1. Introduction

In the last few years, the Journal of Volcanology and Geothermal Research (JVGR) has published an increasing number of papers on the perception of volcanic risks (e.g. Dibben and Chester, 1999; Dominey-Howes and Minos-Minopoulos, 2004; Gregg et al., 2004a,b). At the same time, international volcanology conferences have been dedicating more sessions to the human aspects of risk and disasters (e.g. Cities on Volcanoes conferences, International Union of Geodesy and Geophysics congresses, International Association of Volcanology and Chemistry of the Earth’s Interior meetings). This is symptomatic of the increasing attention given by the volcanological community to the human dimension of volcanic activity. Drawing on this growing interest, the present volume focuses on the relationship between volcanic risk and human societies with the aim of developing a holistic approach to the reduction of the harm associated with volcanic activity. To our knowledge, this special edition is unique in drawing on the work of researchers from a wide range of disciplines, e.g. sociology, anthropology, psychology, geography, geology, volcanology and engineering. It brings together a set of both theoretical papers and case studies dealing with a vast range of geographic locations, e.g. the Caribbean, Indonesia, Italy, New Zealand, the Pacific, the Philippines and the USA. The articles published in this special issue follow different scientific paradigms and engage in an insightful debate on the role of risk perception and other social and economic factors in shaping people’s behaviour in the face of volcanic hazards. In this editorial paper, we set out the conceptual background behind the different scientific paradigms that structure social science studies of risk perception, and briefly review the existing volcanic risk perception literature. This should enable the reader to critically assess the contribution of the present volume to our understanding of risk perception and people’s behaviour in volcanic environment.

2. Scientific paradigms of risk perception

Two fairly separate strands of research inform the scientific study of volcanic risk perception. These arise from the broader risk perception literature, which is discussed first, and then the more specific study of natural hazards.

Risk perception was studied initially using mainly psychometric and econometric methods. The first dominant piece of work was by Starr (1969), who used a revealed preference methodology, and argued from this that there were distinct differences in society’s acceptance of voluntary rather than involuntary risks. Researchers exploring peoples expressed views on risk revealed a wider number of dimensions that seemed to be used to organise some of the many risks that confront individuals (Fischhoff et al., 1978; Slovic et al., 1980). The three main dimensions that were identified were: dread (i.e. a risk’s catastrophic nature), familiarity (i.e. knowledge and familiarity of consequences), and number of people exposed. When the social context of risk perception has been explored, social roles have been shown to differentiate how hazards are perceived (Slovic et al., 1980). Individual and group differences seem to affect what aspects of the risk phenomena an individual see as salient, the frame of reference used and what risks are seen as important (Wynne, 1992). This may lead to risk perception being framed by a groups’ trust in the institutions responsible for mediating the threat (Kasperson, 1992; Wynne, 1992).

The idea that differences in risk perception might naturally arise from society, has been central to the Cultural theoretical approach to risk perception (Douglas, 1966; Thompson, 1980). It is argued that whatever objective dangers may exit in the world, social organizations will emphasize those that reinforce the moral, political, or religious order that holds the group together (Rayner, 1992, p. 87) and therefore that individuals actively choose what to fear (and how to fear it), in order to support their way of life (Dake and Wildavsky, 1993, p. 43). Risk selection is said to be based on cultural biases or deeply held beliefs and worldviews whose value lie in the defence of particular patterns of social relations. That can be summarised under four main archetypes egalitarians, individualists, hierarchists, and fatalists (Douglas and Wildavsky, 1983). More generally it is argued that membership of social organisations and groups will affect what risks individuals identify for attention and how they are integrated into existing patterns of belief (Green et al., 1990). The affect of cultural biases on perceptions of risk will be felt especially strongly when any ‘objective assessment’ of risk is very difficult or impossible (Adams, 1995) when people are especially likely to impose meaning onto the uncertainty.
A psychosocial explanation for why some risks become more a focus for concern than others can be found in the risk amplification theory (Kasperson et al., 1988; Kasperson, 1992). Based on the assumption that most of the information people receive on risk is through communication rather than direct experience, it explains how various psychological, social and cultural factors lead to the perception of risk being either attenuated or intensified. The key arguments of risk amplification theory being that information on risk can be viewed as a signal and that when it passes through particular stations (e.g. groups of scientists, newspaper or pressure groups) it undergoes predictable transformations. Different aspects of the risk are either attenuated or intensified and therefore groups and individuals have different interpretations of hazard events (Kasperson et al., 2003).

