

New Zealanders' Judgments of Earthquake Risk Before and After the Canterbury Earthquake: Do they Relate to Preparedness?

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Previous research has examined judgments about earthquake likelihood after citizens have experienced an earthquake, but has not compared judgments in the affected region with other regions. Following the Darfield (Canterbury) earthquake, this research compared earthquake risk judgments in the affected region and those outside the region. Participants in Christchurch, Wellington and Palmerston North judged the likelihood of an earthquake before and after the 2010 Canterbury (Darfield) earthquake, near Christchurch. Wellington was chosen as there had been higher expectations of an earthquake in that area. Palmerston North was chosen to be comparable to Christchurch before the Darfield earthquake, in that many New Zealanders have expected an earthquake in Wellington, not Palmerston North. Participants judged earthquake likelihoods for their own city, for the rest of New Zealand and for Canterbury. Christchurch participants also indicated their preparedness before and after the earthquake. Expectations of an earthquake in Canterbury were low before the Darfield earthquake in all three regions and rose significantly after that earthquake. In contrast, Wellingtonians' judgments of the likelihood of an earthquake in Wellington were high before the Darfield earthquake and did not rise after that earthquake. Christchurch participants' risk perceptions showed only a weak relation to their preparedness. These results clarify how disasters such as major earthquakes affect judgments of earthquake risk for citizens inside and outside the affected area. The results show that these effects differ in cities where an earthquake is expected. Broader issues about preparing for earthquakes are also discussed.

This paper focuses on the Christchurch earthquake in relation to risk perception and preparedness. Risk assessment is not the main factor in preparedness; in fact, risk assessment is often a weak predictor of being ready or prepared, as in the case of preparing for an earthquake. Some research finds no relationship between the two (risk assessment and preparing) (Cowan, McClure, & Wilson, 2002; Hurnen & McClure, 1997; McClure, Sutton, & Sibley, 2007; Slovic, Fischhoff, &

Lichtenstein, 1982; Spittal, McClure, Walkey, & Siegert, 2008). This is partly because many citizens are fatalistic and think that their actions will not make any difference (McClure, Allen, & Walkey, 2001; McClure, Walkey, & Allen, 1999; Spittal et al., 2008; Spittal, Siegert, McClure, & Walkey, 2002). However, recognition of the risk is a prerequisite for voluntary action, and unless people recognise the risk, they are unlikely to take action.

One factor affecting risk perception is personal experience; usually, if people have a personal experience of the hazards, they take the risk more seriously (Burger & Palmer, 1992; Helweg-Larsen, 1999; Sattler, Kaiser, & Hittner, 2000). The Police are very familiar with this, and say that the comment they hear most often after accidents is: "I never thought it would happen to me." This effect interacts with a second bias where people think disasters are going to happen to other people, not to

themselves (Burger & Palmer, 1992; Helweg-Larsen, 1999; Mileti & Darlington, 1995; Spittal, McClure, Siegert, & Walkey, 2005; Weinstein, 1980).

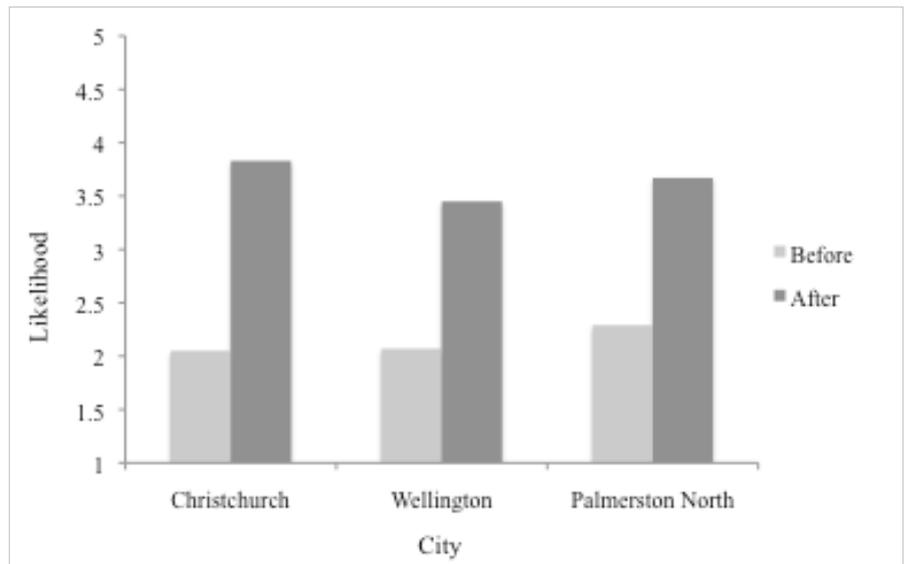
The Christchurch Risk Study

To clarify these risk biases, this paper reports a study that we carried out after the first Canterbury earthquake, the Darfield earthquake in September 2010 (McClure, Wills, Johnston, & Recker, 2011). We were interested in how people in Christchurch, Wellington and Palmerston North changed in their perception of risk of a future earthquake after a significant local earthquake.

