

An intervention to increase earthquake and fire preparedness

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Abstract

Levels of natural hazard preparedness continue to be low across cultures. Studies on natural hazard preparedness have consistently found that simply providing people with information about risk is not sufficient to change preparedness behaviours. Research in the field of social representations and emergency preparedness indicate that it is a combination of cognitive, emotional, and cultural factors that affect preparedness behaviours. Therefore, understanding how personal, social, and cultural dynamics influence people's interpretations of risk is essential if one is to intervene effectively in hazard preparedness. The existing natural hazard preparedness literature contains two major shortcomings. Firstly, studies of community emergency preparedness interventions are scarce. Secondly, the majority of these studies are imprecisely described; many lack detailed information regarding the study's procedures and the content of the interventions. Such work hinders development of the field of natural hazard preparedness: replication of interventions is difficult and publics are subjected to interventions with little empirical support. In order to develop the field of hazard preparedness, a multidisciplinary team of researchers aims to design, conduct and evaluate a rigorous cross-cultural intervention for fire and earthquake preparedness. The present study will explore the different cognitive, emotional, and cultural factors that play a role in emergency preparedness with the goal of improving earthquake and fire emergency preparedness behaviours among lay people.

Keywords: preparedness, natural hazards, intervention, earthquake, fire, community resilience, behaviour change.



1 Introduction

It is critical to adopt and maintain preparedness measures at the household level if risk of injury and damage at home is to be reduced. Such measures also minimise the disruption that follows a natural disaster. Disaster preparedness measures range from securing heavy objects, structural retrofitting, and storing food and water, to having communication and evacuation plans. It is known that a prepared community recovers faster and more effectively after a disaster (Mileti *et al.* [1]). This, in turn, translates into a more resilient public that is able to effectively respond before, during, and after the disaster (Lindell *et al.* [2]). Preparedness or readiness thus constitutes the first phase of resilience. In a world where globalization, gentrification, and climate change are rapidly increasing, the building of resilience is critical.

While it is in people's best interests to make safety-related plans before a disaster occurs, the existing literature shows that most people are not prepared for action in emergency situations [3–9]. Even people who live in areas where natural disasters occur frequently are not prepared [10–14]. Authorities have frequently attributed the lack of preparedness among communities to a lack of information. Thus, according to this model, sometimes termed the deficit model [15–19], it is often believed that the provision of hazards information to the public encourages preparation. Nonetheless, studies have consistently found that merely providing people with information about risks and their consequences is not sufficient to affect preparedness behaviours [4–6, 20–22]. Furthermore, previous experience with natural disasters has not been found to be a good predictor of preparedness [12, 23–29]. Hence, simply being aware of the risk, in particular earthquake risk does not increase the propensity to undertake protective behaviours (Solberg *et al.* [30]).

In the past years, research has attempted to understand what influences and predicts people's preparedness behaviours [5, 6, 21, 31]. A few studies have focused their efforts on interventions to improve preparedness behaviours at the household level, with little success. In addition, their procedures and methods are imprecisely described and evaluated. This paper summarizes a review of current community interventions on earthquake and fire preparedness, and then describes our Challenging Risk project, a multidisciplinary, cross-cultural, community intervention for earthquake and fire preparedness.

2 The social psychological literature on natural hazard preparedness

The psychology of risk field has increasingly accepted that perceptions are influenced by emotional and sociocultural factors [32], rather than purely rational factors; such perceptions then drive behaviour [10]. Along with the host of cognitive biases that colour risk perception stands a wide range of emotional and sociocultural factors (e.g., anxiety, trust and fatalism) that mediate the execution of preparedness actions.