The view that risk-taking behaviour can be directly related to risk perception has been convincingly challenged in many studies and yet this problematic proposition can still be described as the ‘dominant’ theoretical concept in natural hazard research (Hewitt, 1983; Chester, 1993). This dominant approach is often centred on a perception-adjustment paradigm (White, 1945; Kates, 1971; Burton et al., 1993), where an individual: (1) appraises the probability and magnitude of extreme events; (2) canvasses the range of possible alternative actions; (3) evaluates the consequences of selected actions; (4) chooses one or a combination of actions (Burton et al., 1993, p. 101). Until an individual is aware of a hazard, he or she will not start on the process of decision making and as different people have different thresholds at which they become aware of a hazard and therefore decide on different levels of behavioural adjustments or adaptations so risk behaviour varies (Burton et al., 1993). The decision making model is viewed in more recent work as bounded (i.e. non-optimal ‘satisficing’ behaviour under constrained information) but is still focused on a perception-adjustment paradigm.

In contrast to this it is argued that the perception of a natural hazard and behaviour that may affect the threat it poses, is more related to societal organisation and values than perceptions of geophysical conditions and that disasters are not explained by behaviour peculiar to the disaster event but rather by the nature of society in a particular geographic location (Torry, 1979; Susman et al., 1983; Hewitt, 1983). Physical extremes should be viewed as just one aspect of the context within which an individual or group functions, in most places and segments of society where calamities are occurring, the natural events are about as certain as anything within a person’s lifetime, or at least that of himself, his children and grandchildren (Hewitt, 1983, p. 26). In many circumstances there might not be a causal relationship between risk perception and behaviour; rather behaviour would be constrained by social structure. Therefore in order to understand risk perception it would be necessary to understand the wider social context in which individuals are situated.

3. Volcanic risk perception in the literature

Researchers’ interest in volcanic risk perception dates back to the 1960s and has been deeply influenced by White’s work. In line with White’s perception-adjustment paradigm, most of the early studies consider that people’s behaviour when facing volcanic threat is deeply influenced by risk perception. Most of the early studies also focused on volcanoes located in industrialized countries, especially in the USA. One of the first studies was published by Lachman and Bonk (1960) in relation to the 1960 eruption of Kapoho volcano in Hawaii. It was followed by another study on Hawaii by Murton and Shimabukuro published in 1974. Both works were pioneering and acted as springboards for later studies of people’s perception of risk associated with the 1980 Mount St. Helens eruption (Greene et al., 1981; Perry et al., 1982; Perry and Lindell, 1990a,b; Lindell and Perry, 1993). Hodge et al. (1979) at the same time made a comparative study between USA Cascades and Hawaii volcanoes. Since the 1990s, a larger number of studies have investigated the link between risk perception and people’s behaviour in volcanic environment in Europe (Dibben and Chester, 1999; Davis and Ricci, 2004; Dominey-Howes and Minos-Minopoulos, 2004; Davis et al., 2005), the USA (Perry, 1990; Gregg et al., 2004a,b), the Caribbean (D’Ercole and Rançon, 1994, 1999; Lesales, 1997; Leone and Lesales, 2004, 2005), New Zealand (Johnston et al., 1999; Paton et al., 2001; Becker et al., 2001; Johnston and Houghton, 1995; Finnis et al., 2004), Japan (Yoshii, 1992; Nomura et al., 2004), Mexico (Medrano, 2005; López-Vázquez et al., 2006) and the Philippines (Gaillard et al., 2001). These studies are basically hazard-centered and conclude that volcanic risk perception is primarily shaped by hazard knowledge which largely depends on previous experience of volcanic eruption and/or information provided by different media. Murton and Shimabukuro (1974) underline the role of personal experience in high risk perception and positive adjustment in the face of potential eruptions in Hawaii. Johnston et al. (1999), Paton et al. (2001) and Becker et al. (2001) carried out a perception-adjustment study prior and after the 1995 eruption of Ruapehu volcano in New Zealand. Not surprisingly, they confirm that experiencing an actual eruption is a major influence on volcanic hazard knowledge and risk perception. They however warn that people’s behavioral adjustment may infer from their ability to cope with (objectively) minor impact the ability to cope with any future occurrence or assume that future events will not exercise an adverse effect on them (Johnston et al., 1999, p. 123). Johnston and Houghton (1995) also conducted a survey among school children of the Central North Island in New Zealand exposed to different natural hazards including volcanic eruptions. Their research confirms once again the fundamental importance of experience in high risk perception. Gregg et al. (2004a) also linked good hazard knowledge and risk perception to eruption experience and repose time. They further corroborate White’s assessment that people with the higher risk perception are likely to be best prepared in the event of an eruption. Using mental maps, French geographers (D’Ercole and Rançon, 1994, 1999; Leone and Lesales, 2004, 2005) showed that the spatial dimension of risk perception is also closely related to the experience or memory of past events. In the case of Mount Pelée, in Martinique, people tend to link the threatened areas to those affected by the 1902 eruption that buried the town of St Pierre. In relation to the experience of previous events, D’Ercole (1991, 1994, 1996) and D’Ercole and Pellete (1992) add that the
distance to the volcano and the length of residence are significant determinants that shape risk perception when the volcano is dormant like Mount Cotopaxi in Ecuador. To our knowledge, only the study of Hodge et al. (1979) following the Mount Baker 1975 eruption in the USA challenges experience as the critical factor in defining the level of risk perception in the face of volcanic hazards. As well as previous experience of volcanic events, risk perception may be enhanced by information campaigns. The role of the media in determining risk perception is stressed by Greene et al. (1981), Perry et al. (1982), Perry and Lindell (1990a,b), Lindell and Perry (1993) following Mount St Helens 1980 eruption. They considered the source and frequency of information received and its credibility as a significant factor influencing volcanic risk perception. On the other hand, Dominey-Howes and Minos-Minopoulos (2004) note, for unclear reasons, a lack of understanding of volcanic hazards on the island of Santorini despite vigorous educational programs.

