

The shaky south (or not): towards improving communities understanding of earthquake risk in Otago and Southland

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ABSTRACT

Understanding how people interpret and respond to earthquake risks is vital to any strategy for earthquake risk reduction. Acknowledging that there is a wide range of interpretations of risk is important in determining how we understand acceptable risk, and prompt preparedness and other mitigation measures. Acceptable risk in the context of safety involves interactions between natural (physical and engineering) and human factors. This is a challenge for Otago and Southland because these regions lie in what is described as ‘low seismic hazard zones’ compared to other more seismically active parts of Aotearoa New Zealand. Consequently, public perceptions of seismic hazard are likely to downplay the risk, even though this relatively low seismic hazard is still high compared to other countries given the whole of NZ lies on an active tectonic plate interface. In 2016, a postal survey was used to investigate community understanding of earthquake risk in Oamaru and Dunedin. Results show that although most respondents had no personal experience of a significant earthquake (Dunedin: 80%, Oamaru: 65%), the majority agreed that preparing for earthquakes will improve their ability to deal with disruptions to community life following an earthquake (Dunedin and Oamaru: both 78%). This paper presents the results of the 2016 survey and highlights the need for further discussion in terms of current earthquake resilience policy and practices at national and regional levels. Challenges and opportunities for earthquake risk reduction in Otago and Southland have relevance for other lower seismic zones in Aotearoa New Zealand, such as Auckland and Northland.

1 INTRODUCTION

Understanding how people interpret and respond to earthquake risks is vital to any strategy for earthquake risk reduction (Becker et al. 2013, Vinnell et al., 2018). How the community understands acceptable risk, and how those risk perceptions prompt preparedness and other mitigation measures is important in determining how to engage with stakeholders in risk reduction activities (Eiser et al. 2012). Acceptable risk in the context of earthquake safety involves interactions between multiple natural (physical and engineering) and human factors. This is a challenge for Otago and Southland because these regions lie in what is described as ‘low seismic hazard zones’ compared to other more seismically active parts of Aotearoa New Zealand. Consequently, public perceptions of seismic hazard are likely to be downplay the risk, even though low seismic hazard is a relative term in NZ given the whole country lies on an active tectonic plate interface.

These comparisons can lead to low preparation (particularly mitigation actions such as strengthening homes) and therefore poorer outcomes in areas which are at objectively lower, but still significant, seismic risk (McClure et al., 2011; 2015). How people perceive their risk, including how that risk is communicated, can have meaningful impacts on preparation behaviour such as earthquake strengthening (Vinnell et al., 2018). National and city level surveys show an increase in preparation following a significant event (e.g., Vinnell et al., 2019); however, at this point damage and harm has already occurred. It is therefore critical to explore and aim to reduce barriers to earthquake preparation based on pre-event factors such as risk perception.

2 METHOD

In 2016, a postal survey was used to investigate community understanding of earthquake risk in Oamaru and Dunedin (Johnston et al. 2017a). Five hundred survey questionnaires were hand delivered to residences in Oamaru on 25th August 2016 and Dunedin on 26th August 2016. Households were randomly selected within the above communities. Surveyed respondents were asked to be the person in the household aged 18 years or older who most recently had a birthday. Confidentiality was assured and respondents remained anonymous. This study was conducted in accordance with Massey University’s Code of Ethical Conduct for Research, Teaching and Evaluations Involving Human Participants.

Survey respondents were asked to answer 28 questions investigating their earthquake experience, knowledge, and preparedness. Additionally, seven demographic questions were included to ensure that the study covered a representative cross section of the communities. Respondents were asked to post back the completed questionnaire in the postage-paid envelope provided. 172 responses to the survey were received from Dunedin and 122 from Oamaru.

