding a job, marrying someone wealthy, receiving job recognition). When the generation task was harder (i.e. participants were asked to list a further six natural disasters that had occurred), their perceptions of risk regarding the life events were less pessimistic than when the generation task was easy (i.e. list just two disasters). In fact, their risk perceptions were more in line with a control group who had not been encouraged to think about any natural disaster, including the tsunami. The authors concluded that the difficult generation task had made participants aware of the low probability of natural disasters and thus counteracted the negative effect induced by thinking about the original type of disaster (the tsunami) [30]. In the present study, the relationship between objective and perceived risk was tested directly, the third hypothesis being:

(3) Objective risk will influence risk perception.

1.3 Cultural and personal characteristics

Nationality and cultural factors also appear to be influential [31, 3]. People from countries such as Spain, Turkey and the UK have been found to display a constantly above average concern for the risk terrorism poses to their nation [32]. These country effects are believed to relate to the long-term history these countries have with terrorist attacks [32].

Furthermore, in a study comparing the risk perception of participants from Sweden, Spain, the UK and France [33], results indicated country differences in the perceived risk (to oneself and others combined) posed by hazards such as nuclear power; Swedish participants' risk ratings were lowest, followed by ratings from the UK, then Spain and finally France. It seemed that trust played a part in some of the variation, although was not a strong determinant. Moreover, a comparison between participants from Turkey and Norway [34], this time in relation to road traffic hazards, similarly revealed country differences in risk perception, which were related to attitudes and behavior when participants were from Norway but not from Turkey.

The current study sampled widely, across several countries. It was not clear from previous research exactly where or why national differences might be expected, nor what effect country of residence might have on perceived risk to one's self as opposed to others/the general public. Nevertheless, the following fourth hypothesis was tested:

(4) Perceived risk will differ between countries.

Finally, in addition to country of residence, other sociodemographic or personal characteristics have been reported to affect risk perception, e.g. higher perceived risk when participants are of female gender [35, 36, 12, 14, 15], older age [36, 14], married [37] or a lower level of education [36, 14], although it is questionable whether such factors have a strong effect [37]. Personal characteristics were taken into account in the current study also.

2. METHOD

2.1 Sample

As part of the EU-funded BeSeCu (Behaviour, Security and Culture) project a sample was drawn of 1112 citizens who had survived a fire in a domestic or public setting, an earthquake, a terrorist attack or a flood in one of the European countries where project partners were based (i.e. Germany, Czech Republic, Poland, Sweden, Spain, Turkey, UK and Italy). All participants gave their informed consent and met the following inclusion criteria: 1) at least 18 years of age; 2) the emergency services attended the incident; 3) the emergency did not happen any earlier than 1999. Participants' data were obtained through a self-report instrument (BeSeCu-S) which was the result of a cross-national development process [38] including literature review, expert consultations, focus groups with survivors and first responders and a pretest. Participants who did not provide data for all of the risk perception items (n=31) or their country of residence (n=3) were excluded from the present study. Furthermore people were eliminated if they currently lived in a country that was not one of the aforementioned European countries (n=5). The sample of UK participants had to be eliminated as well since this sample was too small for further analysis (n=28). The final sample comprised 1045 participants (94.0% of the total sample). There were no differences concerning gender ($\chi^2(1)=1.60$, $p=.206$), relationship status ($\chi^2(1)=0.23$, $p=.629$), education level ($\chi^2(2)=0.10$, $p=.949$) or age ($F(1,1069)=0.18$, $p=.674$).

2.2 Risk perception and hazard experience

Participants were asked: *In your opinion, how likely is it that, in the future, you will become a victim of the following emergency situations?* The situations covered the five different types of emergency event participants had survived as well as a traffic accident, the latter allowing for cross-national comparisons of a commonly high frequency emergency event. Perceived risk for each event was assessed on a scale from 0% to 100%.

Experience with one of the five emergency events of main interest was a main inclusion criterion for all BeSeCu project participants, but they were asked further about prior emergency experiences: *Before the incident occurred, had you ever experienced any of the* *following incidents? Please tick all that apply. (*Answer options were: *a fire in a home; a fire in a public building; an earthquake; a terrorist attack; a flood).*Hazard experience was then coded for each event as Yes vs. No.

2.3 Objective risk

Country-specific objective risk in this paper was based on available hazard occurrence data which are displayed in Table I. For each country, the number of events that occurred during a specific time period was multiplied by 100 and then divided by the mean population [(39)] of the country during this time period. For terrorist attacks, earthquakes and floods this number was divided by the number of years in the respective time period in order to get the one-year risk. The resulting one-year risk was then multiplied by the mean life expectancy of the country [(40)] which resulted in the corresponding lifetime risk (see Table II). Note, for earthquakes, floods and terrorist attacks, the objective risk was calculated using the data on being affected or injured by the event rather than the number of events in the time period.

