

**Risk and Resilience Factors Reported by a New Zealand Tertiary Student
Population After the 4th September 2010 Darfield Earthquake**

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An online survey of 3,571 University of Canterbury tertiary students was undertaken four to six weeks after the M_w 7.1 Darfield (Canterbury) earthquake impacted Christchurch, New Zealand. The aim was to identify factors indicating increased psychological risk after the event, and so gauge the well-being of the student population, while gathering feedback on the University's post-earthquake communication strategy. The majority of students reported diminished stress during aftershocks since the event, and 93% reported 'feeling OK again' at the time of survey completion. More than 95% reported being satisfied or very satisfied with the University's communication strategy, and would recommend the University to other students. Students also reported concern about the potential impact of the earthquake on their academic performance. Heightened risk was associated largely with aspects of impact exposure. Established risk factors, such as damage to residences, were confirmed in these findings. Short absences from the city after the event were also associated with increased risk. Identifying significant risk factors, and indicating the importance of rapid and regular post-disaster communication,

these findings are particularly relevant for those involved in tertiary institutional planning for future disaster events.

Keywords: Tertiary students, Earthquake resilience, Disaster risk.

Introduction

The use of surveys to assess student populations after disasters is a recommended post-crisis recovery strategy for education institutions, gathering information for the purposes of response, and to improve planning ‘for the next crisis’ (US Department of Education 2007). Post-event investigations of this kind are also actively fostered in New Zealand by the Ministry of Civil Defence and Emergency Management (MCDEM) (Smith 2009) as part of its mandate to develop the resilience of New Zealand society (CDEM Act 2004; McManus et al. 2007). Student populations are an important group to consider as they constitute a large number of mostly young, single individuals many of whom have relocated specifically for the purpose of study. However empirical studies of disaster impacts on aspects of personal and academic functionality in tertiary student bodies are largely concerned with US tertiary student populations after hurricanes (e.g., Anderson and Manuel 2004; Gill et al. 2007; Gutierrez et al. 2005; Helweg-Larson 1999; Lemieux et al. 2010; Mulilis and Duval 1993; Phillips and Herlihy 2009; Pickens et al. 1995; Plummer et al. 2008; Sloan Consortium 2012; Van Willigen et al. 2005, Watson et al. 2011).

In this paper we report the results of an online survey of 3,571 University of Canterbury tertiary students undertaken four to six weeks after the 4th September 2010 M_w 7.1 Darfield (Canterbury) earthquake in Christchurch, New Zealand. The survey was developed collaboratively between University of Canterbury researchers and staff from service units involved in the University's emergency response after the earthquake. This collaborative approach, like the research method and survey design, is informed by a contemporary (New Zealand) hazard management emphasis on communication, participation, and collaboration as greatly increasing ‘resilience’—defined as the ability of individuals, organizations and communities to maintain or return to their core functions after a disruptive crisis or disaster (e.g., Helm 2009; McManus et al.; 2007). The engagement of and flow of information up from the ‘ground’ level of organizations, communities and government and emergency management structures has also been found to increase resilience (see, e.g., Daly et al. 2009; McManus et al. 2007; Mamula-Seadon 2009; Seville 2009; Van de Walle and Turoff 2008). Note that the concept of resilience is applied in an analogous way in the psychological post-disaster context, where it is used to refer to the ability of individuals to return swiftly to a ‘stable trajectory of healthy

[mental] function' after the psychologically disruptive effects of disasters (Bonnano et al. 2010).

In addition to engaging the student body in a review of the performance of the university, in regards to communications, after the earthquake, the aim was to gain a broad indication of this population's wellbeing at this point in time by gathering data concerning psychological factors consistently associated with increased risk and resilience after a range of disaster types. It has been established, for example, that the extent of impact exposure (including exposure to danger and injury, and accommodation damage) is linked to increased psychological risk in both tertiary student and general populations (Bonnano et al. 2010; Goenjian et al. 2001; Norris et al. 2002). Conversely, perceptions of self-efficacy and of self-control have been associated with a range of positive recovery outcomes (Bonnano et al. 2005; 2010; Brosz Hardin et al. 1994; Karanci et al. 1999; Murphy 1988; Norris et al. 1999; Sumer et al. 2005), as have perceptions of support from authorities (including the timely provision of accurate information [Kaniasty and Norris 2009]). In addition to gauging the extent to which these established risk and resilience factors were reported by this student population, the survey also aimed to gather new evidence concerning other factors, including cultural or ethnic difference, identification with impacted regions or being 'local', volunteering involvement in the response, and short absences from the impacted region after the event.

4 September 2010 Darfield Earthquake

On Saturday, 4 September 2010 at 4:34 am, a M_w 7.1 earthquake struck the Canterbury region in New Zealand's South Island. The epicentre of the Darfield earthquake was located 40 km west of Christchurch (New Zealand's second largest city, population 372,600 in June 2009)—see Figure 1.

The faulting produced a surface rupture of ~29 km. Strong shaking between 0.1-0.6 times the force of gravity (G) led to some structural damage to city buildings with isolated partial building collapses, significant non-structural damage and - in the city's central and eastern suburbs - extensive liquefaction and lateral spreading close to rivers and streams. The timing of the earthquake was likely to have contributed to relatively low rates of injury and absence of direct fatalities, as most people were at home in bed. Water, electricity and telecommunications were restored to much of the city within hours to days, although buried services, including water and sewerage, were disrupted for significantly longer periods in some eastern suburbs of the city (Giovinazzi et al. 2011).

At the time, 15,830 students were enrolled in assessable courses at the University of Canterbury, one of the nation's largest tertiary institutions. In the early morning, on the last weekend of the mid-semester break, the 84 hectare Christchurch campus was almost completely deserted. The university suffered major non-structural and minor to moderate structural damage in the earthquake. The University Emergency Operations Centre self-

activated immediately, and a considered, ongoing communication process with the student body began with the first (daily) email communication at 1pm on the day of the event. By the end of the second day, a Facebook page had been set up, which had gained 5370 ‘likes’ two weeks later (Seville et al. 2011). The website was updated several times a day. Care was taken to ensure that Facebook, Twitter and daily email communications with students were always consistent with the latest website update. The emphasis was on open, transparent transmission of information, and empathetic communications, with attention given to the way the student (and other campus) audiences might receive information (Seville et al. 2011).

Figure 1. Map of Greater Christchurch



Note: The red star marks the epicenter of the Darfield earthquake. The blue circle marks the University of Canterbury campus.

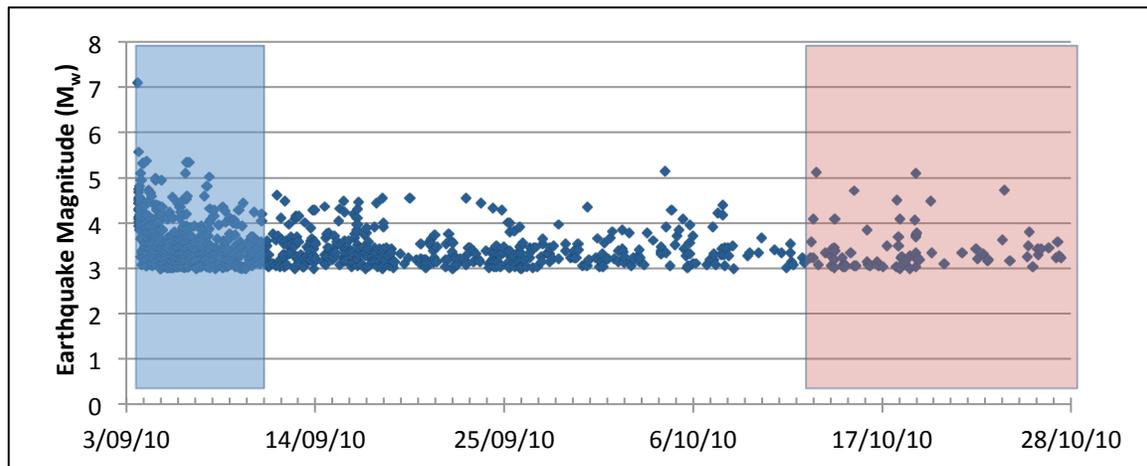
Occurring as Term 4 of the academic year was due to begin, the earthquake was followed by significant aftershock activity. The number of aftershocks of M_w 3.0 or higher decreased from hundreds per day to several each day during the two weeks in which the surveys were completed, as shown in Figure 2. The online survey data were collected from four to six weeks after the main event, and included questions that referred back over the intervening period.

