Risk judgments and social norms: Do they relate to preparedness after the Kaikōura earthquake?

John McClure[1]
Millie Ferrick[1]
Liv Henrich[1]
David Johnston[2]

[1] Victoria University of Wellington, Wellington, New Zealand.

[2] Joint Centre for Disaster Research, Massey University, New Zealand .

Author correspondence:
John McClure
School of Psychology,
Victoria University of Wellington,
PO Box 600,
Wellington 6140
New Zealand.
Email: john.mcclure@vuw.ac.nz

URL: http://trauma.massey.ac.nz/issues/2019-2/AJDTS_23_2_McClure.pdf

Abstract

Research has shown that preparation for natural hazard events reflects several factors including risk judgments and the cost of the actions. Research has also shown the effects of norms in other domains but very little research regarding natural hazards. This study examined risk judgments and preparedness norms following the recent Kaikōura earthquake. Wellington citizens judged the risk of earthquakes in Wellington, Kaikōura, and other parts of New Zealand ("elsewhere") before and after the 2016 Kaikōura earthquake. They also reported their preparation and perception of norms for different categories of actions. Judgments of the risk of a further earthquake occurring following the Kaikōura earthquake rose more for Kaikōura than for Wellington and elsewhere, but participants still judged an earthquake more likely in Wellington and elsewhere than in Kaikōura. Preparation was positively related to risk judgment and to the judgment that preparing was normative, particularly for survival actions. These findings suggest that normative information adds to the effect of risk perceptions about the probability of an earthquake to enhance preparation for these hazards. This finding can be applied in risk communications for earthquakes and other hazards by referencing norms for adaptive behaviours.

Keywords: *Earthquake, risk perception, norms, preparedness, optimism*

Levels of Preparedness for Hazards

Aotearoa New Zealand (NZ) is one of several locations globally that are vulnerable to earthquakes. This risk has been illustrated by recent damaging earthquakes in Canterbury (2010-2011), the Cook Strait (2013), and most recently, Kaikōura (2016). Despite the known earthquake hazard in these areas, many citizens in NZ as elsewhere are not well prepared (Johnston, Tarrant, Tipler, Coomer, Pedersen, & Garside, 2011; Lindell & Perry, 2000; Solberg, Rossetto, & Joffe, 2010). Furthermore, those who do prepare have typically performed more survival actions such as obtaining medicines than actions to mitigate damage such as removing brick chimneys (Charleson, Cook, & Bowering, 2003; Spittal, McClure, Siegert & Walkey, 2008). In Wellington for example, 73% of the population reported undertaking survival preparedness actions whereas only 24% reported actions to mitigate damage (Spittal et al., 2008). Although survival actions are invaluable in preparing for a major earthquake, damage mitigation is crucial for limiting structural damage to buildings as well as loss of life (Russell, Goltz & Bourque, 1995). It is therefore important to clarify what factors lead to more people making these preparations.

Psychological and Economic Factors and Preparation

Research has shown links between low levels of preparedness and several psychological and economic factors that are barriers to action. These include people's fatalism and lack of efficacy (the feeling that they can do nothing to prevent harm from an earthquake; McClure, Allen, & Walkey, 2001; Paton, 2003), their risk-taking tendency, and the cost of mitigating actions (Eiser, et al., 2012; Heller, Alexander, Gatz, Knight, & Rose, 2005; Lindell & Perry, 2000; Paton, 2018; Solberg et al., 2010). People living in rental accommodation cannot undertake most important mitigation actions such as strengthening a house or apartment. A lack of trust in authorities' hazard communications also inhibits preparation (Solberg et al., 2010).

Judgment of risk is an important prerequisite for people to prepare for a hazard (Slovic, 1987; Slovic & Weber, 2002). If people show unrealistic optimism, thinking that they are less at risk than others, then they prepare less for future events such as earthquakes (Burger & Palmer, 1992; Larsson & Enander, 1997; Sattler, Kaiser & Hittner, 2000; Weinstein, 1980). In contrast, experience of an earthquake increases risk judgments and leads to increases in preparation, unless the effects of the earthquake are minor, in which case people may become over-optimistic (Becker, Paton, Johnston, Ronan, & McClure, 2017; Lindell & Perry, 2000; Solberg et al., 2010).

A recent series of studies examined New Zealanders' risk perception in different locations following the 2010-11 Canterbury and 2013 Cook Strait earthquakes (McClure, Henrich, Johnston & Doyle, 2016; McClure, Johnston, Henrich, Milfont & Becker, 2015; McClure, Wills, Johnston & Recker, 2011). The studies assessed judgments of earthquake likelihood in these locations before and after the earthquakes. People rated the likelihood of an earthquake in Christchurch and other parts of New Zealand higher after the earthquakes than they recalled before, but they rated an earthquake in Wellington equally likely before and after the earthquakes and more likely than elsewhere in New Zealand. These findings suggest that people recognise that Wellington is a high-risk area for earthquakes.

Regarding preparedness, McClure et al. (2016) found that 60% of Wellington participants claimed they prepared prior to the 2013 Cook Strait earthquake whereas 74% said they had prepared since the earthquake. However, many people are unrealistically optimistic about their own and others' personal risk and so do not prepare (e.g. McClure et al., 2015; Spittal et al., 2008). Research shows that mere recognition of the risk of a disaster occurring often fails to translate into preparation (Paton, Smith & Johnston, 2000; Rustemli & Karanci, 1999; Weinstein, Lyon, Rothman, & Cuite, 2000b). As noted above, other factors play a role in reducing or increasing preparation, including fatalism and perceived efficacy, cost, home ownership, place attachment, and experience of prior events (Eiser et al., 2012; Paton, 2003; Paton, 2018 Solberg et al., 2010), Another key, although under-studied, factor is social norms, which are focused on here.