*** Please insert Table I about here ***

*** Please insert Table II about here ***

2.4 Personal characteristics

Sociodemographic characteristics were recorded and coded as follows: Gender (Male vs. Female), Age (in years), Relationship (Yes vs. No) and Education (Low (1) vs. Medium (2) vs. High (3)). In addition to general education, participants' education related specifically to emergencies was assessed with the Emergency Knowledge Scale (EKS) which contained the following question: *Before the incident occurred, what knowledge did you have that* *would be of use in an emergency?* Seven different statements were assessed on a 5-point-Likert scale ranging from 1 (*not at all*) to 5 (*extreme*): *I had professional knowledge, gained from working for the emergency services; I had first aid knowledge, gained from a first aid course; I had fire safety knowledge, gained from being a warden/fire safety officer; I had taken part in fire drills at school; I had taken part in fire drills at work; I had read safety notices/evacuation plans in public places, such as in hotel rooms, train carriages, etc.;* and *I had thought about what would happen if an emergency occurred in such a location and had prepared my own evacuation plan.* Responses to the seven statements were aggregated and the mean score was used in analyses.

3. DATA ANALYSIS

The particular method of multilevel analysis used was restricted maximum likelihood (REML) estimation as it provides reasonable[(41)] variance estimates if a small number of groups is used [(42)]. The required number of groups for multilevel analysis is a contentious issue. Several researchers have put forward rules of thumb for a minimum number yet these differ wildly, e.g. 20 groups for every 30 individuals, 30 groups for the same number of individuals, 50 groups for 20 individuals, 100 groups for 10 individuals. While the authors of this paper agree that the more groups (and individuals per group, not an issue here) the better, we also agree with statisticians such as Gelman [(43)] who argue that while conducting multilevel modeling with a smaller number of groups may not be ideal, it may be optimal when the alternative is "classical" regression modeling which does not acknowledge the nested nature of the data and may produce results that are less easy to interpret.

A series of six analyses were run, the dependent variable being perceived risk for, in turn, a domestic fire, a public fire, a terrorist attack, a flood, an earthquake and a traffic accident. For each analysis a stepwise approach was used, starting with the intercept-only model which included just the dependent variable and country factor but no predictors (model 0). The constant for fixed effects represents the mean value of intercepts and the constant for random effects refers to the variance of the country-level. In the subsequent model, individual-level predictors were included (model 1). In the final model (model 2), the country-level predictor objective risk (for the same event as the dependent variable) was added. Since experience with a traffic accident was not assessed in this study (see Table IV), only the impact of other experiences on traffic perceived risk (i.e. cross-over effects) was investigated for that case. In all models the predictors age, education, emergency knowledge and objective risk were centered on their grand mean in order to facilitate the interpretation of the corresponding coefficients. The fit of the two models was compared with the likelihood ratio test and the amount of variance at the country-level was calculated using the intraclass correlation (ICC). The ICC can "be defined as the proportion of the variance in the outcome that is between the groups or higher level units." [44] Analysis of variance (ANOVA) and $\chi 2$ tests, as well as their corresponding effect sizes Cramers' *V* and *η*, were calculated using SPSS to test differences between countries. Multilevel analyses were conducted using STATA 11.0.

4. Results

4.1 Sample and descriptive results

Sociodemographic characteristics are presented in Table III while Table IV displays the hazard experience of this sample by country of residence. In total, the type of event experienced most often by participants was a domestic fire, with terrorist attacks experienced least. However, there were some differences in hazard experience across countries, e.g. markedly more experience with terrorism in Spain (30.1%) than in other countries (0.5-5.8%).

*** Please insert Table III and Table IV about here ***

The amount of prior emergency knowledge in this sample could be considered small or at best moderate (*M*=2.20, *SD*=0.87) with a range of *M*=1.93 (*SD*=0.69) in Italy to *M*=2.56 in Turkey (*SD*=1.14). Internal reliability in the present sample was good (Cronbach's α=.81). Perceived risk, irrespective of type of event, was always highest for people in Turkey and usually rather low for participants in Sweden (see Table V).

*** Please insert Table V about here ***

4.2 Intercept-only models

The intercept-only models (model 0) revealed a statistically significant amount of variation in perceived risk due to the country of residence (see Table VI). The amount of variance between the seven countries (ICC) ranged from 3% in public fire perceived risk to about 53% of the total variation in earthquake perceived risk. The variation at the individual-level (residual) was much greater than the variation on the country-level (constant) for all risks except for earthquakes.

