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Edited by Saskia M. van Manen, Claudine Jaenichen, Klaus Kremer, Tingyi S. Lin, and Rodrigo Ramírez

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Chapter 9

Awareness to preparedness

A design-led approach to building resilience and readiness for the next Alpine Fault earthquake

Alice Lake-Hammond and Caroline Orchiston

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9 Awareness to preparedness

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Introduction

There is increasing evidence to support investment in activities which mitigate the impact of disasters and enable avenues for sustainable development in recovery and reconstruction. Concepts of Building Back Better, Disaster Risk Reduction, resilience and readiness are now commonplace not only within agencies working in the disaster and development fields but also at a governmental (public), business (private) and individual (personal) level (Aldrich 2012; Rodin 2015; UNDRR 2015). It is generally accepted that investment in programs which support these objectives, reduce risk and build resilience saves money and is more effective in the long-term than investment which focuses solely on disaster response. However, while the potential economic and social benefits of resilience and readiness initiatives are widely recognized in theory, it is not always clear *how* this potential is met in practice.

The United Nations Office for Disaster Risk Reduction (UNDRR) defines resilience as: "The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner" (UNDRR 2017). In New Zealand, this definition is supported by a National Disaster Resilience Strategy, which aims to:

> Strengthen the resilience of the nation by managing risks, being ready to respond to and recover from emergencies, and by enabling, empowering and supporting individuals, organisations and communities to act for themselves and others, for the safety and wellbeing of all.
>
> (NEMA 2019, 3)

For an individual and their community to have the resources and capacity to *act for themselves and others* requires them to be involved in the process of preparing for disaster. Communities need to be active in planning, organizing and actioning initiatives which reduce risk and increase resilience, pre- and post-disaster. This involvement implies not only a knowledge of potential risk but also an engagement by the community in a collective understanding of its vulnerabilities, level of preparedness and its capacity to absorb, adapt and recover in the face of sudden and often shocking systemic change. In terms of emergency preparedness, resilience is then not simply an awareness of the potential impacts of disaster but an active engagement and participation in taking steps to increase preparedness at both an individual and community level. Initiatives aimed at preparing communities for emergency events must not only *inform* about hazards, they

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must also *enable* the sharing of knowledge which increases awareness and understanding of risk, supports action toward preparing for disaster and builds resilience across all levels of a community – public, private and personal.

This chapter shares insights from AF8 [Alpine Fault magnitude 8] a collaborative program of work aimed at building societal resilience to a magnitude 8 Alpine Fault earthquake across the South Island of Aotearoa New Zealand. Specifically, it describes the 'AF8 Roadshow: The Science Beneath Our Feet', a central communication and engagement initiative of the AF8 Programme, as a case study illustrating a design-led approach to public education aimed at supporting a community-centered journey from hazard awareness to emergency preparedness. It begins with an overview of the concepts underpinning the design and delivery of the AF8 Roadshow, highlighting principles from the fields of design and risk communication to illustrate the value of design thinking in the development of communications aimed at increasing community readiness. It then provides a brief summary of earthquake risk and preparedness levels in Aotearoa New Zealand, the context for this case study. Finally, it outlines AF8's approach to building resilience for a large Alpine Fault earthquake and reflects on how principles from design have been applied in the AF8 Roadshow to support a process of problem-solving for a future event. This case study does not cover the detailed solutions or preparedness actions taken because of this process. Instead, it focuses on the process itself, documenting and explaining the approach taken in the design and delivery of the AF8 Roadshow to offer insights and learnings on *how* a design-led approach to public education for emergency management can support a journey from awareness to preparedness.

Awareness to preparedness: a process of problem-solving

The journey a community or individual takes from awareness to preparedness is essentially a process of problem-solving. It is neither linear nor straightforward, and taking a 'one-size-fits-all' approach to engaging communities in activities aimed at reducing risk and building resilience often proves inadequate (McBride 2017). There has been a noticeable absence of a coherent communication framework to support such initiatives (Burnside-Lawry et al. 2013), nor is there a clear definition for what communication that engages communities in risk reduction activities is (Bryner 2016), making it difficult to prescribe and implement effectively. Instead, communication activities aimed at increasing levels of emergency preparedness and building resilience typically employ a range of approaches often adapting principles and methods from other disciplinary fields to inform the engagement process (Pal et al. 2020). This adaptation of principles from other disciplines is supported by hazard risk researchers, who advocate that the communication of risk:

> …should be transdisciplinary and deliberative: it is not linear but rather should be informed by and through engagement between authorities and audience. Understanding the vulnerabilities, values and culture of the audience is critical – not least because these factors will affect how advice and warnings are interpreted, and whether or not they are acted upon.
>
> (Donovan et al. 2019, 4–5)

A transdisciplinary, deliberative and non-linear approach is fundamental to methodologies of design thinking and human-centered design, which recognize that people who

face the problems are the ones who hold the key to their answer and offer a range of approaches and tools to enable interactive and iterative problem-solving processes (IDEO 2015).