The Effects of Social Norms on Preparedness

Social norms comprise people's judgment of what behaviours are socially appropriate in a given situation (Cialdini, 2003; Fehr & Fischbacher, 2004). Research shows that these norms play a role in both desirable and undesirable actions (Cialdini, 2003). This research also shows the effects of two main sub-types of norms: injunctive and descriptive norms. A descriptive norm is the perception that a behaviour is performed by the majority of the relevant population. A well-known example is an experiment that increased the number of hotel guests re-using their towels by telling them that a majority (over 70%) of other guests did this (Goldstein, Griskevicius, & Cialdini, 2007). In contrast, an injunctive norm is the perception that a behaviour is approved of within a social group. For example, research showed that theft of petrified wood in a National Park in the United States decreased when researchers installed a sign asking visitors not to remove the wood and stating such acts were theft, expressing an injunctive norm of not stealing (Cialdini et al., 2006).

Lindell and Perry (2000) suggested that the communication of social norms through peer groups could enhance positive responses to natural hazards. However, there is little research on norms affecting earthquake preparedness (Solberg et al., 2010). The limited research that does exist on norms and natural hazards suggests that social norms do influence preparation. McIvor and Paton (2007) found that people who had social networks that support preparedness believed that preparation improves disaster outcomes, which is an important belief for combatting the barrier of fatalism mentioned above. Mileti and Darlington (1997) found that people discounted their risk from earthquakes until they were aware of the norm that others recognised the risk (See also Sorensen & Sorensen, 2007; Thompson, Garfin, & Silver, 2016). Becker, Paton, Johnston, and Ronan's (2012) qualitative research on the effect of social norms on hazard preparedness in three NZ towns suggests that preparedness was not seen as normative by many participants; people who did prepare were seen as abnormal or "over the top". However, this study was performed before the 2010-2011 Canterbury earthquakes and the most recent major earthquake disaster was the magnitude 7.8 Hawke's Bay earthquake in 1931. So, this study occurred during a period of earthquake quiescence, possibly explaining the norm of non-preparation. In contrast, in research on bushfire preparedness in at-risk areas of Australia,

Morrison, Lawrence, and Oehmen (2014) found a strong relationship between preparedness and exposure to social norms supporting preparedness. This study performed in 2012-13 followed the Australian "Black Saturday" fires in 2009 and other damaging bushfires in 2011.

These findings suggest that social norms do indeed play a role in hazard preparedness. However, few studies have attempted to quantify or manipulate social norms to examine their relationship to people's earthquake preparedness or to distinguish the effects of the two main sub-types of norms: injunctive and descriptive. In one study focusing on this issue, Vinnell, Milfont, and McClure (2018) examined how citizens' judgments of legislation on earthquake-prone buildings (EPBs) related to descriptive and injunctive norms for earthquake preparation. The descriptive norm message read "Currently, Wellingtonians are strengthening an average of 72 earthquake-prone buildings a year to at least [the current legal minimum] standard, which means that at least 80% of these buildings will be strengthened within the 15-year time frame if this rate continues". The injunctive norm message read: "In a recent survey, 76% of Wellingtonians said they support this [building] legislation requiring the strengthening of earthquake-prone buildings". Vinnell et al. found that exposure to both the injunctive norm and a combined descriptive and injunctive norm increased support for the legislation. Hence this research suggests that injunctive norms, at least, can influence earthquake preparation.

The Present Research

This study examines judgments and preparation following the 2016 Kaikōura, NZ, earthquake. Previous research shows that the occurrence of a natural hazard can impact areas beyond where the hazard occurred (McClure et al., 2016; Mulilis, Duval & Lippa, 1990; Reve, 2011). In line with this literature, the current study examines how the occurrence of an earthquake affects people's attitudes and behaviours relating to earthquakes in different regions. This design allows for comparison with the previous studies with a similar design following the Canterbury and Cook Strait earthquakes (McClure et al., 2015; 2016).

With regard to risk judgments, this study simulated these previous studies on risk judgment in different locations but substituted Kaikōura for Canterbury and Cook Strait as the location of the recent earthquake. Participants judged the likelihood of an earthquake in three regions (Kaikōura, Wellington, and other parts of NZ), both before (recall) and after the 2016 Kaikōura earthquake. We expected that participants would rate an earthquake in Kaikōura more likely after the 2016 earthquake than they recalled before, but still lower than Wellington. As recalled probabilities are retrospective judgments subject to hindsight bias (Blank, Musch, & Pohl, 2007), we added two questions from McClure et al. (2016) asking whether the risk of earthquakes was more real, plausible, and important to them since the Kaikōura earthquake. We expected that participants would report preparing more after the Kaikōura earthquake than before.

The study also bridged the gap between the previous studies on risk judgments and preparedness (e.g. McClure et al., 2016) and research on the effects of norm messages (e.g., Vinnell et al., 2018). We examined social norms in the form of judgments of how much friends, family, co-workers, and neighbours support preparation (injunctive norm) and have prepared (descriptive norm). Rather than examining how norm information affects judgments as in Vinnell et al.'s (2018) study, this research examines people's perceptions of those norms following the 2016 Kaikōura earthquake.

We anticipated that people with higher norm scores (i.e., who perceive stronger norms in their social groups) would report more preparation than those with lower norm scores (i.e., who perceive weaker norms; Morrison et al. 2014). Specifically, we expected that those who report that their friends, family, co-workers, and neighbours see preparedness actions as important and have performed these actions would themselves have performed more of these actions.

Method

Design

The study employed a questionnaire where participants made judgments about the likelihood of earthquakes in three locations (Kaikōura, Wellington, and the rest of NZ) before (using recall) and after the Kaikōura earthquake and reported their preparation and norms judgments.

Participants

Participants were 241 residents of Wellington, NZ, of whom 165 (68%) were female, 49 (20%) were male, and one (1%) identified as "other", while the remaining 26 (11%) did not specify gender. The majority of participants (52%) were in the 21-30 age group. The questionnaire

targeted those living in Wellington because of the known earthquake risk in the area and because the city sustained significant damage to its central business district in the 2016 Kaikōura earthquake.

