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The role of risk perception, risk communication, and comparative risk principles in resilience building

L.J. Vinnell
Joint Centre for Disaster Research, Massey University

ABSTRACT

Increasing resilience to earthquakes through choices such as building design requires people to understand, evaluate, and act on risk. Therefore, any communication efforts, either formal or informal, which are aimed at motivating resilience-related decisions should include a consideration of principles of risk perception and risk communication. Decades of research have established numerous factors which influence whether and how people perceive a risk such as a large earthquake. Effective risk communication requires an understanding of these factors as well as principles of communication and hazard-related behaviour generally. Done poorly, risk communication can not only be ineffective, it can also be detrimental to efforts to encourage particular decisions, such as deciding to build for earthquake resilience. A common form of risk communication is the use of comparative risk, where the likelihood and/or impact of one hazard is compared to one or more other hazards. While comparative risk can be a useful way to provide context and aid decision making, it can also easily backfire if used without an understanding of risk perception principles. This paper will present a concise overview of some of these key risk perception principles, basics of risk communication, and perspectives on appropriate use of risk comparisons.

1 THE PSYCHOLOGY OF RISK

All actions to build earthquake resilience, whether it is an individual storing water or a commercial building owner carrying out seismic retrofitting, at least in part involve a consideration of the risk which the action seeks to address. Anyone working to promote and encourage resilience building should therefore bear in mind how the people with whom they are working understand and perceive risk, and how they might be influenced by choices in risk communication. Risk perception is an adaptive mechanism, evolved tens of thousands of years ago, to help protect us from danger. This means that perception and related behaviour is not always entirely rational, given that our risk context today is vastly different from the risk context in which the human brain evolved. As well as these evolutionary influences, how people understand and

perceive risk, and respond to risk communication, varies based on a range of sociodemographic factors. We have known for decades that thinking about risk is a daily part of life for the public, and that the way they do this is different than scientists and experts (Gurabardhi et al., 2004). However, for a similarly long time there has been a shift away from risk education (Frewer, 2004) meaning that there are considerable differences in definitions of risk perception (Doyle & Becker, 2022).

1.1 Defining risk

One of the most important steps in ensuring beneficial risk communication and conversations is understanding how your audience understands "risk", as there are many different ways to define and conceptualise it. Commonly, risk is conceptualised as probability, neglecting consequence (e.g., fatality risk, as commonly used in risk comparisons, focuses on the probability of a single fixed outcome; Doyle & Becker, 2022; Wolff et al., 2019), or separated from both likelihood and consequence entirely (Wilson et al., 2018). Risk can be considered a noun (e.g., earthquakes *are* a risk), a verb (e.g., risking earthquake impacts), or a quality of something (e.g., earthquakes *pose* risk). Often, risk is considered some combination of likelihood and consequences, sometimes including exposure, vulnerability, or both. Given that exposure and vulnerability can be considered aspects of consequence (i.e., to determine the consequence of an earthquake, it is necessary to know what is exposed to impacts and how vulnerable it is), this paper will use the common definition of risk as based on the likelihood of an event occurring and the severity of the consequences should the event occur.

1.2 Overview of the paper

This paper is intended to be a brief introduction to some of the key principles of risk perception and communication to highlight the complexity of the area and the importance of avoiding assumptions, rather than a comprehensive explanation of all considerations. First, I will discuss the role of risk perception in motivating resilience actions, and the types of factors which influence it. One of these, risk tolerance, will then be covered in more detail given its key role in the relationship between risk perception and action as well as the prevalence of its use in guidance documents (e.g., Toka Tū Ake's Risk Tolerance Methodology, 2023; Ministry for the Environment's Proposed National Policy Statement for Natural Hazard Decision-making, 2023). Then, I will introduce some examples of considerations for risk communication, including the challenges of using risk comparisons.

2 RISK PERCEPTION

While risk perception is a prerequisite for mitigation and preparation actions, it is not often found to be a *predictor* of behaviour. That is, people need to perceive a risk to act to reduce it (either its likelihood or its impacts), but this is not enough in and of itself to motivate action. One reason for this is that the relationship between risk perception and behaviour is likely non-linear (Solberg et al., 2010). If people perceive no risk, they are unlikely to act. However, simply increasing how risky a person perceives something like an earthquake to be does not necessarily lead to an increase in resilience actions. If a risk is perceived as too extreme, people likely become fatalistic (believe that the risk is too big to be reduced or prepared for; McClure et al., 2001) and therefore unlikely to act. Other psychological factors are critical to converting risk perception to behaviour, including self-efficacy (the individual's belief that they are capable of carrying out the resilience action) and response-efficacy (the belief that the action will have the intended outcome of increasing resilience; Vinnell et al., 2021a). It is therefore important to understand both how people perceive a risk as well as the other considerations involved in their risk decision making.

