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Why do people prepare for natural hazards? Developing and testing a Theory of Planned Behaviour approach

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A B S T R A C T

Natural hazards such as earthquakes and tsunami can have adverse impacts on infrastructures and populations globally. In Wellington, New Zealand, perception of these risks is high but many people are poorly prepared. Using the Theory of Planned Behaviour in a pre-registered longitudinal study, we assessed intentions, cognitions, and beliefs about the behaviour of preparing for natural hazards at Time 1 (N= 153) and self-reported behaviour one month later with 61 participants from the sample at Time 2. Experiential attitudes, instrumental attitudes, self-efficacy, and perceived descriptive norms explained approximately 34% of the variance in intentions, which in turn predicted preparation for natural hazards, although confidence in this result is qualified by the small sample size. Further, this study identified several key beliefs related to preparing, such as the belief that preparing helps people to get through a natural hazard event better, that people can make the effort to prepare, and that preparing can be fun and rewarding. These beliefs offer specific and tangible factors which can be efficiently addressed in public education campaigns. Secondly, this study addressed a number of common methodological limitations in how the Theory of Planned Behaviour is conceptualised, applied, and measured, by incorporating consistent inclusion of constructs and belief measures and coherence between measures of intentions and behaviour. This research supports the implementation of the two-factor distinction, splitting attitudes into instrumental and experiential, social norms into descriptive and injunctive, and perceived behavioural control into controllability and self-efficacy as well as including the belief measures which indirectly explain intentions. The Theory of Planned Behaviour has a long history of beneficial applications to a variety of behaviours, but the recommendations made here for future use aim to improve the usefulness of the theory in research beyond natural hazards, including comparisons of findings between studies.

Disaster impacts are increasing due to a combination of population growth heightening exposure to hazards as well as climate change driving more frequent and severe high-impact weather events such as cyclones and drought (Paton and Buergelt, 2019; Tippett, 2018). Estimates indicate that disasters triggered by natural hazards cost the global economy over US$500 billion each year, while over a million people were killed and another billion impacted by disasters during the two decades from 1998 to 2017 (Wallacemacq and House, 2018). Social scientists have examined ways to reduce these impacts, particularly in disaster-prone areas (e.g., Becker et al., 2015; Solberg et al., 2010). The present research contributes to this literature by investigating the psychological constructs that might contribute to preparation for natural hazards in a disaster-prone region in Aotearoa New Zealand (NZ), a country prone to a range of natural hazards such as earthquakes, tsunami, landslides, and floods (Khan et al., 2012).

Indeed, NZ has been affected by several severe earthquakes, as well as wildfires and meteorological hazards such as storms and droughts, in the past decade. In particular, the Canterbury Earthquake Sequence in 2010/2011, which claimed 185 lives and caused billions of dollars of damage and loss (Potter et al., 2015), has led to an ongoing conversation around how to reduce the impacts of such events (e.g., strengthening building codes; Vinnell et al., 2018). Subsequent events such as the 2016 Kaikōura earthquake have likewise stimulated research on how to reduce impacts of natural hazards (Vinnell et al., 2019).

The Wellington Region, which includes the capital city of New Zealand, has long been known to be at objectively high risk of a powerful earthquake (Smith, 2015). Recent estimates suggest that as many as 1,500 people could be killed if an earthquake similar in magnitude to the 2011 Christchurch earthquake struck Wellington City, with as many as 12,000 injuries overwhelming local health systems (George, 2017). Because of the city's geography, a large earthquake could split the wider region into 23 different areas with no roading access which would take up to 120 days to fully reconnect, while electricity would likely be disrupted for up to six months and water for up to a year (Brown et al., 2019). The property damage and economic loss could be so severe that the city would never fully recover.

While understanding of the specific features of Wellington's risk continues to develop, the general danger posed by earthquakes has long been known, and as a result decades of public education campaigns have aimed to encourage residents to prepare. Although the vast majority of people in Wellington are aware of this earthquake risk, evidence from previous research suggests that such education programmes do not lead to significant increases in preparedness (Johnston et al., 2013; Lindell and Whitney, 2000; Paton et al., 2005). This is perhaps

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because there is a disconnect between the beliefs about hazards held by the public and by those who are communicating risk information, rather than that information not being of a high enough quality (Paton and Buergelt, 2019). It is therefore important to understand the beliefs held by citizens which affect their preparation behaviour. In this investigation, we employ and extend the Theory of Planned Behaviour (TPB; Ajzen, 1991) to assess intentions to prepare for natural hazards and predict preparation behaviour.

Several risk-specific theories have been developed to explain and predict people's behaviour in relation to natural hazards, including the Person-relative-to-Event model (Duval and Mulilis, 1999), Protection Motivation Theory (Tanner et al., 1989), the Protective Action Decision Model (Lindell and Perry, 2012), and Community Engagement Theory (Paton, 2013). These theories share some similarities and have strengths suitable for specific contexts; however, none of these theories aligned completely with the goals of the present research.

The first goal of this research is to explain and predict people's preparation for natural hazards in order to inform behaviour change interventions. To achieve this, the theory needs to treat behaviour as a specific outcome, have been previously applied to a range of behaviours and communities, and include a combination of previously supported and novel constructs which can be modelled simultaneously and targeted in interventions. The Theory of Planned Behaviour uniquely meets all of these criteria.

The second goal of this research, and the main goal of the paper, is to implement improvements and refinements to an existing theory rather than attempting to generate a new theory. The TPB has been applied previously to a broad range of behaviours (briefly reviewed below), but many of these applications could be improved methodologically. It follows that developing a comprehensive set of measures for this theory will likely be more impactful than doing the same for more narrowly-applied theories such as those developed and used solely in the disaster field.

The Theory of Planned Behaviour

The TPB proposes that the primary determinant of a given behaviour is intention to carry out that behaviour. Intention in turn is informed by attitudes about the behaviour, perceptions of social norms relating to the behaviour, and perceptions of control over carrying out the behaviour (perceived behavioural control; PBC). Meta-analyses have found support for the usefulness of the TPB in predicting a range of behaviours (Armitage and Conner, 2001) including health-related behaviours such as nutritional choices and smoking (Guo et al., 2016; McDermott et al., 2015; Riebl et al., 2015; Topa and Moriano, 2010) and environmental-related behaviours such as use of public transport and "green" consumption (Si et al., 2019). Below we provide a brief description of each TPB component.

Intentions are typically measured with questions regarding whether individuals anticipate engaging in the behaviour in the near future (e.g., Francis et al., 2004) and are therefore particularly relevant for behaviours that require planning and conscious thought. The first component shown to predict behavioural intentions is attitudes about the behaviour; this refers to whether individuals see the behaviour as positive or negative (Ajzen, 2011). The attitude construct is differentiated into attitudes about the *experience* of enacting the behaviour (experiential attitudes) and attitudes about the *outcomes* of the behaviour (*instrumental* attitudes; Francis et al., 2004). Social norms relate to influences on an individual's behaviour caused by what is perceived as "normal" within that individual's social group. While *injunctive* norms refer to whether a behaviour is approved of or not (e.g., Ajzen, 2002; White et al., 2009), *descriptive* norms refer to prevalence of the behaviour (Cialdini et al., 1990). Research has demonstrated that descriptive and injunctive norms are discrete concepts (e.g., Vinnell et al., 2018) with different motivational mechanisms (Hamann et al., 2015).

Finally, PBC refers to the general level of control that individuals perceive themselves to have over whether they carry out the behaviour. This can refer to whether individuals are able to plan to carry out the behaviour, rather than the behaviour being seen as involuntary (*controllability*), as well as whether individuals have the capability to carry out the behaviour in terms of individual factors such as time, knowledge, effort, and finances (*self-efficacy*).

Beyond the three TPB components of attitude, social norms, and PBC outlined above (hereafter referred to as "cognitions"), the theory also includes beliefs, which function as antecedents of the TPB constructs (e.g., attitude beliefs precede attitudes; Ajzen, 2006; McMillan et al., 2009). People develop beliefs about a behaviour, which then influence the attitudes, perceptions of norms, and perceptions of control that they develop. If these beliefs operate as proposed, then targeting these beliefs, rather than the constructs they inform, should lead to greater success in interventions (Ajzen, 2006; Darker et al., 2007). Although belief measures are seldom included in TPB studies (e.g., Hardeman et al., 2002), evidence supports the targeting of beliefs in behavioural interventions (e.g., Elliott and Armitage, 2009).

