International Journal of Disaster Risk Reduction 1 (2012) 5–16

Contents lists available at SciVerse ScienceDirect

International Journal of Disaster Risk Reduction

journal homepage: www.elsevier.com/locate/ijdrr

Review Article

Risk interpretation and action: A conceptual framework for responses to natural hazards

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ARTICLE INFO

Article history:
Received 7 February 2012
Received in revised form
30 May 2012
Accepted 31 May 2012
Available online 15 June 2012

Keywords:
Risk
Hazard
Interpretation
Decision
Trust

ABSTRACT

Understanding how people interpret risks and choose actions based on their interpretations is vital to any strategy for disaster reduction. We review relevant literature with the aim of developing a conceptual framework to guide future research in this area. We stress that risks in the context of natural hazards always involve interactions between natural (physical) and human (behavioural) factors. Decision-making under conditions of uncertainty is inadequately described by traditional models of 'rational choice'. Instead, attention needs to be paid to how people's interpretations of risks are shaped by their own experience, personal feelings and values, cultural beliefs and interpersonal and societal dynamics. Furthermore, access to information and capacity for self-protection are typically distributed unevenly within populations. Hence trust is a critical moderator of the effectiveness of any policy for risk communication and public engagement.

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Revisiting Eiser et al. (2012)—Risk Interpretation and Action: A Conceptual Framework for Responses to Natural Hazards

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Abstract

This review examines Eiser et al.'s (2012) conceptual framework for risk interpretation and action in the context of natural hazards. The article makes an important contribution to disaster risk reduction and risk research more generally by illuminating the social and behavioural processes that influence how individuals interpret and act upon risk. Drawing on psychology and decision science, the paper highlights how uncertainty, heuristics, experience, learning, and trust shape risk-related decision-making. The study addresses the persistent gap between information and action in disaster risk reduction and demonstrates the complex interplay of behavioural processes in this context. Although the paper does not succeed in developing a fully coherent conceptual framework, it has nevertheless been influential in advancing subsequent work on, for instance, risk communication, early warning systems, knowledge-to-action research, practice for disaster risk reduction, and other fields of risk research.

Keywords

Risk interpretation • Decision-making • Uncertainty • Natural hazards • Disaster risk reduction

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J. Weichselgartner et al. (eds.), *Six Decades of Risk Research*, Civil Protection, Disaster Management, and Resilience 8, https://doi.org/10.1007/978-3-032-30515-2_36

36.1 Introduction

The review article by Eiser et al. (2012) sought to develop a conceptual framework for future research on how individuals interpret risks associated with natural hazards and how, on this basis, they arrive at specific courses of action. The paper takes as its point of departure the observation that disasters cannot be understood solely in terms of physical hazard processes but are also the outcome of human interpretation, decision-making, and action. Against this background, the article does not aim to provide an exhaustive account of the causal factors of disasters. Instead, it focuses on the question of how risks are interpreted and acted upon within contexts shaped by vulnerability and resilience. To address this question, the authors—established scholars in risk research with backgrounds in psychology, policy analysis, and disaster risk management—examine how individuals and groups deal with uncertainty, revise their beliefs based on experience and learning, and make choices among available courses of action. Drawing on concepts and theories from psychology and decision science, the article seeks to make the processes of risk interpretation and decision-making under uncertainty analytically accessible for both researchers and practitioners in the field of natural hazards. Although published in the *International Journal of Disaster Risk Reduction* and thus clearly aiming to inform the disaster risk reduction discourse, the framework itself is not limited to a specific hazard type or risk domain. It is formulated at an abstract, conceptual level to be transferable to a wide range of contexts in which risk interpretation and decision-making under uncertainty are involved. This generalisability likely constitutes one important reason for the article's broad reception within the wider field of risk research.

36.2 Analysis

The conceptual framework presented in the paper seeks to answer the question of how risks are interpreted and acted upon. The authors approach this question from the perspective of decision science and psychology, focusing on (1) how individuals and groups deal with uncertainty, (2) how they update their beliefs on the basis of feedback, and (3) how they make choices among alternatives. Thus, the article draws attention to behavioural aspects and processes informing risk interpretation and action based on that interpretation for disaster risk reduction.