Design as an active process of problem-solving (and not just a product of actions) offers a means of translating hazard information, interpreting risk and organizing knowledge in ways that can enable preparedness action, through empathy, problem scoping, ideation, testing and iteration (Repia and Bailey 2021). This active design process is not limited to designers, hazard risk specialists or emergency management experts, as Simon proposes: "everyone designs who devises courses of action aimed at changing existing situations into preferred ones" (1988, 67). The application of design thinking in emergency management offers opportunities to involve the public in the problem-solving process, positioning them as active co-creators of solutions alongside scientists and emergency managers, not simply passive recipients of information. Design provides effective approaches for the development of community-led readiness and response activities, recognizing communities and individuals as vital participants in the journey from hazard awareness to emergency preparedness, both as local knowledge holders and first responders.

Aotearoa New Zealand: living on the 'Shaky Isles'

Aotearoa New Zealand (NZ), or the 'Shaky Isles' as it is often called, is no stranger to earthquakes. Located at the boundary of the Australian and Pacific plates at the south-western corner of the Pacific Ocean, NZ's geographic location and diverse climate leaves the island nation vulnerable to a wide range of natural hazards. Earthquakes are particularly challenging to plan and prepare for due to their unpredictability and the uncertainty of their impacts. NZ's National Geohazard Monitoring Centre (NGMC) records an average of ~20,000 earthquakes every year, the equivalent of ~50–80 earthquakes per day (GeoNet n.d.-a). While most of these seismic events are small and go unnoticed, less frequent, larger events have shown their ability to cause considerable destruction and devastation, with long-term implications for recovery, as seen following the 2010–2011 Canterbury earthquake sequence (GeoNet n.d.-b,c) and the 2016 Kaikōura earthquake (GeoNet n.d.-d) in NZ's South Island. Despite the destructive potential of earthquakes, it is also worth noting that NZ exists because of this plate boundary. It is movement on the plate boundary, with its powerful uplift along the spine of the South Island and deep subduction off the east coast of the North Island that forms the geological foundations for NZ's stunning landscape – which many communities feel fortunate to call home and others travel across the world to explore.

Since 2006 NZ's National Emergency Management Agency (NEMA) have commissioned an annual survey to monitor levels of awareness and preparedness and identify triggers and barriers to preparing for disasters in NZ. The findings are used to inform NEMA's public information and national campaign strategies. Data collected by the survey over the last decade shows levels of preparedness rise after major natural hazard events, specifically the 2010–2011 Canterbury earthquakes, the 2016 Kaikōura earthquake and even during the onset of the global pandemic in 2020. However, it also shows that these levels drop off in the years following a major event, as seen from 2013 to 2016 in the time between the Canterbury and Kaikōura events and from 2017 to 2019 between the Kaikōura earthquake and the start of the pandemic. The most recent survey in 2021 indicates that New Zealanders continue to have a high awareness (92%)

and understanding (85%) of disaster risk. However, only 20% of New Zealanders are considered prepared at home and only 13% are considered fully prepared (at home and away) if a disaster were to strike today (NEMA 2021).

NEMA's 2021 survey also identified 'Lack of knowledge' about what to do to prepare as a high priority barrier to address to increase preparedness levels. 'Likelihood of event', or complacency about what disasters could happen in their area and 'Optimism', or a belief that they will probably never experience a disaster first-hand, were also identified as important secondary barriers to address. The 'Lack of knowledge' barrier was significantly higher in the 15–30 year age bracket (42%), indicating that campaigns and public education approaches have not been as effective in engaging younger audience groups. The top trigger to encouraging preparation across all New Zealanders was identified as: 'Social norm – what friends and family think', indicating that New Zealanders are more likely to take action to get prepared themselves if they perceive that their friends and family think it's important to do so. The survey also found that over a quarter (28%) of New Zealanders think the single most important thing we can do to ensure our communities can withstand and recover from disaster is 'Public education about hazards, risks and preparedness'.

Geography and first-hand experience offer clear evidence that NZ will experience large earthquakes with potentially catastrophic consequences in the future. While it is impossible to predict when the next one will occur, more must be done to retain levels of hazards awareness between events and translate understandings of hazard risk into tangible actions which increase preparedness. There is a need for public education initiatives that can support this process, bridge knowledge gaps, mitigate complacency between events and address the perception that disasters happen somewhere else to other people – particularly initiatives that can reach and engage younger audiences in conversations about hazard risk and preparedness.

AF8: preparing for an Alpine Fault earthquake

The Alpine Fault represents the meeting of the Pacific and Australian plates in the South Island of NZ. At its full extent, the fault stretches for ~800 km along almost the entire length of the island and is deemed capable of generating large magnitude 8 earthquakes, with major implications for the South Island and nationally. The last event of this size is understood to have occurred in 1717 and no significant activity on the Alpine Fault has been recorded since. However, scientific evidence shows that the fault has a history of generating regular, large earthquakes (Cochran et al. 2017). Newly updated probabilities indicate there is a 75% chance of an Alpine Fault earthquake occurring in the next 50 years and that there is an 82% chance it will be a magnitude 8+ event (Howarth et al. 2021). Hazard and risk modeling indicates that the impacts of an earthquake this size will have major implications for the entire South Island and will generate a disaster of national significance (Orchiston et al. 2018). Although impossible to predict, the science strongly indicates that NZ is now at a time where communities, organizations and the nation should actively be taking steps to build resilience and increase levels of preparedness for a future large Alpine Fault earthquake. It is vital that policymakers, planners and the public understand the implications of this science in their local context and are enabled to act to be better prepared.