There is mixed evidence for the importance of these TPB constructs in natural hazard preparation. Instrumental attitudes are similar to response-efficacy and outcome expectancy, which have been repeatedly shown to be strongly associated with preparation (e.g., Becker et al., 2015; Johnston et al., 2013; Lindell and Whitney, 2000; Paton et al., 2005, 2010; Vinnell et al., 2017), whereas little research has directly explored the role of experiential attitudes in disaster preparation. Similarly, self-efficacy is one of the most commonly discussed cognitive factors related to preparedness (e.g., Becker et al., 2015; Duval and Mulilis, 1999; Lindell and Whitney, 2000; Paton et al., 2015) Rowney et al., 2014), whereas controllability has no direct equivalent in the disaster literature, although related concepts such as perceptions of personal versus government responsibility for preparedness have received some attention (Becker et al., 2015; Paton et al., 2005). Other research has demonstrated social norm effects (e.g., Becker et al., 2014, Vinnell et al., 2018), but most work tends to look at one type of social norm in isolation (Ozaki and Nakayachi, 2015), does not incorporate the descriptive/injunctive distinction (e.g., McIvor and Paton, 2007), or examines less specific social cues (Bourque, 2013; Sanquini et al., 2016).

Using the TPB as a framework therefore presents an opportunity to explore relatively novel constructs for the disaster field. This strategy offers the potential to reveal new targets for preparation interventions and campaigns while also examining well-established constructs so that some informative relationships within the TPB could be identified, regardless of any novel findings.

Extending the theoretical and applied scope of the TPB

Numerous meta-analyses and reviews support the TPB as a prediction and measurement tool, as well as providing support for the theory as a way to inform behaviour change interventions. However, there are several ways in which the typical application of the theory can be improved.

The two-factor distinction. Although attitudes have been recognised as comprising both instrumental and experiential (or affective) components for over a decade, few studies include this distinction. Indeed, Darker et al. (2007) report that the predictive capability of the two types of attitudes differ but argue that more evidence is necessary. Further, some researchers have argued that the subjective norm component should be dropped from the TPB given weak and inconsistent findings in the literature while others have argued that the weakness in this element could be due to poor and inconsistent operationalization and measurement, which often involves single-item measures (Armitage and Conner, 2001). The Cialdini et al. (1990) focus theory of normative conduct divides social norms into descriptive and injunctive norms. This offers a way to strengthen this component of the model, yet this division has been infrequently and inconsistently applied in TPB studies. Finally,

previous research has found that both PBC generally and self-efficacy specifically play a significant role in the model, although they were not historically tested in conjunction (for a review, see Armitage and Conner, 2001). In fact, some formulations of the model define PBC as self-efficacy (Ajzen, 2011). As noted above, recent research suggests that PBC has two distinct but related components: perceived controllability (whether the individual thinks they have control over carrying out the behaviour) and self-efficacy (whether the individual thinks they are able to carry out the behaviour; Ajzen, 2002).

Measurement and modelling. Several authors have argued that the conflicting results in research applying the TPB reflects the use of different measures (e.g., Armitage and Conner, 2001). First, studies often create novel TPB measurement items within the context of each individual study, rather than adapting consistently used and validated scales. Second, there is often inconsistency in the inclusion and operationalization of the constructs themselves, including beliefs. Finally, the analysis used to test the TPB varies between studies. Many use regression analysis (Topa and Moriano, 2010) while others use structural equation modelling as recommended by Ajzen (2011). Importantly, findings can differ between a stepwise regression analysis and a path analysis within a structural equation modelling framework where all paths are tested simultaneously (Topa and Moriano, 2010).

Behaviour. Regardless of weaknesses in the individual components of the model, one of the main challenges of applying the TPB is the definition and measurement of behaviour. Given the wide number of behaviours to which the theory has been applied, there are several inconsistencies in measurement of the behaviour under study. First, some studies refer to specific behaviours (such as having a blood pressure test; Francis et al., 2004) while others refer to broad categories of behaviour (such as healthy eating or exercising, which involve several different behaviours; Manning and Bettencourt, 2011; Riebl et al., 2015). Other differences between studies include whether the behaviour is framed positively (e.g., eating fruit; Hewitt and Stephens, 2007) or negatively (e.g., following a low-fat diet; Armitage and Conner, 1999), and whether the target is to increase engagement in a positive behaviour or to reduce engagement in a negative behaviour. This issue is non-trivial since research has demonstrated that intentions *to do* something differ from intentions *to not do* something (Richetin et al., 2011), including research in relation to preparing for natural hazards (Paton et al., 2005).

The TPB in natural hazard literature

The full TPB has been applied to risk-mitigating behaviours such as health preparedness (e.g., donating blood during disease outbreaks and vaccine intentions; see Ejeta et al., 2015 for a review) but rarely to natural hazard behaviour. The TPB has been applied to bushfire preparation in Australia and wildfire preparation in the United States (Bates et al., 2009; Morrison et al., 2014). These studies both contained some of the inconsistencies common in TPB research; for example, both used the subjective norms construct rather than descriptive and injunctive norms. Further, Morrison et al. (2014) used numerous sources to construct scale measures with differing numbers of items and modelled attitudes and norms as direct predictors of behaviours, contrary to the TPB, while Bates et al. (2009) conflated self-efficacy and instrumental attitudes within the PBC component.

A study of disaster preparation in Iran presents support for the relevance of the TPB (Najafi et al., 2017), but the approach used in this study can be improved in several ways. The authors used past preparation both to dichotomise preparedness (producing unequal groups of 10% prepared versus 90% unprepared) and as the behavioural outcome in the model, contrary to the theory. It is important to test predictors of behaviour longitudinally or experimentally, rather than relying solely on correlational design studies. Further, as with the fire studies mentioned above, this research measured only subjective norms and did not include all theorised constructs in the TPB. A follow-up study in Iran assessed TPB beliefs in relation to earthquake preparation but did not examine whether these beliefs causally related to preparation (Najafi et al., 2018).

In sum, these studies support the potential of the TPB to explain and predict preparation for natural hazards, one of the two main goals of this research. However, these studies also demonstrate several methodological limitations common within the wider TPB literature. The second goal of this research, therefore, was to develop a TPB measurement tool which addresses these limitations, as outlined in the next section.

The present research

The TPB has not yet been thoroughly applied to the area of natural hazard preparation, despite support from researchers in the field of natural hazards (e.g., Beatson and McLennan, 2011), including bushfires (Bates et al., 2009; Morrison et al., 2014) and earthquakes (Najafi et al., 2017; 2018). Advancing these natural hazard studies and TPB research, we employ the full TPB model and address the methodological issues listed above. This study also included surveys at two time points; intentions, explanatory cognitions (attitudes, social norms, and PBC), and beliefs were measured at Time 1 whereas preparation behaviour was measured one month later at Time 2.

Hypotheses

Although the TPB proposes that all included cognitions (attitudes, social norms, and PBC) will be significantly related with intentions, the explanatory power of these cognitions may differ depending on the particular behavioural intention (Armitage and Conner, 2001), and some constructs of the TPB do not have empirical support in the field of natural hazard preparation. Our hypotheses are therefore primarily based on the findings of our earlier study (see Vinnell, 2020, Study 2). We expected that experiential attitudes, instrumental attitudes, and self-efficacy would be positively associated with intentions to prepare for natural hazards, whereas perceived descriptive norms, perceived injunctive norms, and controllability would not be associated with these intentions. Further, intentions to prepare were expected to positively predict hazard preparation behaviour for all three preparation measures conducted one month after the initial survey, with an effect consistent with previous findings from the TPB literature (e.g., Armitage and Conner, 2001).

Our predictions around intentions to prepare, instrumental attitudes, and self-efficacy are consistent with the existing natural hazard literature as well as the TPB model. Some evidence would suggest a significant relationship between intentions and descriptive and injunctive norms. However, many TPB studies demonstrate that social norms are a relatively weak explanatory factor, consistent with social norm theory where effects are larger when norms are congruent (Hamann et al., 2015), the population is less economically-developed and individualistic (Fischer et al., 2019), the situation is new or ambiguous (Goldstein et al., 2007), and the decision-making process is more automatic than deliberative (Kredenster et al., 2012). The context of this research does not fit these situations.

Two other exploratory analyses were included. First, a potential direct effect of PBC (self-efficacy and controllability) on behaviour was tested. Second, we tested whether specific belief measures would lead to increased model fit and demonstrate stronger associations with their concordant cognitive components than the general belief measures. That is, whether experiential attitude beliefs would be more strongly associated with experiential attitudes than general attitude beliefs, and so on. This study, including the above predictions and planned exploratory analyses, was pre-registered on the Open Science Framework: https://osf.io/xnepu/

Method

Study design

This study used a longitudinal design to examine whether intentions to prepare for natural hazards would predict behaviour over time. This involved testing all components of the TPB including beliefs, cognitions, and intentions at Time 1 and then testing behaviour one month later at Time 2. We assessed preparation behaviour with three measures: a single item about preparation in general over the last month, a list of specific actions participants could report taking over the last month, and whether participants requested or declined an earthquake-planning guide.