Materials

The first eight questions of the questionnaire assessed risk perception, with six questions assessing how likely participants judged an earthquake in Kaikōura, in Wellington, and in another part of NZ both before (recall) and after the 2016 Kaikōura earthquake. These questions were adapted from McClure et al. (2016) and used seven-point Likert-type response scales ranging from 1 ("Not at all likely") to 7 ("Very likely"; see the Appendix for the full survey). The remaining two risk perception questions asked if the risk of an earthquake had become more real and plausible since the Kaikōura earthquake ("yes"/"no") and whether the combined occurrence of the Canterbury (2010-2011), Cook Strait (2013). and Kaikōura (2016) earthquakes made the risk of an earthquake more important for them and their region. This final question also used a seven-point Likert-type response scale ranging from 1 ("Not at all") to 7 ("Very much").

The questions regarding preparation asked participants whether they had made any preparations for an earthquake before or after the Kaikōura earthquake for four types of preparation options: basic survival actions such as stocking up on food, contents damage mitigation such as attaching shelves to wall, structural damage mitigation such as chimney removal, and logistics planning such as planning a meeting place**.** Participants could tick all options they had performed ("yes"/"no").

The next questions assessed participants' views regarding EPBs. A fatalism question asked participants to rate whether they believe strengthening EPBs reduces the risk of damage and loss in a major earthquake using a seven-point Likert-type response scale ranging from 1 ("Not at all") to 7 ("Very much"). Two questions asked for estimates of how many of the 5500 buildings in Wellington subject to EPB legislation were earthquake-prone and how many of these buildings are taken off the EPB list annually due to being strengthened, demolished, or re-assessed.

Five questions relating to social norms asked about participants' perceptions of their peers' attitudes and behaviours towards earthquake preparedness. Four questions were prefixed with "For the next four questions please rate how strongly you agree or disagree with the statements" and used a seven-point Likert scale from "Strongly disagree" to "Strongly agree". The questions read:

1) "Most of my friends, family, co-workers and neighbours have taken some survival actions (e.g. acquiring emergency supplies such as food, water and a radio) to prepare for the aftermath of a large earthquake in the future." [Descriptive norm];
2) "Most of my friends, family, co-workers and neighbours have taken some mitigation actions (e.g. removing their chimneys or getting an earthquake check of their home) to limit the damage their home might incur in the event of a large future earthquake." [Descriptive norm];
3) "Most of my friends, family, co-workers and neighbours think that it is important to prepare for potential future earthquakes." [Injunctive norm]; and
4) "Most of my friends, family, co-workers and neighbours would view me favourably if I prepared for a potential future earthquake." [Injunctive norm].

A fifth norms question asked what percentage of the Wellington population participants thought had taken steps to prepare for an earthquake. Participants were asked to give a specific percentage; range options were not provided.

Lastly, questions asked if participants incurred damage in the Kaikōura earthquake and if they had any additional comments about earthquakes or the Kaikōura earthquake (due to space limitations, these are not reported here; see Ferrick, 2017). Demographic questions assessed gender, age, number of dependent children in their home, and suburb.

Procedure

Participants were recruited through the Facebook social media platform and the survey was hosted on Qualtrics. Participation was voluntary and anonymous, and participants could withdraw at any time. The survey questions have low risk ethics approval from Massey University (ID 4000017003). A link to the questionnaire was posted on Facebook. Participants clicked the link if they were Wellington residents and then followed the prompts. The questionnaire could be accessed from any Internet-enabled device. After completion, the participants were thanked and debriefed and could enter a prize draw for a $60 supermarket voucher. Identifying information for this draw was provided through a separate link to maintain anonymity. The study was

run in January 2017, nine weeks after the magnitude 7.8 Kaikōura earthquake on November 14th, 2016 and generated 241 responses.

Results

Judgments of Earthquake Likelihood

Figure 1 shows the mean ratings for likelihood of an earthquake in each of the three locations before (recall) and after the Kaikōura earthquake. We performed a 3 (Location: Wellington, Kaikōura, other part of NZ) x 2 (Time: Before, After) repeated measures analysis of variance (ANOVA) on the earthquake likelihood ratings, with both independent variables being within-subjects. This test compares a number of mean scores to identify whether there is a significant difference between them as a whole. Post-hoc tests then identify between which scores there are significant differences, if any. This analysis showed a main effect of time, where participants judged an earthquake more likely after the Kaikōura earthquake (M = 5.65, SD =1.06) than before (M = 4.88, SD = 1.16), $F(1, 240) = 119.30$, $p < .001$, $\eta^2 = .33$. There was also a main effect for location, F (1, 240) = 102.16, $p<.001$, $\eta^2 = .30$; follow-up ANOVAs showed that participants rated an earthquake more likely in Wellington (M = 5.55, SD =1.13) than in Kaikōura (M = 4.61, SD = 1.20), $F(1, 240) = 135.69$ $p < .001$, $\eta^2 = .36$, and more likely in other parts of New Zealand (M = 5.64, SD = 1.27) than in Kaikōura, $F(1, 240) = 135.72$, $p < .001$, $\eta^2 = .36$.

The analysis also showed a two-way interaction between location and time. Follow-up ANOVAs showed that in their recall of before the earthquake, participants rated an earthquake more likely for Wellington and other parts of New Zealand than in Kaikōura, F (1, 240) = 37.77, $p <.001$, $\eta^2 = .14$, and showed that this difference decreased after the earthquake. Following the earthquake, the increase in ratings of likelihood was significantly larger for Kaikōura (M = 1.24, SD = 1.58) than for Wellington (M = 0.63, SD = 1.37), $t(240) = 5.82$, $p < 0.001$ and other parts of New Zealand (M = 0.44, SD = 1.20), $t(240) = 7.84$, $p <.001$, although the likelihood of an earthquake was still seen as lower for Kaikōura than for the other two locations. Of the 241 participants, 187 (77.6%) answered that they thought that the risk of an earthquake was more real and plausible since the Kaikōura earthquake. The risk of an earthquake had become important to participants since the combined occurrence of the Canterbury, Cook Strait, and Kaikōura