AF8 [Alpine Fault magnitude 8] is a collaborative program of scientific modeling, response planning and community engagement designed to build societal resilience to

Figure 9.1 The AF8 co-creation model.

the next Alpine Fault earthquake. It aims to share the Alpine Fault hazard and impact science and preparedness information widely, through communication and engagement activities, to increase awareness, enable conversation and build societal preparedness to natural hazard events in the South Island (AF8 n.d.). Recognizing that no single body of information or discipline can solve the complex problem of a magnitude 8 earthquake on the Alpine Fault, AF8 brings together multiple domains of knowledge across research, policy and practice, in science, emergency management and community, to co-create solutions which can enable planning and preparedness activities (Figure 9.1).

AF8 is best understood as a 'boundary organization', a concept applied to science/policy partnerships aimed at the joint construction of knowledge and/or collaborations involving multiple stakeholders and domains of knowledge (Beaven et al. 2017). This positioning has enabled the Programme to take an interdisciplinary approach to its activities, adapting and applying principles of co-design and storytelling to generate new

knowledge that can help increase the South Island's preparedness for a future Alpine Fault earthquake. Since 2016, AF8 has worked…

> …across traditional silos of policy, practice and research to collectively address a common objective: to improve the ability of Civil Defence Emergency Management (CDEM) groups, infrastructure utilities, welfare organisations and communities to respond to future major earthquakes within the South Island of New Zealand. An event of this scale will require a collaborative response across regional boundaries, so a major focus within the project is to build relationships and increase collaboration.
>
> (Orchiston et al. 2018, 390)

Now in its seventh year, this collaborative approach has proven effective in facilitating the problem-solving process, which began by defining the problem, asking: 'why and what are we preparing for?' to inform and explore solutions on 'how can we plan and prepare for it?'. A key output of this process is the co-created AF8 Scenario which draws on interdisciplinary earthquake research to outline a maximum credible event scenario for a future Alpine Fault earthquake; telling the story of the Alpine Fault and illustrating the potential risk and impacts it poses for the South Island (Orchiston et al. 2016). In design, scenarios are applied to explore and test future thinking. Similarly, in emergency management, hypothetical scenarios are often employed as a tool to frame the hazard problem to develop and test solutions for future events. They are most often used to communicate potential risk pre-disaster, providing a tangible definition of the problem and identifying key considerations for the collaborative problem-solving process. The AF8 Scenario was workshopped with researchers, emergency managers and their partners, bringing together multiple domains of knowledge, in the development of the South Island Alpine Fault Earthquake Response (SAFER) Framework, which has been successful in providing a concept of coordination for inter-regional and inter-agency response planning for an Alpine Fault earthquake (AF8 2018).

Another key objective of AF8 has been to increase public awareness and preparedness for a future event. To do this, AF8 has adapted the AF8 Scenario in the development and delivery of public education activities aimed at encouraging community readiness, extending the Programme's collaborative approach to bridge the knowledge gap between the problem of a large Alpine Fault earthquake and the people it is most likely to impact through the engagement platform of the *AF8 Roadshow*.

The AF8 Roadshow: The Science Beneath Our Feet

The 'AF8 Roadshow: The Science Beneath Our Feet' is a key public education activity of AF8. It aims to share Alpine Fault hazard science with communities likely to be impacted by the next Alpine Fault earthquake, and is designed to enable conversations, activate local knowledge and support informed decision-making to increase awareness of, and preparedness for, a future event. The AF8 Roadshow makes the AF8 Scenario accessible to South Island communities in a way that encourages critical thinking and conversation. It raises awareness by illustrating that this event is inevitable and that it will have long-lasting consequences for the entire South Island. Most importantly, it creates a space of active engagement where this awareness can begin to be translated into preparedness.

The 2019 and 2021 AF8 Roadshows featured in this case study visited communities in geographic locations, rather than distinct communities of knowledge, practice, culture or ethnicity, focusing first on rural and remote settlements most likely to impacted by isolation, service outages and communication challenges determined from the AF8 Scenario and its shake-map (see Figure 9.2). The AF8 Roadshow is not the only activity AF8 delivers to engage communities in conversations about the hazard risk, the Programme also supports individual public talks for specific groups and community resilience projects including iwi Māori (the indigenous people of Aotearoa New Zealand) at marae (community meeting house) and whānau (family) preparedness wānanga (educational forums) around Te Waipounamu, the South Island. However, a key strength of the AF8 Roadshow is its framing of the next major Alpine Fault earthquake as a South Island-wide, and indeed national, disaster event. By designing, delivering and promoting the AF8 Roadshow under one South Island-wide banner it reinforces the message that this is not an event that is going to happen to someone else over there, it is something that will impact all of us and we all have a part to play. It supports social networks by providing a platform for multiple domains of knowledge, experience and expertise to come together