It is important to note that this survey was closed several months **before** the M_w 6.2 aftershock on 22 February 2011, which led to widespread and severe damage in Christchurch, including injury and loss of life.

Research Literature

Over the last twenty years, international research based on survey data after earthquakes and other disasters has tended to focus on aspects of disaster impact on general—rather than tertiary student—populations. Much of this work examines levels of preparedness, panic, and other immediate post-event responses (e.g., Bourque et al. 1993; Quarantelli 1993), aspects of post-disaster volunteerism (e.g., Dynes et al. 1990; Mileti and O’Brien 1993; St. John and Fuchs 2002), and communication after disasters (e.g., Simola 1993). Perhaps the largest body of relevant research has been focussed on the physical and psycho-social effects that major disasters have had on populations (see for example Bonnano et al. 2005; 2007; 2010; Dirkzwager et al. 2006; Ginexi et al. 2000; Norris et al. 2002).

Figure 2: Frequency and Magnitude of Earthquakes



Note1: (aftershocks) > M_w 3.0 to 28 October 2010 following the 4 September 2010 M_w 7.1 earthquake in the Christchurch and central Canterbury region (Source: GeoNet, 2011).

Note 2: The blue section denotes the week after the earthquake, and the pink section the period of survey completion.

Risk Factors After Disasters

Tertiary student population studies in this area are largely concerned with the effects of hurricanes, rather than earthquakes. It should be noted that hurricanes and earthquakes impact and unfold in quite different ways. Hurricane landfalls are typically predicted to at least some degree, and unfold for one to several days—often requiring evacuation before,

during, or immediately after the event; after this, however, the risk of further damage is minimal. Earthquakes are not predicted, and the majority of destructive impact usually occurs during the initiating event, lasting from seconds to minutes; aftershock sequences, however, can continue for months and even years, with a degree of ongoing risk of damage and injury.

Despite these differences in impact, however, certain psychosocial impact trends have been found to apply after a range of different disaster types (including hurricanes and earthquakes) in both general and tertiary student populations (Bonnano et al. 2010). Only a few studies involving tertiary students have used online surveys (Gill et al. 2007; Lu and Yang 2011; Sloan Consortium 2012). The largest of these is the Gill et al. (2007) comparison of psychological and other disaster impact factors among 3,410 Mississippi State University (MSU) students with those reported by 7,100 students from three New Orleans universities (3,410) three months after Hurricane Katrina. Although MSU students experienced significant disruption as a result of the hurricane, few were forced to evacuate, and the main campus was only closed for two days. By contrast, the population of New Orleans was forced to evacuate, and most of the New Orleans university campuses were closed for the rest of the semester. Gill et al. (2007) found that the New Orleans students reported levels of depressive symptoms and loss of confidence three times higher than those reported by MSU students; the New Orleans students also reported significantly higher stress and anxiety levels (Gill et al. 2007).

The linking of *direct disaster exposure* with higher stress levels and lower functionality among tertiary students in this study is consistent with the much wider range of studies showing a strong correlation between both the extent of exposure to disaster impact (including accommodation damage, casualties, evacuation, and sense of personal danger), and higher levels of stress, with poorer recovery outcomes (Bonnano et al. 2010; Goenjian et al. 2001; Norris et al. 2002). A number of other tertiary student population survey studies carried out after hurricanes have arrived at similar findings, whether the surveys were mailed, or administered in class or over the phone (Gutierrez et al. 2005; Lemieux et al. 2010; Norris et al. 1999; Pickens et al. 1995; Watson et al. 2011). In surveys conducted with a range of tertiary student population samples after the Northridge earthquake, Helweg-Larsen (1999) found that post disaster stress clearly decreased over time. This decrease was not, however, associated with an increase in optimism about risk from future earthquakes.

Most of the tertiary student studies are based on data gathered, like that in the UC survey, after the event, so they lack comparative data concerning stress levels and perceptions of functionality before the event. Research that has included pre- and post-event data from the same subjects has, however, confirmed that populations recently impacted by disasters report stress, anxiety, depression and related health problems at rates higher than both similar pre-event populations, and those in less impacted areas (Bonnano et al. 2010; Dirkzwager et al. 2006; Ginexi et al. 2000). Disaster exposure has

been linked to serious longer term psychological harm, however, in only a small minority of exposed individuals (Bonnano et al. 2010; Norris et al. 2002).

In other areas, there is less agreement. The effect of displacement in itself, for example, remains contested. Gill et al. (2007) identified evacuation as one of the stressors contributing to higher stress levels reported by New Orleans students after Hurricane Katrina, and Mawson (2007) has argued that separation from familiar people and surroundings during and after disasters can be more stressful, and have more destructive consequences, than physical danger. However Watson et al. (2011) found that direct disaster exposure correlated with higher stress levels even when student populations were not displaced by Hurricane Ike, and Bonnano et al. (2010) report that the small number of studies that have separated out the effects of other risk factors have found that displacement *in itself* has no significant negative psychological consequences.

Similarly, there is some disagreement over the extent to which different cultural backgrounds affect recovery outcomes. Van Willigan et al. (2005) found that cultural difference was a factor in recovery outcomes among the general population surveyed a year after Hurricane Floyd, but that it did not factor into recovery outcomes for tertiary students surveyed six weeks after the event. Again, drawing on several studies, Bonnano et al. (2010) found that the effect of cultural difference is often confounded with other socio-cultural factors, including income and social status, noting that work accounting for these factors identified no significant differences in recovery outcomes between individuals from different cultural backgrounds.

There is much more agreement when it comes to sex difference. Research in tertiary student populations tends to indicate that women students report higher stress levels after hurricanes (Gutierrez et al. 2005) and immediately after earthquakes (Anderson and Manuel 2004). Likewise, the consensus emerging from research carried out after a range of disasters, in different parts of the world, has found that women tend to report higher levels of stress and depressive symptoms after disasters than do men (Bonnano et al. 2010; Goenjian et al. 2001; 2005; Karanci et al. 1999; Norris et al. 2002). It has been argued that a significant contributing factor in this variance concerns a difference in subjective exposure to the event. Anderson and Manuel (2004) found that female tertiary students assessed within 24 hours of the Loma Prieta earthquake reported higher stress levels, and also attributed a longer duration to the earthquake than male students, whose estimates were closer to the actual duration. Identifying a similar difference in subjective exposure between boys and girls among Guatemalan adolescents in the aftermath of Hurricane Floyd, Goenjian et al (2001) found that girls were much more likely to attribute high levels of threat to the event than were boys. When adjusted for this, the difference between male and female posttraumatic stress levels disappeared (Goenjian et al. 2001; Bonnano et al. 2010), indicating that the difference in subjective exposure may be a factor in the gender difference in these reported stress levels. Similarly, in a study of gender differences in coping strategies and psychological distress after the 1995 Dinar

Earthquake in Turkey, Karanci et al. (1999) found that greater distress after the earthquake was related to the attribution of higher levels of threat to the event among women. In addition, they linked this distress with the fact that women were more likely to perceive that subsequent events were out of their control than men, who were more likely to use problem-solving coping strategies and other forms of perceived self-control (Karanci et al. 1999).