3 RESULTS

3.1 Understanding and risk perceptions

Most respondents had no personal experience of a significant earthquake (Dunedin: 80%, Oamaru: 65%). Respondent views on the likelihood of future earthquakes produced a polarised response; it was considered unlikely by 31% from Dunedin, and 26% from Oamaru. When asked if the Canterbury Earthquake Sequence had made the risk of an earthquake become more real or plausible, 83% of Oamaru and 78% of Dunedin respondents reported that it had. This is consistent with the findings of McClure et al. (2015), who found the Canterbury earthquake sequence had resulted in elevated risk perceptions in Wellington and Palmerston North, and Vinnell et al. (2019) who found that people in Wellington were more concerned about earthquakes after the 2016 Kaikōura event. Earthquakes were seen as a threat to personal safety by the majority of respondents in the two locations (Dunedin: 89%, Oamaru: 92%), daily life (Dunedin: 87%, Oamaru: 83%), and property (Dunedin: 93%, Oamaru: 94%).

When asked how prepared they were for a major earthquake, 54% of Dunedin, and 55% of Oamaru, reported that they were prepared, very prepared, or totally prepared (“prepared” henceforth). Across both locations, a lower percentage of respondents thought that other members of their community were prepared for a major earthquake (Dunedin: 48%, and Oamaru: 35%), and a higher percentage of respondents thought that their local Council was prepared for a major earthquake (Dunedin: 64%, and Oamaru: 70%). Less than a third of respondents had prepared a household emergency plan (Dunedin: 16%, and Oamaru: 27%). However, a higher percentage of respondents reported that they had stored at least three litres of water per person, per day for three days (Dunedin: 45%, and Oamaru: 51%).

Most respondents agreed that preparing for earthquakes will improve their ability to deal with disruptions to family/community life following an earthquake (Dunedin and Oamaru: 78%), fewer agreed that preparing for earthquakes will significantly reduce the damage to their home should an earthquake occur (Dunedin: 35%, and Oamaru: 39%). The majority of respondents agreed that most people cannot afford to retrofit their building (Dunedin: 70%, and Oamaru: 74%), and that buildings might still suffer earthquake damage even after retrofitting (Dunedin: 83%, and Oamaru: 84%). Potential influences on these responses, including cognitive and self-report biases, will be considered in future work.

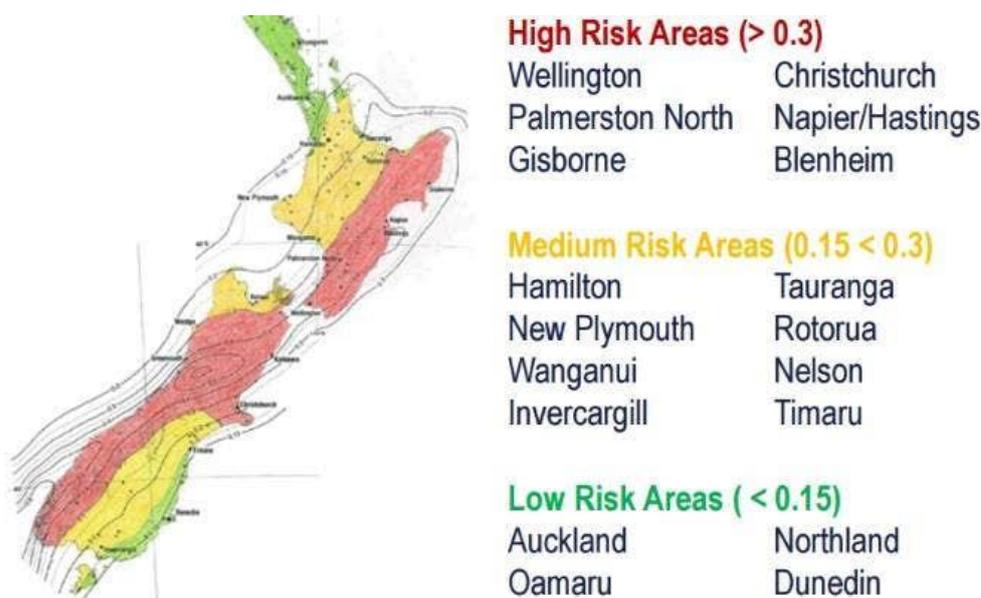


Figure 1:

The Building Act differentiates three regions of New Zealand, based on their relative seismic risk. High risk regions are defined as having a Z factor of greater than 0.3, moderate risk regions have a Z factor of between 0.15 and 0.3, and low risk regions have a Z factor of less than 0.15 (Building Act 2004). The Z factor is the seismic hazard factor that would influence the design of new buildings built in that region (Building Act 2004). Essentially, the higher the Z factor, the greater the chance of a seismic event, so the buildings being built would require more earthquake proofing. The low seismic regions of New Zealand include Northland, Auckland, Oamaru and Dunedin.