Participants

One thousand five hundred participants were randomly selected from a list combining the electoral rolls of the urban Wellington region (i.e., Wellington, Hutt City, Upper Hutt, and Porirua City Councils). This number was calculated to achieve a probability sample of approximately 383 participants at Time 1 (using the equation provided by Dillman et al., 2014, p. 78), assuming a low response rate. A recent study of natural hazard preparedness in Wellington using a postal recruitment method achieved a response rate of approximately one-third (Doyle et al., 2018). Although a sample of this size with complete data at both time points would be preferable, assuming moderate attrition between the two time points would mean an initial recruitment size beyond the time, financial, and resource capabilities available for the present study. The planned sample size of approximately 400 participants at Time 1 was expected to result in a sample size comprising data at both time points of at least 100–200 participants (e.g., Satherley et al., 2015). This is considered a minimum for structural equation modelling analyses by conventional standards (Boomsma, 1985) as well as more recent, rigorous standards (Wolf et al., 2013).

The 1,500 randomly selected participants were mailed a recruitment letter giving a brief description of the research and a link to access the online survey, with data collection running from the 11th of October 2019 to the 7th of November 2019. Of those who responded to the first survey, 87 agreed to participate in the Time 2 survey, which was emailed to them approximately one month after the Time 1 survey. One month allows time for some behaviour to be undertaken while limiting the influence of potential confounds such as the occurrence of a natural hazard event.

Time 1 sample. One hundred and fifty-three participants commenced the Time 1 survey for an approximate response rate of 10%. This is much lower than the anticipated response rate of approximately one-third based on similar methods used in previous research with the same population (Doyle et al., 2018), and therefore some of the following statistical analyses differ from those laid out in the pre-registration document. Two participants did not answer any questions beyond the first intentions scale and were excluded from the dataset. All participants consented, were over the age of 18, lived in the urban Wellington region, and understood the presented definition of natural hazards so no exclusions were made for these factors. Participants were on average 51 years old (ranging from 18 to 86) and most had completed at least secondary school (94.4%). Men and women were equally represented in the sample (50.7% and 49.3%, respectively); however, most were Pākehā (European descent: 81.9%) with Māori (the indigenous people of NZ) under-represented (2.1%).

Time 2 sample. Sixty-three participants completed the Time 2 survey for a response rate of approximately 74% from the Time 1 sample. Two participants did not provide their email address to link their responses to their Time 1 data and were excluded. All remaining 61 participants responded to at least one behavioural measure. The mean age of this sample, 52.37 years ($SD = 16.12$) did not significantly differ from the mean age of the Time 1 sample, $p = .66$. Further, 30 participants identified as male and 31 as female, which again did not differ from the ratio in the Time 1 sample, $p = .84$. The ratio of participants' ethnicity identifications and education level could be not compared between the two samples as most cell sizes within the chi-square test would be too small. However, again the majority (86.9%) identified as Pākehā and had gained at least a secondary school qualification (95.1%).

Materials

Time 1 survey. The online survey included a range of measures adapted primarily from two TPB questionnaire construction guides (Ajzen, 2013; Francis et al., 2004). All components of the TPB model were measured with four item scales with the exception of the two attitude belief scales (see Table 1). These two scales contained six items to allow for an exploratory test of the instrumental and experiential distinction at the belief level. Participants also reported their experience of natural hazard events and prior preparation behaviour. At the beginning of the survey, participants were asked if they understood the following definition:

"This survey will ask a number of questions about **natural hazards**. For the purpose of this research, a natural hazard is a process or force of nature, such as an earthquake, flood, tsunami, landslide, wildfire, storm, and volcanic eruption, which has the potential to cause negative consequences such as damage, injury, and/or disruption to lifelines (e.g., roads, water, electricity, food and medical supplies)."

All participants indicated that they understood this definition.

Natural hazard experience. Of this three-item measure, two questions were adapted from McClure et al. (2011) and the third added for this study. The questions asked: "Have you or someone close to you suffered **damage** to your home or possessions in a natural hazard event in the past?"; "Have you or someone close to you been **harmed** in a natural hazard event in the past?"; and "Have you experienced natural hazard events which didn't cause you harm or damage but made you feel **scared or vulnerable**?". All items used a 7-point Likert-type response scale, ranging from "Never" to "A moderate amount/Moderately/A moderate number" (respectively) to "A lot/Severely/A lot" (respectively).

Past preparation. This measure presented a list of 19 behaviours to increase preparedness for a range of natural hazards but with a focus on earthquakes, drawn from several scientific (McClure et al., 2015; Mulilis et al., 1990; Spittal et al., 2006) and government sources (such as getready.govt.nz and National Emergency Management Agency leaflet material). Participants were presented with the following instructions:

> "**Please indicate which of these preparations you or someone in your household have made for the specific purpose of a natural hazard.** If you've done one of these in the past but can no longer benefit from it (e.g., stored food years ago which you've since thrown out) please respond 'No'. If you have done part of the action (e.g., purchased a torch but not a battery-powered radio) please respond 'Partly'."

For each behaviour, participants could respond "Yes", "No", "Partly", "Unsure", or "Not applicable". The instructions and the behaviours were worded so as to make the behaviours applicable for as many people as possible; for example, including the behaviour of others in the household or including asking the landlord to carry out actions which tenants cannot. The 19 behaviours were:

- Store water
- Store non-perishable food
- Make an emergency kit
- Make an emergency plan (e.g., knowing where to meet family)
- Store supplies (such as plastic bags and toilet paper) to use as an emergency toilet
- Purchase items to use if power is lost such as a torch, radio, or gas cooker
- Obtain a fire extinguisher for my household

Table 1
Theory of Planned Behaviour scales.

Scale	Question	'1' label	'7' label	Adapted from
Intentions	I expect to prepare for a natural hazard	Strongly disagree	Strongly agree	Francis et al. (2004)
	I want to prepare for a natural hazard	Strongly disagree	Strongly agree	Francis et al. (2004)
	I intend to prepare for a natural hazard	Strongly disagree	Strongly agree	Francis et al. (2004)
	I plan to prepare for a natural hazard	Strongly disagree	Strongly agree	Ajzen (2013)
Attitudes				
Experiential	I think that preparing for a natural hazard is: (reverse coded)	Simple	Complicated	Ajzen & Madden (1986)
	I think that preparing for a natural hazard is:	Boring	Enjoyable	Ajzen & Madden (1986)
	I think that preparing for a natural hazard is:	Unpleasant	Pleasant	Ajzen & Madden (1986)
	I think that preparing for a natural hazard is: (reverse coded)	Rewarding	Unrewarding	Ajzen & Madden (1986)
Instrumental	I think that preparing for a natural hazard is:	Useless	Useful	Ajzen & Madden (1986)
	I think that preparing for a natural hazard is:	Unimportant	Important	Ajzen & Madden (1986)
	I think that preparing for a natural hazard is:	Unnecessary	Necessary	Ajzen & Madden (1986)
	I think that preparing for a natural hazard is:	Pointless	Valuable	Ajzen & Madden (1986)
Behavioural belief strength	Preparing for a natural hazard will result in me and my home getting through a hazard event better	Strongly disagree	Strongly agree	Ajzen (2013)
	I will feel like I'm doing something life-saving if I prepare for a natural hazard	Strongly disagree	Strongly agree	Francis et al. (2004)
	Preparing for a natural hazard can be a fun experience	Strongly disagree	Strongly agree	Ajzen (2013)
	Preparing for a natural hazard can be a rewarding experience	Strongly disagree	Strongly agree	Ajzen (2013)
	It is complicated to prepare for a natural hazard (reverse-coded)	Strongly disagree	Strongly agree	Francis et al. (2004)
	It is expensive to prepare for a natural hazard (reverse-coded)	Strongly disagree	Strongly agree	Francis et al. (2004)
Outcome evaluation	Getting through a natural hazard better is:	Extremely bad	Extremely good	Ajzen (2013)
	Doing something life-saving is:	Extremely bad	Extremely good	Francis et al. (2004)
	Doing something complicated is:	Extremely bad	Extremely good	Francis et al. (2004)
	Doing something expensive is:	Extremely bad	Extremely good	Francis et al. (2004)
	Doing something fun is:	Extremely bad	Extremely good	Francis et al. (2004)
	Doing something rewarding is:	Extremely bad	Extremely good	Francis et al. (2004)
Descriptive norms				
Direct	Most people like me have prepared for a natural hazard	Strongly disagree	Strongly agree	Ajzen (2002)
	The people in my life whose opinions I value have prepared for a natural hazard	Strongly disagree	Strongly agree	Ajzen (2002)
	How many of the people who are important to you do you think have prepared for a natural hazard?	None	All	White et al. (2009)
Normative belief strength	Most of my friends and family have prepared for a natural hazard	Definitely false	Definitely true	Ajzen (2013)
	Most of my neighbours have prepared for a natural hazard	Definitely false	Definitely true	Ajzen (2013)
	Most Wellingtonians have prepared for a natural hazard	Definitely false	Definitely true	Ajzen (2013)
	Most New Zealanders have prepared for a natural hazard	Definitely false	Definitely true	Ajzen (2013)
Identification with referent	When it comes to preparing for a natural hazard, how much do you want to be like your friends and family?	Not at all	Very much	Ajzen (2013)
	When it comes to preparing for a natural hazard, how much do you want to be like your neighbours?	Not at all	Very much	Ajzen (2013)
	When it comes to preparing for a natural hazard, how much do you want to be like other Wellingtonians?	Not at all	Very much	Ajzen (2013)
	When it comes to preparing for a natural hazard, how much do you want to be like other New Zealanders?	Not at all	Very much	Ajzen (2013)
Injunctive norms				
Direct	Most people who are important to me approve of my preparing for a natural hazard	Strongly disagree	Strongly agree	Ajzen (2002)
	Most people like me approve of my preparing for a natural hazard	Strongly disagree	Strongly agree	Ajzen (2002)
	The people in my life whose opinions I value approve of my preparing for a natural hazard	Strongly disagree	Strongly agree	Ajzen (2002)
	Amongst the people who are important to you, how much agreement would there be that preparing for a natural hazard is a good thing to do?	No agreement	A great deal of agreement	White et al. (2009)