Resilience Factors After Disasters

Karanci et al. (1999)'s findings contribute to a wider body of work that has linked perceptions of self-efficacy to a range of positive recovery outcomes after disasters (e.g., Bonnano et al. 2005; 2010; Brosz Hardin et al. 1994; Karanci et al. 1999; Murphy 1988; Norris et al. 1999; Sumer et al. 2005; Kessler et al. 2006 cited in Bonnano et al. 2010).

The perception of social support, including that provided by authorities, has also been found to correlate positively with psychological resilience in tertiary student populations after disasters (Beggan 2011; Gill et al. 2007; Pickens et al. 1995; Van Willigen et al. 2005). Again, this is consistent with a wider body of literature that has identified the extent of *perceived* support, or the subjective experience of being socially supported, as an important indicator of resilience and coping after disasters (Bonnano et al. 2005; La Greca et al. 1996; Kaniasty and Norris 1990; La Greca et al. 1996; Norris and Kaniasty 1996). Longitudinal studies indicate that, over time, support that is actually received by individuals and communities after disasters only contributes to increased resilience when it creates the *perception* of social support (Norris and Kaniasty 1996; Kaniasty and Norris 1990). In fact, perceived support has been found more consistently to be predictive of lower stress levels, better adjustment, and better recovery outcomes than the social support that is actually received (Norris and Kaniasty 1996; Kaniasty and Norris 1990).

The perception that authorities have provided accurate and timely information after disasters is of particular relevance in this context (Kaniasty and Norris 2009). While this is not the focus of US studies after hurricanes, several do provide evidence of a link between lower stress levels and the extent to which tertiary students perceive that their home university has provided appropriate information and other forms of support after hurricanes (Beggan 2011; Gill et al. 2007; Gutierrez et al. 2005; Pickens et al. 1995; Van Willigen et al. 2005; Watson et al. 2011).

Variance Between Populations

Some research, however, underlines the extent to which student populations—as large, diverse temporary communities brought together from both within and beyond the locale of the institution for the purpose of learning—may experience the impact of a disaster differently from a more general population. Surveying student and non-student

populations after the Loma Prieta earthquake, for example, Mulilis and Duval (1993) found that these students were not as well prepared for disaster as non-students.

The largest difference between tertiary student and more general populations was reported by Van Willigan et al (2005), who surveyed 852 East Carolina University college student households and 309 non-student households after the impact of Hurricane Floyd. Gathering self-reported indicators including forced relocation and property damage, they found that student populations surveyed in the month after the hurricane were less inclined than non-student households (surveyed one year later)¹ to manifest sex, income and cultural bias in impact (Van Willigen et al. 2005). In addition, noting the high levels of support from both university and federal authorities reported by these students, they suggested that these and other factors specific to this tertiary population may have caused it to have been ‘buffered’ from the impacts of Hurricane Floyd relative to other residents, even those of the same age, income bracket, and cultural background. Van Willigen et al. (2005)’s findings indicate that tertiary student populations cannot be understood to be simply representative of a larger, general population.

Moreover, other studies have underlined the extent to which the US tertiary student populations that feature in most of this research may differ significantly from those in other countries. In a Japanese transnational comparison of university student populations after the Northridge and Hanshin (Kobe) earthquakes, for example, Ikeuchi et al. (1999) found that students impacted by the Northridge earthquake were not as severely personally affected by the loss of personal property as those surveyed in Kobe, even when difference in disaster exposure and the scale of each event is taken into account. Ikeuchi et al (1999) suggested that this may be due to different Japanese and American understandings of the relation of self to property.

So while findings from general and tertiary student populations are often broadly consistent, caution should be taken in attempts to generalise the findings of the present survey more widely. The University of Canterbury student population is likely to have experienced the impact of the Darfield earthquake differently from both that of the broader Christchurch population and also from comparably impacted tertiary student populations in other countries—whether due to cultural factors, the differing demographics characterising such populations, regulations governing tertiary enrolments, or other aspects of this particular local New Zealand context.

New Zealand Context

Most New Zealand disaster population surveys to date have been focussed on assessing disaster preparedness (e.g., Becker and Johnston 2012; Becker 2010; Leonard et al. 2004; Paton et al. 2008), and other aspects of community resilience (e.g., Daly et al. 2009; Paton 2006). A lack of major events in urban areas before the Darfield earthquake provided limited opportunities to research the impact of disasters in New Zealand.

There have been several relevant recent studies researching the effects of the Darfield earthquake on populations. Lindell et al. (forthcoming) have found that information and emergency preparedness are related to adaptive actions. Several studies concerning tertiary student populations are focussed on the effect of psychosocial impacts on student performance. Kemp et al. (2011) for instance found that while surveyed University of Canterbury students reported stress, sleeplessness and academic disruption after the earthquake, 2010 grades were slightly better than those achieved in the same courses in 2009, the year before the earthquake (Kemp et al. 2011). By contrast, however, Wilkinson et al. (2013) found that Christchurch-based University of Otago students impacted by the Darfield earthquake did not perform as well that year as those based in Dunedin (the second largest city in NZ's South Island, 364 kms from Christchurch), or those impacted by the subsequent and much more disruptive Christchurch earthquake in February 2011. They suggest that this may be either because the Darfield earthquake occurred mid-semester, or because those studying after the February event overcompensated for the drop in results after the earlier event (Wilkinson et al. 2013). The Helton et al. (2011) study of earthquake-related cognitive disruption in 17 University of Canterbury students after the Darfield earthquake suggested that earthquake impacts can lead to impaired cognitive function. They found that in *Sustained Attention to Response Tasks* (SART; Robertson et al. 1997), students reporting cognitive disruption made more errors, even when the SART data was corrected for sex, stress, and anxiety. Suggesting this may be the result of the greater cognitive load associated with coping in the aftermath of an earthquake, Helton et al. (2011) may have identified part of the mechanism causing those exposed to higher levels of disaster impact to be at higher psychological risk. Their findings supported the value of self-reported perceptions of personal functionality, and also showed no sex difference in performance.

The present survey was administered to the same student population as the Kemp et al. (2011) and Helton et al. (2011) participants were recruited from, and also addressed student reactions to the Darfield earthquake. There were two broad objectives. Firstly, to establish a broad indication of the resilience of this population in relation to the extent of exposure to accommodation damage, an established risk factor, and to perceptions of self-efficacy, and of self-control, and of support from authorities (including the timely provision of accurate information), which have been linked to positive recovery outcomes. The second objective was to gather evidence concerning less well established psychological correlates of factors including cultural or ethnic difference, identification with impacted regions or being 'local', volunteering involvement in the response, and short absences from the impacted region after the event.

Method

Participants

As shown in Table 1, there were 3571 completed surveys received. Comparing the respondent demographics to that of the total student population from which they were recruited indicates the sample amounted to 22% of the total student body on the date of the Darfield earthquake, and was a good representation of it in terms of sex, ethnicity and level of study. Regarding international students, the phrase “home country” was intended to elicit students’ national identifications, rather than their legal citizenship status. It is likely that many permanent residents responded to this question by nominating their country of origin, rather than New Zealand, in this context.