2.1 Predictors of preparedness

Cognitive biases, such as optimistic bias, where people believe that they are less at risk of being affected by a danger when compared to others, or normalization bias, which postulates that people who experience little or no harm in an earthquake are less likely to heed future earthquake warnings, affect how risk is perceived by the public and hinder preparedness [10, 24, 33]. By way of contrast the following have been reported to be good predictors of preparedness: behavioural intention [20, 34], perceived self-efficacy [31], collective efficacy [31], empowerment [31], perceived outcome expectancy [31], critical awareness [21, 31], social cohesion [21, 35, 36], sense of community [9, 37], community participation [21, 31, 35, 36, 38, 39], and trust in the authorities [31, 40]. Nevertheless, the relationship between awareness and preparedness is complex and there are several variables that have been reported to affect this relationship. Emotional and sociocultural variables, such as such as anxiety, trust and fatalism, moderate the relationship between hazard awareness and actual preparedness behaviours [10, 34, 41–43], as well as personal responsibility [4–6, 20]. Research has also shown that being a home owner versus renter and having children or dependents increases seismic adjustment [5, 44].

In summary, it seems that people's interpretation of their risk, their feeling about it, their sense of their own efficacy, and that of their community are far more central than awareness of it, in determining their preparedness actions. Consequently, studying how personal, social, and cultural factors influence how people interpret risk is essential if we are to intervene in hazard preparedness.

3 Intervention studies on earthquake and fire preparedness

The literature on earthquake and fire community preparedness interventions is scarce. Despite there being a wide range of mass media and internet-based natural disaster preparedness sites, documentation and evaluation of them is rare. An additional problem is that, when documented and/or evaluated, most are vaguely described. Furthermore, few have been proven to demonstrate increased disaster preparedness behaviours at the household level. Therefore, more explicit and better designed natural hazard preparedness interventions are needed so that they can be replicated and improved. The goal would be to engage publics in interventions based within strong empirical evidence.

An online Google Scholar search with the words “natural hazards intervention”, “natural disaster preparedness” and “preparedness intervention” of earthquake community preparedness intervention studies yielded a result of nine studies. Four of them were on earthquakes and other natural hazards, such as landslides and/or floods [11, 45–47], two focused solely on earthquakes [48, 49], one on cyclones [50], and two on disasters in general [51, 52]. Studies were conducted in Turkey [11], Martinique [48], Los Angeles, USA [51, 52], Australia [50], Iran [45], Pakistan [49], New Zealand [46] and Taiwan [47]. Some of the studies were conducted during critical time periods [11, 47, 50]. Some studies targeted vulnerable populations, such as children, teachers and

parents and were conducted in schools [46, 49] and two studies were done on low-income minorities [51, 52]. The studies contained a number of limitations. Some studies did not describe the actual content of their intervention [11, 47, 49, 50]. Two of them did not evaluate the intervention's [47, 49] effectiveness. Furthermore, some studies did not use control groups [46, 51, 52], leading to unreliable results. Overall, most of the methods, including materials, recruitment of participants and measures used, are not clearly described. Regarding their generalizability, several used respondent driven sampling leading to homogeneous samples, and therefore, sample bias [51, 52]. Finally, regarding a theoretical orientation, most were not explicit about containing one, though others used a theoretical model for their interventions [11, 46, 50, 51]. Leaving aside these limitations, some of the ingredients of successful interventions can be found among these studies. Overall, earthquake preparedness interventions proved successful in affecting adjustment measures when including hands-on training, face-to-face interactions, and those that targeted empowerment and community cohesion.

The literature on home fire preparedness is larger than the one on earthquakes, with most of the studies conducted in the U.S. [53–58]. A review of home fire preparedness interventions studies showed that most of them focused on smoke alarm canvassing and smoke alarm installations, which proved to be among the most effective interventions to improve fire preparedness behaviours as well as reducing fire related deaths and injuries [54, 57]. In addition, the presence of fire service personnel appears to be the most effective method of distributing smoke alarms Douglas *et al.* [59]. Again hands-on training was the most effective in improving preparedness responses Miller *et al.* [58]. Nonetheless, studies have consistently shown that the level of preparation for fire hazards tends to be poor [56, 58, 60]. This is consistent with existing literature on fire preparedness in the U.S. [58, 61, 63]. For instance, having a smoke alarm was found to reduce the risk of death by 40%–50%. However, 40% of fires reported to fire departments occur in homes without alarms and 70% of fire deaths occur in homes with either no smoke alarm or where the alarm malfunctioned (Ballesteros and Kresnow [60]). The functionality of alarms remains a problem [54, 56], and so does the lack of rigor in the evaluation designs of these studies.