*** Please insert Table VI about here ***

4.3 Random-intercept models

The first model of each analysis (model 1) only included the individual level variables. The results in Table VII and VIII demonstrate higher perceived risk for all events when participants were female. A negative relationship between age and perceived risk as well as a positive relationship between emergency knowledge and perceived risk was found for all events. Education had an impact on perceived risk for domestic fires, terrorist attacks, floods and earthquakes, with less-educated participants assigning higher perceived risk values in these cases. For all events, hazard experience was an important predictor for perceived risk. Experience with a particular event increased perceived risk for that event, although it had only a minor impact on perceived risk for other events.

Compared to model 1, model 2 – which now included the country-level variable objective risk – produced a significantly better model fit for perceived risk concerning terrorist attacks ($\chi^2(1)=6.66$, $p<.01$), floods ($\chi^2(1)=4.72$, $p<.05$) and earthquakes ($\chi^2(1)=13.86$, $p<.001$). Models 1 and 2 for perceived risk concerning traffic accidents ($\chi^2(1)=-1.58$, $p=1.00$), domestic fires ($\chi^2(1)=0.53$, $p=.469$) and public fires ($\chi^2(1)=-0.17$, $p=1.000$) did not differ significantly from one another. Compared to the intercept-only models there was a significant reduction in country-level variance now for all models. Objective risk not only explained a great amount of country-level variance concerning perceived risk for terrorist attacks and earthquakes but it was also a significant predictor which was positively associated with perceived risk for these events. The greatest amount of country-level variance (88%) was explained by model 2 for earthquake perceived risk. The ICC decreased from .53 in model 0 to .12 in model 2. Concerning terrorist attack perceived risk, 78% of country-level variance was explained by model 2. Almost a quarter of the country-level variance for traffic accident perceived risk (24%) was explained by model 2. For domestic fire perceived risk an increase in country-level variance was detected (from model 0 to model 1). Perceived risk concerning public fires and floods was reduced by including the individual level variables (model 1) but not by including the objective risk (model 2). The amount of explained variance at the individual level also varied across perceived risk for the different events (i.e. 3% for domestic fires, 6% for traffic accidents, 9% for public fires, 16% for terrorist attacks, 21% for floods and 51% for earthquakes in model 2).

*** Please insert Table VII and VIII about here ***

5. DISCUSSION AND LIMITATIONS

The present study investigated the impact of hazard experience, objective risk and country of residence on perceived risk for different emergency events. Hypothesis (1) stated there would be a positive relationship between hazard experience and the perceived risk of the experienced hazard. The results support this hypothesis since experience with a particular hazard was one of the most important predictors of perceived risk of that same hazard and its influence was in a positive direction. The greatest impact was found for flood experience on perceived risk of a flood, followed by earthquake experience on perceived risk of an earthquake, which suggests that experience is especially important regarding events that are less universal. These results are in line with previous results concerning the impact of experience on perceived risk of floods [14, 17] and earthquakes [13]. Increased perceived risk with experience may be explained by the availability heuristic [9] and SARF theory; it is proposed that people assess the ease with which events can be recalled when making judgments about risk. If recalling an event is easy, which is likely to be the case for people who have experienced an emergency, that event will be perceived as being more likely to occur and posing greater consequences than events which are more difficult to bring to mind [9]. While the emotional and impactful nature of emergencies might make recalling past experiences easier, a recency effect would also facilitate recall. As mentioned above, the relationship between hazard experience and perceived risk was strongest for floods and earthquakes. In the current sample, flood survivors mainly experienced their events in the Czech Republic, Germany and Poland while the greatest proportion of earthquake survivors came from Turkey and Italy. Looking at the past occurrences of earthquakes in Italy and Turkey, it can be noted that about half of the past events in these countries since 1900 happened within the last 30 years (i.e. 43.8% for Italy and 48.7% for Turkey). For floods, the recency of the events is even stronger (i.e. 91.7% for the Czech Republic, 85.7% for Germany and 61.5% for Poland). Therefore, these hazards may still be topics of conversation among family and community members, keeping the events rehearsed in their minds. Moreover, there may still be visual reminders in the physical/built environment, e.g. damaged buildings or infrastructure awaiting restoration. This might explain the relatively greater impact of experience of these hazards on perceived risk.