Table 1. Demographic Characteristics of the Survey Sample Compared With That of the Enrolled Population on the 4th September 2010, the Date of the Darfield Earthquake

Demographic Characteristics	Survey Sample (<i>n</i> = 3571) (22% of enrolled population)	Enrolled Population (<i>n</i> = 15,370)
Male	44% (<i>n</i> = 1571)	46% (<i>n</i> = 7,070)
Female	56% (<i>n</i> = 2000)	54% (<i>n</i> = 8,300)
New Zealand	80% (<i>n</i> = 2877) ‘home country’	78% (<i>n</i> = 12,499) NZ citizens
International	20% ‘home country’ other than NZ. The three largest national cohorts (in decreasing order of size) were China, Malaysia, and the United States.	10% International enrolments 12% NZ Permanent Residents The three largest national cohorts (in decreasing order of size) were China, Malaysia, and the United States.
Undergraduate programs	79% (<i>n</i> = 2,794)	81% (<i>n</i> = 12,959)
Masters or PhD programs	16% (<i>n</i> = 536)	15% (<i>n</i> = 2,2358)

Just over half (42% [*n* = 1,190]) of the 80% who identified New Zealand as their home country named (wider) Christchurch as their hometown; an additional 8% [*n* = 500] named other local Canterbury regions. This underlines the extent to which this university population reflects a wider range of the local population than those on most Western campuses, as a result of the Education Act (1989). Stipulating that New Zealand universities must accept all domestic applicants who either meet relevant academic qualifications, or are 20 years of age or older (regardless of academic qualifications), this legislation has also led to the University’s comparatively high undergraduate to postgraduate ratio.

Materials: Survey Development

Developed collaboratively between UC researchers and service unit staff, the survey was designed to provide a snapshot of student perceptions—of the impact the earthquake had on their personal and academic functionality, of changes in this effect over 4-6 weeks since the event, and of the university communication strategy after the earthquake.

It should also be noted that this snapshot of student perceptions is specific to the time at which the survey was completed. While recall of past emotional states has been found to be generally reliable, it can be subject to systematic biases, often reflecting emotions at the time of the recall (Bonnano et al. 2010; Dirkzwager et al. 2006; Levine and Safer 2002). It follows that questions requiring students to assess changes over time should not be taken as accurate indications of earlier emotional states, or actual times taken to return to individual functionality, but rather indicate the extent to which students are aware of emotional changes since the earthquake. Note also that those who reported the shortened term and study week as academically disruptive were *anticipating* that this would be the case four to six weeks after the event. Again, the value of this data is as an indication of student perceptions of academic disruption at this point.

Questions were written in conversational language, asking for immediate, rather than contemplative answers. For example, the question concerning self-perceptions of individual functionality asked how long it took for a student ‘to feel OK again’. This phrase was chosen by students from different cultural and language backgrounds as a useful indication of baseline personal functionality, meaning ‘functional, but not necessarily great’ (as one student put it).

In total, the survey contained 43 multiple choice questions, with many offering the opportunity to provide qualitative comments as well², and three open-ended questions. In addition to demographic information (Q1-2), 4 broad themes were addressed—perceptions of safety, functionality and stress levels during aftershocks (Q12-13, 16 18-19, 35-37), study disruption (Q15-17, 32-34), student perceptions of the university communications strategy (Q21-29), and study environment (Q38-40), and impacts on individual and personal environments (Q3, 6-11, 14-15, 20, 30-31).

The two open-ended questions of most relevance invited further free text comments on the university response—‘What do you think the University did well after the earthquake?’ and ‘How do you think that University response to the earthquake could have been improved?’ (Q39)³. Responses to ‘What did you think the University did well’ were provided by 3022 respondents (87%) and 2147 (61%) responded to ‘How do you think the University response could have been improved?’ For each of these questions a number of broad categories of response were identified by the first author (SB) and each respondent’s comments were coded into one of these categories. There were three categories of areas in which the University was identified as having ‘done well’—the provision of information and communication; safety and wider university response. Two

additional categories of response were included for the question asking about improvements to the University response—academic adjustment and speed of access to campus. To ensure reliability in this coding, an independent coder who was blind to the purpose of the research was provided with the list of categories and coded a randomly selected sample of 100 responses to each question. There was agreement on 96 of the codings for the question about doing well, and on 92 of the codings for the question asking about improvements. Given this high level of agreement, the remainder of the comments and the reported results are based on the first author's coding. Details of the responses are provided in relevant parts of the results sections; a summary is provided below. For the question asking about what the University had done well, 74% of responses referred to aspects of the university's provision of information and communications, 6.5% to safety aspects and 20% to aspects of the wider university response. While the following question invited suggestions on improvements to the university response, the largest percentage (30%) of responses actually suggested that no improvements to the University response were required. Faster access back to campus or to University resources was the most common improvement identified (24% of responses), followed by improvements to course and assessment adjustments (20%), safety (7%), and communication (6%).

Note also that since no questions in the survey were mandatory, the total responses vary by question, according to the number who chose to answer them. (The survey question set is available on request from the corresponding author). A web based survey was selected as being the most efficient to distribute, socialise and analyse results. Qualtrix was used for the web based survey tool. In line with University policy, approval was obtained from the University of Canterbury Human Ethics Committee prior to the survey being administered.

Procedure

On 13 October 2010, an initial email was sent to all current enrolled students from the staff member responsible for student communications during the earthquake response, inviting them to contribute to research by participating in the survey. The survey was accessible via a link in the email, which was also on the University's 'recovery webpage' and its Facebook site. The use of an anonymous link, available on the web, means that there was a possibility that some of the respondents were not students. To minimize this possibility, the data cleaning process eliminated participants who did not respond to any of the questions (e.g., year of study, academic disruption, college) that could only be answered by students. The survey ran from 13-28 October, 2010.

Results

Earthquake Disruption: Personal and Academic

Personal Functionality

As a general gauge of the extent to which they felt they had returned to baseline personal functionality, respondents were asked to look back and self-assess how long it had taken them to ‘feel OK again’ after the earthquake on 4 September. Longer time intervals were needed by smaller percentages of respondents, with 45% recalling feeling OK within one day, and 73% within a week. Only 15% reported taking more than two weeks to ‘feel OK again’; these included the 7% who reported they were ‘still not OK’ at the time of survey completion.

The largest percentage (42%) of male respondents selected one hour, while the largest percentage of female respondents (18%) reported that it had taken one week to feel OK again. While the percentage of female responses tracks down through ‘two weeks, more than this, and still not OK’, it continues to exceed the percentage of male responses at this end of the spectrum. Where 21% of women reported either taking more than two weeks to feel OK, or still not feeling OK, only 8% of men reported this way.

Students were asked to recall the level of stress caused by aftershocks in the week after the earthquake (Q12), and compare that to ‘now’ (the time of survey completion). Results show that most students perceived a significant decrease in stress caused by aftershocks over the 4-6 weeks since the earthquake, going from almost 39% who report finding aftershocks stressful or very stressful in the first week after the earthquake to 12% at the time of survey completion.

Again, at the time of survey completion, men were less likely to report aftershock stress than women. Men were also less likely to report aftershock stress during the week after the earthquake, and slightly more likely to feel safe living in Christchurch after the earthquake than women. While 98% of respondents reported recalling feelings of safety living in Christchurch before the earthquake, 86% reported feeling safe in the city at the time of survey completion.

There are only slight (less than 5%) differences in responses to these questions by students according to reported home country. The only large non-domestic cohort, those identifying another home country, moreover, appears to track New Zealand responses closely when it comes to time taken to feeling OK again. Importantly, there is little variation in the percentage of each national group who report that they are ‘still not OK’ at the time of survey completion (with all at around 7%), or in the percentages of those still struggling with high levels of aftershock stress (3% of New Zealand respondents, compared with 5% of those of other national origin).