Most of these interventions on fire or on earthquake preparedness, when evaluated, were based on self-report measures only, such as surveys and questionnaires. In contrast, our intervention aims to include home visits and review images and documentation of their preparedness behaviours, in addition to administering self-report measures.

4 Designing an intervention on earthquake and fire preparedness

The existing approach to risk continues to be too specific to particular hazards. Authorities take into account the possibility of earthquakes, tsunamis, fires, and the collapse of systems, but they view and handle them separately. To our



knowledge there is no published community intervention study that combines earthquake and home fire safety preparedness measures. By including both hazards together in one intervention, we develop an integrated multihazard preparedness approach [63]. In addition, by including home fire preparedness, a hazard with higher incidence than earthquakes and, therefore, one that the public has experienced and witnessed, the more everyday risk gets paired with the longer return period risk. This may facilitate a more everyday routine of adopting disaster preparedness measures at home.

According to Michie *et al.* [69] behaviour change interventions need to be based on theoretical models of behaviour that explain the behaviour change process. The field of natural hazard preparedness has used several theoretical models in their interventions, such as the person-relative-to-event-model (Duval and Mulilis [5]), the precaution adoption process model (Weinstein and Sandman [64]), and the emotion focused coping model (Lazarus and Folkman [65]). Models with proven success in the prediction of preparedness behaviours are the theory of planned behaviour and protection motivation theory [66, 67], and they provide a strong basis for developing an intervention on natural hazard preparedness. Recent studies have attempted to develop models to predict the adoption of natural hazard preparedness with good success [21, 68]. Existing models of natural hazard preparedness largely rely on more rational factors tapped by the theory of planned behaviour and protection motivation theory, and this has been proven to be not enough to explain preparedness behaviours. Thus including just cognitive factors is not enough to understand this relationship between risk awareness and hazard preparedness.

In a separate line of enquiry, it has been found that understanding the sociocultural factors that affect preparedness behaviours in a community is essential to intervene in them. Joffe *et al.* [10] interviewed a sample of lay people in Seattle, Washington; Osaka, Japan; and Izmir, Turkey, and found that, consistent with existing literature, awareness of seismic adjustment behaviour was not translated into action. They found that the majority of respondents in Seattle felt less at risk for earthquakes than their counterparts in the area of San Andreas Fault due to a perceived geographical distance from the threat. Osaka respondents also felt they were less at risk for earthquakes, compared to people living in developing countries, arguing for Japan's advanced technology. In Izmir, people felt largely defeatist regarding preparedness largely because of their extreme lack of trust in their government and builders, regarding the solidity of their buildings, as well as the potential to get assistance and aid in the event of an earthquake. In addition, those cultures with higher levels of anxiety in relation to earthquakes prepared less, while those with lower anxiety and even a positive sense of awe in relation to earthquakes engaged in more adjustment measures. Furthermore, those with least trust in their societal institutions prepared least with those with more trust preparing more. Finally, individuals with higher fatalism tended to prepared less in contrast to those with an 'I can' attitude, who tended to prepared more.

Grounded in this work on social representations of earthquakes, and having reviewed the existing literature on earthquake and fire preparedness and on

behaviour change interventions, this study aims to conduct a cross-cultural intervention on earthquake and fire preparedness behaviours in Seattle, United States and Izmir, Turkey. It will analyse the effect of the interventions in the targeted communities to see if these can bring about behaviour change. We will use a modified version of Paton's model of natural hazard risk reduction preparedness [21, 68], which proposes motivation, outcome expectancy, and self-efficacy beliefs as main predictors of preparedness. Paton adds a fourth variable to his model, intentions to prepare; however, since the literature on intentions as a predictor of behaviour seems unclear, we will leave this fourth variable out. Instead, we will incorporate the emotive variables of anxiety and trust, as well as sociocultural variables, such as sense of responsibility, empowerment and social cohesion into the intervention as predictors of preparedness. The proposed intervention will target the following determinants of behaviour, self-efficacy, outcome expectancy, and motivation, through different behavioural techniques. First, in order to increase motivation we will use rewards, incentives, graded tasks, social encouragement and support, as well as persuasive communication as behaviour change techniques (Michie *et al.* [69]). In order to affect perceived self-efficacy, techniques proven to be effective in this behavioural domain, such as self-monitoring, rehearsal, coping skills, graded tasks, social encouragement and support, and feedback will be employed. Lastly, to increase perceived outcome efficacy, we will employ persuasive communication and feedback, as proven effective techniques of behaviour change.