Hypothesis (2) stated that hazard experience would affect perceived risk for at least some other hazards and was also supported to a certain extent as some cross-over effects were found. Experience with a public fire not only increased perceived risk of a public fire but also perceived risk of a terrorist attack. Similarly, experience with a public fire and a terrorist attack increased perceived risk of a traffic accident. It is possible that the cross-over effects for the latter might have diminished if experience of traffic accidents had been included as well. However, there was clearly something in the participants' experiences with public fires and terrorist attacks that bore relation to their perceptions of traffic accidents. In all the aforementioned cross-over effects, the events have context in common. Terrorist attacks, public fires and traffic accidents would in almost all circumstances occur in a public setting. Thus if a person had experienced an emergency before in a building (or outdoor space) that was not so familiar, surrounded by lots of people who also might not have been so familiar, with a place of safety and comfort some distance away, they might have been able to easily picture themselves, the threat and their ability to cope in those circumstances again when imagining the context of the non-experienced events. The effect might have been aided by explicitly asking participants about their own likelihood of becoming a victim of these events. This theory is supported by the additional finding of a negative relationship between experience with both domestic fires and earthquakes and perceived risk of floods. Again, these three events share a (private setting this time) context. Assuming the consequences of the fire and earthquake experiences were not too severe, it is likely that participants remained in the same home afterwards but took steps to protect family/property in the future (e.g. planned escape routes, secured fixtures) and therefore may have perceived less risk from a flood. While this theory may explain the findings reported here, it is not clear whether it could explain the presence or lack of cross-over effects reported in previous research [14, 15] . Further investigation is needed and should attempt to disentangle the issue of self-relevance and give greater focus to contextual factors.

Of course, if the above theory was the primary explanation for the results described above from the current study, significant reciprocal cross-over effects would be expected also (e.g. of terrorist attack experience on perceived risk of a public fire, flood experience on perceived risk of a domestic fire/earthquake, etc.), which was not the case here. One possible issue that might have complicated matters is the way in which perceived risk was operationalized in this study. Becoming a victim might mean something different for people with experience than for people without. The word *victim* might have been interpreted as *getting killed* by many people without experience whereas many of those with experience might have interpreted it as meaning *being affected* since their last exposure to an emergency event had obviously not killed them. Being more ambiguous, *being affected* could have brought to mind different things for different people in different contexts.

The results of the final models (model 2) allow comment on hypothesis (3) which stated that objective risk would influence risk perception. The greatest impact of objective risk on perceived risk was found for earthquakes and for terrorist attacks. For the latter, the high perceived risk values of participants in Turkey and Spain were in line with the objective risk for terrorist attacks, which was highest for people in Turkey and Spain. This result indicates that people might have some awareness of the objective risk and this awareness could inform risk perception. As stated earlier, awareness might arise from (the lack of) hazard experience (their own and possibly that of family, friends, colleagues) and/or exposure to information about the objective risk. Previous reports of a positive relationship between objective and perceived flood risk were not confirmed by this study as the impact of objective risk did not reach statistical significance. Though the model including objective flood risk was statistically different from the model without objective risk, the results demonstrated an increase rather than a decrease in country-level variance. One possible explanation for the lack of a significant correlation between objective flood risk and perceived risk of a flood might be the operationalization of objective risk. A positive relationship between objective and perceived flood risk was found in previous studies whenever the objective flood risk was more geographically specific; that is, regions were divided into specific low and high risk areas [14, 17] or flood plain maps were utilized [28]. The use of a global objective flood risk for an entire country might not always be appropriate to reveal the impact of objective risk estimations.

Hypothesis (4) stated there would be differences in perceived risk between the countries and was supported by the findings. Perceived risk for all events was significantly influenced by country of residence although the extent of the influence differed across events. The greatest variation between countries was found for perceived risk of an earthquake followed by perceived risk of a terrorist attack and perceived risk of a flood. Half of the total variance in perceived risk of an earthquake could be accounted for by country of residence. Country differences concerning traffic accidents, fires and floods can be considered as rather small, since less than 10% of the total variance was due to the country factor [45]. Descriptive results support these findings. Concerning perceived risk of an earthquake, the values assigned by participants in Turkey and Italy were much larger compared to participants in the other countries. In general, participants from Turkey scored very high across all perceived risks, which is line with previous results [34, 13]. The fact that, as discussed earlier, Turkey is no stranger to experiencing earthquakes and the finding of cross-over effects with other emergencies affecting private settings might partly explain this. In addition, Turkey's road safety record might have played a part. Elevated perceived risk of traffic accidents in Turkey have previously been related to a less safe traffic system as well as problems in road and vehicle quality [34], which is supported by the very high numbers of traffic accidents in this study. Higher perceived risk of a terrorist attack for participants in Spain and Turkey are also in line with previous findings [32], and likely connected to these countries' histories of terrorism conducted by separatist groups. However, the results of model 2 need to be taken into consideration because country-level variances were significantly reduced when objective risk was incorporated. Although the country-level variation remained significant for all hazards after this, the variation in perceived risk of a terrorist attack and an earthquake was substantially reduced from 12% to 3% and from 53% to only 12% of the total variance respectively. This implies that the effect of factors connected to country of residence beyond the frequency with which the country experiences an event (e.g. cultural attitudes) may be quite small. However, objective risk had no significant impact on perceived risk of fires (domestic and public), floods or traffic accidents, nor did it decrease country-level variance. For example, with the exception of Turkey, perceived risk of domestic and public fires was very similar across countries even though objective risks differed. It may be that the majority of such events are not considered sensational enough by journalists/broadcasters (perhaps due to relatively less visible destruction than seen with, say, an earthquake or bombing), thus these events receive little nationwide attention by the media and consequently there is less need for governments and other agencies to publicize objective risk information as a counteraction, the result being lower awareness of the objective risk.