More than 95% of respondents from all groups recall feeling safe living in Christchurch before the earthquake. At the time of survey completion, however, these percentages have dropped. Again, those selecting New Zealand and the US as home countries are only slightly (less than 5%) more likely to report feeling safe living in Christchurch after the earthquake than other respondents.

Academic Disruption

It is important to note that when completing the survey, students were not in a position to comment realistically on earthquake-related disruption to their study going forward. Asked to estimate the effect of the earthquake on their study, only 8% ($n = 270$) reported that there had been no real change in their study as a result of the earthquake. By contrast, 46% ($n = 1,590$) estimated that there had been some effect on their study, with a further 31% ($n = 1,080$) estimating that the effect of the earthquake on their study had been significant. Asked to indicate any particular factors that had been disruptive in this context, 46% reported aftershock stress was impacting on their study, while more than 60% indicated that the library closure, proposed shorter study week, and shorter term were disruptive.

When asked to rank these factors from the most to the least important cause of disruption, participants ranked the shorter term length as being the most disruptive. This was closely followed by the shorter study week, with library closure ranked as the third most disruptive factor, and stress caused by aftershocks as fourth. Loss of laboratory access and earthquake-related problems at home came in as the least disruptive of these six listed factors at 5 and 6 respectively. There were no significant differences in these rankings as a function of either sex or home country.

The levels of participants selecting ‘stress caused by aftershocks’ as a disruptive study factor showed a greater variance by home country than the aftershock stress questions. This factor was slightly more likely to be selected by those respondents identifying Malaysia, China and ‘other’ as home countries, at 53%, 55% and 55%, compared with the survey average of 46%.

The 20% of free text responses to the question asking ‘How do you think the university response to the earthquake could have been improved?’ that referred to improvements in courses or assessment suggested a wide, and sometimes contradictory, range of improvements to the management of disrupted courses and assessments (including less/more coursework and/or assessments, the removal of examinations, and extending the term and/or pre-examination study week). These responses constituted the third largest category of responses to this question and so index the level of academic concerns at the time.

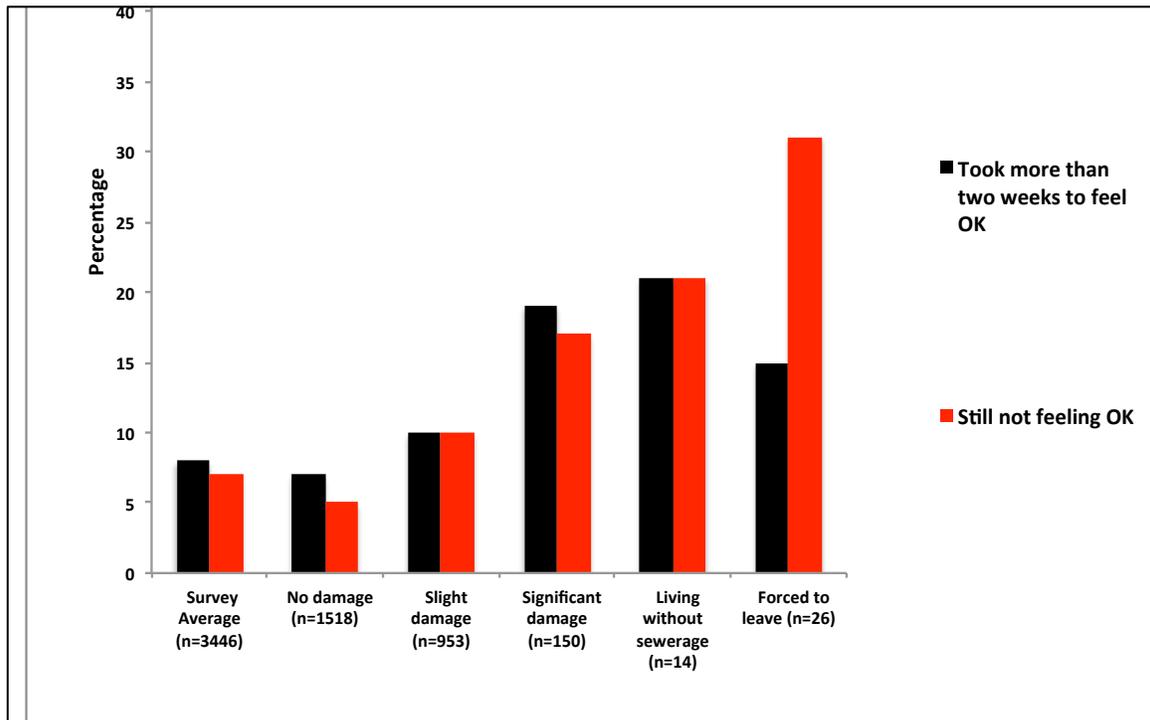
Impact of Individual Circumstances on Personal and Academic Functionality

Accommodation Damage

Nearly half (43.3%) of respondents indicated that the Darfield earthquake had caused some damage to their accommodation, while 7.1% ($n = 192$) had experienced significant accommodation damage. The comparatively small numbers of students reporting significant damage in the Canterbury survey reflects the location of the university—in the west of Christchurch where there was much less liquefaction, lateral spreading and structural property damage (see Figure 1). The vast majority of those reporting damage reported New Zealand as their home country; of the few non-New Zealand students reporting that they lived in a private flat or house, almost none reported damage.

There appears to be a relationship between the level of accommodation damage, and the time taken to feel OK again. A majority of those reporting no damage estimated that it took them a week or less to feel OK again, with the highest number of respondents choosing 1 hour, and percentages decreasing over time, as shown in Figure 3. Though consistently selecting longer times than those with no damage, those reporting slight damage also peak at one hour, with most reporting that they felt OK within one week. However those reporting significant damage, loss of sewerage and forced displacement are all more heavily represented in the last three categories, taking two weeks or more to feel OK.

Figure 3. Longest Times to Feeling OK Again

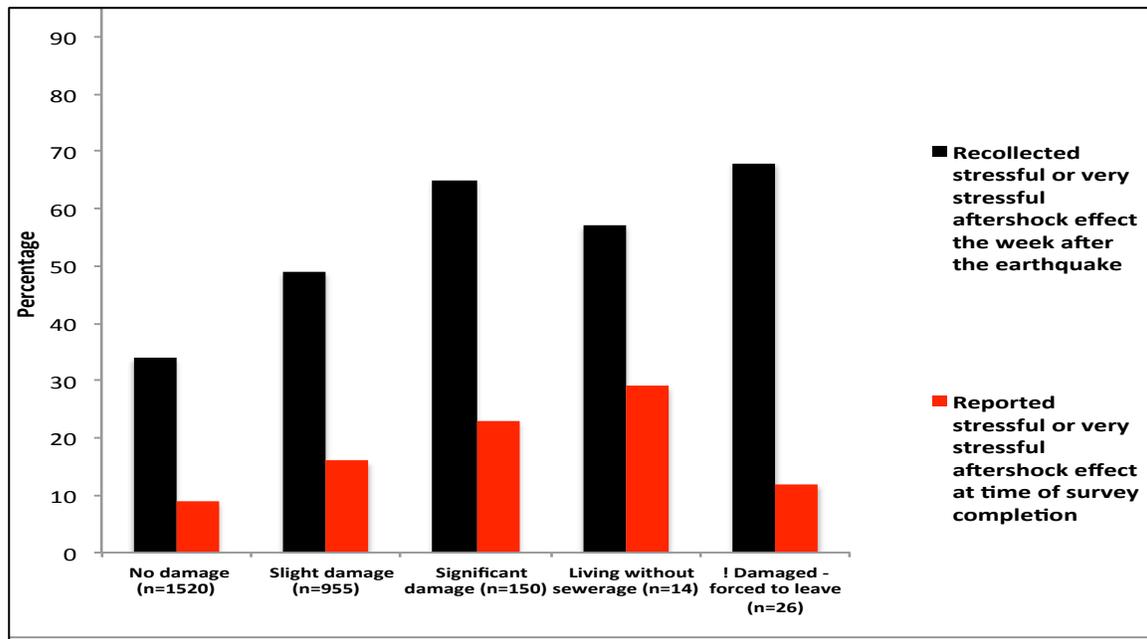


Note: % according to level of accommodation damage

A similar relationship is apparent when looking at responses regarding accommodation damage and questions concerning stress caused by aftershocks. Overall, 39% of the 3444 respondents remembered aftershocks in the first week after the earthquake as stressful or very stressful; at the time of survey completion, this percentage was 12% ($n = 410$) of the 3486 valid responses.