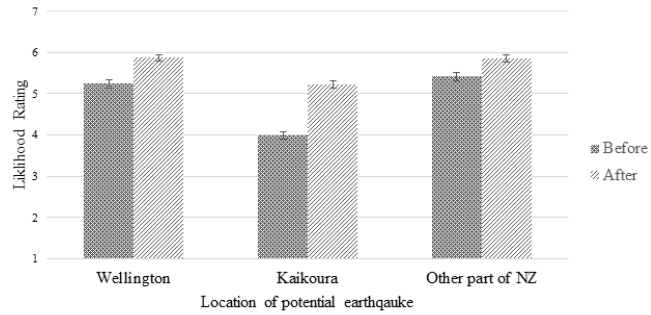

Figure 1. Mean ratings of the likelihood of an earthquake in different locations before and after the Kaikōura earthquake.

earthquakes with the mean rating near the top of the scale (M = 5.81, SD = 1.47).

Preparedness Actions

Overall, 133 participants (55.2%) recalled some preparations prior to the Kaikōura earthquake and 132 participants (54.8%) reported preparation actions since the Kaikōura earthquake, mostly survival and logistics actions, as shown in Figure 2. A frequency analysis using a chi-square test showed there was no difference in overall preparation before and after the Kaikōura earthquake, χ^2 (241) = 0.92, *ns*.

To compare the risk (earthquake likelihood) judgments of participants who did and did not prepare *before* the Kaikōura earthquake, we performed a 2 (Preparation: Yes or No) by 3 (Location; Wellington, Kaikōura, other part of New Zealand) by 2 (Time; Before, After) mixed design ANOVA where Preparation was a between-subjects factor and Location and Time were repeated measures completed by all participants. This analysis showed a two-way interaction between preparation before the Kaikōura earthquake and time, $F(1, 240) = 7.44$, $p = 0.01$, $\eta^2 = .03$, where recalled risk before the earthquake was lower for those who had prepared (M = 4.45, SD =1.55) than those who had not (M = 5.23, SD =1.55), $F(1, 240) = 30.39$, $p <.001$, $\eta^2 = .19$, whereas

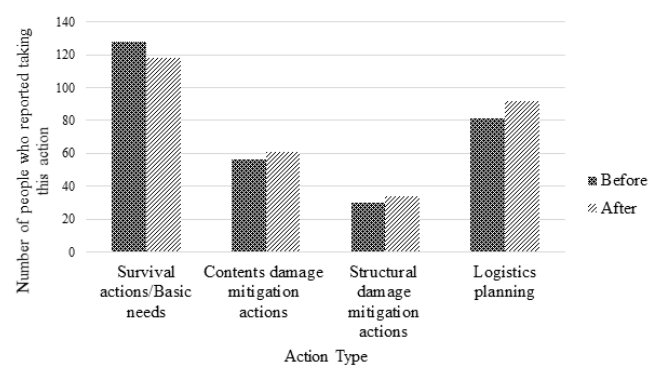

Figure 2. Numbers of participants who had undertaken each type of preparedness action before and after the Kaikōura earthquake.

perceived risk after the earthquake did not differ between those who had prepared (M = 5.43, SD =1.39) and those who had not (M = 5.84, SD =1.55), $F(1, 240) = 1.64$, p = .20, η^2 = .01. A three-way interaction between location, risk judgments, and preparation before the earthquake showed that the increase in perceived risk for Kaikōura after the earthquake was only for participants who had prepared before the event, $F(1, 240) = 13.76$, $p < .001$, η^2 = .05.

The same analysis with preparation *since* the Kaikōura earthquake showed a similar interaction between preparation and time, $F(1, 240) = 14.98$, $p < .001$, η^2 = .06 where recalled risk before the earthquake did not differ between those who prepared since the event (M = 4.99, SD =1.71) and those who did not (M = 4.79, SD =1.55), whereas the perceived risk after the earthquake was lower for those who prepared since the event (M = 5.47, SD =1.39) than for those who did not (M = 5.81, SD =1.55).

Social Norms

We tested correlations between each of the norm variables to check for relationships between norms for different types of preparations (survival and mitigation) and different types of norms (descriptive and injunctive). Table 1 shows the correlations between the four social norms questions and estimates of others' preparation. These correlations were mostly positive and significant and ranged from small to moderate. The correlations between the descriptive and injunctive norms questions suggest that these are related in people's minds, particularly for the importance of preparing and survival actions. Participants estimated that 51% of the Wellington population had made some preparations.

Table 1.
Correlation matrix for questions measuring perceptions of social norms.

	1	2	3	4	5
1. Estimate percent of prepared Wellington citizens	-				
2. Social norms (descriptive) - Survival	.21**	-			
3. Social norms (descriptive) - Mitigation	.07	.34**	-		
4. Social norms (injunctive) - Importance	.15*	.64**	.31**	-	
5. Social norms (injunctive) - Favourability	.06	.38**	.21**	.45**	-

Note. *p<.05 (two-tailed); **p<.01 (two-tailed)

This variable significantly correlated with two of the four norms questions: the survival and importance norms.

To test our predictions of how social norms related to preparedness actions, we created an overall norm score by calculating the mean of participants' scores on the four norms questions. A mixed design ANOVA testing differences in means for the overall norm score between those who had prepared and those who had not found that those who reported preparing *before* the earthquake were significantly higher on the combined norms (M = 4.80, SD = 0.92) than those who did not (M = 4.39, SD = 1.11), $F(1, 216) = 6.72$, p = .01, η^2 = .03. The same effect was seen for reported preparation *after* the earthquake: had prepared (M = 4.91, SD = 0.94); had not prepared (M = 4.25 SD = 1.03), $F(1, 216)$ = 22.45, p<.001, η^2 = .09 The interaction between before and after (i.e., effect of time) was not significant, $F(1, 216) = 3.36$, p = .068, η^2 = .01.