(*continued on next page*)

Table 1 (*continued*)

Scale	Question	'1' label	'7' label	Adapted from
Normative belief strength	Most of my friends and family approve of my preparing for a natural hazard	Strongly disagree	Strongly agree	Ajzen (2013)
	Most of my neighbours approve of my preparing for a natural hazard	Strongly disagree	Strongly agree	Ajzen (2013)
	Most Wellingtonians approve of my preparing for a natural hazard	Strongly disagree	Strongly agree	Ajzen (2013)
	Most New Zealanders approve of my preparing for a natural hazard	Strongly disagree	Strongly agree	Ajzen (2013)
Motivation to comply	When it comes to preparing for a natural hazard, I want to do what my friends and family think I should do	Strongly disagree	Strongly agree	Ajzen (2013)
	When it comes to preparing for a natural hazard, I want to do what my neighbours think I should do	Strongly disagree	Strongly agree	Ajzen (2013)
	When it comes to preparing for a natural hazard, I want to do what other Wellingtonians think I should do	Strongly disagree	Strongly agree	Ajzen (2013)
	When it comes to preparing for a natural hazard, I want to do what other New Zealanders think I should do	Strongly disagree	Strongly agree	Ajzen (2013)
PBC				
Self-efficacy	I am confident that I can prepare for a natural hazard	Strongly disagree	Strongly agree	Francis et al. (2004)
	If I wanted to, I could prepare for a natural hazard	Strongly disagree	Strongly agree	Ajzen (2002)
	For me to prepare for a natural hazard is: (reverse coded)	Extremely easy	Extremely difficult	Ajzen (2002)
	For me to prepare for a natural hazard is:	Definitely impossible	Definitely possible	Ajzen (2002)
Controllability	The decision to prepare for a natural hazard is beyond my control	Strongly disagree	Strongly agree	Francis et al. (2004)
	My preparing for a natural hazard is up to me	Strongly disagree	Strongly agree	Ajzen (2013)
	It is mostly up to me whether or not I prepare for a natural hazard	Strongly disagree	Strongly agree	Ajzen (2013)
	How much control do you believe you have over preparing for a natural hazard?	No control	Complete control	Ajzen (2002)
Control belief strength	In the next month, I will have the money to prepare for a natural hazard	Extremely unlikely	Extremely likely	Ajzen (2013)
	In the next month, I will think about preparing for a natural hazard	Extremely unlikely	Extremely likely	Ajzen (2013)
	In the next month, I will have the time to prepare for a natural hazard	Extremely unlikely	Extremely likely	Ajzen (2013)
	In the next month, I will make the effort to prepare for a natural hazard	Extremely unlikely	Extremely likely	Ajzen (2013)
Power of control factors	Having enough money would make me more likely to prepare for a natural hazard	Strongly disagree	Strongly agree	Ajzen (2013)
	Thinking about preparing would make me more likely to prepare for a natural hazard	Strongly disagree	Strongly agree	Ajzen (2013)
	Having the time would make me more likely to prepare for a natural hazard	Strongly disagree	Strongly agree	Ajzen (2013)
	Making the effort to prepare for a natural hazard would make me more likely to prepare	Strongly disagree	Strongly agree	Ajzen (2013)

- Purchase a water tank
- Cloud-store important documents and/or photos on an internet server
- Make sure that my house is insured for damage caused by natural hazards
- Seek out information about the different natural hazard risks posed to my home
- Have the strength of my building checked (or ask landlord to do the same)
- Fasten tall furniture to the wall
- Secure movable objects in my home (such as computers and TVs)
- Strengthen my house/its foundations (or ask landlord to do the same)
- Ensure that heavy objects are stored on the floor and at the bottom of cupboards
- Identify people in my neighbourhood who need checking up on in a natural hazard event
- Store enough emergency supplies to help others not in my household
- Identify my local Community Emergency Hub so I can volunteer in a natural hazard event

Time 2 survey. The follow-up survey included the same experience measure described above, as well as three measures to assess preparation behaviour between Time 1 and Time 2.

Preparation behaviour. First, a single question asked participants, "**In the past month,** how much preparation have you done for a natural hazard event?", to which they responded on a 7-point Likert-type scale from 1 (None) to 7 (A lot). Second, the same measure of past behaviour used in the Time 1 survey, which presented a list of actions that participants could report undertaking, was used here but with the specific time frame of the past month. Third, participants were asked if they would like to receive an earthquake planning guide (Wellington Region Emergency Management Office n.d).

Descriptive statistics

Descriptive statistics and Cronbach's alpha were calculated using SPSS Version 25. All other analyses were run in Mplus Version 8.1

Table 2
Descriptive statistics for all TPB scales.

Cognition	Factor	*N*	Mean	*SD*	Response range	*α*
Attitude	Experiential	148	4.23	1.11	1 to 7	.69
	Instrumental	148	6.44	1.01	1.25 to 7	.95
	Beliefs					
	General	148	26.33	5.26	14 to 42	.55
	Experiential	148	23.46	6.73	8.67 to 39.67	.20
	Instrumental	148	29.31	6.67	10 to 49	.30
Norms	Injunctive	148	5.44	1.09	1.50 to 7	.83
	Descriptive	148	3.95	1.36	1 to 7	.89
	Beliefs					
	Injunctive	147	18.58	10.40	1.50 to 49	.87
	Descriptive	146	14.49	6.26	4 to 33.25	.86
PBC	Self-efficacy	146	5.67	0.99	3 to 7	.79
	Controllability	146	6.05	0.88	3.50 to 7	.67
	Beliefs					
	General	145	14.75	6.55	1 to 32.20	.82
	Self-efficacy	145	10.96	5.09	1 to 21	.89*
	Controllability	145	20.43	10.98	1 to 49	.70*
Intentions		139	5.26	1.44	1 to 7	.87

Note. All cognition measures had a possible range of 1 to 7, with a midpoint of 4. All belief measures had a possible range of 1 to 49, with a midpoint of 25 within the model. * = Spearman-Brown coefficient.

Table 3
Confirmatory factor analysis fit criteria results for individual TPB constructs.

Cognition	Factor	χ^2	df	*p* value	Ratio	CFI	RMSEA	SRMR
Attitudes	Instrumental	3.37	2	.186	1.69	.986	.068	.013
	Experiential	5.36	2	.069	2.68	.963	.106	.042
	Beliefs	10.32	2	.006	5.16	.949	.166	.034
	Item 4 with 3	0.02	1	.894	0.00	1.00	.000	.001
Norms	Injunctive	5.12	2	.075	2.56	.969	.104	.031
	Descriptive	0.49	2	.781	0.25	1.00	.000	.007
	Injunctive beliefs	12.55	2	.002	6.28	.932	.189	.042
	Item 2 with 1	0.02	1	.886	0.00	1.00	.000	.001
	Descriptive beliefs	5.80	2	.055	2.90	.964	.114	.045
PBC	Self-efficacy	9.05	3	.029	4.53	.934	.117	.074
	Controllability	27.86	3	.000	9.29	.737	.238	.160
	Item 3 with 2	5.79	2	.059	2.90	.961	.112	.070
	PBC beliefs	19.02	2	.000	9.51	.852	.242	.067
	Item 3 with 1	3.04	1	.081	3.04	.982	.119	.015
Intentions		3.96	2	.138	1.98	.983	.081	.026

Note. Entries under the "Factor" heading which are in italics report modifications to the model to improve fit. These modifications were based on the indices provided in the Mplus output.

(Muthén and Muthén, 1998–2017). Table 2 presents the descriptive statistics for each of the TPB constructs at Time 1. All direct TPB scales demonstrated adequate to good reliability, as did most of the belief measures. However, the attitude belief measures demonstrated poor reliability based on the threshold stipulated in the pre-registration. Removing item 5 (expensive) or item 6 (complicated) increased the reliability of the general attitude belief measure to .73 or .64, respectively, removing item 5 increased the reliability of the instrumental attitude belief scale to .69, and removing item 6 increased the reliability of the experiential attitude scale to .76. Therefore, the following analyses do not include either the "expensive" or "complicated" attitude belief items. Table 3 presents fit criteria results for the TPB components, which generally indicate good fit.