In addition to hazard experience and objective risk, significant effects were observed in the final models of female gender (positive), age (negative), education (negative) and prior emergency knowledge (positive) on perceived risk. These effects were observed for all events, with the exception of public fires and traffic accidents when the variable was education. The influence of sociodemographic characteristics on risk perception has been raised before in past research but with questions over whether they explain much variance in perceived risk [(31)]. The current study looked at education further by including a measure of how well educated participants perceived themselves to be with regards specifically to emergencies. The greater the perceived knowledge concerning topics like first aid and participation in fire drills, the higher the perceived risk concerning all emergency events. A study with survivors of floods and landslides found no significant relationship between knowledge of mitigation actions and perceived risk to one's own life when the event was a flood and a negative significant relationship when it was a landslide [(12)]. The relationship between knowledge and perceived risk was positive, and significant, for both events when the risk question asked about whether the event would be likely to occur in the survivors' community. These mixed results highlight the need to be clear about what is meant by perceived risk. Furthermore, the study [(12)] only included a single question on knowledge and that was related to mitigation actions for floods/landslides. The current study's measure comprised several items on knowledge that would be relevant to other emergency events as well as the one in question with the results showing that this knowledge impacted perceived risk for all six events in a rather global manner.

No study is without limitation and, therefore, some important issues need to be considered. As stated earlier, some researchers have questioned the use of multilevel analysis when there is only a small number of groups. In the current study there were seven groups (countries). Hox[(41)] states that if the number of groups is around 10, the variance estimates are too small. Thus, it might be possible that country-level variance is underestimated in this study. Nevertheless, the findings here still demonstrate that country-level variance in perceived risk might be substantially reduced if objective risk data are considered. With respect to objective risks in this study, attempts were made to collect such data for each type of event from a single source. However, this was not always possible, for example, with the country-specific occurrence data for traffic accidents, and so the collection of these data might therefore differ between the countries. The possibility of objective risk information having been collected differently in each country might mean an over- or underestimation of any observed impact of objective risk. Unfortunately, differences in the reporting of the occurrence of, and outcomes from, hazards is a problem that has existed for some time. However, as countries forge closer political ties and more standardized regulations and practices, this may pose less of a challenge to international research in the future. Another issue is that the country samples might not be representative, which limits the generalizability of these findings. Furthermore, a crucial selection bias might be present since it is possible that people with an especially high level of perceived risk took part in the BeSeCu project in order to support research regarding emergency events. If one perceives a very high likelihood of becoming a victim again in the future, one might want to take an active role to enhance knowledge regarding these incidents. If, on the other hand, someone has experienced an event but still evaluates the future risk as very low, one might not be as motivated to participate, since there is no obvious future benefit in doing so.

In conclusion, this paper shows that experience with a hazard elevates perceived risk for that hazard and potentially for some other hazards also. Furthermore, it reveals an effect of country of residence on perceived risk; an effect which greatly depends on the hazardous event investigated and which might diminish if country-specific objective risk is taken into consideration. Future studies should attempt to replicate these findings with a broader range of countries and look further into why experience of one type of event might have a cross-over effect on perceived risk for certain other types of event (e.g. shared context, specific type of consequences, etc.).Finally, this paper reveals that emergency knowledge, gained in a variety of ways (i.e not just through professional training but through school, work, notices, autodidacticism) can have a wide-ranging elevating effect on perceived risk.

Acknowledgment

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Table I

Number of different incidents across years and countries.