Of those reporting no accommodation damage, only 34% remembered being stressed or very stressed by aftershocks in the week after the earthquake, and only 9% reported high aftershock stress levels at the time of survey completion. By contrast, the percentage reporting high aftershock stress levels appears to increase with the level of accommodation damage, both in the week after the earthquake and at the time of survey completion, as shown in Figure 4.

Figure 4. Aftershock Stress Levels over Time



Note: % according to level of accommodation damage

The interesting exception is the group who reported being forced out of their accommodation by earthquake damage. While they remembered the highest level of aftershock stress the week after the earthquake, and were most likely to report that they are still not OK (see Figure 3), only 12% of this group reported high aftershock stress levels at the time of survey completion. This last percentage is consistent with the overall survey average, and below that of participants living with even slight accommodation damage. The same group are also much more likely to feel safe in Christchurch at the time of survey completion than are those reporting accommodation damage in other categories. Students reporting slight or significant accommodation damage were more

likely to report a significant effect on study (at 38% and 42%, respectively) than the survey average (31%).

When it comes to selecting ‘library closure’, ‘shorter term’, and ‘shorter study week’ as causes of study disruption, the percentage of those living without, or with only slight damage to accommodation are within two percentage points of the survey averages. However those reporting higher levels of accommodation damage select the shorter term and study week less often than those with less damage. As might be expected, these respondents are more likely to select ‘earthquake related problems where I live’, and ‘aftershock stress’, than the survey average, with these responses tracking up with the level of reported damage.

Leaving the City

A minority (14%; $n = 480$) of survey respondents left Christchurch to get away from the aftershocks. Of those who left 84% ($n = 410$) were from New Zealand (14.5% of New Zealand respondents overall). Of these, 31% ($n = 126$) identified Christchurch as their hometown, while 67% came from other parts of the country (a further 2% did not report a hometown). A further 1.6% ($n = 8$) of survey respondents who left Christchurch came from China, 1% ($n = 5$) from Malaysia, 2.6% ($n = 13$) from the US, and 7.6% ($n = 37$) from ‘other’ countries of origin. Of the respondents from Christchurch, 9% left the city, compared with 20% of all respondents naming other New Zealand hometowns. Slightly more women (16.5%) than men (10.3%) reported leaving the city in the week following the initial earthquake. Those who left Christchurch suffered similar levels of accommodation damage to those that did not, and in many other respects the two groups respond to most questions in similar percentages.

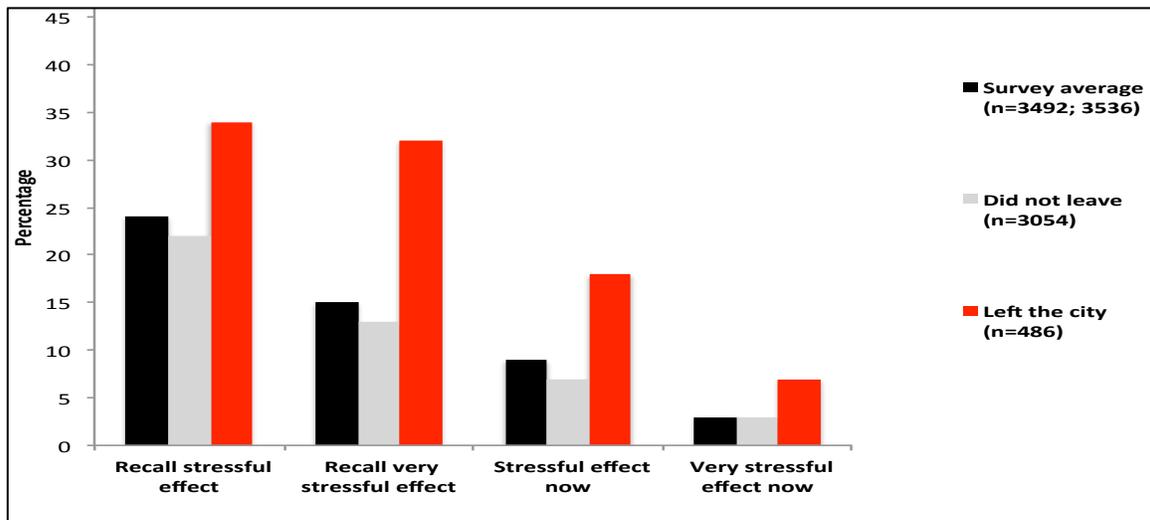
They responded differently, however, to questions around personal resilience. Only 76% ($n = 360$) of those who left the city now feel safe in Christchurch, compared with the 88% ($n = 2623$) of those who stayed in Christchurch (and the 87% survey average). This group were also more likely to report finding aftershocks stressful or very stressful at the time of survey completion, and when recollecting the week after the earthquake, as shown in Figure 5.

When looking back to self-assess how long it had taken before they felt OK again, this group were also more likely to report taking longer to feel OK, as shown in Figure 6. Moreover, when the time spent away for the city is considered, the percentages of respondents selecting ‘still not OK’ appear to trend up according to the length of time away. Only 15% of those ($n = 16$) away for 1-2 days or ($n = 39$) 3-7 days are still not OK, but 24% of those away for 1-2 weeks ($n = 21$) self-assess as ‘still not OK’.

Students who left the city were more likely to rate the effect of the earthquake on their study as significant, at 38%, compared with 30% ($n = 897$) of those who stayed, and 31% ($n = 1,078$) of overall respondents. The main factor in this study disruption appears