Correlations between intentions and each of the cognition components were calculated in Mplus to control for the error in the observed items (see Table 4). Intentions correlated positively with all cognition components, ranging from weak to moderate. Most components were correlated with each other, with the exception of descriptive norms which only correlated significantly with instrumental attitudes and injunctive norms.

Predicting intentions

The lower-than-expected sample size did not provide enough power to test a full latent structural equation model including all TPB constructs as well as behaviour; therefore, a simpler structural equation model explaining intentions to prepare without behaviour variables was tested. In this model, each of the scale items were treated as observed variables loading on latent constructs. Intentions to prepare and PBC were then tested as predictors of preparation behaviour in separate analyses. The model explaining intentions demonstrated acceptable fit: $\chi^2(881) = 1869.97, p < .001$, $\chi^2/df = 2.12$, RMSEA = 0.086, 95% CI [.081, 0.092], CFI = 0.72, SRMR = 0.15.

As shown in Fig. 1, all belief constructs were significantly associated with their related cognitions. As expected, instrumental attitudes, experiential attitudes, and self-efficacy were positively associated with intentions to prepare while injunctive norms and controllability were not associated. Unexpectedly, descriptive norms were also positively associated with intentions. Overall, the four TPB factors explained approximately 34% of the variance in intentions to prepare for natural hazards.

Table 4
Correlations between intentions and TPB cognition components.

	Intentions	Inst Att	Exp Att	Inj Norm	Des Norm	SE	Control
Intentions	–	.39***	.40***	.26*	.29**	.38***	.25*
Inst attitudes		–	.52***	.36***	.17*	.28**	.35***
Exp attitudes			–	.28**	.12*ns*	.38***	.39***
Injunctive norm				–	.42***	.33**	.28*
Descriptive norm					–	.16*ns*	-.01ns
Self-efficacy						–	1.02***
Controllability							–

Note. Inst = Instrumental, Exp = Experiential, Inj = Injunctive, Des = Descriptive, SE = Self-efficacy, Control = Controllability. * = $p < .05$, ** = $p < .01$, *** = $p < .001$, *ns* = $p >$ or = .05.

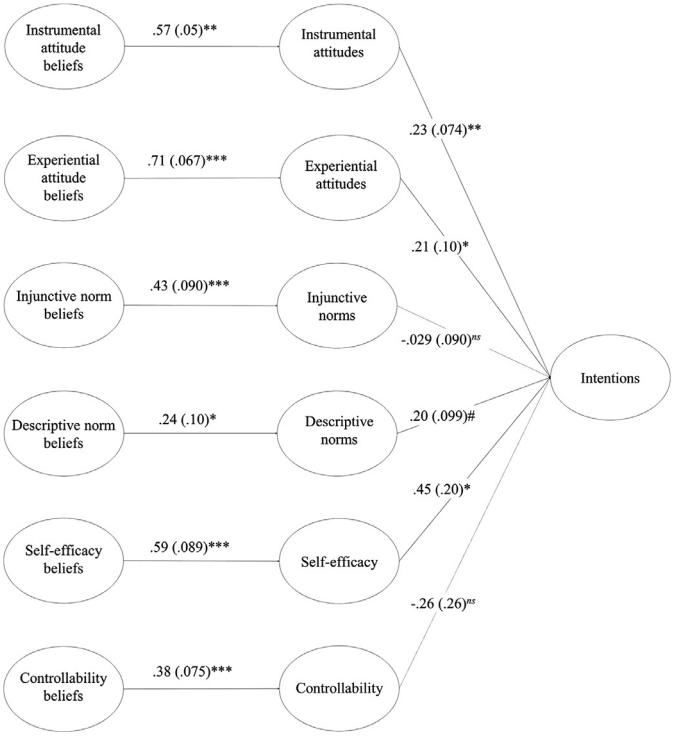

Fig. 1. Structural equation model of TPB constructs explaining intentions to prepare for natural hazards. R^2 for intentions = 0.34, * = $p < .05$, ** = $p < .01$, *** = $p < .001$, ns = $p > .05$, # = $p = .05$.

Predicting behaviour

The TPB does not hypothesise that attitude and norm components directly relate to behaviour, so these factors were not included in the following analyses. It is important to note when interpreting these results that only a relatively small sample size was available for these analyses on behaviour which was measured at Time 2. Despite the sample-size limitation, intentions to prepare positively predicted self-reported general preparation as expected, $\beta = 0.25$ ($SE = 0.10$), $p < .05$, demonstrating that those participants who had stronger intentions to prepare at Time 1 reported having done more preparation at Time 2 than those who had weaker intentions. However, when self-efficacy and controllability were included in the regression along with intentions, no factors significantly predicted behaviour ($p = .90$, 0.93, and 0.49, respectively).

Given the past focus on self-efficacy and the well-supported role this factor plays in natural hazard perceptions, a third regression tested only intentions and self-efficacy as predictors of behaviour.[1] In this regression, self-efficacy again was not significantly associated with preparation, $p = .22$. However, intentions predicted preparation, $\beta = 0.22$ ($SE = 0.096$), $p < .05$. This exploratory analysis suggests that some conceptual overlap of intentions with the controllability variable suppressed the association between intentions and behaviour, although considerable overlap in controllability and intentions would be contrary to the lack of a direct association between the two variables.

As above, intentions to prepare positively predicted the number of preparation actions undertaken, $\beta = 0.20$ ($SE = 0.088$), $p < .05$. However, and again similar to the above results, when self-efficacy and controllability were included in the regression along with intentions, no factors significantly predicted behaviour, $p = .96$, 0.96, and 0.92, respectively. When removing controllability from this regression, as for the single-item measure of behaviour, self-efficacy was again non-significant, $p = .96$, but intentions significantly predicted behaviour, $\beta = 0.20$ ($SE = 0.090$), $p < .05$.

Forty-three participants requested the earthquake planning guide and 18 declined. In contrast to the prediction, intentions to prepare alone did not significantly predict requests for the earthquake guide, $p = .83$. When self-efficacy and controllability were included in the model, intentions again did not significantly predict request behaviour, $p = .90$, nor did controllability, $p = .96$. However, self-efficacy was a significant predictor of request behaviour, Estimate = 0.002, ($SE = 0.046$), $p < .001$, such that the odds of requesting the earthquake planning guide decreased when participants had higher self-efficacy. Although this is a small effect, indicating a 1.4% difference in odds between those who scored the highest and those who scored the lowest, this finding suggests that those who see themselves as more capable of preparing for natural hazards see less need for additional information or preparing tools such as a planning guide.

Identifying beliefs

Regressions examined the direct association between belief scale items and their related cognition for the three significant explanatory components (instrumental attitudes, experiential attitudes, and self-efficacy) to identify the most important beliefs within each construct to target. Both instrumental attitude beliefs were significantly associated with instrumental attitudes: the belief that preparing will result in getting through a natural hazard event better, $\beta = 0.38$ ($SE = 0.094$), $p < .001$, and that preparing is a life-saving action, $\beta = 0.25$ ($SE = 0.068$), $p < .001$. A follow-up Wald test comparing the strength of these paths was non-significant, $p = .22$, suggesting that the two beliefs are equally important predictors of instrumental attitudes.

Similarly, both experiential attitude beliefs were significantly associated with experiential attitudes: preparing can be a fun experience, $\beta = 0.43$ ($SE = 0.095$), $p < .001$, and preparing can be a rewarding experience, $\beta = 0.31$ ($SE = 0.10$), $p < .01$. Again, the paths did not significantly differ in strength, $p = .41$. Only participants' belief that they would be able to put in the effort to prepare was significantly associated with self-efficacy, $\beta = 0.34$ ($SE = 0.13$), $p < .05$. Participants' belief that they will think about preparing was not associated with self-efficacy,

[1] This test was not run for the behaviour of requesting an earthquake-planning guide as intentions alone did not predict behaviour and therefore controllability could not have a suppressive effect.

$p = .88$. Finally, while the descriptive norm belief scale was positively associated with descriptive norms, none of the individual belief items demonstrated significant associations (p values ranged from 0.095 to 0.551), suggesting that participants form holistic perceptions of descriptive norms rather than prioritising a particular referent group.

Discussion

Preparing for natural hazards can ameliorate the personal, social and economic impacts of disasters. In this pre-registered longitudinal study, we employed and extended the Theory of Planned Behaviour (TPB) to explain intentions and predict natural hazard preparation behaviour in a general sample of residents of an earthquake-prone region (Wellington, New Zealand). As predicted, instrumental attitudes, experiential attitudes, and self-efficacy were significantly and positively associated with intentions to prepare for natural hazards while a fourth factor, perceived descriptive norms, also unexpectedly demonstrated a significant association with these intentions. The amount of variance in intentions explained by the above factors (approximately 34%) is within the range typical for TPB studies (e.g., Armitage and Conner, 2001), though is towards the low end of expected effect sizes. It is likely that the lower variance explained here than in most previous research is a result of using structural equation modelling which controls for errors associated with all items, which is not the case in the typical regression approaches used in many TPB studies.