2.1 Likelihood versus consequence

Probability neglect bias (Slovic & Peters, 2006) suggests that people focus on the severity of potential impacts over the likelihood of occurrence. In particular, when the potential consequences of a risk are extreme enough, the likelihood becomes essentially irrelevant. However, other research shows that people tend to prioritise lower consequence, higher probability risks (Solberg et al., 2010). These latter findings are logical in the evolutionary context of risk perception as an adaptive mechanism; people tend to prioritise risks which are more immediate (temporal distance; Solberg et al., 2010; Spence et al., 2011), more concrete (Lermer et al., 2016; Tversky & Kahneman, 1974), and when they can more easily think of instances (availability heuristic; Tversky & Kahneman, 1974). For example, people may prioritise motor vehicle accidents over earthquakes because the impacts are (perceived to be, at least) possible to occur immediately, easier to imagine, and people are more likely to have been in, or known someone who has been in, a car crash rather than severely impacted by an earthquake. Further, there is a tendency for non-experts to discount a low probability as zero probability (Corotis, 2006).

However, recent research suggests that both elements of risk are important (Wilson et al., 2018), just in different contexts and for different people. For example, perceptions of the likelihood of a lahar occurring, but not severity of impacts, were associated with intentions to prepare and having an evacuation kit, while women and those who lived in a lahar zone perceived significantly higher potential consequences but no difference in likelihood (compared to men and those who do not live in the hazard zone, respectively; Vinnell et al., 2021b). Other research found that experimentally triggering thoughts of multiple hazards affected perceptions of consequences, but not likelihood (Vinnell et al., under review). It is probable, then, that these two factors of likelihood and outcome severity are discrete aspects of laypeople's' consideration of risk rather than simply pieces of a risk calculation (Le & Arcodia, 2018; Terpstra & Lindell, 2012; Wolff et al., 2019).

2.2 Audience characteristics

As well as non-expert versus expert, there are many other individual differences which can influence how risks are perceived and acted on. People can vary in their predisposition towards cognitive biases such as fatalism and heuristics such as availability (mentioned above), previous experience of the risk, and sociodemographics (e.g., the "white male effect; Finucane et al., 2000). The "public" tend to consider risk problems dichotomously and in isolation (e.g., safe or not safe) compared to regulators who need to consider a range of actions and alternatives, often addressing multiple objectives and competing risks and considering higher level (e.g., societal) impacts. While evidence for differences between genders and ethnicities is mixed (Becker et al., 2015), there is a general pattern where members of dominant social groups (hence the "white male effect") are likely to perceive lower risk and to be less likely to act on it.

2.3 Risk characteristics

Risks are not created equal; how people perceive and choose to act on a risk depends on various characteristics of that risk. These characteristics include (but are not limited to): whether the risk is known or unknown (both by science and/or the perceiver), affective responses such as feelings of dread, catastrophic potential, whether the risk is voluntary or involuntary, whether there is a perceived moral responsibility to address the risk, how new the risk is, and the nature of the risk (e.g., biological, technological, natural, anthropogenic). This means that people think about car accidents differently than earthquakes, which are older, less controllable, inspire more dread, and have more catastrophic potential (Henrich et al., 2018). These differences also have implications for the use of risk comparisons in communication, discussed later.

3 RISK TOLERANCE

Recent research has shown the relationship between risk perception and behaviour is affected by risk tolerance (Anderson et al., 2024). Risk tolerance is highly individual, driven by personal factors such as general appetite or aversion to risk. The decision to choose to tolerate a risk can involve considerations of the benefits of the risk (e.g., living in a tsunami hazard zone might mean good views and easy beach access), the costs and benefits of risk reduction (e.g., risks which can be reduced cheaply and easily are likely to be less tolerable), characteristics of the hazard (as mentioned above), and affective reactions (also mentioned above). It is also possible that people consider other risks when asked whether they will tolerate a specific one. For example, people may be more tolerant of earthquake risk if they believe that there is a limited resource pool for risk reduction and those resources would be better put towards addressing another risk such as traffic accidents (Vinnell et al., 2018). Therefore, a risk can be high but tolerable, or low and intolerable; risk perception can *influence* risk tolerance, but they are separate judgments.