We then ran a logistic regression to test whether the individual social norms items predicted preparedness prior to the earthquake. The peers' survival actions norms question was the sole significant predictor of preparation, both before, $B(SE = .14) = .25$, OR = .76, [95% CI = .61, .99] , $p < .05$, and after $B(SE = .13) = .45$, OR = .64, 95% [CI = .49, .83], $p < .001$ the earthquake.

Fatalism and Estimates of Earthquake-Prone Buildings

Overall, participants demonstrated weak fatalism biases with a high average perception that strengthening earthquake-prone buildings reduces harm and loss from an earthquake (M = 5.47, SD = 1.55). One-way ANOVAs found no relationship between fatalism and preparedness before the earthquake, $F(1, 225) = 0.75$, p = .39 or after the earthquake, $F(1, 225) = 2.27$, p = .13, possibly reflecting a ceiling effect due to the high overall ratings. Participants greatly overestimated the number of the 5500 eligible buildings in Wellington that are rated earthquake prone (M = 2621; the correct number at this date was 654); however, they also overestimated the number of buildings removed annually from the EPBs list (M = 219); the correct number is about 50 (McCrae, McClure, Henrich, Leah, & Charleson, 2017). As noted by a reviewer of this paper, the proportion of buildings removed from this list relative to the number of buildings they judge to be prone (8%), is close to the correct proportion (7.6%).

Discussion

Risk Judgments for Different Locations

As predicted, participants' rating of the likelihood of a future earthquake was higher after the Kaikōura 2016 earthquake than their recall of the risk before. This finding is consistent with previous findings (Greening & Dollinger, 1992; Kung & Chen, 2012; McClure et al., 2016; McClure et al., 2015; McClure et al., 2011). The results also highlight that location plays a role, in that the change in likelihood was greatest for Kaikōura compared to Wellington, and smallest for other locations. This difference reflects the impacts of the recent earthquake in Kaikōura.

However, the Kaikōura likelihood ratings were still lower than the two other locations. This finding is interesting given how soon after the Kaikōura earthquake the data were obtained. The higher risk rating for Wellington may reflect the fact that Wellington has a well-known earthquake risk, with one expert estimate of a magnitude 7.5 earthquake occurring in Wellington on average once every 500 years with a potential death toll of 1,600 people (Cousins, 2013; see also Gulliver, 2015; Langridge, Leonard, van Dissen, & Wright, 2012). Risk judgments for the other parts of New Zealand may also be higher than for Kaikōura because people may have thought of locations such as Christchurch which recently experienced two major damaging earthquakes (Doyle, Johnston, McClure, & Paton, 2011; Greening & Dollinger, 1992; Kung & Chen, 2012). These judgments show that estimates of earthquake risk are based on several factors, not only the location of the most recent seismic event(s). These estimates also show that a rise in perceptions of earthquake risk is not restricted to the region where a recent earthquake has occurred. Efforts to get people to prepare can capitalize on this heightened perception of the risk following an event, regardless of the location of either the earthquake itself or the particular targeted population.

Preparedness Behaviours

Contrary to predictions, participants reported no more preparation following the Kaikōura earthquake than prior. A possible reason for this finding is that participants had recently experienced the 2010-11 Canterbury or 2013 Cook Strait earthquakes which occurred only 5 and 3 years respectively before the 2016 Kaikōura earthquake. Participants may have prepared after these prior earthquakes and did not feel the need to prepare again following the Kaikōura earthquake (McClure et al., 2016; Russell et al., 1995; Weinstein, Lyon, Rothman, & Cuite, 2000a). Past research found that reviewing logistics increased after the second of the Cook Strait earthquakes (Doyle et al., 2018). This increase may not continue after a third event (in this case, the Kaikōura earthquake) and many preparations such as attaching a hot water cylinder need doing only once. Participants in this study reported more survival actions than mitigation actions, in line with previous findings (Heller et al., 2005; Spittal et al., 2008). However, it is likely that some citizens who planned mitigation actions following the Kaikōura earthquake had insufficient time to do this by the time of this study (Miceli, Sotgiu, & Settanni, 2008). To deal with this issue, future similar research could measure intentions, with questions such as "Are you actively planning to take [mitigation] actions?", possibly with a time frame and priority rating scale.

Although preparation was no higher after the Kaikōura earthquake than before, it did relate to recall judgments of the risk of an earthquake. Recall of this risk before the Kaikōura earthquake was higher for those who had prepared than for those who had not, whereas these risk judgments after the earthquake were the same for the two groups (cf. Paton, 2003). This finding suggests that those who prepare prior to an earthquake are more likely to recognise the potential risk, consistent with previous research (McClure et al., 2016; Miceli et al., 2008). Perceived risk is not sufficient on its own for people to prepare and, as noted above, there are many other barriers to action; however, recognising the risk serves as a prerequisite to voluntary actions.

Preparation and Social Norms

In line with our predictions, those participants who had prepared typically had higher scores for the combined norms variable. That is, citizens who perceived their peers to be more prepared were themselves more likely to be prepared than those who perceived this norm as weaker. This finding applies to preparation before and after the Kaikōura earthquake and extends previous research on the relation of norms to actions to mitigate hazards (Morrison et al., 2014; Vinnell et al., 2018).

When the norms questions were examined individually, however, the only individual question that was significantly associated with preparation was the descriptive norm item stating that most of their peers have taken survival actions to prepare for an earthquake. This finding may reflect the fact that survival actions are more frequent than mitigation actions, which many

of their peers may not have undertaken. Interestingly, participants' perceptions of how their peers judge the importance of preparation and how they would approve of the respondent preparing (both injunctive norms) did not predict preparation. These findings suggest that descriptive norms relate to preparation more than injunctive norms do, whereas Vinnell et al., (2018) found the opposite. There is clearly a need for research to clarify which types of norm affect hazard preparation and when. It may be that people report doing what other people do in a type of conformity effect (descriptive norm) but when given norm messages as in Vinnell et al., they are susceptible to messages expressing people's evaluations and approval of those actions (injunctive norms). Regardless of whether this is the case, the valuable finding here and in Vinnell et al. is that norms do have a relationship to earthquake preparation, giving another string to the bow of interventions.