3.2 Shakeout

The ShakeOut earthquake drill, which encourages people to practice the actions “Drop, Cover and Hold” for an imagined earthquake and to get prepared, was established by the Southern Californian Earthquake Commission in 2008 to build preparedness and awareness for a future San Andreas earthquake (Jones et al. 2011). In 2009, the West Coast undertook the first New Zealand version of ShakeOut with support from

Californian colleagues (Orchiston et al. 2013), with national ShakeOut drills developed since that time (McBride et al., 2019; Vinnell et al., 2020). Although fewer than a third of respondents from Dunedin or Oamaru reported having participated in New Zealand ShakeOut earthquake drills, a higher percentage of respondents took part in the October 2015 national drill (Dunedin: 22%, and Oamaru: 23%) compared to participation in any other previous earthquake drills, such as the September 2012 ShakeOut or the West Coast ShakeOut (Dunedin: 14%, and Oamaru 14%).

3.3 Trust

Dunedin respondents expressed moderate levels of trust in their local council's ability to adequately respond to earthquakes in Dunedin (29%). A larger proportion in Oamaru (62%) trusted their local council to meet the needs of residents. Trust in media was varied, with 29% of Dunedin respondents and 49% in Oamaru trusting the information provided by media. Further, trust levels in community leaders were similar to trust in councils or media in both Dunedin (29%) and Oamaru (49%). Trust in information sources such as media or local leaders is important in promoting earthquake preparedness in communities, especially where earthquakes may not be a salient issue as highlighted in the next section.

3.4 Thinking and talking about risk

Respondents were asked how often they think and talk about earthquake risk. Dunedin (17%), and Oamaru (20%) respondents thought frequently about earthquake risk. While this is low, those who talked about earthquake risk frequently was much lower; in Dunedin (6%) and Oamaru (6%).

4 DISCUSSION

This paper presents the results of a 2016 survey of public perceptions of seismic risk in areas of the country with relatively low seismic risk. The study highlights the need for further discussion in terms of current earthquake resilience policy and practices at national and regional levels and identifies challenges and opportunities for earthquake risk reduction in Otago and Southland. While experiences such as the Canterbury Earthquake Sequence have prompted thinking about earthquakes, this has likely dissipated over time. In Otago and Southland, risk perception and salience of the earthquake threat are all low, resulting in lower levels of preparedness and participation in activities like earthquake drills. Methods do exist to motivate preparedness but rely on raising awareness and perceptions first in a non-confrontational and non-anxiety producing way, so that the threat becomes a relevant issue that people feel they need to, and are capable of, addressing (Becker et al., 2015). Here-in lies the challenge in low-risk seismic zones.

This research has relevance for other lower seismic zones in Aotearoa New Zealand, such as Auckland and Northland. The results of similar surveys conducted as part of this project in Auckland are reported elsewhere (Johnston et al., 2017b,c). Further, over the next two years (2022-2024) additional work is planned to engage with the communities of Southland, Otago, Auckland, and Northland around understanding of earthquake risk, including discussions with respective councils to understand the current nature and extent of earthquake risk reduction policies and practices.

5 ACKNOWLEDGEMENT

The authors thank QuakeCoRE, a New Zealand Tertiary Education Commission-funded Centre, for funding and supporting the research. This is QuakeCoRE publication number 0751. We also acknowledge funding from the National Science Challenges: Resilience to Nature's Challenges Kia manawaroa – Ngā Ākina o Te Ao Tūroa.