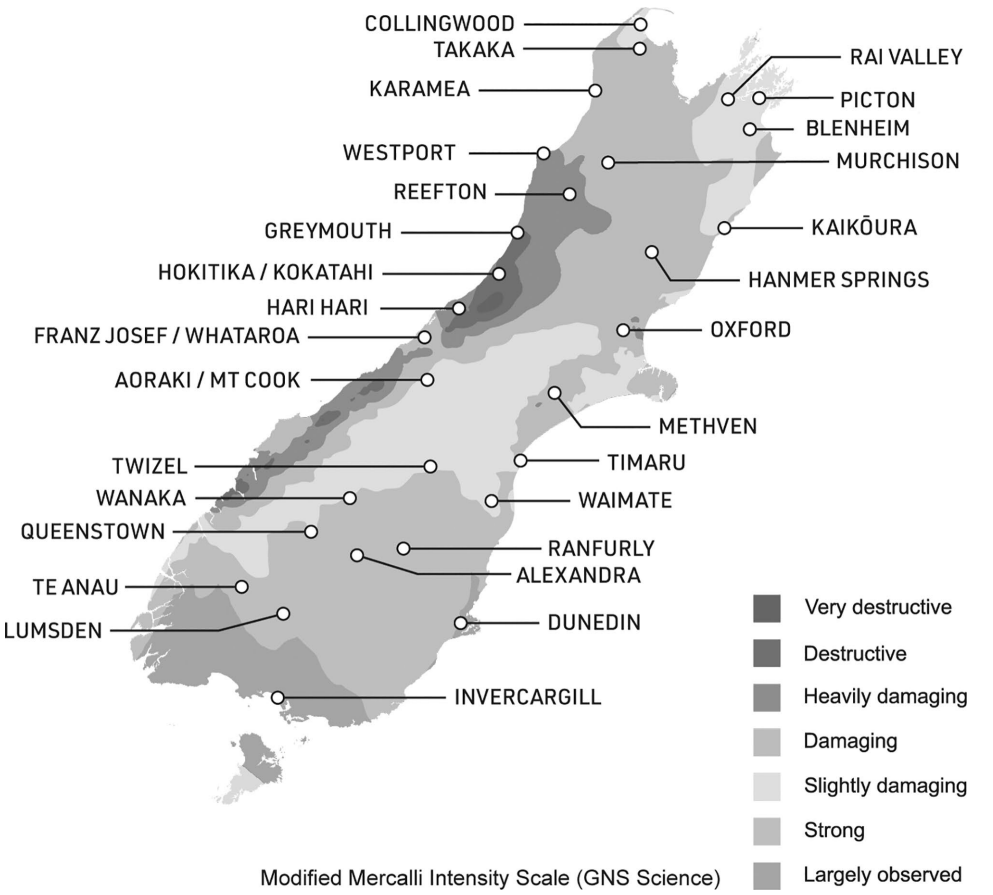

Figure 9.2 Locations visited during the 2019 and 2021 AF8 Roadshows shown on a shake-map illustrating the potential intensities of shaking of the magnitude 8 Alpine Fault South-to-North rupture scenario.

in one conversation, emphasizing that the better connected we are beforehand, the easier it will be to support each other following the next major Alpine Fault earthquake.

New Zealanders have shown their excellence at coming together instinctively to support each other during emergency events. However, as NEMA's 2021 survey findings show, it doesn't take long for complacency (and perhaps fatigue) to set in between events. The AF8 Roadshow encourages people to have conversations and build community networks in advance, to be better prepared for future events. It aims to mitigate complacency by sharing the AF8 Scenario in a community setting, making it accessible in a local context where it is of most relevance to that community and enabling conversations about the hazard risk, future impacts and readiness. This is where collective knowledge comes alive and where solutions begin to be considered and acted upon. Whether that is identifying local vulnerabilities, resources and expertise, prompting discussions with friends and family or the beginnings of a community plan, anything communities do to prepare now will make a difference in the future. The AF8 Roadshow provides a space where such informed problem-solving and decision-making can happen.

The AF8 Roadshow includes both public talks and school visits with communities from around the South Island. Schools are a key audience because: the next Alpine Fault earthquake is likely to happen within the students lifetime and will have long lasting impacts over many years (meaning young people must be included in this conversation); the NEMA 2021 survey findings show lack of knowledge as a barrier to preparedness for young people; and, the AF8 Roadshow offers an opportunity to inspire our young scientists and community leaders of tomorrow. In smaller, rural centers, visiting the school at the same time as holding a public talk meant that, in some places, the AF8 Roadshow engaged ~20% of the local population in Alpine Fault hazard and preparedness information in one day – maximizing the opportunity for intergenerational conversations to continue within families and the wider community beyond the AF8 Roadshow visit itself.