Participants' estimates of how many Wellington citizens had prepared for an earthquake correlate with perceptions of their peers' survival actions (descriptive norm) and beliefs about the importance of preparing (injunctive norm). Again, this may be because people think that survival actions are the most easily performed so they infer that most people have taken this type of action. A related interesting finding is participants' estimate of the number of EPBs, which assesses a perceived norm of compliance with building standards. We made no predictions on this item, as it is a new measure. Of the 5500 eligible buildings in Wellington, participants greatly overestimated how many were earthquake-prone (2600), four times the actual number (650). This finding suggests people imagine a norm of not rectifying these buildings and may reinforce fatalism about ever making the city resilient. However, participants also greatly overestimated the number of buildings removed from this earthquake-prone list annually. This judgment shows that their estimates of the proportion of buildings being rectified is close the actual proportion (8%), even if their idea of the absolute numbers on both measures is greatly inflated.

Limitations and Future Directions

One limitation of the current research is that the respondents were relatively young and the majority were female, so the conclusions may not generalize to the wider population. Older participants are more likely to be homeowners and potentially have carried out more mitigation actions than people who are renting. A participant's friends, as evoked in the norms questions, are likely to be in a similar situation as that participant. However, the sample was not limited to students or any other group, so the results are more generalizable than some comparable studies which draw their sample from one specific population (e.g., students). Another possible limitation is the proximity in time between the Kaikōura earthquake and the survey, which allowed little time for mitigation actions to be completed. As mentioned above, future research with this design could add a question on whether people intend to carry out such actions. A further possible limitation is that the recall risk judgments are subject to hindsight bias, as recalled probabilities may be biased by subsequent events (Blank et al., 2007). However, the earthquake likelihood data on these recall measures are close to pre-Canterbury earthquake data in Wellington and Christchurch (comparative data for Kaikōura are not available; Becker, 2010) which suggests that hindsight did not greatly affect recall judgments. In addition, the questions on the greater reality of the risk since the earthquake are less subject to this potential hindsight bias. Researchers should be aware that the way questions are framed influences the judgments the questions are intended to elicit (McClure & Hilton, 1998; Schwartz, 1999).

Conclusion

In addition to supporting previous findings on risk judgments following earthquakes, this research shows that people who prepare more for earthquakes tend to believe that such preparation is the norm more so than people who do not prepare. This finding particularly applies with survival actions and descriptive norms. These findings suggest that norms provide an additional tool to apply to the difficult task of getting people to prepare more for natural hazards and could be used in risk messaging campaigns to this end. As illustrated in Vinnell et al.'s (2018) study, one way this can be achieved is by presenting messages where a majority (i.e., the norm) have performed an action (descriptive norm) or approve of that action (injunctive norm).

Acknowledgements

We thank Caspian Leah for contributing. The research was part-funded by the National Science Challenge: Resilience to Nature's Challenges and a Victoria University of Wellington Summer Scholarship. This project was also partially supported by QuakeCoRE, a New Zealand Tertiary Education Commission-funded Centre. This is QuakeCoRE publication number 0462.

References

Becker, J. S. (2010). Understanding disaster preparedness and resilience in Canterbury: Results of interviews, focus groups and a questionnaire survey. *GNS Science Report, 2010/50*. 99 p.

Becker, J. S., Paton, D. P., Johnston, D. M., & Ronan, K. R. (2012). A model of household preparedness for earthquake: How individuals make meaning of earthquake information and how this influences preparedness. *Natural Hazards, 64,* 107-137. doi: 10.1007/s11069-012-0238-x

Becker, J. S., Paton, D., Johnston, D. M., Ronan, K. R., & McClure, J. (2017). The role of prior experience in informing and motivating earthquake preparedness. *International Journal of Disaster Risk Reduction, 17,* 179-193. doi: 10.1016/j.ijdrr.2017.03.006

Blank, H., Musch, J., & Pohl, R.F. (2007). Hindsight bias: On being wise after the event. *Social Cognition, 25*, 1-9. doi: 10.1521/soco.2007.25.1.1

Burger, J. M., & Palmer, M. I. (1992). Changes in generalization of unrealistic optimism following experiences with stressful events: Reactions to the 1989 California earthquake. *Personality and Social Psychology Bulletin, 18*, 39-43. doi: 10.1177/0146167292181006

Charleson, A. W., Cook, B., & Bowering, G. (2003). Assessing and increasing the level of earthquake preparedness in Wellington homes. In *2003 Pacific Conference on Earthquake Engineering* (pp. 137-144). Retrieved from www.nzsee.org.nz/db/2003/View/Paper137s.pdf

Cialdini, R. B. (2003). Crafting normative messages to protect the environment. *Current Directions in Psychological Science, 12*(4), 105-109. doi: 10.1111/1467-8721.01242

Cialdini, R. B., Demaine, L. J., Sagarin, B. J., Barrett, D. W., Rhoads, K., & Winter, P. L. (2006). Managing social norms for persuasive impact. *Social Influence, 1,* 3-15. doi: 10.1080/15534510500181459

Cousins, W. J. (2013). Earthquake damage and casualties due to large earthquakes impacting Wellington region. *GNS Science Report, 2013/41*. 12 p.

Doyle, E. E. H., Johnston, D. M., McClure, J., & Paton, D. (2011). The communication of uncertain scientific advice during natural hazard events. *New Zealand Journal of Psychology, 40*(4), 39-50.

Doyle, E. E. H., McClure, J., Potter, S. H., Becker, J. S., Johnston, D. M., Lindell, M. K., …., & Coomer, M. A. (2018). Motivations to prepare after the 2013 Cook Strait Earthquake, N.Z. *International Journal of Disaster Risk Reduction, 31*, 637–649. doi: 10.1016/j.ijdrr.2018.07.008

Eiser, J. R., Bostrom, A., Burton, I., Johnston, D. M., McClure, J., Paton, D., … & 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: 10.1016/j.ijdrr.2012.05.002.