4.1 Methods

The proposed intervention will be conducted first in Seattle, U.S.A, in the summer of 2015, and then in Izmir, Turkey, following up the previous study done by Joffe in these two coastal cities with high seismic risk. Study objectives are to increase household preparedness measures for earthquakes and home fires in lay people and to evaluate changes in their levels of motivation, self-efficacy, perceived outcome, trust, empowerment, anxiety, and social cohesion, as well as levels of adjustment measures, before and after the intervention. The study will use a non-randomised control, longitudinal intervention, with pre-test and post-test design. In order to assess the effects of the intervention we will have a control group, which will consist of people from a neighbourhood geographically separated from the intervention one. Individuals in both groups will fill out an online questionnaire to assess their baseline level of preparedness. Following the completion of the questionnaire, participants in the intervention group will complete a workshop on fire and earthquake preparedness. Directly after the intervention as well as three and 12 months one, both groups will fill out the questionnaire to assess intervention effects. The intervention group will participate in a six-hour interactive, face-to face, hands-on practice workshop, divided in two afternoons, and led by an expert in emergency management training. The workshop will have approximately 30 people each and it will include hands-on training, as well as using interactive tools, such as uploading their photos and videos on social media sites, to demonstrate adjustment

behaviours. In addition, participants will receive home visits from the fire department and one of our researchers, who will ask them to demonstrate some of their adjustment behaviours in their household (e.g., test the smoke alarms, show how they secured heavy objects).

4.1.1 Sample

The sample for the study in both Seattle and Izmir will be 200 adults recruited using professional recruitment companies to enlist matched samples of 100 participants from each neighbourhood, who will then be assigned to each group, intervention or control. Neighbourhood selection has been carefully done by a team of multidisciplinary researchers (structural engineers, experts in citizen science, and psychologists) who cautiously reviewed census data and other governmental and local data and travelled to Seattle for 15 days to visit different neighbourhoods and ultimately select two that are sociodemographically representative of the city. The same will be done for Izmir.

4.1.2 Measures

Empowerment, perceived self-efficacy and perceived group efficacy, perceived outcome expectancy, anxiety, trust, fatalism, and demographics will be assessed in the questionnaire. Preparedness behaviours will be assessed by the questionnaire, with 19 items measuring earthquake adjustments and 16 on fire safety. In addition, in between workshops, an expert from the fire department and one of the co-leaders of the workshops will make home visits to the houses that participated in the workshop, to evaluate preparedness measures and assist individuals with their implementation if they are having questions or problems.

5 Conclusions

The field of natural hazard disaster preparedness is in need of better designed interventions on natural hazard preparedness in order to engage the public in successful interventions. In addition, recent studies emphasize the need for a multihazard approach to emergency preparedness interventions. A public that is better prepared for multiple hazards is better prepared for specific and unpredictable hazards, and is therefore more resilient. To our knowledge this is the first intervention that combines earthquake and home fire preparedness, and that aims to compare results among different cultures, Seattle, USA and Izmir, Turkey. In addition, this intervention was carefully designed by a team of multidisciplinary researchers, from the fields of structural engineering, citizen science and social psychology, who previously evaluated the social representations of earthquakes in lay people in Seattle and Izmir (Joffe *et al.* [10]). Results of these thorough interviews have allowed this team to develop detailed interventions tailored to match the social representations of each location. This study has significant implications for the field of natural disaster preparedness at an international level as well as for the area of interventions on natural hazard preparedness, as it will allow for replication, improvement, and therefore development of the field.



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