Public talks

The public talks are open to all, attracting people of all ages with standing room only at some venues. They are hosted by the local emergency management group in each region, who use the AF8 Roadshow to connect with communities and ensure local messaging is consistent. The presentations run for ~1 hour and feature an adapted version of the AF8 Scenario using graphics and an animation to illustrate the key information. These are brought together in a narrative sequence that begins by identifying the hazard, then outlining the potential impacts and secondary consequences, before finishing with locally specific information and preparedness messaging. The presentations are typically followed by often lengthy Q&A sessions of up to ~1–2 hours (depending on the audience), offering the community an opportunity to clarify the information shared and ask questions about details relevant to them. These two-way conversations are crucial to the interpretation of risk at a local level and often continue well beyond the meetings with follow-up emails and on social media. They also continue within the community itself as networks form and preparedness plans are made supported by local emergency management (Figure 9.3).

The AF8 Roadshow leverages the close partnership between science and emergency management, demonstrating the value of working together to be better prepared for natural hazard events in New Zealand. In 2021, ten presenters with diverse expertise from various NZ universities and research institutes supported the delivery of 16 public talks. Where possible, speakers are invited to present in locations where their expertise

Figure 9.3 AF8 Roadshow public talks at Alexandra and Kokatahi in 2021. Photographs taken by AF8.

was of direct relevance to that community. For example, in Blenheim, Hikurangi subduction zone science was shared alongside Alpine Fault information, recognizing the transition zone between these two large plate boundary faults at the top of the South Island. Additionally, the AF8 Roadshow is not just an opportunity for presenters to share their expertise, they also learn from the community with local knowledge and points of further research enquiry often surfacing through conversations in the Q&A sessions. These interactions have the potential to generate new understandings of hazard risk as audiences and experts collectively seek to find solutions that can increase preparedness levels for the next Alpine Fault earthquake.

School visits

The school visits vary depending on student population, schools and location. The sessions are designed to align with the New Zealand Curriculum Levels 4–6 (Ministry of Education 2023) and in most cases targeted at Year 9–10 students (ages 13–14

years). However, at remote area schools or schools teaching natural hazards sessions were expanded to include students from Years 3–13 (ages 6–18 years), adapting the content to suit the learning level without minimizing the key messages. The school sessions are designed to increase hazard awareness and risk literacy through interactive tools, storytelling and solution-focused activities. They run for ~1 hour, for 20–30 students at a time with enough flexibility to fit with school timetables and class sizes. The sessions are delivered by a communicator, supported by a local emergency management officer, and are broken into three stages, which follow a similar narrative sequence to the public talks: Stage 1: Discovering the Alpine Fault: What is the Alpine Fault and what can its past tell us about future earthquakes? Stage 2: Understanding impacts and consequences: What would an Alpine Fault earthquake be like? Stage 3: Preparing for emergency events: What can we do to be better prepared? The activities at each stage are designed to ensure the students depart the session not only with a better understanding of the hazard and its impacts in relation to them, but also having had multiple conversations with their own peers about how they can be better prepared for it.

Stage 1 is delivered using a series of mapping activities and narratives to tell the story of the Alpine Fault – how we know about it, what we know, how it moves and what that means today and in the future. The centerpiece is a machine-modelled 3D topographic map of the South Island, painted white so that it can be projected down on to from above enabling a hands-on experience (instead of the formal PowerPoint used for the public talks). The students gather around and locate themselves and other communities around the South Island on the map using mini monopoly houses. The projections are then used to communicate the geography, geology, the location of the Alpine Fault and its movement, all in relation to their location, demonstrating how clues in our own landscape can help to better understand and investigate hazard risk. The map provides an engaging tool that makes the AF8 hazard and impact information more tangible and accessible for the students (Figure 9.4).

Stage 2 focuses on key terminology used in describing and defining earthquakes to increase risk literacy by explaining terms like: magnitude, Modified Mercalli Intensity (MMI), P waves, S waves and epicenter. A mini shake-table programmed with the 2016 Kaikōura earthquake shaking data is used to demonstrate the intensity of shaking generated during this real-life event at three different geo-locations (Figure 9.5): Timaru (south of the epicenter), Kaikōura (near the epicenter) and Wellington (north of the epicenter). Each location shows the same magnitude 7.8 earthquake but with very different intensities of shaking: Timaru = MMI ~2–3, Kaikōura = MMI ~8 and Wellington = MMI ~7. These numbers are interpreted and explained using a large format MMI scale that students can walk along to identify how the earthquake felt in the different locations. For younger students this stage can be adapted to simply demonstrate the terms without going into the detailed definitions, while the shake-table can be used to practice life safety actions e.g., the students must stay in their Drop, Cover and Hold until the table stops shaking.