This is still a relevant issue for research and policymaking as it addresses the "information-to-action" gap in disaster risk reduction that has been acknowledged as a key barrier at the science-policy interface (Weichselgartner and Kasperson 2010). Eiser et al. (2012) highlight an important issue for disaster risk reduction, namely that with better scientific data and information on hazards and risk, there is also a need to unpack the social and behavioural aspects of how risk interpretation informs action for enhanced disaster risk reduction.

While the need for improved and interoperable data (UNDRR 2023) is still prevalent, Eiser et al. (2012) emphasise the role of social processes of risk interpretation, foregrounding that action based on information is socially contingent and the result of intricate processes of interpretation and decision-making (Weichselgartner and Kasperson 2010). As a result, the article offers a process-oriented definition of risk: "Rather than attempting to define risk in terms of topics, however, we can attempt to do so in terms of processes […]. Decision sciences traditionally define risk as a function of (a) the likelihood and (b) the value […] risk arises not just from how some future can be described, but from the uncertainty […] surrounding that description" (Eiser et al. 2012, p. 7). This conceptualisation not only focuses on uncertainty as the constitutive condition of risk but also problematises the apparent objectivity of both likelihood and value. In doing so, the authors align with established critiques of the rational actor paradigm (see Jaeger et al. 2001) and open up analytical space for psychological, cultural, and social determinants of risk interpretation (see Chaps. 7, 11, 12, 21, and 42). Drawing on Prospect Theory by Kahneman and Tversky (1979), the authors emphasise that decision-making is structured by reference points and framing effects rather than by objective expected values (see Chap. 4). As they note, "'gain' and 'loss' are not absolute but relative to an implied reference point that represents one's expectations" (Eiser et al. 2012, p. 8).

However, this framing is not accompanied by a rigorous conceptualisation of uncertainty itself. While the authors acknowledge that uncertainty may relate to both the likelihood of events and the evaluation of their consequences, they do not develop a systematic typology that would allow these dimensions to be analytically distinguished. The statement that "As well as uncertainty over the likelihood of an event, there may be uncertainty over the value of the consequences, in part because 'value' means many things" (Eiser et al. 2012, p. 7) remains largely descriptive. Given that uncertainty constitutes the foundational premise of the framework, this limitation is all the more surprising given that the field of risk research has long been characterised by a debate on the epistemic foundations of risk assessment (see, e.g. Funtowicz and Ravetz 1990; Rosa 1998, 2008; van Asselt 2000), which, in turn, informed the distinction between "complexity," "uncertainty," and "ambiguity" as a conceptual yardstick for addressing challenges related to the state and quality of knowledge concerning hazards and risks (Renn 2008; Stirling 2003). Since the beginning of the 2000s, risk scholars have drawn attention to the role of ambiguity in risk assessment, referring both to epistemological issues, i.e. the existence of different scientifically valid interpretations of the same assessment result, and to normative issues, i.e. divergent valuations of the outcomes associated with risk (e.g. Klinke and Renn 2002; Renn 2008; Renn et al. 2011). However, this discourse primarily informed risk assessment circles; thus, disciplinary silos within risk research may explain why this literature was sidelined in this publication.

The most theoretically distinctive element of the paper is the application of Signal Detection Theory (SDT) to the analysis of risk interpretation. Originally developed in perceptual psychology (Green and Swets 1966; Swets 1973), SDT conceptualises

decision-making under uncertainty as a problem of distinguishing signal from noise. Eiser et al. (2012) adapt this framework to the context of natural hazards, where decision-makers must determine whether ambiguous information should be interpreted as indicative of actual danger. The analytical value of this framework lies in its capacity to conceptualise the trade-offs inherent in risk interpretation. A cautious decision criterion reduces the probability of failing to detect a real danger but increases the frequency of false alarms, while a less cautious criterion produces the inverse pattern. As the authors emphasise, "[i]t all comes down to what kinds of errors we are prepared to accept and what kinds we are anxious to avoid" (Eiser et al. 2012, p. 10). This is particularly relevant in the context of disaster risk, where the consequences of different types of error are often highly asymmetric. Consequently, risk interpretation necessarily involves normative judgements regarding acceptable levels of risk, a discussion the paper alludes to several times but ultimately sidesteps.