Interestingly, only a few studies followed the radical paradigm of disaster research to assess people’s behaviour and risk perception in volcanic environment. The most comprehensive research, by Dibben (1999), concludes that the behaviour and vulnerability of people in the face of volcanic hazards is deeply rooted in the socio-economic context and the historical development of the place as shown in case studies in São Miguel, Azores (Chester et al., 1999; Dibben and Chester, 1999), and around Mount Etna in Italy. Additional insights from the surroundings of Vesuvius volcano, still in Italy, similarly trace vulnerability to high population densities and social and economic marginalization (Chester et al., 2002). Chester (1993) further reviews a large set of case studies through the lens of people’s responses to volcanic hazards in both the developing and industrialized worlds. He concludes that societies’ response are complex and variable in time and space and underlines the importance of anthropogenic factors in the occurrence of disasters identified with volcanic eruptions. In another pioneer and landmark study around Mount Merapi in Java, Indonesia, Laksono (1988) describes how inhabitants of the flanks of the volcano returned to their original homes soon after the government resettled them in Sumatra. The unfamiliar place of evacuation seemed more risky to the Merapi people than living on the slopes of an active volcano with cultural familiarity and existing coping mechanisms (Schlehe, 1996; Dove, 2007a,b; Dove and Hudayana, in press). Wisner et al. (2004) recently revisited three cases of volcanic eruptions (i.e. the 1985 Nevado del Ruiz eruption in Colombia, the 1995–1998 activity of the Soufrière Hills of Montserrat and the 2002 awakening of Mount Nyiragongo in the Democratic Republic of Congo) to highlight the role of political institutions, access to livelihoods, dependent economies and armed conflicts in shaping social vulnerability in the face of volcanic hazards. D’Ercole (1991, 1994, 1996; D’Ercole and Peltre, 1992), Tobin and Whiteford (2002), Lane (2003), Lane et al. (2003) note that the strength of livelihoods is critical in defining people’s vulnerability and behaviour in the face of volcanic hazards in Ecuador. Medrano (2005) similarly showed how risk perception around Mount Popocatépetl in Mexico is linked to socio-economic and political forces. Schlehe (2005), Chester (2005a) and Bankoff (2004) focused on the influence of religion on people’s behaviour and risk perception. They show how religion continues to influence people’s perception and response to volcanic hazards not solely among traditional communities but in Christian societies as well. A wide range of studies by anthropologists further show how traditional societies are strongly bonded to the volcano they live on and how their perception of associated risk is biased. For instance, Belshaw (1951), Keesing (1952), Ingleby (1966) and Schwimmer (1969) have documented how Mount Lamington in Papua New Guinea is central to the life of Sangara, Sasemhata and Orokaiva ethnic groups. Still in Papua New Guinea, Mount Rabaul is the focus of Tolai’s life (To Waninara, 2000). Mount Pinatubo also plays a central role in the cultural life of the Aetas of the Philippines as shown by Shimizu (1989, 2001), Seitz (2004), Tima (2005) and Gaillard (2006). Schlehe (1996), Forth (1998) and Frömming (2001) focused on the place of Merapi and Flores volcanoes in Indonesian societies. Queseda (2005, 2007) documented how people of Niuafo’ou (Tonga) and Hawaii nurture intimate relationships with their respective volcano.