Stage 3 is designed to involve students in conversations with their classmates and peers about what they themselves can do to be better prepared, rather than tell them what they should do or give them a list to take home to their parents or guardians. A set of purpose-designed cards are used to play a game (adapted from McWaters and Moore 2012), each card has an item you might put in an emergency kit on it (Figure 9.6). The game is designed to facilitate conversations between the students as to what they think

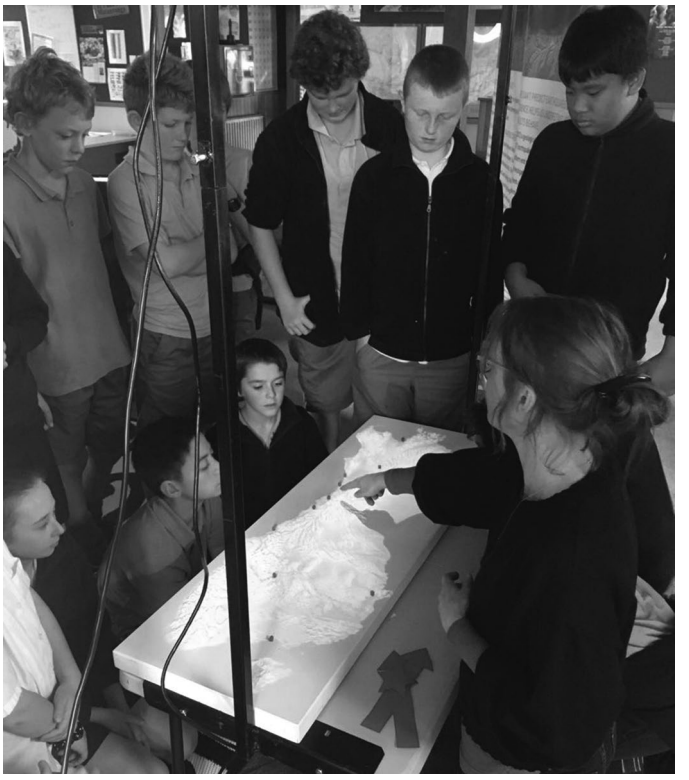

Figure 9.4 Students gathered around the 3D topographic map of the South Island at South Westland Area School, Hari Hari to learn about the Alpine Fault. Photograph taken by C. Orchiston.

Figure 9.5 Students at Darfield High School, Darfield and Mt Aspiring College, Wānaka interacting with the shake-table and MMI scale to learn earthquake terminology. Photographs taken by the author and C. Orchiston.

would be most important or useful for them to prepare in advance, to make their lives more comfortable in an emergency event. They are asked to consider mini scenarios based on the impacts of an Alpine Fault earthquake such as, power outages, isolation, having to evacuate etc.

Figure 9.6 Students play a preparedness game using purpose-designed cards at Otago Girls High School, Dunedin NZ. Photograph taken by the authors.

Each student is given a card with an emergency preparedness item on it and a post-it on the back to keep score on (Figure 9.6). A space is cleared so there is room to move and the rules explained. When the students are asked to shuffle, they are instructed to move around the space swapping cards with passing classmates. When they are asked to stop, they are instructed to find a partner and compare cards (if there is an odd number a teacher is asked to join in). In their pairs they must compare the items on their two cards and decide which is the most important or useful of the two items to prepare in advance and how much more important or useful it is compared to the item on the other card. Once this has been discussed and decided, the two students are asked to score the cards out of a total of 7. For example, if one item is significantly more important or useful than the other then it would get a score of 7 and the other would get a 0; or, if the two items are deemed relatively equal in importance, then one would get a score of 4 and the other a 3. The two scores must add up to 7 and there can be no half marks. Once the scores are recorded on the back of the cards the students are asked to shuffle again. This process is repeated 3–5 times, as time allows, then the scores are tallied up so that each card has a total.

The students are then asked to form a continuum line from lowest to highest total, before taking turns to read the emergency preparedness items on their card aloud and revealing how they have been ranked through the process. There is then another opportunity to discuss and determine if the ranking is accurate and agreed. Students can opt to move items up or down the rankings, but they must explain why, before the class takes a vote on the final placings. These discussions are an opportunity for the emergency management officer to share further preparedness information and ideas. For smaller classes, younger students or if the session is short on time the game can be shortened to a card sorting or continuum activity (IDEO 2015, 57) without needing to facilitate the active shuffling.

Reception and feedback

Overall, the AF8 Roadshow has been well-attended and well-received. The only negative feedback has been that the tour should be bigger. With the promotion of each public talk, there have been several comments and queries from people asking when the AF8 Roadshow is coming to their town. At each talk a quick show of hands at the start identifies several repeat-attendees who are coming back to hear more about the Alpine Fault, with some people traveling great distances to get to a talk near them (~220 km one-way in one instance). The length of the Q&A sessions, where the audience can increase their comprehension of the information being shared, find relevance and share their own knowledge in return, also indicates a high level of active engagement at the public talks.