The questionnaire asked for Christchurch citizens' recall of their pre-earthquake risk perception: "Before the Darfield earthquake, how probable did you think it was there would be a big earthquake in or near Christchurch?" A second question asked: "Since the Darfield earthquake, how probable do you rate a future earthquake in Christchurch?" The same questions were asked in Wellington and Palmerston North.

Questions also asked Wellington and Palmerston North participants for their recall of the likelihood of an earthquake in their own city – and in any other part of New Zealand (NZ). Questions then asked for their judgments of the likelihood of a future earthquake in each of these three areas (Christchurch, their own city, and another part of NZ). Judgments were given on Likert scales. A related question asked "If you've previously thought an earthquake in or near Christchurch was unlikely, why was that?" with space for open ended responses that were coded by two coders.

Questions on other issues asked "Were you aware of information and warnings to prepare prior to the earthquake?" and "did you see this information as relevant to you?" and for Christchurch citizens "Did you suffer serious damage to your home or not?"; and for Wellington and Palmerston North citizens, whether they had friends, family or close



acquaintances in Christchurch. Christchurch participants were also asked about their preparedness for an earthquake.

The results have been published in McClure et al. (2011). In judgments of the likelihood of an earthquake in Christchurch before and after the September earthquake, likelihoods rose significantly in all three cities (Figure 1). There was a main effect for the 'before and after the earthquake' time factor, which shows that it was a similar effect across all three cities. Time showed that these likelihood judgments were correct; after the first earthquake (i.e., after September 2010), there was another big earthquake in Canterbury in February 2011.

Interestingly, Wellingtonians expected an earthquake in Wellington prior to the earthquake more than Cantabrians did for Canterbury, and that expectancy in Wellington showed no change after the earthquake in Christchurch. So Wellingtonians did not think an earthquake in Wellington was any more likely after the September earthquake; and they were correct.

In contrast, for Palmerston North, the rise in their expectancy of an earthquake looks modest (Figure 2) but is statistically significant. Thus Palmerston North citizens saw a likelihood of an earthquake in Palmerston North (and also in another part of New Zealand) as more likely after the Darfield earthquake.

▲ **Figure 1.** The perceived likelihood of an earthquake occurring in or near Christchurch before and after the Canterbury Earthquake. (1= not at all likely, 5 = very likely)

These judgments of earthquake likelihood before the earthquake are recall data and thus subject to recall effects, but they are consistent with data collected before the earthquake (Becker, 2010).

With regard to the question: "If you've previously thought an earthquake in or near Christchurch was unlikely, why was that?" the most frequent reply was "because Christchurch is not on a fault line". Most Cantabrians are aware of the Alpine Fault, and they thought an earthquake was more likely near the Southern Alps or the Alpine Fault that runs down those Alps. They assumed there were no fault lines near Christchurch. Secondly, they said that there have not been any earthquakes in this region before (some qualified this view with the term 'recently'). They found out after the earthquake that they were wrong: there had been earthquakes in the region. Many New Zealanders, including Cantabrians, did not know that the spire of Christchurch Cathedral, which collapsed in the February earthquake, had been knocked down by earthquakes twice before, in 1888 and 1901. The Cathedral was damaged less significantly by earthquakes in 1881 and 1922. As this all happened some time ago, people had either never known about it or forgotten.

that it is not just Wellington that is at risk, and fortunately New Zealand's building standards partially reflect this expert knowledge.

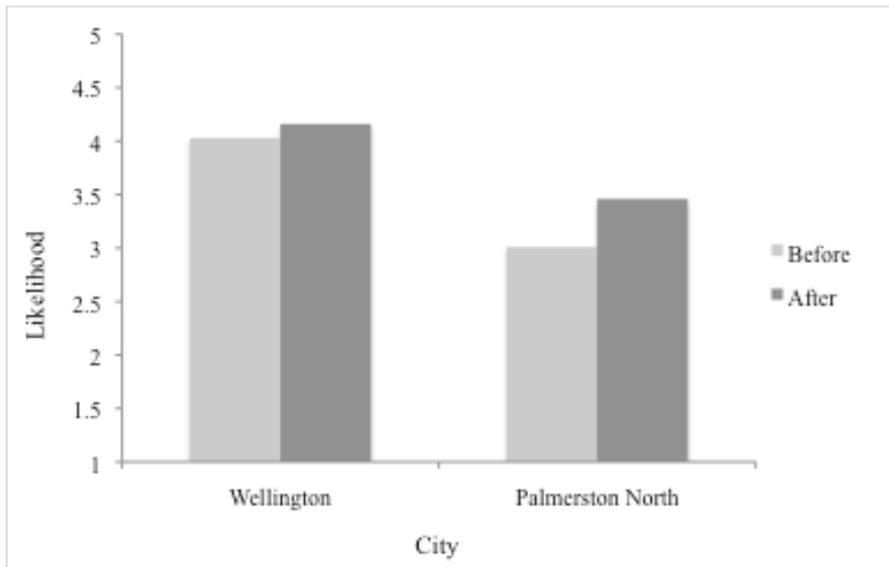
What Is Preparedness and How Do We Increase It?