Fehr, E., & Fischbacher, U. (2004). Social norms and human cooperation. *Trends in Cognitive Psychology, 8*(4), 185-190. doi: 10.1016/j.tics.2004.02.007

Ferrick, M. (2017). *Risk judgment and social norms: Do they relate to preparedness after the Kaikoura earthquakes* (Unpublished Summer Scholarship thesis). Victoria University of Wellington, New Zealand.

Goldstein, N. J., Griskevicius, V., & Cialdini, R. B. (2007). Invoking social norms: A social psychology perspective on improving hotels' linen-re-use programs. *Cornell Hotel and Restaurant Administration Quarterly, 48*(2), 145-150. doi: 10.1177/0010880407299542

Greening, L., & Dollinger, S. J. (1992). Illusions (and shattered illusions) of invulnerability: Adolescents in natural disaster. *Journal of Traumatic Stress, 5*, 63-75. doi: 10.1007/BF00976811

Gulliver, A. (2015, May 10). Major changes to earthquake strengthening rules. *Stuff.* Retrieved from www.stuff.co.nz/

Heller, K., Alexander, D. B., Gatz, M., Knight, B. G., & Rose, T. (2005). Social and personal factors as predictors of earthquake preparation: The role of support provision, network discussion, negative affect, age, and education. *Journal of Applied Social Psychology, 35*(2), 399-422. doi: 10.1111/j.1559-1816.2005.tb02127

Johnston, D., Tarrant, R., Tipler, K., Coomer, M., Pedersen, S., & Garside, R. (2011). Preparing schools for future earthquakes in New Zealand: Lessons from an evaluation of a Wellington school exercise. *Australian Journal of Emergency Management, 26*, 24-30.

Kung, Y., & Chen, S. (2012). Perception of earthquake risk in Taiwan: Effects of gender and past earthquake experience. *Risk Analysis, 32*(9), 1535-1546. doi: 10.1111/j.1539-6924.2011.01760.x

Langridge, R., Leonard, G., van Dissen, R., & Wright, K. (2012). Let's talk about earthquakes: Wellington edition [PDF file]. Retrieved from http://wellington.govt.nz/~/media/services/rates-and-property/earthquake-prone-buildings/files/eq-letstalk.pdf

Larsson, G., & Enander, A. (1997). Preparing for disaster: Public attitudes and actions. *Disaster Prevention and Management, 6*, 11-21. doi: doi: 10.1108/09653569710162415

Lindell, M. K., & Perry, R. W. (2000). Household adjustment to earthquake hazard: A review of research. *Environment and Behavior, 32*(4), 461-501. doi: 10.1177/00139160021972621

McClure, J., Allen, M. W., & Walkey, F. H. (2001). Countering fatalism: Causal information in news reports affects judgements about earthquake damage. *Basic and Applied Social Psychology, 23*, 109-121. doi: 10.1207/S15324834BASP2302_3

McClure, J., Henrich, L., Johnston, D., & Doyle, E. (2016). Are two earthquakes better than one? How earthquakes in two different regions affect risk judgments and preparation in three locations. *International Journal of Disaster Risk Reduction, 16,* 192-199. doi: 10.1016/j.ijdrr.2016.03.003

McClure, J., & Hilton, D. (1998). Are goals or preconditions better explanations: It depends on the question. *European Journal of Social Psychology, 28*, 897-911. doi: 10.1002/(SICI)1099-0992(1998110)28:6<897:AID-EJSP902>3.0.CO;2-P

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 and Trauma Studies, 2011*(2), 3-10.

McCrae, C., McClure, J., Henrich, L., Leah, C., & Charleson, A. (2017). Reactions to earthquake hazard: Strengthening commercial buildings and voluntary earthquake safety checks on houses in Wellington, New Zealand. *International*

Journal of Disaster Risk Reduction, 28, 465-474. doi: 10.1016/j.ijdrr.2017.12.007

McIvor, D., & Paton, D. (2007). Preparing for natural hazards: Normative and attitudinal influences. *Disaster Prevention and Management, 16*, 79-88. doi: 10.1108/09653560710729839

Miceli, R., Sotgiu, I., & Settanni, M. (2008). Disaster preparedness and perception of flood risk: A study in an alpine valley in Italy. *Journal of Environmental Psychology, 28*, 164-173. doi: 10.1016/j.jenvp.2007.10.006

Mileti, D., & Darlington, J. (1997). The role of searching in shaping reactions to earthquake risk information. *Social Problems, 44*, 89-103. doi: 10.2307/3096875

Morrison, D., Lawrence, C., & Oehmen, R. (2014). *Community level influence on individual behaviours*. Melbourne, Australia: Bushfire and Natural Hazards CRC.

Mulilis, J-P., Duval, S. T., & Lippa, R. (1990). The effects of a large destructive local earthquake on earthquake preparedness as assessed by an earthquake preparedness scale. *Natural Hazards, 3*(4), 357-371. doi: 10.1007/BF00124393

Paton, D. (2003). Disaster preparedness: A social-cognitive perspective. *Disaster Prevention and Management, 12*(3), 210-216. doi: 10.1108/09653560310480686

Paton, D. (2018). Disaster risk reduction: Psychological perspective on preparedness. *Australian Journal of Psychology*, *71*, 1-15. doi: 10.1111/ajpy.12237.

Paton, D., Smith, L., & Johnston, D. (2000). Volcanic hazards: Risk perception and preparedness. *New Zealand Journal of Psychology, 29*(2), 86-91.