The reception from schools has been equally positive, with participants often asking when the *AF8 Roadshow* can come back and inquiries from new schools asking when they can host it for their students. The design and delivery of the sessions have received positive feedback from both teachers and students:

> My class was fully engaged in exploring the wide range of activities and information as it was presented in a way which really hooked them. They were able to build a much stronger understanding in a short period of time as the roadshow makes connections with the way children learn best. The presenters were fantastic! The experiments, explanations, choices of what they showed the different age groups. The best Science based opportunity I have had as a teacher too.
>
> (Teacher, AF8 Roadshow 2019)

> The 3D mapping demonstrated the content really well. Students were able to visualize content that had been previously discussed. The tutor was inclusive and made sure everyone could see and have input into the discussions.
>
> (Teacher, AF8 Roadshow 2021)

> Thank you for coming, this was really interesting and really useful.
>
> (Student, AF8 Roadshow 2021)

> I'm really scared of earthquakes. But now I understand why we have them and what I can do about them, I feel much better. Thank you for coming.
>
> (Student, AF8 Roadshow 2021)

Feedback from local emergency management officers has also been positive, many recognize the AF8 Roadshow as the most effective way to bring their communities together to connect, learn more about their landscape through science and develop community plans:

> This is a fantastic opportunity for our communities to be involved in learning more about an event that could impact on them. The Roadshow really makes science accessible.
>
> (Emergency Management Officer, AF8 Roadshow 2021)

The design, delivery and success of the AF8 Roadshow is due to an inclusive, collaborative effort where research provides the foundation for robust community-led discussions

and informed decision-making, supported by hazard risk experts and local emergency management. By creating a space for knowledge sharing and collective problem-solving the AF8 Roadshow has been effective in raising and retaining hazard awareness between events; increasing risk literacy for future events; building trust; and enabling conversations on how to be better prepared within communities (including young people) in locations likely to be impacted by the next Alpine Fault earthquake. This success owes a lot to the breadth and depth of the interdisciplinary collaboration within the NZ earthquake research and emergency management communities, who acknowledge the importance of engaging the public in Alpine Fault hazard information and enabling community-led conversations on its implications. The AF8 Roadshow is now a permanent fixture in the AF8 Programme's activities to ensure these valuable conversations can continue over time. The next AF8 Roadshow is planned for 2023.

Conclusion

This chapter has not attempted to provide a 'one-size-fits-all' solution or clear definition of what communication that engages communities in risk reduction activities is. If it did, it would no doubt be inadequate as previous research has shown. Instead, it offers an example of how a design-led approach to facilitating the journey of awareness to preparedness positions communities alongside earthquake researchers and emergency managers as active participants in a process of problem-solving for future events. This application of design thinking principles in public education for emergency preparedness reflects the aims of NZ's National Disaster Resilience Strategy and recognizes that the communities who face the risk not only hold the key to the solutions but are also those who will act on these solutions to support themselves and others in a disaster. It is vital that communication initiatives be designed to include the public, as active participants and contributors of local knowledge to the process of preparing for disasters, if they are to act for themselves and others in response to future emergency events. While the solutions themselves will vary depending on community, geography, hazard risk, impacts and vulnerabilities, it is the process of collective problem-solving itself which offers the opportunity to raise awareness, translate and interpret hazard risk, organize knowledge and identify actions which can increase preparedness.

The AF8 Roadshow case study also offers a practical example of how we may bridge the gap between national endorsement and local implementation of initiatives designed to build trust and increase collective resilience across all levels of community – public, private and personal. It is not enough to agree with or simply accept the need for investment in community-centered risk reduction and resilience initiatives. Real sustainable investment in collaborative engagement activities over time is critical for effective and efficient long-term planning that can support sustainable development in recovery and reconstruction. Moreover, intergenerational approaches that enable conversations and the ongoing development of knowledge are essential if we are to reduce risk and build resilience for future events, while also increasing levels of emergency preparedness in the present. In sharing insights from the AF8 Roadshow, this chapter supports the need for further documentation, development and evaluation of design-led, community-centered reduction and readiness initiatives to strengthen the investment case and inform how potential returns can be met in practice. Just as we cannot predict the next earthquake, we cannot know how much better our response and recovery from the next major Alpine Fault rupture will be because of the AF8 Roadshow. What we can see and share however, are the ongoing investment

dividends we receive through stakeholder and audience feedback, growing engagement levels, an increasing appetite for hazard information and opportunities for knowledge sharing through collaborative initiatives that inform decision-making, support collective problem-solving and prompt preparedness actions.

References

AF8. 2018. *SAFER (South Island Alpine Fault Earthquake Response) Framework*. Invercargill: Emergency Management Southland.

———. n.d. "What Is AF8?" AF8 [Alpine Fault Magnitude 8]. Accessed October 1, 2021. https://af8.org.nz/what-is-af8/.

Aldrich, D. P. 2012. *Building Resilience: Social Capital in Post- Disaster Recovery*. Chicago, IL: University of Chicago Press.

Beaven, S., T. Wilson, L. Johnston, D. Johnston, and R. Smith. 2017. "Role of Boundary Organization after a Disaster: New Zealand's Natural Hazards Research Platform and the 2010–2011 Canterbury Earthquake Sequence." *Natural Hazards Review* 18 (2). https://doi.org/10.1061/(ASCE)NH.1527-6996.0000202.