We acknowledge that our expected response rate was optimistic, although it was based on a previous similar study and was therefore not implausible. While the small sample size at Time 2 limits the confidence of results from behaviour regressions, several findings are worth discussing. Intentions at Time 1 did not predict whether participants requested an earthquake planning guide at Time 2; however, self-efficacy did predict this behaviour, with those scoring higher being less likely to request the guide. This finding is unsurprising in that those who see themselves as more capable of preparing for natural hazards would logically be less likely to gather information on how to undertake this behaviour. The lack of association between information seeking and intentions to prepare suggests that the behaviour of information-seeking is perceived differently than the behaviour of actually undertaking preparation actions (Paton et al., 2005; Paton et al., 2001).

Another explanation for the lack of association between intentions and information-seeking is that the intention–behaviour association is less likely to be significant when the measures used are not aligned as is the case here (Ajzen, 2011). When behaviour was assessed with a continuous measure, intentions to prepare positively predicted preparation behaviour, with associations that were weak to moderate in strength. Intentions, therefore, are important to encourage in terms of increasing preparation for natural hazards. However, the well-documented intention–behaviour gap (Sniehotta et al., 2005) suggests that a second method for increasing behaviour specifically targeted at this problem would be beneficial.

Theoretical and practical implications

As well as examining cognitions and beliefs which relate to preparation for natural hazards, this research developed and tested a TPB measurement tool addressing several inconsistencies common throughout the wider literature. This study supports the use of the two-factor distinction in the cognition components of the TPB: attitudes into experiential and instrumental, norms into injunctive and descriptive, and PBC into controllability and self-efficacy. The identification of some but not all beliefs associated with the explanatory variables highlights the importance of including belief measures, especially when the aim of the research is to identify specific, targetable factors for intervention, as is the case here. This study provides a set of tested measures which can be easily adapted to different behaviours to increase the consistency between TPB studies and therefore make comparisons between these studies more meaningful. However, different salient attitude and control beliefs for each new behaviour should be ascertained at the outset and used to adapt the items employed here. Finally, the varied findings between the different behaviour measures reinforces the importance of ensuring that the intention and behaviour measures used within a study are compatible.

While the concepts of outcome expectancy and fatalism (similar to instrumental attitudes) are well supported as relevant to natural hazard preparation (Johnston et al., 2013; Lindell and Perry, 2000), this study clarifies specific aspects of these concepts that could be targeted. For example, it is useful to know that communications can convey preparing as beneficial, without having to specify particular benefits, and that communications which do specify particular benefits should include that these actions can be life-saving. Given that survival actions are undertaken at a higher rate than mitigation actions (Spittal et al., 2008), this latter finding suggests that emphasizing how steps such as strengthening the foundations of a house may save the lives of its occupants (as well as reducing damage) could be an effective way to encourage such behaviour.

In contrast with instrumental attitudes, research in the natural hazard field has not tested experiential attitudes as a predictor of preparation. While several programmes locally and internationally have aimed to make both understanding risk and preparation actions engaging for children using games (e.g., Dreaver, 2018), little research has tested the same for adults; one exception found only small benefits in knowledge of protective actions (Gampell et al., 2020). Finally, despite the finding of McClure et al. (2015) that not thinking about undertaking a particular action was one of the most common reasons for inaction, the current study found that participants' belief that they will think about preparing was not significantly associated with self-efficacy, whereas the belief that they will be able to put in the necessary effort was. It is possible that participants think about preparing generally, rather than specifically as was assessed in McClure et al. (2015), and that it is lack of willingness to put in the effort that inhibits them acting rather than not thinking about it (see also Doyle et al., 2011).

Several suggestions have been made in the literature to increase the translation of intentions into behaviour, including goal setting and implementation intentions (Ajzen, 2006; Ajzen, 2011; Hardeman et al., 2002; Gollwitzer, 1999; Riebl et al., 2015; Webb and Sheeran, 2006). These aligned concepts can be applied together (Hardeman et al., 2002), where participants break down a particular broad task such as preparing for natural hazards into smaller tasks (goal setting; Locke et al., 1981) and decide how, when, and (if relevant) where they will undertake those smaller tasks (implementation intentions; Gollwitzer, 1999). Goal setting has been used to increase preparation for earthquakes by Wellington businesses (McClure et al., 2015) and implementation intentions have been used successfully to supplement the TPB in behaviour change interventions as a way of bridging the intention–behaviour gap. For example, implementation intentions have fully mediated the effect of intentions on physical activity in the study by Sniehotta et al. (2005) and increased the effectiveness of an intervention to reduce snacking behaviour (Karimi-Shahanjarini et al., 2013). This is an important direction for future research.

Limitations

Contrary to expectations based on previous similar research, only a relatively small sample was obtained for this study. This difference is possibly due to the new method used here of providing an online link for participation rather than a paper survey and a return envelope, although no rural areas were sampled, and internet access is nearly universal across New Zealand (InternetNZ, 2017). Due to this smaller than expected sample, the data collected was underpowered to test behaviour as part of the full model. Testing the intention–behaviour association separately did not allow for a test of the proportion of variance explained in behaviour as planned in the pre-registration. This low response rate

also increases the likelihood of a self-selection bias, as potentially participants with strongly positive or strongly negative views of preparing were more motivated to take part in the study.

This study used postal recruitment to select a random sample from the population. The sample had a gender ratio accurately reflecting the Wellington population, but minority ethnicity groups were underrepresented. However, the overall purpose of this research is to inform a non-targeted intervention and demographic variables typically appear to have weak effects on risk perception and preparation (Becker et al., 2015).

TPB studies tend to use self-report measures of behaviour (e.g., Hardeman et al., 2002) which are open to biases such as social desirability (van de Mortel, 2008), as such data are typically easier, quicker, and cheaper to collect (Ajzen, 2002). Findings on how behavioural measurement affects the intention–behaviour relationship are conflicting, with some showing a stronger association for self-report measures (Armitage and Conner, 2001; McEachan et al., 2011) and others showing a stronger association for objective measures (Webb and Sheeran, 2006). Although this study uses self-report, several aspects of the method address the inherent limitations of this method. First, Ajzen (2002) suggests that one way to improve the validity of self-report behaviour measures is to use multiple items. It is likely that individuals will be better at accurately reporting whether they have stored water than how many times in the past month they have eaten fruit, for example. Second, the behavioural item offering an earthquake-planning guide is a more objective measure of behaviour than self-report.

Strengths

This study has several strengths in statistical, theoretical, and practical respects. First, the use of structural equation modelling to test how the TPB cognitions explain the variance in intentions allows for more confidence in the findings than if regression models had been used (Ajzen, 2011; Topa and Moriano, 2010), although this test would ideally have included behaviour had the data been sufficiently powered. Second, inconsistencies in how behaviour is measured, both within and across TPB studies, likely contributes to conflicting findings. For example, the association between intentions and behaviour has been found to be both weaker (Webb and Sheeran, 2006) and stronger (Armitage and Conner, 2001) when the behaviour measure is self-report. Though Ajzen (2011) argues that the intentions and behaviour measures should be compatible within studies, this recommendation is not applied in all TPB studies. The inclusion of three different behaviour measures, then, presents a significant strength of this study.

Although the multi-item behaviour measure is self-report, it assesses objective actions rather than a holistic judgement as is required in the single-item behaviour measure. Consistent with findings from Armitage and Conner's (2001) meta-analysis showing that self-report measures demonstrate stronger associations than objective measures, intentions predicted the single-item behaviour measure better than the multi-item behaviour measure. It is possible, however, that this small difference in paths is due to the single-item behaviour measure being more similar to the intentions measure (i.e., response on a 7-point scale, referring to the behaviour generally). While these two potential explanations cannot be tested here, the differences in associations found in this study support the careful evaluation and future exploration of the role of behaviour measure construction.

In addition, this study tests the full TPB model, including behaviour, all proposed subcomponents, the level of antecedent beliefs, and the two-factor distinction at that belief level. In addition, although the dataset did not provide sufficient power to test this full model with all variables included at once, this study demonstrates that it is feasible to present all necessary items in a single study. Using the full model in this way allows for the identification of which attitudes, norms, and control perceptions are relevant to intentions and behaviour, and goes beyond testing broad concepts such as outcome expectancy (i.e., instrumental attitudes) and self-efficacy to include specific relevant beliefs which can be more easily and directly targeted in public education campaigns. Previous research using the TPB suggests that behaviour change interventions to target specific beliefs are more effective than interventions to target the cognitions broadly (e.g., Ajzen, 2011; Darker et al., 2007; Elliott and Armitage, 2009; Hardeman et al., 2002).

In conclusion, this study demonstrates that instrumental attitudes, experiential attitudes, self-efficacy, and descriptive norms meaningfully relate to intentions to prepare for natural hazards. In relation to the aim of suggesting factors for a behaviour change campaign to target, five beliefs were found to be important: the belief that preparing (1) will get the individual through a hazard event better, (2) is a life-saving action, (3) can be fun, (4) can be rewarding, and (5) is an effort of which they are capable. The findings here present potential ways to increase the effectiveness of public education campaigns and interventions to increase natural hazard preparation.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Ajzen, I., 1991. The Theory of Planned Behavior. Organ. Behav. Hum. Decis. Process. 50, 179–211. doi:10.1016/0749-5978(91)90020-T.