There are three strands to action: legislation, incentives, and personal voluntary action.

Legislation

The first is legislation. New Zealand does have building regulations for new buildings and, positively, New Zealand is a relatively non-corrupt country that enforces these regulations. As a consequence, there are not 2,000 or 10,000 people dead following the Canterbury earthquakes. Some countries have the same building regulations as New Zealand, but in earthquakes most of the buildings collapse due to corruption that has resulted in building standards not being enforced. The New Zealand regulations are also being steadily upgraded. No commercial building built since 1985 killed anybody, and nor did almost any private homes. In New Zealand, commercial buildings are made so that they won't kill people in an earthquake, and those built since 1985 did not. However, perhaps they should be built as in Japan, so that they will still be useable after the earthquake. It would only cost 5-10% more in construction costs. Some old buildings in Christchurch had been strengthened, including both Christchurch Cathedrals. They are now badly damaged by the earthquakes, but if they had not been strengthened, they would have been like other historic buildings that are now a pile of rubble.

Engineers knew that there is a lot of soft soil in the East of the city, and that if Christchurch were to have an earthquake, there would be considerable damage in these areas. Articles and TV documentaries in the 1990s reported this risk. New Zealanders cannot leave this issue to Councils; this is too dangerous, as Councils permit buildings on soils that are likely to liquefy in an earthquake. New Zealand may not have high levels of corruption, but Councils can



▲ **Figure 2.** The perceived likelihood of an earthquake in participants' own city before and after the Canterbury Earthquake in Wellington and Palmerston North. (1 = not at all likely, 5 = very likely)

Thirdly, they thought that Wellington (or the North Island) was at greater risk. And perhaps that was accurate in terms of probabilities. But events don't always follow probabilities.

This judgment reflects an interesting pattern. It is as if Christchurch people thought that Wellington is more likely to have the earthquake, and therefore they don't (or didn't) see a need to prepare in Christchurch. This view suggests a dangerous leap in people's thinking, analogous to middle-aged people thinking: "teenagers more likely to have car accidents, so therefore I don't need to drive safely."

Often the perceived likelihood of earthquakes does not relate to preparation. However, in this study, there was a weak but significant relationship between Christchurch people's recall of the likelihood of an earthquake before the Darfield earthquake and their preparation. On the question "Were you aware of information and warnings to prepare prior to the earthquake", there was no difference between the three cities. Interestingly, Christchurch people said they knew all about the warnings, but on the question "Did you see this

information as relevant to you", they said they thought it wasn't relevant to them because the earthquake was going to be in Wellington.

People who have suffered harm or damage in an accident such as a car accident usually see the future risk of that hazard as higher. But in this case, when asked "Did you suffer serious damage to your home or not", Christchurch citizens who suffered damage did not see the future risk from earthquakes as higher than those who had not experienced major damage. This differs from the usual finding and may reflect a ceiling effect. One novel finding is that Wellington and Palmerston North citizens with friends, family or close acquaintances in Christchurch saw the risk of another earthquake in Christchurch as higher. This finding is interesting, because it suggests that if people have an emotional bond to someone in Christchurch, they see the risk in Christchurch as higher. From a personal perspective, having a daughter in Christchurch who works every Saturday in an Addington café that is made of brick, which fortunately has been strengthened, one author can understand that.

In summary, these data offer some lessons for preparation strategies and lessons for the media. First, it is not just Wellington that is at risk of an earthquake. New Zealanders have a fixation on Wellington's risk; this is analogous to adults who think that young people are the only ones with alcohol problems. Seismologists know

obviously be pressured by developers to permit building on unsuitable land. New Zealand therefore needs a national regulation stipulating that if people are building on soft soil or sand they need better foundations. Engineers could provide a formula for this; indeed, this principle is already being applied in the rebuild of Christchurch, where there are different building specifications for sites with different soil composition.