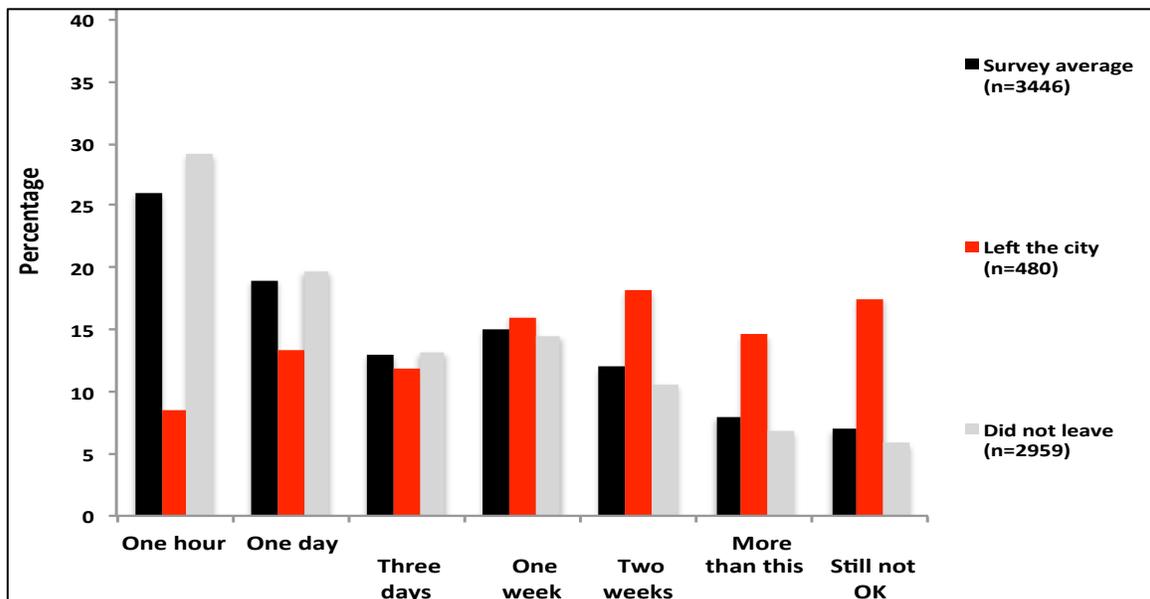
to be aftershock stress, since this is the only disruptive element in which there is a significant variation in the percentage of those that left from that of those that stayed. 70% ($n = 329$) of those that left the city select 'stress caused by aftershocks' as disruptive of study, compared with 43% ($n = 1234$) of those that stayed (and 46% [$n = 1,557$] in the wider survey).

Figure 5. Stressful or Very Stressful Aftershock Effect the Week after the Earthquake (‘Recalled’) and at the Time of Survey Completion (‘Now’)



Note: % according to whether participant left the city after the earthquake

Figure 6. Time Taken to Feel OK Again After the 4 September Earthquake



Note: % according to whether participants left the city after the event.

Earthquake Responses

Students were asked how they responded to the initial 4 September earthquake and chose from the following range of options: got down on the ground; got under a table, or desk; left the building; stayed in bed; stood in a doorway; I did not know what to do; other. The majority of 3,128 respondents stood in a doorway (39%) or stayed in bed (32%); text responses indicate that most of those (9%) that selected ‘other’ also stayed in bed during the initial shaking. Another 8% left the building, 4% did not know what to do, and 3% got down on the ground.

Most of these groups were consistent with the survey average when it came to reporting aftershock stress levels and time taken to feel OK again. The small number ($n = 118$) reporting that they did not know what to do, however, appeared to report much higher levels of aftershock stress at the time of survey completion (twice the survey average), and of time taken to return to functionality. Those ($n = 91$) who reported that they got down on the ground were also more likely to report this way, although these differences were not as pronounced. Thirty-six percent of those who ‘did not know what to do’ during the initial shaking reported that they did not feel safe living in Christchurch since the earthquake (compared with the survey average of 14%).

Volunteering

Twenty nine percent ($n = 1,008$) of the survey respondents reported that they had volunteered help during the weeks after the earthquake. Interestingly, the responses from students who volunteered and those who did not appear to be distributed in similar proportions in all of the survey questions. The only question featuring a slight (around 5%) difference between volunteers and non-volunteers concerns factors causing study disruption. Of those that did not volunteer after the earthquake, 68% ($n = 1,613$) rated library closure, 66% (1,564) rated the shorter term and 61% ($n = 1,449$) rated the shorter study week as disruptive of their study, all of which were 1% below the respective survey averages (69%, 67% and 62%). In contrast, 72% ($n = 714$) of volunteers found the library closure disruptive, 71% ($n = 705$) rated the shorter term disruptive and 65% ($n = 645$) selected the shorter study week. It is possible that at this point after the earthquake, these volunteers were particularly aware of having spent a large amount of time away from study, and so were slightly more likely to anticipate that the shorter term and study week would be disruptive of their study than those who did not volunteer.

Perceptions of the University Communication Strategy

Eighty-six percent of respondents reported that they had received information from the university within 48 hours of the event (i.e., by the end of the weekend), and 97%

reported that earthquake news and updates provided by the university were useful (49%) or very useful (48%). Ninety-six percent of respondents reported that they would recommend the university as a place to study. Moreover, these levels of satisfaction are only slightly lower among those reporting higher stress levels and longer times to feel OK again, with all above 90%.

The free text responses to the question asking what the University had done well also indicate high levels of satisfaction with the University's communication strategy, with 74% of responses specifying communication as the best thing about the University's response to the earthquake. Those that went into more detail appreciated the regularity with which the website was updated, the daily emails, and the fact that the information was always current. Only 6% of free text responses to the question asking what the University could have improved suggested response communication could have been improved, with most of these relating to the use of additional media including text messaging, and/or radio updates (as noted above, the largest category of text response to this question was that no improvements were necessary [31%]).

Discussion

Overall, the survey results tend to support the link that has been established elsewhere between satisfaction with the provision of information by authorities and improved psychological resilience. Levels of self-reported functionality (feeling 'OK again') are comparable with the proportions of respondents who reported being satisfied or very satisfied with the provision of information to students after the event, indicating that this was a resilient student population four to six weeks after the earthquake.

Unlike those in the tertiary student population surveyed by Van Willigan et al. (2005), male and female respondents in this UC population differ when it comes to aftershock related stress and feelings of functionality. Note again that the Helton et al. (2011) findings suggest that, in this population at least, these data may reflect a difference in reporting, rather than functionality.

The data concerning home country suggests that cultural and national differences did not contribute to significant differences in risk and resilience levels in this tertiary student population and that, at this point after the event, post-disaster stress and other risk indicators were not higher among local residents who identify with a damaged 'home' town, or whose communities and families may also be dealing with the impact of the earthquake. Neither were they higher among those who, coming from elsewhere, do not have the same local support networks. There are also no significant reporting differences between those who volunteered and those who did not.

As in other studies, those students in the present survey reporting higher levels of accommodation damage report higher aftershock-related stress levels, and longer times taken to return to a sense of functionality (Bonnano et al. 2010; Gill et al. 2007; Pickens

et al. 1999). The number of students reporting significant accommodation damage, and particularly those experiencing forced relocation, is extremely small. It is interesting however that students who report having been forced to leave their accommodation report levels of aftershock-related stress and perceptions of safety at the time of survey completion at levels well below those reporting other levels of accommodation damage. This may be related to moves into less damaged accommodation, in less significantly impacted areas of the city. If this were the case, it would suggest that the higher levels reported by students in the other categories of significant damage may be associated with ongoing exposure to accommodation damage. At the same time, the comparatively large percentage of those forced to leave who report that they are still not OK suggests that such a move may be associated with feelings of dysfunctionality unrelated to lower feelings of safety and aftershock stress levels.

Leaving the city altogether after the initial earthquake, even for short periods of time, appeared to be associated with higher aftershock stress levels, lower feelings of safety, and longer times to return to feelings of functionality. Although post-impact evaluations have been discussed in the literature, the psychological correlates of this kind of voluntary, short term departure (as distinct from forced or longer-term evacuation) have not been reported before. These findings are significant, given that as many as 50,000 of the wider population appear to have left the city for short periods in the first 6 weeks after the (22 February 2011) Christchurch earthquake (Newell et al. 2012; Nissen and Potter 2011). There are several factors possibly involved in these trends. Those experiencing higher stress levels after the earthquake for whatever reason are more likely to have left, and to have stayed away longer, than those who did not. Secondly, those who left existing local networks may have experienced a drop in perceived social support, which has been linked to higher stress levels. Mawson's (2005) findings concerning the importance of familiar people and surroundings after disasters may also be a factor here. This comparatively large sample indicates an apparent relationship with the length of time spent out of the city, and, as in Mawson's hypothesis, New Zealand respondents from outside Christchurch are slightly over-represented in the group that left the city. If this were a determining factor, however, there should also be at least some corresponding disparity in wider reporting between those from Christchurch and respondents from elsewhere. Since this is not the case, and since those who left report academic disruption by aftershock stress at such high levels (70%, almost twice the survey average of 46%), it seems likely that those who stayed may have become more accustomed to the aftershocks and other aspects of the earthquake aftermath, and so adjusted to them more quickly. The timing of the survey also makes this particularly likely; four to six weeks after the event, many of those who left the city had only recently returned⁴.