	Czech R	Germany	Italy	Poland	Sweden	Spain	Turkey
Fires (2004)[46]	20,550	179,272	212,837	161,720	24,620	-	60,801
Terrorist attacks (1990-2010)[47]	17	554	205	32	45	966	1,925
being injured	27	466	124	36	26	1,610	3,057
Earthquakes (1900-2012)[48]	0	2	32	1	0	3	76
affected	0	1,675	1,054,521	1,050	0	15,390	6,924,005
Floods (1900-2012)[48]	12	14	37	13	2	26	38
affected	322,332	536,758	2,865,312	368,574	-	749,160	177,8520
Traffic accidents (2008)	22,481[49]	320,614[49]	218,963[49]	49,054[49]	18,462[49]	93,161[49]	950,120[50]

Table II

Country-specific objective risk (in % of the mean population) for different events.

	Czech R	Germany	Italy	Poland	Sweden	Spain	Turkey
Fires	15.50	17.35	29.77	31.98	22.14	-	6.55
Terrorist attacks	0.00063	0.00270	0.00144	0.00032	0.00204	0.00940	0.01093
injured	0.00101	0.00228	0.00087	0.00035	0.00118	0.01566	0.01736
Earthquakes	0.00	0.00	0.00	0.00	0.00	0.00	0.00
affected	0.00	0.00	1.33	0.00	0.00	0.03	7.02
Floods	0.00	0.00	0.00	0.00	0.00	0.00	0.00
affected	2.15	0.47	3.60	0.65	-	1.30	1.80
Traffic accidents	16.60	31.18	29.78	9.72	16.20	16.44	96.93

Table III

Sociodemographic characteristics of the sample (N=1045)

	Gender (%)		Relationship (%)		Education (%)			Age	
	Male	Female	No	Yes	Low	Medium	High	*M*	*SD*
Czech Republic (n=166)	30.7	69.3	37.3	62.7	13.9	20.5	65.7	44.11	17.13
Germany (n=202)	43.6	56.4	29.4	70.6	10.0	29.0	61.0	41.11	15.61
Italy (n=169)	42.3	57.7	30.4	69.6	2.4	7.8	89.8	32.57	13.58
Poland (n=184)	46.7	53.3	28.4	71.6	4.4	1.1	94.5	39.43	12.79
Spain (n=103)	49.5	50.5	28.2	71.8	17.5	12.6	69.9	44.45	12.11
Sweden (n=81)	42.0	58.0	45.0	55.0	20.0	5.0	75.0	47.12	19.79
Turkey (n=140)	64.4	35.6	31.4	68.6	12.9	9.4	77.7	37.47	11.67
χ^2*(df)/ F(df1,df2)*	36.34*** (6)		11.06 (6)		127.12*** (12)			14.93*** (6,1029)	
Cramers´V; η	.19		.10		.25			.28	

Table IV

Amount of participants with experience of each type of hazard (N=1045)

	Total		Czech R.		Germany		Italy		Poland		Spain		Sweden		Turkey	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Domestic fires	622	59.8	95	57.2	140	69.7	55	33.1	126	68.5	51	49.5	75	92.6	80	57.6
Public fires	220	21.2	30	18.1	39	19.3	24	14.5	32	17.5	39	37.9	22	27.2	34	24.5
Terrorist attacks	50	4.8	3	1.8	4	2.0	2	1.2	1	0.5	31	30.1	1	1.2	8	5.8
Floods	264	25.4	103	62.0	55	27.4	25	15.1	50	27.3	10	9.7	4	4.9	17	12.3
Earthquakes	223	21.4	2	1.2	18	9.0	120	71.0	3	1.6	9	8.7	1	1.2	70	50.7

Table V

Country-level characteristics concerning emergency knowledge and perceived risk

	Emergency knowledge		Domestic fire PR		Public fire PR		Terror PR		Flood PR		Earthquake PR		Traffic PR	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Total	2.20	0.87	32.88	28.37	26.70	25.89	15.96	23.44	25.97	28.93	21.41	28.87	52.79	29.84
Czech Republic	2.00	0.69	32.73	27.63	26.77	26.75	15.78	24.61	37.92	31.11	11.82	21.70	58.31	28.34
Germany	2.43	0.84	29.87	28.63	22.39	24.50	14.15	22.04	19.58	27.86	7.90	14.85	51.40	30.64
Italy	1.93	0.69	25.75	21.76	25.14	20.00	12.95	15.86	22.71	21.28	43.79	27.16	52.39	26.48
Poland	2.09	0.84	38.17	30.34	26.46	28.02	8.16	16.09	27.97	32.71	7.09	15.88	51.75	31.24
Spain	2.13	0.89	28.38	27.94	26.85	26.19	24.87	26.58	19.19	22.73	13.53	20.37	47.82	28.09
Sweden	2.47	0.92	27.85	27.36	25.11	25.53	9.71	18.90	9.36	14.76	4.75	9.86	38.87	30.02
Turkey	2.56	1.14	46.31	29.40	37.42	28.56	32.19	31.74	38.03	31.58	61.43	28.50	61.96	30.00