4. Contribution of the present JVGR special issue

The papers in this special edition take forward a number of the themes arising from the existing volcanic risk perception literature.

Plans for populations residing on or close to volcanoes to evacuate, rather than to permanently migrate or be removed, during periods of crisis are a common feature of many societies adaptation to volcanic risk. Evacuations will often be difficult, especially when the numbers of people that need to be evacuated are large and where the settings from which they are moving are complex. The case of Vesuvius, in Italy, is both significant and interesting; significant, because of the size of the ‘at risk’ population and interesting because there has been a large scale evacuation plan since 1995, the National Emergency Plan for Vesuvian Area (NEPV A). Three papers in this edition explore the levels of understanding and readiness to evacuate that exists amongst different sections of this population. Barberi et al., find that although the people they interviewed had a realistic view of the hazards they were exposed to, they did not have a clear understanding of the evacuation plan itself or confidence in the officials who would have to organise an evacuation. The lack of confidence in officials seems to be justified given the findings of Solana et al., who interviewed civil authorities in and around Vesuvius, and found that that their knowledge of how they should respond to a volcanic crisis was incomplete. Carlino et al. similarly found that for high school students, although they had a realistic perception of the risk, they were concerned about how they could protect themselves. They also had a poor understanding of the NEPV A. All papers conclude that there is therefore a need for some kind of programme of education, though given the findings of Barberi et al., that other economic and social problems are felt to be more significant by people living in and around Vesuvius, the relative significance of volcanic risk above other concerns needs to be carefully considered. They suggest that encouraging residents to be more involved in planning for an evacuation may be helpful in encouraging a greater understanding and confidence in any plans.
It is therefore important to understand how messages about risk are formed and transformed as they move within a society. Haynes et al. investigate how the risk information assumes different forms and meanings as it is produced and reproduced by different groups in a society, in this case on the Caribbean Island of Montserrat. They find a tension between local politicians who are trying to avoid being seen to make unpopular decisions and scientists who are trying to resist being drawn into making policy decisions rather than simply providing ‘neutral’ scientific based predictions of risk. They also show that people living under volcanic threat are actively considering the benefits associated with more risky behaviour and this in turn influences conceptualisation of risk. Paton et al. discuss the problem of trying to increase a population’s level of preparedness. They argue that a population’s intention to prepare is in fact not strongly related to the experience of volcanic activity but is instead influenced by social processes: the belief in the benefits of mitigation, community involvement and trust in institutions. Perry and Lindell explore wider sets of adjustments to hazards. They examine people’s self-protective behaviour to three hazards: wildfires, earthquakes and volcanic activity, in two Californian communities in the USA. They find that levels of risk perception are not predictive of the number of adjustments made but that individual’s sense of responsibility for their own protection and experience of property damage are.

A different kind of evacuation context is explored by Leonard et al. They examine the tourist and ski complex on the slopes of Ruapehu volcano, New Zealand. The particular problems planners have in this context is the transitory nature of the population. As a result a great deal of the responsibility for successful evacuations lies with the staff of the tourist facilities. Leonard et al. find that although perception of the level of the risk is accurate, this does not necessary lead to effective behaviour. A five-step model for effective warning is proposed.