Bryner, V. 2016. "Communicating the Sciences of Disaster Risk Reduction: Media Stories Surrounding the Canterbury Earthquakes of 2010–2011." Doctor of Philosophy, Dunedin, University of Otago. http://hdl.handle.net/10523/7250.

Burnside-Lawry, J., Y. Akama, and P. Rogers. 2013. "Communication Research Needs for Building Societal Disaster Resilience." *Australian Journal of Emergency Management* 28 (4): 29–35.

Cochran, U. A., K. J. Clark, J. Howarth, G. P. Biasi, R. Langridge, P. Villamor, K. R. Berryman, and M. J. Vandergoes. 2017. "A Plate Boundary Earthquake Record from a Wetland Adjacent to the Alpine Fault in New Zealand Refines Hazard Estimates." *Earth and Planetary Science Letters* 464 (April): 175–88.

Donovan, A., M. Borie, and S. Blackburn. 2019. "Changing the Paradigm for Risk Communication: Integrating Sciences to Understand Cultures." In GAR 2019. United Nations Office for Disaster Risk Reduction [UNDRR].

GeoNet. n.d.-a. "Earthquake Statistics." GeoNet. Accessed October 1, 2021. https://www.geonet.org.nz/earthquake/statistics.

———. n.d.-b. "M 6.2 Christchurch Tue, Feb 22 2011." GeoNet. Accessed October 1, 2021. https://www.geonet.org.nz/earthquake/story/3468575.

———. n.d.-c. "M 7.2 Darfield (Canterbury) Sat, Sep 4 2010." GeoNet. Accessed October 1, 2021. https://www.geonet.org.nz/earthquake/story/3366146.

———. n.d.-d. "M 7.8 Kaikōura Mon, Nov 14 2016." GeoNet. Accessed October 1, 2021. https://www.geonet.org.nz/earthquake/story/2016p858000.

Howarth, J., N. C. Barth, S. J. Fitzsimons, K. Richards-Dinger, K. J. Clark, G. P. Biasi, U. A. Cochran, R. Langridge, K. R. Berryman, and R. Sutherland. 2021. "Spatiotemporal Clustering of Great Earthquakes on a Transform Fault Controlled by Geometry." *Nature Geoscience* 14 (April): 314–20.

IDEO. 2015. "The Field Guide to Human-Centered Design." IDEO.

McBride, S. 2017. "The Canterbury Tales: An Insider's Lessons and Reflections from the Canterbury Earthquake Sequence to Inform Better Public Communication Models." Doctor of Philosophy, Wellington, Massey University.

McWaters, V., and J. Moore. 2012. "35." Creative Facilitation. Accessed August 23, 2022. http://eho.zrs.mybluehost.me/wp-content/uploads/35.pdf.

Ministry of Education. 2023. "The New Zealand Curriculum, Curriculum Achievement Objectives by Level." Accessed October 1, 2021. https://nzcurriculum.tki.org.nz/The-New-Zealand-Curriculum.

NEMA. 2019. *National Disaster Resilience Strategy*. Wellington: National Emergency Management Agency [NEMA].

———. 2021. *Disaster Preparedness Survey 2020*. National Emergency Management Agency [NEMA]. https://www.civildefence.govt.nz/assets/Uploads/public-education/report-disaster-preparedness-survey-en-jul21.pdf.

Orchiston, C., T. Davies, R. Langridge, T. Wilson, J. Mitchell, and M. Hughes. 2016. *Alpine Fault Magnitude 8: Hazard Scenario*. Invercargill: Report Commissioned by Project AF8, Environmental Southland.

Orchiston, C., J. Mitchell, T. Wilson, R. Langridge, T. Davies, B. Bradley, D. Johnston, A. Davies, J. Becker, and A. McKay. 2018. "Project AF8: Developing a Coordinated, Multi-Agency Response Plan for a Future Great Alpine Fault Earthquake." *New Zealand Journal of Geology and Geophysics* 61 (3): 389–402.

Pal, I., J. von Meding, S. Shrestha, I. Ahmed, and T. Gajendran, eds. 2020. *An Interdisciplinary Approach for Disaster Resilience and Sustainability*. 1st ed. Singapore: Springer Singapore.

Repia, H., and J. Bailey. 2021. "Designing Tsunami Risk Communication with Communities: A Site-Specific Case Study from Tūranganui-a-Kiwa, Aotearoa New Zealand." *Australasian Journal of Disaster and Trauma Studies* 25 (1): 3–16.

Rodin, J. 2015. *The Resilience Dividend, Managing Disruption, Avoiding Disaster, and Growing Stronger in an Unpredictable World*. London: Profile Books.

Simon, H. 1988. "The Science of Design: Creating the Artificial." *Design Issues, Designing the Immaterial Society* 4 (1/2): 67–82.

UNDRR. 2015. "Sendai Framework for Disaster Risk Reduction 2015–2030." United National Office for Disaster Risk Reduction [UNDRR].

———. 2017. "Terminology: Online Glossary." United National Office for Disaster Risk Reduction [UNDRR]. Accessed October 1, 2021. https://www.undrr.org/terminology#R.