Note. Emergency knowl.= emergency-related knowledge; PR = perceived risk

Table VI

Results of multilevel analyses predicting perceived risk for different hazards (random intercept-only-model)

	Domestic Fire PR	Public fire PR	Terror PR	Flood PR	Earthquake PR	Traffic PR
	Model 0	Model 0	Model 0	Model 0	Model 0	Model 0
Fixed effects	*Coeff. (z)*	*Coeff. (z)*	*Coeff. (z)*	*Coeff. (z)*	*Coeff. (z)*	*Coeff. (z)*
Constant	33.47 (10.80)***	27.14 (12.93)***	16.80 (5.16)***	27.56 (7.85)***	21.48 (2.58)*	51.98 (19.40)***
Random effects	Var. (*SE*)	Var. (*SE*)	Var. (*SE*)	Var. (*SE*)	Var. (*SE*)	Var. (*SE*)
Constant	52.17 (36.65)***	21.70 (17.03)***	70.25 (43.04)***	68.51 (47.08)***	483.53 (281.12)***	43.86 (30.32)***
Residual	766.65 (35.84)	653.29 (30.85)	497.34 (22.37)	809.71 (37.73)	437.09 (19.57)	862.25 (38.25)
ICC	.06	.03	.12	.08	.53	.05

Note. *<.05 **p<.01 ***p<.001; Domestic and Public fire PR calculations do not include Spain and Flood PR calculations do not include Sweden, since no objective risk could be calculated in those instances.

Table VII

Results of multilevel analyses predicting perceived risk for domestic and public fires and terrorist attacks (Models 1 and 2)

	Domestic Fire PR		Public fire PR		Terror PR	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Fixed effects	*Coeff. (z)*	*Coeff. (z)*	*Coeff. (z)*	*Coeff. (z)*	*Coeff. (z)*	*Coeff. (z)*
Constant	23.93 (5.36)***	23.84 (5.16)***	16.99 (5.05)***	16.99 (5.01)***	10.66 (2.95)**	10.01 (3.67)***
Gender (Male=ref.)	5.65 (2.96)**	5.68 (2.97)**	5.69 (3.24)**	5.69 (3.25)**	6.16 (4.17)***	6.21 (4.21)***
Age	-0.23 (-3.61)***	-0.23 (-3.61)***	-0.31 (-5.30)***	-0.32 (-5.31)***	-0.10 (-2.06)**	-0.11 (-2.17)*
Education	-6.57 (-4.06)***	-6.52 (-4.03)***	-2.93 (-1.95)	-2.81 (-1.87)	-4.03 (-3.27)**	-4.00 (-3.26)**
Relationship (No=ref)	4.25 (2.16)*	4.27 (2.17)*	4.40 (2.45)*	4.45 (2.47)*	-0.99 (-0.66)	-0.94 (-0.62)
Emergency knowledge	3.69 (3.18)**	3.66 (3.14)**	3.44 (3.24)**	3.37 (3.16)**	3.97 (4.44)***	3.88 (4.35)***
Domestic fire exp.	8.25 (3.52)***	8.24 (3.51)***	3.65 (1.70)	3.61 (1.68)	1.28 (0.73)	1.29 (0.73)
Public fire exp.	2.48 (0.97)	2.45 (0.95)	11.08 (4.69)***	11.01 (4.65)***	6.05 (3.09)**	5.78 (2.95)**
Flood exp.	-4.62 (-1.87)	-4.65 (-1.88)	-2.47 (-1.09)	-2.53 (-1.12)	0.20 (0.10)	0.68 (0.36)
Terror exp.	10.76 (1.59)	10.62 (1.57)	10.99 (1.79)	10.72 (1.74)	19.32 (5.36)***	17.83 (4.98)***

Table VII continued

Results of multilevel analyses predicting perceived risk for domestic and public fires and terrorist attacks (Models 1 and 2)