6 REFERENCES

- Becker, J. S. (2010). Understanding disaster preparedness and resilience in Canterbury: Results of interviews, focus groups and a questionnaire survey. *GNS Science*, Report No. 2010/50
- Becker, J. S., Paton, D., Johnston, D. M., Ronan, K. R. (2013). Salient beliefs about earthquake hazards and household preparedness. *Risk Analysis*, 33 (9), 1710-1727. Doi: 10.1111/risa.12014.
- Becker, J.; Paton, D.; Johnston, D. 2015. Communication of Risk: A community resilience perspective, *GNS Science Report 2015/66*. 30 p.
- Eiser, J. R., Bostrom, A., Burton, I., Johnston, D. M., McClure, J., Paton, D; van der Pligt, J., White, M. P. (2012). Risk Interpretation and Action: A Conceptual Framework for Responses to Natural Hazards. *International Journal of Disaster Risk Reduction* 1:5-16. DOI: <http://dx.doi.org/10.1016/j.ijdr.2012.05.002>.
- Johnston D.M., Becker J.S., Orchiston C., Egbelakin T., Coomer M.A. 2017a. Earthquake Awareness and Preparedness in Dunedin and Oamaru - a 2016 survey: Data report. Lower Hutt (NZ): GNS Science. (*GNS Science Report 2017/12*). 61 p. doi:10.21420/G21C7V.
- Johnston, D.M., Becker, J.S., Orchiston, C., Egbelakin, T., Thompson, M.A., & Coomer, M.A. 2017b. Earthquake awareness and preparedness in Auckland - a 2016 survey: Data report. *GNS Science report 2017/10*. 39 p. + appendix. <https://doi.org/10.21420/G28W29>
- Johnston, D.M., Becker, J.S., Orchiston, C., Egbelakin, T., Thompson, M.A., Pace, B., & Coomer, M.A. 2017c. Earthquake awareness and preparedness in Hamilton - a 2016 survey: Data report. *GNS Science report 2017/11*. 29 p. + appendix; <https://doi.org/10.21420/G2530P>
- Jones, L. and M. Benthien (2011). Preparing for a “Big One”—The great southern California ShakeOut, *Earthquake Spectra* 27, 575–595.
- McBride, S. K., Becker, J. S., & Johnston, D. M. (2019). Exploring the barriers for people taking protective actions during the 2012 and 2015 New Zealand ShakeOut drills. *International Journal of Disaster Risk Reduction*, 37, 101150.
- McClure, J., Johnston, D., Henrich, L., Milfont, T., & Becker, J. (2015). When a hazard occurs where it is not expected: Risk judgments about different regions after the Christchurch earthquakes. *Natural Hazards*, 75, 635-652. Doi: 10.1007/s11069-014-1338-6.
- McClure, J. Wills, C., Johnston, D. & Recker, C. (2011) How the 2010 Canterbury (Darfield) earthquake affected earthquake risk perception: comparing citizens inside and outside the earthquake region. *Australasian Journal of Disaster Trauma Studies* 2:3–10
- Orchiston, C., Manuel, C., Coomer, M., Becker, J., Johnston, D. (2013). The 2009 New Zealand West Coast ShakeOut: improving earthquake preparedness in an area of high seismic risk. *Australasian Journal of Disaster and Trauma Studies*, vol. 2013 (2): 34-42.
- Vinnell, L. J., Milfont, T. L., & McClure, J. (2018). Do social norms affect support for earthquake strengthening legislation? Comparing the effects of descriptive and injunctive norms. *Environment and Behavior*, 51, 376-400. doi: 10.1177/0013916517752435
- Vinnell, L. J., Milfont, T. L., & McClure, J. (2019). The impact of the Kaikōura earthquake on risk-related behaviour, perceptions, and social norm messages. *Australasian Journal of Disaster and Trauma Studies*, 23(2), 53-64.
- Vinnell, L. J., Wallis, A., Becker, J. S., & Johnston, D. M. (2020). Evaluating the ShakeOut drill in Aotearoa/New Zealand: Effects on knowledge, attitudes, and behaviour. *International Journal of Disaster Risk Reduction*, 48, 101721.