Ajzen, I., 2002. Perceived behavioral control, self-efficacy, locus of control, and the Theory of Planned Behavior. J. Appl. Soc. Psychol. 32, 665–683. doi:10.1111/j.1559-1816.2002.tb00236.x.

Ajzen, I. (2006). Behavioral interventions based on the Theory of Planned Behaviour [PDF file]. Retrieved from http://people.umass.edu/aizen/pdf/tpb.intervention.pdf

Ajzen, I., 2011. Behavioral interventions: design and evaluation guided by the Theory of Planned Behavior. In: Mark, M.M., Donaldson, S.I., Campbell, B. (Eds.), Social Psychology and Evaluation. Guilford Press, New York, US, pp. 72–101.

Ajzen, I. (2013). Constructing a Theory of Planned Behavior questionnaire [PDF file]. Retrieved from: http://www.midss.org/sites/default/files/tpb.construction.pdf

Ajzen, I., Madden, T.J., 1986. Prediction of goal-directed behavior: attitudes, intentions, and perceived behavioral control. J. Exp. Soc. Psychol. 22, 453–474. doi:10.1016/0022-1031(86)90045-4.

Armitage, C.J., Conner, M., 1999. Distinguishing perceptions of control from self-efficacy: predicting consumption of a low fat diet using the Theory of Planned Behaviour. J. Appl. Soc. Psychol. 29, 72–90. doi:10.1111/j.1559-1816.1999.tb01375.x.

Armitage, C.J., Conner, M., 2001. Efficacy of the Theory of Planned Behaviour: a meta-analytic review. Br. J. Soc. Psychol. 40, 471–499.

Bates, B.R., Quick, B.L., Kloss, A.A., 2009. Antecedents of intention to help mitigate wildfire: implications for campaigns promoting wildfire mitigation to the general public in the wildland-urban interface. Saf. Sci. 47, 374–381. doi:10.1016/j.ssci.2008.06.002.

Beatson, R., McLennan, J., 2011. What applied social psychology theories might contribute to community bushfire safety research after Victoria's "Black Saturday". Aust. Psychol. 46, 171–182. doi:10.1111/j.1742-9544.2011.00041.x.

Becker, J.S., Paton, D., Johnston, D.M. (2015). Communication of risk: a community resilience perspective. *GNS Science Report* 2015/66. 30 p.

Becker, J., Paton, D., Johnston, D., Ronan, K., 2014. Societal influences on earthquake information meaning-making and household preparedness. Int. J. Mass Emerg. Disasters 32 (2), 317–352.

Boomsma, A., 1985. Nonconvergence, improper solutions, and starting values in LISREL maximum likelihood estimation. Psychometrika 50, 229–242. doi:10.1007/BF02294248.

Bourque, L., 2013. Household preparedness and mitigation. Int. J. Mass Emerg. Disasters 31 (3), 360–372.

Brown, C., McDonald, G., Uma, S.R., Smith, N., Sadashiva, V., Buxton, R., … Daly, M., 2019. From physical disruption to community impact: modelling a Wellington Fault earthquake. *Australas. J. Disaster Trauma Stud.* 23 (2), 65–76.

Cialdini, R.B., Reno, R.R., Kallgren, C.A., 1990. A focus theory of normative conduct: recycling the concept of norms to reduce littering in public places. J. Pers. Soc. Psychol. 58 (6), 1015–1026.

Darker, C.D., French, D.P., Longdon, S., Morris, K., Eves, F.F., 2007. Are beliefs elicited biased by question order? A Theory of Planned Behaviour belief elicitation study about walking in the UK general population. Br. J. Health Psychol. 12, 93–110. doi:10.1348/135910706x100458.

