

Research paper

Risk perception and volcanic hazard mitigation: Individual and social perspectives

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Abstract

This paper discusses how people's interpretation of their experience of volcanic hazards and public volcanic hazard education programs influences their risk perception and whether or not they adopt measures that can mitigate their risk. Drawing on four studies of volcanic risk perception and preparedness, the paper first examines why experiencing volcanic hazards need not necessarily motivate people to prepare for future volcanic crises. This work introduces how effective risk communication requires communities and civic agencies to play complementary roles in the risk management process. Next, the findings of a study evaluating the effectiveness of a public volcanic hazard education program introduce the important role that social interaction amongst community members plays in risk management. Building on the conclusions of these studies, a model that depicts preparing as a social process is developed and tested. The model predicts that it is the quality of the relationships between people, communities and civic agencies that determines whether people adopt measures that can reduce their risk from volcanic hazard consequences. The implications of the model for conceptualizing and delivering volcanic hazard public education programs in ways that accommodate these relationships is discussed.

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1. Introduction

On a global scale, volcanic hazards represent a significant threat to many communities. In her review of research from United States Geological Survey and Smithsonian Institute sources, Mayell (2002) describes how there are some 457 volcanoes with cities that house 1 million or more people located within 100 km of them. In communities whose proximity renders them susceptible to experiencing adverse impacts from volcanic processes, the active management of the associated risk is essential.

In this paper, risk is conceptualized as a product of a) the likelihood (probability) of a hazard event occurring, and b) the

consequences of hazard activity (Hood and Jones, 1996). This definition represents risk perception as comprising two general components. The first concerns how people estimate the probability of volcanic hazard activity occurring, and how they interpret this likelihood information (Slovic, 2000). The second addresses the relationship between volcanic hazards and the consequences they can create when they interact with the environments in which people live. This paper focuses on the latter aspects of risk.

A focus on the consequences side of the risk equation is justified by its importance as a target for risk management initiatives. Although people are interested in knowing about the likelihood of hazard occurrence, it tends to be less salient than information on consequences and their management for their decision making about whether or not to prepare for hazard consequences (Mayer et al., 1995; Sjöberg, 1999; Lion et al., 2002; Paton et al., 2005). A key goal in risk communication is

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encouraging people to adopt preparedness measures that reduce their risk by increasing their ability to manage hazard consequences.

For example, if people know to tape house windows or cover air conditioning units, they can reduce damage from ash inundation. Having face masks can reduce risk from inhaling ash. Similarly, having spare air filters for vehicles facilitates continued transportation availability, and knowing how to remove ash from households, roofs and vehicles limits property and infrastructure damage. People can increase their capacity to meet basic needs by storing food and water, and having a household volcanic emergency plan can ensure that families know what to do should an eruption occur.

These protective measures reduce the likelihood of injury, death and property damage and contribute to peoples' capacity to cope with and adapt to volcanic hazard consequences during an eruption event. Their adoption thus increases people's capacity to manage their risk. However, knowledge of one's proximity to volcanic hazards or susceptibility to their consequences does not guarantee taking action to mitigate the associated risk. Levels of preparedness are often low, even when those at risk are aware of their circumstances (Ballantyne et al., 2000; Paton, 2006). Understanding why this is the case, and identifying alternative ways to increase people's ability to mitigate their risk, is thus an important aspect of volcanic hazard risk management.

This paper discusses how people's interpretation of their experience of both volcanic hazards and public education programs influences their risk perception and whether or not they adopt measures that can mitigate their risk. The content derives from four studies of volcanic risk perception and preparedness conducted by the authors (Johnston et al., 1999; Ballantyne et al., 2000; Paton et al., 2001; Paton, 2006). The paper opens with a discussion of how experience of volcanic hazard consequences need not necessarily act as a catalyst for preparing. Next, it discusses why simply providing information to people can fail to change risk perception or motivate volcanic hazard preparedness. Finally, the paper integrates the lessons from these studies to develop and test a model. The model predicts that it is the quality of the relationships between people, communities and civic agencies that determines whether people adopt measures that can reduce their risk from volcanic hazard consequences.

2. Understanding people's beliefs about volcanic risk

People's beliefs about volcanic hazards and what can be done to manage their consequences can be formed and maintained in several ways. One relates to hazard experience. Another involves informing people, usually via public hazard education programs, about the hazards they face and the measures and actions they can adopt to mitigate their risk.

That hazard experience can increase preparedness is evident from observation of communities that face regular exposure to volcanic hazard activity. For example, as a result of its proximity to Sakurajima volcano, the city of Kagoshima in Japan receives ashfall and ballistic debris on some 113 days per year. In

response, the city has developed building codes, ash removal practices and community attitudes and preparedness that facilitate continuity of societal functions during periodic volcanic episodes (Johnston, 2004). Clearly, when a consistent need to confront hazard consequences prevails, mechanisms capable of actively managing risk can be established within the fabric of a community. There are, however, few places in which such regular occurrences can be relied upon to sustain this level of preparedness. This makes it pertinent to ask whether less frequent experience of volcanic hazard consequences can be similarly effective.

2.1. Risk perception and infrequent volcanic hazard experience

The 1995 eruption at Ruapehu volcano, New Zealand (Fig. 1) occurred in the midst of a research program investigating volcanic risk perception and preparedness. Ruapehu has a return period of some 50 years, with its previous major eruption occurring in 1945. Consequently, this eruption provided an opportunity to examine how infrequent experience of volcanic hazard consequences influenced risk perception and preparedness. A survey of risk perception and preparedness had been conducted in several communities susceptible to experiencing volcanic hazards prior to the 1995 Ruapehu eruption. During the eruption, one community surveyed before the eruption, Hastings (Fig. 1), received ash fall (Johnston et al., 1999). By re-surveying the same people ($N=202$) who responded to the initial survey, it was possible to assess how experiencing volcanic hazard consequences affected risk perception and preparedness. Full details are available in Johnston et al. (1999). Key findings and their implications for understanding volcanic risk perceptions are discussed here.



Fig. 1. The location of Ruapehu and the three study sites. Map courtesy of GNS Science.

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