On the one hand, the overall survey results indicate that this student population may be more likely to report lower stress levels and higher perceptions of functionality overall than those surveyed in the US after hurricanes, even when overall levels of

accommodation damage (as an indication of disaster exposure) are similar. The 7% that report they were ‘still not OK’ at the time of survey completion, for example, is considerably lower than the 22% of tertiary students reporting that they had still not returned to ‘pre-disaster mental health functionality,’ when surveyed seven months after experiencing Hurricane Ike (Watson et al. 2011). Aftershock-induced stress differs from that experienced after hurricanes, in that it is an ongoing stressor. It is notable then that although indexing aftershock-induced stress specifically, rather than general stress levels, overall levels of reported stress during aftershocks appear lower than levels of reported stress in tertiary student populations surveyed, for example, after Hurricanes Charley and Frances struck central Florida within a three week period. Almost 50% of the 107 students surveyed look back to recall feeling ‘stressed out’ as they started the fall semester ten days after Hurricane Charley, while 73% recalling feeling ‘stressed out’ after Hurricane Frances made landfall in central Florida two weeks after the start of the semester (Gutierrez et al. 2005). At the time of survey completion, 30% of the same group reported high or very high stress levels (Gutierrez et al. 2005) overall, compared with the less than 12% of UC student who reported still finding aftershocks stressful or very stressful at the time of survey completion.

In this context the high levels of satisfaction with the university provision of information reported by the UC survey respondents are also noteworthy. In large part, they indicate the effectiveness of the University communications strategy, and the speed with which it updated the website and began a series of regular personalised email communications with the student population less than twelve hours after the event is reflected in these responses. Here too, timing is likely to be a factor. Bonnano et al. (2010) note that perceptions of—and satisfaction with—communication and other support drop over time after disasters, particularly concerning that provided by authorities responsible for response and recovery. It is also possible that those who chose to respond to the survey were those who were more engaged with the university community, or that the survey itself was perceived as a positive element in the suite of communication support provided by the organisation.

Even so, when compared with the results of US tertiary student populations surveyed after hurricanes of comparable impact—such as Ike, Charley and Frances—these levels of reported satisfaction with the provision of information indicate that the University’s crisis communication strategy is likely to have contributed to a high perception of social support from the organisation, and in this way factored in the comparatively low stress and higher functionality levels reported by the Canterbury students. Similarly, Van Willigen et al. (2005) linked the high levels of university support reported by students after Hurricane Floyd to the fact that they reported stress levels and other impacts at much lower levels than the non-student local population. By contrast, students who reported higher levels of stress-related health conditions when surveyed after Hurricane Ike also complained of being ‘left in the dark’ without ‘accurate and up to date post-

storm information' for days, due to the fact that the organisation's website was down, and that there was no consistent approach to the provision of information in the days and weeks after the storm (Watson et al. 2011: 366).

On the other hand, however, these New Zealand tertiary students appear to be much more likely to report academic disruption than US students after hurricanes. On Galveston island after Hurricane Ike, for example, 35% of 513 surveyed students indicated that the event had had no academic effect (Watson et al. 2011), compared with only 8% who responded this way in the Canterbury survey. Similarly, while the shortened semester was singled out by Sloan survey (2012) participants as the most academically disruptive consequence of Hurricane Katrina, it was reported this way by only 30% of these respondents, compared with the 60% who identified this, along with two other factors, as academically disruptive in the Canterbury survey.

Once again, timing is likely to factor in two ways into these discrepancies. Firstly, the Canterbury students are responding in the immediate aftermath of the earthquake, when they were not yet in a position to know what effect the disaster would have for the rest of the semester. Those surveyed at approximately 4-6 weeks after Hurricane Floyd by Van Willigen et al. (2005) were not asked to report on the academic disruption caused by the event, and so do not offer a comparison. Students were surveyed seven months after Hurricane Ike, and throughout the semester in the Sloan Consortium survey (2012). Secondly, the high levels of concern over the shortened term, and loss of exam study time, can also be related to the Wilkinson et al. (2013) hypothesis concerning timing. If the disruptive effect of such events is inversely related to their proximity to the end of semester, as they suggest, the Darfield earthquake's timing approximately five weeks before the end of year examinations began would make it more academically disruptive than events that occur (like most US hurricanes) in the early stages of the academic semester (Wilkinson et al. 2013).

Conclusions

Overall, this large self-selected sample tended to report at similar levels, indicating comparatively low levels of aftershock stress, and high perceptions of functionality, safety, and satisfaction with the university's provision of information. This homogenous reporting tendency seems to over-ride differences in home country and (New Zealand) home town, and between those that volunteered after the event and those that did not, to this extent suggesting the 'buffering' effect of the university environment identified by Van Willigan (2005).

Gender difference is the only pre-existing demographic characteristic that does not conform to this trend; if, as Helton et al. (2011) suggest, the higher levels of reported stress and cognitive disruption reported by female UC students may not manifest in gender differences in post-disaster performance, this may reflect a difference in reporting.

Other respondent groups that are more likely to report higher levels of aftershock stress and less likely to feel functional and safe are characterised by aspects of negative disaster impact, rather than pre-existing demographic or psychosocial characteristics. Those appearing to be at higher risk include those who did not know what to do in response to the initial earthquake, who experienced accommodation damage, or who temporarily left the city after the event. Pointing to student groups likely to be at risk in future events, these findings help to contribute to tertiary institution disaster response planning.

In addition, the links between the perception of not knowing what to do during the initial earthquake and psychosocial risk four to six weeks after the event are consistent with the Lindell et al. (forthcoming) findings linking information and preparedness to adaptive action, and underline the importance of ensuring that student populations are engaged in institutional preparedness training before disaster onset. As well as improving immediate post disaster outcomes, such training may also contribute to individual *perceptions* of preparedness, which these data suggest may be a positive factor in short to medium term psychological resilience.

Comparatively high levels of concern about the academic disruption associated with the earthquake were of concern, and underline the importance of addressing this aspect of disaster disruption as rapidly and decisively as possible after an event, of planning for such strategies in advance, and of communicating with student populations to address the relevant academic anxiety. Finally, these findings underline the importance of regular, up to date communications with student bodies during and after disasters, using as many media as possible.

Notes

1. Helweg-Larsen's (1999) research found that post-disaster stress levels reported by tertiary students decreased over time, which would suggest that the differences between the student and non-student household survey findings cannot simply be attributed to the fact that they were surveyed at different times post-disaster.
2. In most cases, less than 5% of respondents chose to add a free text response to their quantitative answer, so these have not been included in the analysis.
3. The third open-ended question asked for 'any other comments'; the 1,022 responses to this question ranged very widely, and were not particularly pertinent to the focus of this article.
4. Becoming accustomed to aftershocks is also likely to be a factor in reported drops in aftershock stress, and the rise in perceptions of functionality reported over this time; these are also likely to have been largely an effect of the passage of time. In addition, both city and university functionality had significantly improved 4-6 weeks after the initial event, and there had also been a drop in the frequency of aftershock activity for the week preceding (and during) the period of survey completion (see Figure 1).

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