Eiser et al. (2012) aim to expand on the original SDT by emphasising the role of learning and feedback for improving decision-making. Especially in the case of natural hazards, they point out challenges for learning from the outcomes of decisions, for instance, the difficulty of correctly distinguishing between real danger and a "false alarm" due to avoidance behaviours that do not allow individuals to experience what would have occurred in the absence of preventive action. Several other challenges for learning are mentioned in the paper, e.g. that "false alarms" may lead to complacency among populations at risk, partial or delayed learning reinforcement, and optimistic bias, where people judge their own risk from hazards to be lower than that of others. While these examples illustrate the complexity of the issues surrounding learning in this context, their integration into SDT and the development of a conceptual framework to guide future research remain underdeveloped.

Finally, the paper emphasises that the interpretation of risk and decision-making in relation to natural hazards is always situated within specific social and institutional contexts, with particular emphasis on the role of trust. Acknowledging that cultural and individual differences may give rise to divergent attitudes towards disasters and to different forms of risk-related decision-making, Eiser et al. (2012) argue that effective risk communication in the context of natural hazards depends not only on the accuracy of the information provided, but also on the perceived competence and integrity of the actors involved. Although this is an important insight for the framework, and moreover empirically well supported (see, e.g. Siegrist and Cvetkovich 2000; Siegrist et al. 2005), its integration with insights from SDT, as well as with the issues raised regarding learning processes in the context of natural hazards, remains underdeveloped. More importantly, questions of agency and of whether individuals have both the capacity and the opportunity to act on their interpretations of risk are acknowledged but not explored further. The pivotal role of people's capacity, as highlighted for instance by Kuhlicke et al. (2011), not only to translate their interpretations of risk into decisions, but also to act upon those

decisions in practice, therefore remains insufficiently addressed in the paper and is not incorporated into the framework.

While the paper arguably does not succeed in developing a fully coherent conceptual framework, it nevertheless identifies several key challenges associated with decision-making under uncertainty that have been pointed out in the literature. Similarly, although the examples discussed are drawn from a wide range of risk domains, the authors succeed in bringing together the lessons derived from these cases for the context of natural hazards and disasters. It may be argued that the paper's principal contribution to risk research lies less in offering a streamlined research agenda than in illuminating the complex interplay between risk interpretation and individual decision-making, as mediated by heuristics, personal experience, learning, and trust.

This scientific contribution is especially noteworthy, given the importance of integrating knowledge and experience from diverse stakeholders and knowledge holders for disaster risk reduction (Albris et al. 2020). Further research on the gaps—or, rather more appropriately, the multiple intervening mechanisms—between risk interpretation and action identified by Eiser et al. (2012) has contributed to a more nuanced understanding of the data-information-knowledge-action chain and of the complex interlinkages between its constituent elements. Methodologies, such as the Disaster-Knowledge Matrix proposed by Spiekermann et al. (2015), provide a systematic approach to identifying barriers that inhibit the transformation of data into information and information into knowledge for decision-making in policy and practice in the context of disaster risk reduction. Similarly, effective risk communication and early warning systems for natural hazards rely on insight regarding risk interpretation and individual decision-making (Dallo et al. 2022; de Elía et al. 2024).

36.3 Conclusion

The paper makes a valuable contribution to the scientific discourse on risk interpretation and action by shifting attention from hazards as purely physical events to the interpretative and decision-making processes that inform risk-related behaviour. Its key achievement lies in demonstrating that human behaviour and actions do not follow automatically from the availability of hazard information, but are mediated by heuristics, experience, learning, trust, and social context. In this regard, the paper addresses a crucial and persisting problem in disaster risk reduction, namely the gap between information and action.

At the same time, the proposed conceptual framework remains less coherent than the article's ambition suggests. The treatment of uncertainty is not systematically developed, and relevant issues such as ambiguity, agency, and the capacity to act upon risk interpretations remain only partially explored. Likewise, the rich discussion of learning, feedback, and trust is not fully integrated into a consistent framework.

These limitations, however, do not diminish the article's significance. Its main contribution lies less in offering a streamlined research agenda than in clarifying the complex interplay between risk interpretation and decision-making. By identifying these intervening mechanisms, rather than resolving them, the paper has helped to shape subsequent work on various risk issues, such as risk communication, early warning systems, and frameworks for identifying conditions under which knowledge can be translated into action.

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