	Domestic Fire PR		Public fire PR		Terror PR	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Fixed effects	*Coeff. (z)*	*Coeff. (z)*	*Coeff. (z)*	*Coeff. (z)*	*Coeff. (z)*	*Coeff. (z)*
Earthquake exp.	-4.09 (-1.36)	-4.16 (-1.38)	0.23 (0.09)	0.15 (0.05)	-0.11 (-0.05)	0.46 (0.21)
Objective risk		-0.29 (-0.71)		-0.22 (-0.95)		852.76 (3.72)***
Random effects	Var. (*SE*)	Var. (*SE*)	Var. (*SE*)	Var. (*SE*)	Var. (*SE*)	Var. (*SE*)
Constant	61.26 (43.25)***	69.41 (53.86)***	18.44 (14.96)***	19.43 (17.04)***	52.06 (33.26)***	12.72 (11.81)**
Residual	721.19 (34.78)	721.16 (34.78)	598.19 (29.06)	598.12 (29.06)	465.97 (21.47)	466.14 (21.49)
ICC	.08	.09	.03	.03	.10	.03

Note. *<.05 **p<.01 ***p<.001; Domestic and Public fire PR calculations do not include Spain, since the objective risk could not be calculated

Table VIII

Results of multilevel analyses predicting perceived risk for floods, earthquakes and traffic accidents (Models 1 and 2)

	Flood PR		Earthquake PR		Traffic PR	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Fixed effects	*Coeff. (z)*	*Coeff. (z)*	*Coeff. (z)*	*Coeff. (z)*	*Coeff. (z)*	*Coeff. (z)*
Constant	20.87 (4.81)***	20.82 (4.59)***	13.19 (1.81)	12.97 (3.68)***	44.34 (11.57)***	44.36 (11.74)***
Gender (Male=ref.)	4.76 (2.69)**	4.79 (2.70)**	6.07 (4.47)***	6.09 (4.48)***	4.48 (2.31)*	4.59 (2.37)*
Age	-0.29 (-4.55)***	-0.28 (-4.52)***	-0.19 (-3.99)***	-0.19 (-4.04)***	-0.35 (-5.30)***	-0.35 (-5.25)***
Education	-6.64 (-4.43)***	-6.64 (-4.44)***	-3.33 (-2.94)**	-3.30 (-2.91)**	-2.28 (-1.42)	-2.21 (-1.38)
Relationship (No=ref)	1.20 (0.66)	1.20 (0.65)	0.71 (0.51)	0.76 (0.55)	2.87 (1.44)	2.87 (1.44)
Emergency knowledge	3.80 (3.49)***	3.82 (3.50)***	3.12 (3.78)***	3.04 (3.68)***	2.81 (2.40)*	2.73 (2.32)*
Domestic fire exp.	-4.66 (-2.26)*	-4.61 (-2.24)*	0.80 (0.49)	0.68 (0.42)	0.72 (0.31)	0.77 (0.33)
Public fire exp.	-0.07 (-0.03)	-0.04 (-0.02)	0.94 (0.52)	0.89 (0.49)	6.05 (2.36)*	6.06 (2.37)*
Flood exp.	28.47 (12.84)***	28.49 (12.84)***	2.42 (1.36)	2.42 (1.37)	2.51 (1.01)	2.70 (1.08)
Terror exp.	0.86 (0.20)	0.99 (0.23)	3.35 (1.00)	3.30 (0.99)	10.63 (2.26)*	10.72 (2.28)*

Table VIII continued

Results of multilevel analyses predicting perceived risk for floods, earthquakes and traffic accidents (Models 1 and 2)

	Flood PR		Earthquake PR		Traffic PR	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Fixed effects	*Coeff. (z)*	*Coeff. (z)*	*Coeff. (z)*	*Coeff. (z)*	*Coeff. (z)*	*Coeff. (z)*
Earthquake exp.	-5.48 (-2.07)*	-5.80 (-2.16)*	15.31 (7.15)***	15.57 (7.32)***	3.18 (1.08)	2.54 (0.85)
Objective risk		2.24 (0.63)***		6.54 (5.48)***		0.11 (1.22)
Random effects	Var. (*SE*)	Var. (*SE*)	Var. (*SE*)	Var. (*SE*)	Var. (*SE*)	Var. (*SE*)
Constant	65.91 (45.55)***	76.20 (57.91)***	338.39 (198.48)***	53.75 (36.69)***	34.92 (25.57)***	32.06 (25.93)***
Residual	617.18 (29.51)	617.16 (29.51)	395.54 (18.23)	395.55 (18.23)	820.61 (37.48)	820.57 (37.48)
ICC	.10	.11	.46	.12	.04	.04

Note. *<.05 **p<.01 ***p<.001; flood PR does not include Sweden, since the objective risk could not be calculated.