Legislation could also require Councils to make the earthquake status of buildings public. Two councils (Hastings and Timaru) tried to conceal and withhold the known earthquake state of local buildings after the Canterbury earthquakes. They justified this action by saying that the information would make people panic. However, their lawyers told them that they legally had to reveal this information. In Wellington, some buildings in the city have been 'red stickered', with a notice on the window announcing that the building is a dangerous earthquake hazard. This is useful, but the notices are small, A4 size, and given the hazard, they should be a metre wide. The message should be strong. Legislation requires these messages to be prominent on cigarette packets. New Zealand also requires more retrofitting of old buildings. It is expensive. But if, after Hawkes Bay, Christchurch had just strengthened just four buildings a year, many of those lovely old brick buildings in Canterbury would have survived, as would their inhabitants. The retrofitted buildings are often not as strong as new buildings, but many of those in Christchurch that had been strengthened survived the earthquakes.

Another useful, low-cost legislative requirement would be to put the earthquake rating of houses on the title. New Zealand has warrant of fitness requirements for cars but not for houses that are worth about \$400,000 each on average. So New Zealand can do more with legislation. A warrant of fitness requires mechanics to check numerous safety features, but anyone can buy a brick house that will collapse like a pack of cards in an earthquake. If an Australian comes to New Zealand and doesn't know that brick houses are

time bombs in this country, they may find to their regret it is likely to collapse on them in an earthquake.

Incentives

In addition to legislation, another strategy is to use incentives, as giving people information is not enough to get them to prepare. Many insurance companies did not apply this principle to houses. If people want to drive a dangerous motorbike or are under 25, they pay more insurance, but at least before the Christchurch earthquakes, people could have a house that was totally unsafe, but pay no more insurance. When the disaster happens, the insurance companies must recover losses or go bankrupt, so everyone must pay (much) more insurance. Insurance could be targeted, or be more conditional. For example, if a house owner has a brick chimney, instead of the usual \$400 premium, they might have to pay \$800 a year, or have a higher excess.

Personal readiness

A key issue is focusing not just on response and recovery, but on readiness. The concept of civil defence is based on the analogy with military defence. Clearly, to have an effective military defence, if people at war are facing guns and tanks shooting at them, the best defence is not just an emergency kit to patch them up after they've been injured or maimed. For readiness and good defence, people need armour that protects them from being injured or killed. In civil defence, people need readiness as well as response and recovery.

An important issue underpinning this concept of defence is that there are different types of preparedness. Having an emergency kit and water is one class of action, and in Wellington, this may be more important than Christchurch, because there are fewer access routes into Wellington, and Fonterra (a large milk supplier) may not convert its milk trucks into water trucks to rescue Wellingtonians. Thus, survival actions such as compiling an emergency kit are important. However, actions to mitigate or prevent damage made in advance of the quake are also important. These

include strengthening buildings, and replacing or reinforcing brick or unreinforced masonry. An example is the Hunter building at Victoria University. The University strengthened this quaint old building, and put concrete and steel bracing inside it – it is like inserting a backbone in a jellyfish. Yet despite the importance of these damage mitigation actions, preparedness messages focus almost solely on survival actions. On the day after the September earthquake, the Dominion Post newspaper ran a big feature saying: "Have you got your emergency kit, etc." One author wrote a letter saying that this is good civic duty you are performing, but it would be useful to also remind people that they need to have a builder check their house. The newspaper duly printed the letter, but when the next earthquake happened on 22 February, the next day, the Dominion Post repeated the mantra "Have you got your emergency kit, etc." The lesson about the importance of actions to mitigate damage was not learned. There needs to be a shift to focus on prevention, not just survival.

When an earthquake happens, the importance of building strength and soil type is obvious. People need to get a builder to check their house or chimney. Our questionnaire found that only two out of 200 had done this. We have mentioned the analogy with military defence. After the Canterbury earthquakes, New Zealand had a window of opportunity where people in other cities were buying more bottles of water and other actions. But Civil Defence did not use this mild anxiety to get people to prepare. That seems to be a missed opportunity. Is not this what these agencies are being paid for? As a consequence, we have buildings like the Dean's beautiful house, with three layers of brick, destroyed in the earthquake. The earthquake damage has cost 15 billion dollars. Preparedness in the form of strengthening buildings would have been expensive, but if builders had strengthened all the brick and unreinforced masonry buildings in Christchurch, this would have cost much less than 15 billion dollars. It's not surprising that Canterbury people now think New Zealand should have

stricter building regulations (Mitchell, 2011).

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Authors' Note

The empirical results included in this paper have previously been reported in McClure, Wills, Johnston, & Recker, (2011) and the figures are reprinted here with permission from *Australasian Journal of Disaster and Trauma Studies*.

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