4 RISK COMMUNICATION

How you communicate risk depends partly on your goals for that communication, so it is important to determine this beforehand (Bier, 2001). Different goals for risk communication can include raising awareness of a risk, educating, motivating action, or gaining acceptance. Ideally, risk communication design should also take into account audience interests, concerns, priorities, and preferences. How messages are understood can be affected by the framing; wording choices (Vinnell et al., 2023), the use of verbal or numerical terms, positive or negative construals (McClure et al., 2009), and use of frequencies versus percentages have all been shown to influence understanding of and response to risk communication messages. For example, members of the Wellington public were more supportive of earthquake prone building legislation when they were told the *number* (as opposed to percentage) of *prone* (as opposed to "acceptable") buildings in the city (Vinnell et al., 2018). The extent to which these and other factors can be considered depends partly on whether the communication is structured or informal, planned or spontaneous (e.g., a marketing campaign compared to a conversation with a building client). Some key principles which are relevant across most contexts are described below.

4.1 Make the risk scary…

As mentioned above, perceiving some level of risk is necessary for people to take action to reduce, mitigate, or prepare for the impacts of that risk. The first step is to understand the existing awareness of the risk and providing education if necessary. The second step is to encourage the audience to see the possibility of the event occurring, and how they might be impacted if it should occur. This could be done by reminding them of previous similar events and making the impacts concrete and personally relevant.

4.2 … but not too scary

Several cognitive biases exist to offer psychological protection from risks which would otherwise be overwhelming. These include unrealistic optimism, where a person acknowledges a risk but believes that they personally will not be impacted (counter to logic, hence "unrealistic"; Spittal et al., 2005) and fatalism (described earlier). Risk communication should therefore aim for a sufficient level of concern to motivate action without prompting unhelpful levels of fear. People are more likely to become fatalistic if they are *only* presented with risk information; it is vital for risk communication to include what the audience is able to do in response to that risk. Reminding people of the actions available to them, their ability to carry out those actions and the support available, and the benefits of those actions will help to avoid audiences of risk communication becoming fatalistic.

5 RISK COMPARISONS

Risk comparisons can be intuitively appealing as a way to communicate risk, especially ones which are newer or less known, but they are controversial (within the literature, at least). It is likely that comparative risk analysis is "neither as pernicious as its detractors claim nor nearly as useful as its proponents allege – particularly as is often practiced" (Finkel, 1996). Risk comparisons are likely to be unhelpful, if not harmful, when they do not consider the range of factors which influence risk judgments (Slovic et al., 1990). Similar to risk communication generally, risk comparisons should be used with a specific goal in mind and include as much context as possible. For example, comparisons of unrelated risks are likely inappropriate for *decisions* about *acceptability* (Slovic et al., 1990). This may be because comparative risk analysis typically uses a mathematical, quantitative value for risk, but "comparative levels of risk defined this way are inconsistent with the trade-off decisions that are made by society at large" (Corotis, 2006, p.4).

To help simplify the context, "risk comparisons" are typically actually "fatality comparisons" (Finkel, 1996). This means that many *hazards* can be quantitatively compared but it undermines the value of the decision because often fatalities are not the only impact. For example, it is difficult to compare societal and individual level risks. One hundred and eighty-five traffic fatalities would not have the social, economic, and environmental impact of the 2011 Christchurch earthquake.

Even focusing on a single outcome such as fatalities can complicate any comparisons and the conclusions of a comparison can depend solely on choices in the risk framing. For example, the risk of dying in a traffic accident in any given year in New Zealand is higher than the chance of dying in an earthquake, but a single large enough event (such as a Hikurangi subduction zone megathrust) could lead to tens of thousands of fatalities. Presenting annual fatality rates versus lifetime rates can meaningfully change the conclusion of a comparison even though the "objective" data is the same (Covello, 1991). Further, such comparisons leave out many of the factors described above such as benefits of the risk and the cost to reduce it and do not take into account variances between the risks, including the uncertainty and variability in the risk data itself and the characteristics of that risk (described above).

6 CONCLUSION

Decades of research has explored how people understand, perceive, and act on risk, as well as how to influence those judgments (often with the ultimate goal of changing behaviour). While the disciplines which approach questions of risk judgments do not tend to deal in facts and rules, there are some general principles which have emerged relatively consistently. This paper has presented some of those principles which can be applied in a most basic sense. This paper has also presented a non-exhaustive range of other relevant factors to demonstrate the complexity of the psychology of risk and to highlight the potential pitfalls of some assumptions (for example, the information deficit belief that people simply need more information about a risk to take resilience actions). Anyone trying to increase awareness or knowledge of a risk, and in particular trying to encourage resilience actions such as seismic strengthening, is encouraged to:

- Understand how your audience understands risk, in particular if they are weighting likelihood or consequence;
- Consider risk tolerance separately, and as holistically as possible (i.e., as much as you can considering other aspects of the risk including benefits, costs to reduce, and characteristics)
- Communicate the impacts of the risk but also pair it with what can be done and how it will help;
- Use risk comparisons only when they will help achieve the specific goal, the nature of the risks and the data available makes comparisons meaningful, and when you are able to provide enough context for useful judgments.

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