Religion, as an aid to understanding, societies living in and around volcanoes may have been an understudied phenomena. Papers by Gregg et al. and Chester et al., in this edition, extend our knowledge by exploring the relationship between religion and volcanic risk perception. Gregg et al. within the context of traditional Hawaiian beliefs in the 1960s and Chester et al. focusing on, in particular, southern Italy. Gregg et al. find a complex set of reactions to various volcanic mitigation measures around Kilauea, but discover a strong negative reaction to bombing amongst those expressing a belief in the volcano goddess Pele. Chester et al. argue that the importance of contemporary religious beliefs in understanding people’s behaviour in volcanic environments may be hidden both by researchers’ post-enlightenment theoretical stances but also the related unease some respondents may have in expressing complex religious responses to volcanic risk to researchers. When peoples’ beliefs are revealed through careful research, the religious is still found to be important.

Gaillard, Lavigne et al. and Dibben all reflect on the importance of understanding how volcanic risk perception and behaviour sits within wider social and economic contexts. Gaillard demonstrates that even when volcanic hazards, in this case the threat from lahars, are clear, frequently recurring and very dangerous, the structural constraints people living around Mount Pinatubo in the Philippines experience result in decisions and behaviour that appears irrational but once are more fully explored, within their social and economic settings, emerge as rational and explicable. Lavigne et al., similarly, find that in central Java, Indonesia, behaviour that increases volcanic risk is closely intertwined with the religious and cultural traditions of the area but importantly it is poverty that drives individuals to exploit ostensibly hazardous areas of the volcano but which generate risks which are no greater than those emerging from everyday struggles for a livelihood. Dibben argues that it is not only in situations of poverty that risk increasing behaviour seems dislocated from the perception of risk. He finds for Mount Etna, in Italy, that people are choosing to live in situations of volcanic risk because of the benefits it brings them in a wide variety of ways. Any feelings of discomfort arising from living in a situation of volcanic risk are reduced through collectively held representations of a beneficial landscape, protection and safety.

The view, that it is inappropriate to consider the ‘volcanic’ aspect of studies of volcanic-human interactions as always or largely negative is taken forward by Dove and by Kelman and Mather. They point out that this may not be the most appropriate starting point for research but one which is encouraged by particular institution positions. Dove illustrates this through a case study of Merapi in Indonesia. He contrasts the representations of the volcano held by the Indonesian government, which is short term, ‘technologising’ and ‘exoticising’, with that of the people of Turgo which in contrast is longterm and ‘domesticating’. This challenges researchers to be sensitive to their own positionality, the extent to which they may be adopting particular socially constructed worldviews which may be significantly different to peoples who are affected by the suggestions emanating from their research. One way to avoid imposing a negative frame of reference is to examine volcanic risk as a manageable risk as are the many other risks impacting life. Kelman and Mather suggest that existing management frameworks could be applied to volcanic environments, in particular a sustainable livelihood approach could be used as an organising principle.

5. Volcanic risk perception and beyond

The set of papers in this special issue of the JVGR represent a unique collaboration between the proponents of different paradigms of risk and disaster research whilst also coming from a wide range of disciplinary backgrounds. This open dialogue enables the identification of some of the key issues for disaster risk reduction.

5.1. Risk perception is important

From the case studies presented in this volume, it is evident that volcanic risk perception is of importance when studying and managing volcanic risks. Carlino et al. show that in some cases, it may be a significant factor in explaining people’s behaviour. If risk perception is not directly connected to people’s behaviour, it is individuals’ experience of previous eruptions that may be critical in...
shaping adjustment to the threat as shown by Perry and Lindell. In line with this, information campaigns may raise people’s perception of risk and help in reducing their vulnerability in the face of volcanic hazards (Carlino et al.; Solana et al.). However Haynes et al., Perry and Lindell and Paton et al. all warn that there is not a simple relationship between information and behaviour. Any programme of education must take into account the complex social processes discussed in all of the papers in this special edition.

5.2. Risk perception should be considered in its wider context

There is enough evidence to suggest that risk perception has to be considered in its larger context. In this volume, Dibben, Chester et al., Dove, Kelman and Mather, Gaillard, Lavigne et al. and Haynes et al. all demonstrate that structural factors may surpass risk perception in importance in defining people’s behaviour. These factors are cultural, social, economic and political in nature. They are independent of the volcanic threats and act as powerful constraints to people’s decision making and capacity to protect themselves.

