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Risk Perception in a Multi-Hazard Environment

KIRA A. SULLIVAN-WILEY [a,b] and ANNE G. SHORT GIANOTTI [c,*]

[a] *Brown University, USA*
[b] *University of Antwerp, Belgium*
[c] *Boston University, USA*

Summary. — Environmental disasters cause enormous losses of life and property every year, a threat that is recognized and addressed in both the Sendai Framework for Disaster Risk Reduction and the 2015 Sustainable Development Goals. Organizations from both the risk reduction and development fields are working to design programs that build risk understanding and risk perception to encourage protective action in communities that are often at risk from multiple, overlapping threats. We know little, however, about how individuals perceive and prioritize multiple hazards at once and how this relates to their adoption of protective action strategies in the developing world. Our work addresses environmental hazard risk perception in a multi-hazard context in eastern Uganda, with particular attention paid to the role that risk reduction and development organizations (RDOs) play in shaping risk perceptions, as well as their potential to influence protective action. To better understand risk prioritization, we used survey data from farming households to generate four indices reflecting several components of risk perception and to predict holistic risk perception through multivariate regression analysis. Our study finds that the factors shaping smallholder risk perception vary among hazards within the study population and that characteristics of both hazards and individuals are important. The regression analysis also reveals a surprising relationship between risk perception, self-efficacy, and protective action. Our findings suggest that risk reduction and development programs can play an important role in affecting both risk perception and the capacity of smallholders to respond to environmental threats. Our work adds to the growing body of literature on how people perceive and respond to risk in a multi-hazard environment, a context increasingly common in a changing world. Improved understanding of how RDO programs in the developing world are engaging with and influencing risk mitigation in the multi-hazard environments is fundamental for reducing vulnerability.
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Key words — risk perception, development organizations, DRR, multi-hazard, Africa, Uganda

1. INTRODUCTION

Globally, environmental disasters result in the death of tens to hundreds of thousands of people (IFRC, 2014) and the loss of US$250 billion to US$300 billion every year (UNISDR, 2015). In addition to the threat of an individual hazard event, there is increasing awareness that hazards are often found in combination with other threats, both environmental and social and that these threats can interact to exacerbate each other in a multi-hazard landscape (Cutter, Mitchell, & Scott, 2000; O'Brien *et al.*, 2012; UNISDR, 2015). High population growth rates exacerbate threats in multi-hazard environments (Huppert & Sparks, 2006) and the threat of climate change, an additional uncertainty overlaying existing vulnerabilities, further complicates the meteorological component of hazards (IPCC, 2014). The international community has recognized the interconnectedness of these threats in the adoption of the Sustainable Development Goals and the Sendai Framework for Disaster Risk Reduction in 2015. Both risk reduction and development organizations (hereafter referred to collectively as RDOs) are making substantial efforts to encourage vulnerable populations to adopt protective actions, designing programs that aim to build risk understanding and risk perception (Shaw & Izumi, 2014; Thomalla, Downing, Spanger-Siegfried, Han, & Rockström, 2006).

In order to take protective actions against a hazard, people must have some understanding of the risk associated with that hazard and the capacity to act on their concern (Lindell & Perry, 2012). While higher levels of risk perception would be expected to lead to higher rates of protective action, this relationship is not always straightforward. In a phenomenon termed the "risk perception paradox", elevated risk perception is not always linked to protective action. A lack of motivation, inconsistencies in perceived responsibility for protection and trust in protective agencies, and the perception of limited self-efficacy (i.e., the capacity to undertake protective actions) have each been found to act as intermediaries to prevent the understanding of risk from translating into action (Wachinger, Renn, Begg, & Kuhlicke, 2013). The decision to take, or not take, action can in turn influence risk perception (Brewer, Weinstein, Cuite, & Herrington, 2004). These challenges in translating risk perception to action may be especially critical in multi-hazard environments where people are vulnerable to multiple, overlapping threats, with which they have limited resources to cope.

Examining risk perception in a multi-hazard environment, and the role of RDOs in shaping those risk perceptions, is important to better reflect the reality of vulnerable individuals and to allow us to tease out the influence of particular hazard characteristics versus individual characteristics on risk perception. Yet we know little about how individuals perceive and prioritize multiple hazards at once and how this relates to their use of the protective actions that are frequently particular to an individual threat (Doss, McPeak, & Barrett, 2008). While a large body of work has examined who perceives risk and why, this work has focused on single hazards in isolation

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(e.g., López-Marrero, 2010 flooding risk perception in Puerto Rico; Nathan, 2008 landslides in Bolivia; Gaillard, 2008 volcanoes in the Philippines; review articles such as Gallina, Torresan, Critto, Sperotto, Glade, & Marcomini, 2016 similarly highlight studies focused on single hazards). Further, none of these studies directly addresses the role of RDOs in affecting risk perceptions in a multi-hazards context.

We address this gap in knowledge through a study of environmental hazard risk perception in a multi-hazard context in the Bugisu region of eastern Uganda. We pay specific attention to the role of risk and development oriented organizations in shaping risk perceptions and their potential to influence protective action. Understanding the factors that shape risk perception and the implications for those on changing action in a multi-hazard environment is important to inform RDOs in their work to reduce risks to the most vulnerable populations.

This paper begins with an overview of the literature on risk perception of environmental hazards and an introduction to our study area of the Bugisu region of eastern Uganda. We then present results of hazard ranking and regression analyses for risk perception that show a disconnect between RDO and local prioritizations and perceptions, the difference in factors shaping perception of different hazards, and the role that RDOs may play in shaping perception. Finally, we discuss the theoretical and policy implications of our study, as well as areas of future research based on this work.