Reve. (2011). Nuclear's health risks on Chernobyl anniversary. Retrieved from www.evwind.es/2011/05/03/nuclear%C2%92s-health-risks-on-chernobyl-anniversary/11411

Russell, L. A., Goltz, J. D., & Bourque, L. B. (1995). Preparedness and hazard mitigation actions before and after two earthquakes. *Environment and Behavior, 27*(6), 744-770. doi: 10.1177/0013916595276002

Rustemli, A., & Karanci, A. N. (1999). Correlates of earthquake cognitions and preparedness behavior in victimized population. *The Journal of Social Psychology, 139*, 91-101. doi: 10.1080/00224549909598364

Sattler, D., Kaiser, C. F., & Hittner, J. B. (2000). Disaster preparedness: Relationships among prior experience, personal characteristics and distress. *Journal of Applied Social Psychology, 30*(7), 1396-1420. doi: 10.1111/j.1559-1816.2000.tb02527.x

Schwartz, N. (1999). Self-reports: How the questions shape the answers. *American Psychologist, 54*(2), 93-105. doi: 10.1037/003-066x.54.2.93

Slovic, P. (1987). Perception of risk. *Science, 236,* 280-285. doi: 10.1126/science.3563507

Slovic, P., & Weber, E. U. (2002). Perception of risk posed by extreme events [PDF file]. Retrieved from www.ldeo.columbia.edu/chrr/documents/meetings/roundtable/white_papers/slovic_wp.pdf

Solberg, C. Rossetto, T., & Joffe, H. (2010). The social psychology of seismic hazard adjustment: Re-evaluating the international literature. *Natural Hazards and Earth System Science, 10*(8), 1663-1677. doi: 10.5194/nhess-10-1663-2010

Sorensen, J., & Sorensen, B. V. (2007). Community processes: Warning and evacuation. In H. Rodriguez, E. Quarantelli, & R. Dynes (Eds.), *Handbook of disaster research* (pp. 183-199). New York, NY: Springer.

Spittal, M. J., McClure, J., Siegert, R. J., & Walkey, F. H. (2008). Predictors of two types of earthquake preparation: Survival actions and mitigation actions. *Environment and Behavior, 40*(6), 798-817. doi: 10.1177/0013916507309864

Thompson, R., Garfin, D., & Silver, C. (2016). Evacuation from natural disasters: A systematic review of the literature. *Risk Analysis, 37*(4)*,* 1-28. doi: 10.1111/risa.12654

Vinnell, L. J., Milfont, T., & McClure, J. (2018). Do social norms affect support for earthquake-strengthening legislation? Comparing the effects of descriptive and injunctive norms. *Environment and Behavior, 51*(4), 376-400. doi: 10.1177/0013916517752435

Weinstein, N. (1980). Unrealistic optimism about future life events. *Journal of Personality and Social Psychology, 39*(5), 806-820. doi: 10.1037/0022-3514.39.5.806

Weinstein, N. D., Lyon, J. E., Rothman, A. J., & Cuite, C. L. (2000a). Changes in perceived vulnerability following natural disaster. *Journal of Social and Clinical Psychology*, *19*, 372-395. doi: 10.1521/jscp.2000.19.3.372

Weinstein, N., Lyon, J. E., Rothman, A.J., & Cuite, C.L. (2000b). Preoccupation and affect as predictors of protective action following natural disaster. *British Journal of Health Psychology, 5*, 351-363. doi: 10.1348/135910700168973

Appendix

Questionnaire

Q1 Before the November 2016 Kaikoura earthquake, how likely did you think it was there would be a big earthquake in or near Wellington?

Q2 Since this earthquake, how likely do you rate a future big earthquake near Wellington?

Q3 Before this earthquake, how likely did you think it was that there would be a big earthquake on the west coast of the South Island (e.g. Kaikoura)?

Q4 Since this earthquake, how likely do you rate a future big earthquake on the west coast of the South Island (e.g. Kaikoura)?

Q5 Before this earthquake, how likely did you think it was that there would be a serious earthquake in another part of New Zealand?

Q6 Since this earthquake, how likely do you rate a future big earthquake in another part of New Zealand?

Q7 Has the risk of an earthquake become more real and plausible to you since this earthquake?

Q8 Has the combined occurrence of the earthquakes in Canterbury in 2010-2011, Cook Strait (2013) and Kaikoura (2016) increased your feeling that this is an important risk for you or your region?

Q9 Before the Kaikoura earthquake, had you made any preparations specifically for an earthquake?

If 'Yes', Q10 Please list these preparations below: [tick those that apply [see method]

Q11 Since this earthquake, have you made any preparations specifically for an earthquake?

If Yes, Q12 Please list these preparations below: [tick those that apply [see method]

Q13 Do you think that strengthening earthquake-prone buildings reduces the harm and loss that results from a really big earthquake?

Q14 There are 5,500 public buildings subject to the legislation on earthquake prone buildings in Wellington. These buildings have all been inspected to see if they are earthquake-prone. How many of the 5500 would you guess are earthquake prone?

Q15 How many of these earthquake prone buildings would you guess are taken off the earthquake-prone list each year due to being strengthened, demolished, or re-assessed?

Q16 What percentage of people in Wellington do you think have taken steps to prepare for earthquakes?

Q17 Most of my friends, family, co-workers and neighbours have taken some survival action/s (e.g. acquiring emergency supplies such as food, water and a radio) to prepare for the aftermath of a large earthquake in the future:

Q18 Most of my friends, family, co-workers and neighbours have taken some mitigation action/s (e.g. removing their chimneys or getting an earthquake check of their home) to limit the damage their home might incur in the event of a large future earthquake:

Q19 Most of my friends, family, co-workers and neighbours think that it is important to prepare for potential future earthquakes:

Q20 Most of my friends, family, co-workers and neighbours would view me favourably if I prepared for a potential future earthquake:

Q21 The above four questions asked about your friends, family, co-workers and neighbours; please rank these groups according to how important they are to you. Rank the most important group as number 1, and the least important group as number 4.

Q22 Did you incur damage in the earthquake?

Q23 Any other comments you would like to make (about earthquakes or the Kaikoura earthquake). (Optional)

Q24-27. Gender, Age, No. of dependent children in your household, Suburb