5.3. Structural constraints to people’s behaviour are powerful in both developing and industrialized countries

A significant contribution of this special issue is that it shows that those constraints are valid for both developing and industrialized countries, in Indonesia, the Philippines, Italy, Montserrat and elsewhere. This is an important finding as it is often assumed that what should be done in developing countries may not necessarily apply to industrialized countries. In this volume, Dibben shows that the search for a better quality of life is pushing people to move out of the city of Catania toward the foothills of Mount Etna despite obvious volcanic threats and alternative, ‘safer’, sites for building being available. Similarly Chester et al. point out that religion may similarly be a powerful constraint to people’s behaviour not solely in pre-industrialized societies but also in Europe.

5.4. People’s livelihoods are central to risk analysis

Kelman and Mather, Dove, Lavigne et al., Haynes et al. and Gaillard show that the first determinant of people’s behaviour in the face of volcanic hazards is often livelihoods. Individuals may choose to risk a potential eruption for the assurance of a better everyday life because it allows access to sustainable livelihoods. Kelman and Mather point out that this is true for both developing and industrialized countries.

5.5. Importance of place

This special issue of JVGR emphasizes that each volcanic context has its own physical environment, cultural heritage, society and political economy. There are no two cases in this volume where people’s behaviour in the face of volcanic hazards is shaped by the same social or environmental forces. A clear understanding of a local society is therefore vital to effective disaster risk reduction in volcanic environments.

5.6. Effective risk reduction requires close collaboration between threatened communities and authorities

In order for the authorities to fully appraise the local context of volcanic risk, local authorities have to work in close collaboration with local communities. It will help them in defining people’s risk perception and the weight of structural constraints such as livelihoods alternatives or the cultural attachment to places. Paton et al., Barberi et al., Kelman et Mather and Leonard et al. show how such a close collaboration may contribute to overcoming differences between people’s behaviour and authorities’ policies.

The identification of these issues argues for a reappraisal of the agenda for reducing disaster risks associated with volcanic hazards which is still basically hazard-focused (Chester, 2005b). It points towards the importance of the Hyogo Framework for Action (HFA) 2005-2015 agreed upon by the representatives of 168 countries which participated to the World Conference on Disaster Reduction, held in Kobe, Hyogo, Japan, in January 2005 (United Nations International Strategy for Disaster Reduction, 2005). The HFA stresses the importance of:

1. making disaster risk reduction a priority;
2. knowing the risks (in its whole dimension not only its hazard-related dimension) and enhancing early warning system;
3. building understanding and awareness using local and scientific knowledge;
4. reducing the underlying, hazard-independent, factors of risk;
5. strengthening disaster preparedness for effective response at all levels.

This 10-year agenda for disaster risk reduction involves blending both hazard-related and non hazard-related measures. It sets the threat from disasters beyond the sole dimension of natural hazards and locates it clearly within people’s vulnerability in the face of nature’s threat. It recommends culturally sensitive mitigation measures which consider the cultural, social, economic and political context. The HFA further emphasizes the importance of people’s livelihoods and asserts that natural hazards cannot be prevented, but it is possible to reduce their impacts by reducing the vulnerability of people and their livelihoods (United Nations International Strategy for Disaster Reduction, 2005, p. 4).

This special issue of JVGR is our small contribution to achieving the goals of the Hyogo Framework for Action 2005-2015. It has modestly contributed to the exploration of new grounds for the study of volcanic risks and open the debate on how to further improve risk management in volcanic environment. Hopefully many more studies will build on this contribution and further raise our understanding of people’s behaviour in the face of volcanic hazards.

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References


Jean-Christophe Gaillard
UMR PACTE 5194 CNRS, Université de Grenoble, 14 bis, Avenue Marie Reynoard, 38100 Grenoble, France.
E-mail address: jean-christophe.gaillard@ujf-grenoble.fr.
Corresponding author.

Christopher J.L. Dibben
School of Geography and Geosciences, University of St. Andrews, St. Andrews, Fife, Scotland, KY16 9AL, UK.
E-mail address: cjld@st-andrews.ac.uk.

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