2. BACKGROUND & THEORETICAL FRAMEWORK

Risk perception is a key component in encouraging protective action in the context of natural hazards (Lindell & Perry, 2012; Wachinger *et al.*, 2013). Risk perception contrasts with "real risk", or the statistical likelihood of fatality from the hazard, through its reference to a person or population's *interpretation* of the hazard and its risk (Sjöberg, 2000). There are three issues implicit in perceived, as opposed to real, risk. First is that, while distinct from real risk, the notion of probability still exists in perceived risk, but instead of reflecting a calculated statistical probability, perceived risk reflects perceived likelihood, which frequently differs from statistical probability in meaningful ways through biases such as the availability heuristic (Siegrist & Gutscher, 2006; Tversky & Kahneman, 1974). Secondly, perceived risk comprises uncertainty in event outcomes and the severity of those outcomes for the individual or group interpreting the risk; even the same physical outcome of a hazard can represent different danger to different people depending on their preferences and coping capacities. Finally, there is the social construction of risk that relates to the level of risk society is willing to accept in exchange for the social benefits associated with its cause, a relationship that is influenced by perceptions of to whom the responsibility for risk mitigation falls (Bronfman, López Vázquez, & Dorantes, 2009; Kasperson *et al.*, 1988). Much early work in the field focused on assessing the differences between perceived and real risk (e.g., Lichtenstein, Slovic, Fischhoff, Layman, & Combs, 1978; Slovic, Fischhoff, & Lichtenstein, 1979, 1980), while later work began investigating the implications of these differences for risk management and risk communication (e.g., Boholm, 1998; Renn, 1999; Wachinger *et al.*, 2013).

A large and mature body of research investigates how people perceive risks associated with technological hazards (e.g., nuclear power, genetically modified organisms). This body of work shows that risk perception varies with respect to the characteristics of the individual perceiver as well as the characteristics of the hazard itself (Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1978; Slovic, 1986; Slovic *et al.*, 1979; Wachinger *et al.*, 2013). Early research identified differences in how expert and non-expert communities perceive risk. While experts generally equate risk with fatality frequency (annual death rates associated with a given hazard), non-experts include factors like catastrophic potential and sensationalism into their risk calculus (Lichtenstein *et al.*, 1978; Slovic *et al.*, 1979). In addition, non-experts tend to rate concern about risks more highly when the hazard is uncontrollable, catastrophic, involuntary, not equitable in its impacts, and not well-understood (Boholm, 1998; Slovic, 1986). Like technological hazards, the most essential components of environmental hazard risk perception are generally considered to be the perceived probability (likelihood) and the severity of the consequences of the hazard (Lindell & Perry, 2012). These, however, are insufficient to account for variability in risk perceptions (Table 1).

The characteristics of the individual also affect risk perception. Characteristics related to social vulnerability are associated with higher risk perceptions of hazards, a relationship likely to reflect individual self-efficacy, or one's perceived ability to affect change (mitigate risk) through protective action (Bandura, 1995; Bickerstaff, 2004; Martin, Bender, & Raish, 2007). Gender, age, and educational attainment are often (though not consistently) found to be mediating factors in risk perception. Women have been found to perceive greater risk than do men, older adults to perceive greater risk than young, and less educated to perceive greater risk than more educated (Flynn, Slovic, & Mertz, 1994; Gyekye & Salminen, 2009; Mayhorn, 2005; Siegrist, 2000; Terpstra & Lindell, 2013; Wachinger *et al.*, 2013). Those living in poverty (Cutter, 1981; Nyland, 1993; Sjöberg, Kolarova, Rucai, Bernström, & Flygelholm, 1996), those with children in the household (Turner, Nigg, & Paz, 1986); people who are divorced or unemployed (Boholm, 1998), and other characteristics like cultural identity (Rohrmann, 1994) have also been shown to be associated with elevated risk perception. Other studies of perceptions of individual environmental risks, however, have found weak or non-existent trends with respect to some or all of these socioeconomic characteristics (Burningham, Fielding, & Thrush, 2008; Plapp & Werner, 2006).

Familiarity and experience can also affect perception of risk. In the context of environmental hazards, direct personal experience has consistently been shown to be positively associated with risk perception (Grothmann & Reusswig, 2006; Heitz, Spaeter, Auzet, & Glatron, 2009; Miceli, Sotgiu, & Settanni, 2008; Plapp & Werner, 2006; Siegrist & Gutscher, 2006; Terpstra, 2011). The recency, frequency, and severity of this experience can affect the strength of its relationship to risk perception (Lindell & Perry, 2012). Those who have experienced mild forms of a hazard, for example, tend to underestimate subsequent danger, with an attitude that Mileti and O'Brien (1992) describe as "normalization bias", whereby people interpret the mild impacts of the early experience as the norm and believe that future severe impacts can also be avoided. This can be seen in the example of non-experts consideration of familiar actions such as driving in a motor vehicle less risky than less familiar actions that are statistically less likely to result in fatalities (Slovic *et al.*, 1979). Baan and Klijn (2004) found that those most experienced with floods were among those least concerned by them, but in this case the effect was mediated through a sense of preparation on the part of the perceiver.

Risk perception is also influenced by communication about risks from external expert sources in complex ways (Fischhoff,

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