Dillman, D.A., Smyth, J.D., Christian, L.M., 2014. Internet, phone, mail, and Mixed Mode surveys: The Tailored Design Method. John Wiley & Sons, Hoboken, NJ.
Doyle, E.E.H., Johnston, D.M., McClure, J., Paton, D, 2011. The communication of uncertain scientific advice during natural hazard events. NZ. J. Psychol. 40, 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. *Int. J. Disaster Risk Reduct.* 31, 637–649. doi:10.1016/j.ijdrr.2018.07.008.
Duval, T.S., Mulilis, J., 1999. A Person-relative-to-Event (PrE) approach to negative threat appeals and earthquake preparedness: a field study. J. Appl. Soc. Psychol. 29, 495–516. doi:10.1111/j.1559-1816.1999.tb01398.x.
Ejeta, L.T., Ardalan, A., Paton, D., 2015. Application of behavioral theories to disaster and emergency health preparedness: a systematic review. PLOS Curr. Disasters doi:10.1371/currents.dis.31a8995ced321301466db400f1357829.
Elliott, M.A., Armitage, C.J., 2009. Promoting drivers' compliance with speed limits: testing an intervention based on the Theory of Planned Behaviour. Br. J. Psychol. 100, 111–132. doi:10.1348/000712608x318626.
Fischer, R., Karl, J.A., Fischer, M.V., 2019. Norms across cultures: a cross-cultural meta-analysis of norms effects in the Theory of Planned Behavior. J. Cross Cult. Psychol. 50, 1112–1126. doi:10.1177/0022022119846409.
Francis, J.J., Eccles, M.P., Johnston, M., Walker, A., Grimshaw, J., Foy, R., … Bonetti, D., 2004. Constructing Questionnaires Based On the Theory of Planned Behaviour: A manual For Health Services Researchers. Centre for Health Services Research, Newcastle Upon Tyne, UK.
Gampell, A.V., Gaillard, J.C., Parsons, M., Le Dé, L., 2020. Exploring the use of the Quake Safe House video game to foster disaster and disaster risk reduction awareness in museum visitors. Int. J. Disaster Risk Reduct. 49, 101670. doi:10.1016/j.ijdrr.2020.101670.
Dreaver, C. (2018, August 5). In case of emergency: Children map community using Lego and Minecraft. Radio New Zealand. Retrieved from https://www.rnz.co.nz/news/national/363368/in-case-of-emergency-children-map-community-using-lego-and-minecraft
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 Restaur. Adm. Q. 48 (2), 145–150.
Gollwitzer, P.M., 1999. Implementation intentions: strong effects of simple plans. Am. Psychol. 54, 493–503. doi:10.1037/0003-066X.54.7.493.
Guo, J.L., Wang, R.N., Liao, J.Y., Huang, C.M., 2016. Efficacy of the Theory of Planned Behavior in predicting breastfeeding: meta-analysis and structural equation modeling. Appl. Nurs. Res. 29, 37–42. doi:10.1016/j.apnr.215.03.016.
Hamann, K.R.S., Reese, G., Seewald, D., Loeschinger, D.C, 2015. Affixing the theory of normative conduct (to your mailbox): injunctive and descriptive norms as predictors of anti-ads sticker use. J. Environ. Psychol. 44, 1–9. doi:10.1016/j.envp.2015.08.003.
Hardeman, W., Johnston, M., Johnston, D., Bonetti, D., Wareham, N., Kinmonth, A.L., 2002. Application of the Theory of Planned Behaviour in behaviour change interventions: a systematic review. Psychol. Health 17, 123–158. doi:10.1080/08870440290013644a.
Hewitt, A.M., Stephens, C., 2007. Healthy eating among 10 –13-year-old New Zealand children: understanding choice using the Theory of Planned Behaviour and the role of parental influence. Psychol. Health Med. 12, 526–535. doi:10.1080/13548500601164396.
InternetNZ. (2017). State of the Internet 2017 [PDF file]. Retrieved from https://internetnz.nz/state-internet-report-2017
Johnston, D., Becker, J., McClure, J., Paton, D., McBride, S., Wright, K., … Hughes, M., 2013. Community understanding of, and preparedness for, earthquake and tsunami risk in Wellington, New Zealand. In: Joffe, H., Rossetto, T., Adams, J. (Eds.), Cities at risk: Living with Perils in the 21st Century. Springer, pp. 131–148. doi:10.1007/978-94-007-6184-1_8.
Karimi-Shahanjarini, A., Rashidian, A., Omidvar, N., Majdzadeh, R., 2013. Assessing and comparing the short-term effects of TPB only and TPB plus implementation intentions interventions on snacking behavior in Iranian adolescent girls: a cluster randomized trial. Am. J. Health Promot. 27 (3), 152–161. doi:10.4278/ajhp.110311-QUAN-113.
Khan, S., Crozier, M.J., Kennedy, D., 2012. Influences of place characteristics on hazards, perception and response: A case study of the hazardscape of the Wellington Region, New Zealand. Nat. Haz. 6, 501–529. doi:10.1007/s11069-012-0091-y.
Kredenster, M.S., Fabrigar, L.R., Smith, S.M., Fulton, K., 2012. Following what people think we should do versus what people actually do: elaboration as a moderator of the impact of descriptive and injunctive norms. Soc. Psychol. Personal. Sci. 3 (3), 341–347. doi:10.1177/1948550611420481.
Lindell, M.K., Perry, R.W., 2000. Household adjustment to earthquake hazard: a review of research. Environ. Behav. 32, 590–630. doi:10.1177/001391600219726.
Lindell, M.K., Perry, R.W., 2012. The Protective Action Decision Model: theoretical modifications and additional evidence. Risk Anal. 32, 616–632. doi:10.1111/j.1539-6924.2011.01647.x.
Lindell, M.K., Whitney, D.J., 2000. Correlates of seismic hazard adjustment adoption. Risk Anal. 20, 13–25. doi:10.1111/0272-4332.00002.
Locke, E.A., Shaw, K.N., Saari, L.M., Latham, G.P., 1981. Goal setting and task performance: 1969-1980. Psychol. Bull. 90, 125–152. doi:10.1037/0033-2909.90.1.125.
Manning, M., Bettencourt, B.A., 2011. Depression and medication adherence among breast cancer survivors: bridging the gap with the Theory of Planned Behaviour. Psychol. Health 26, 1173–1187. doi:10.1080/08870446.2010.542815.
McClure, J., Spittal, M.J., Fischer, R., Charleson, A., 2015. Why do people take fewer damage mitigation actions than survival actions? Other factors outweigh cost. Nat. Hazards Rev. 16 (2), 1–8. doi:10.1061/(ASCE)NH.1527-6996.0000152.
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. Australas. J. Disaster Trauma Stud. 2011 (1), 3–10.
McEachan, R.R.C., Conner, M., Taylor, N.J., Lawton, R.J, 2011. Prospective prediction of health-related behaviours with the Theory of Planned Behaviour: a meta-analysis. Health Psychol. Rev. 5 (2), 97–144. doi:10.1080/17437199.2010.521684.
McDermott, M.S., Oliver, M., Simnadis, T., Beck, E.J., Coltman, T., Iverson, D., … Sharma, R., 2015. The Theory of Planned Behaviour and dietary patterns: a systematic review and meta-analysis. *Prev. Med.* 81, 150–156. doi:10.1016/j.ypmed.2015.08.020.
McIvor, D., Paton, D., 2007. Preparing for natural hazards: normative and attitudinal influences. Disaster Prev. Manag. 16, 79–88. doi:10.1108/09653560710729839.
McMillan, B., Conner, M., Green, J., Dyson, L., Renfrew, M., Woolridge, M., 2009. Using an extended Theory of Planned Behaviour to inform interventions aimed at increasing breastfeeding uptake in primiparas experiencing material deprivation. Br. J. Health Psychol. 14, 379–403. doi:10.1348/135910708x336112.
Morrison, D., Lawrence, C., Oehmen, R., 2014. Community Level Influence On Individual Behaviours. Bushfire CRC, Australia.
Mulilis, J., Duval, T.S., Lippa, R., 1990. The effects of a large destructive local earthquake on earthquake preparedness as assessed by an Earthquake Preparedness Scale. Nat. Hazards 3, 357–371. doi:10.1007/BF00124393.
Muthén, L.K., Muthén, B.O., 1998–2017. Mplus User's Guide. Eighth Edition. Muthén & Muthén, Los Angeles, CA.
Najafi, M., Ardalan, A., Akbarisari, A., Noorbala, A.A., Elmi, H., 2017. The Theory of Planned Behaviour and disaster preparedness. PLoS Curr. Disaste.s doi:10.1371/currents.dis.4da18e0f1479bf6c0a94b29e0dbf4a72.
Najafi, M., Khankeh, H.R., Elmi, H., Pourvakhshoori, N., 2018. Behavioral, normative and control beliefs about earthquake preparedness: a deductive content analysis study. PLoS Curr 10, 17. doi:10.1371/currents.dis.20fbad29d53fb164ac2699dc2736d804.
Ozaki, T., Nakayachi, K., 2015. Effects of descriptive norms and mutual relationships on precautionary behavior toward earthquakes. Jpn. J. Soc. Psychol. 30 (3), 175–182. doi:10.14966/jssp.30.3_175.
Paton, D., 2013. Disaster resilient communities: developing and testing an all-hazards theory. J. Integr. Disaster Risk Manag. 3, 1–17. doi:10.5595/idrim.2013.0050.
Paton, D., Anderson, E., Becker, J., Peterson, J., 2015. Developing a comprehensive model of hazard preparedness: Lessons from the Christchurch earthquake. Int. J. Disaster Risk Reduct. 14, 37–45. doi:10.1016/j.ijdrr.2014.11.011.
Paton, D., Buergelt, P., 2019. Risk, transformation and adaptation: ideas for reframing approaches to disaster risk reduction. Int. J. Environ. Res. Public Health 16, 2594–2612. doi:10.3390/ijerph16142594.
Paton, D., Johnston, D., Smith, L., Millar, M., 2001. Responding to hazard effects: promoting resilience and adjustment adoption. Aust. J. Emerg. Manag. 16 (1), 47–52.
Paton, D., Sagala, S., Okada, N., Jang, Ll-J., Buergelt, P., Gregg, C.E., 2010. Making sense of natural hazard mitigation: personal, social and cultural influences. Environ. Hazards 9, 183–196. doi:10.3763/ehaz.2010.0039.
Paton, D., Smith, L., Johnston, D., 2005. When good intentions turn bad: promoting natural hazard preparedness. Aust. J. Emerg. Manag. 20, 25–30.
Potter, S.H., Becker, J.S., Johnston, D.M., Rossiter, K.P., 2015. An overview of the impacts of the 2010-2011 Canterbury earthquakes. Int. J. Disaster Trauma Stud. 14, 6–14. doi:10.1016/j.ijdrr.2015.01.014.
Richetin, J., Conner, M., Perugini, M., 2011. Not doing is not the opposite of doing: implications for attitudinal models of behavioral predictions. Personal. Soc. Psychol. Bull. 37, 40–54. doi:10.1177/0146167210390522.
Riebl, S.K., Estabrooks, P.A., Dunsmore, J.C., Savla, J., Frisard, M.I., Dietrick, A.M., … Davy, B.M., 2015. A systematic literature review and meta-analysis: the theory of planned behavior's application to understand predict nutrition-related behaviors in youth. *Eat. Behav.* 18, 160–178. doi:10.1016/j.eatbeh.2015.05.016.
Rowney, C., Farvid, P., Sibley, C.G., 2014. "I laugh and say I have 'Earthquake Brain!'": resident responses to the September 2010 Christchurch earthquake. NZ. J. Psychol. 43 (2), 4–13.
Sanquini, A.M., Thapaliya, S.M., Wood, M.M., 2016. A communications intervention to motivate disaster risk reduction. Disaster Prev. Manag. 25, 245–259. doi:10.1108/DPM-11-2015-0256.
Satherley, N., Milojev, P., Greaves, L.M., Huang, Y., Osborne, D., Bulbulia, J., Sibley, C.S., 2015. Demographic and psychological predictors of panel attrition: evidence from the New Zealand Attitudes and Values Study. PLoSONE 10 (3), e0121950. doi:10.1371/journal.pone.0121950.
Si, H., Shi, J., Tang, D., Wen, S., Miao, W., Duan, K., 2019. Application of the Theory of Planned Behavior in environmental science: a comprehensive bibliometric analysis. Int. J. Environ. Res. Public Health 16 (15), 1–26. doi:10.3390/ijerph16152788.
Smith, N. (2015, May 10). More targeted approach to earthquake-prone buildings. Retrieved from http://www.beehive.govt.nz/release/more-targeted-approach-earthquake-prone-buildings
Sniehotta, F.F., Scholz, U., Schwarzer, R., 2005. Bridging the intention–behaviour gap: planning, self-efficacy, and action control in the adoption and maintenance of physical exercise. Psychol. Health 20, 143–160. doi:10.1080/08870440512331317670.
Solberg, C., Rossetto, T., Joffe, H., 2010. The social psychology of seismic hazard adjustment: re-evaluating the international literature. Nat. Haz. Earth. Syst. Sci. 10, 1663–1677. doi:10.5194/nhess-10-1663-2010, 2010.
Spittal, M.J., McClure, J., Siegert, R.J., Walkey, F.H., 2008. Predictors of two types of earthquake preparation: survival activities and mitigation activities. Environ. Behav. 40 (6), 798–817. doi:10.1177/0013916507309864.
Spittal, M.J., Walkey, F.H., McClure, J., Siegert, R.J., Ballantyne, K., 2006. The Earthquake Readiness Scale: the development of a valid and reliable unifactorial measure. Nat. Hazard. 39, 15–29. doi:10.1007/s11069-005-2369-9.
Tanner Jr., J.F., Day, E., Crask, M.R, 1989. Protection motivation theory: an extension of fear appeals theory in communication. J. Bus. Res. 19, 267–276. doi:10.1016/0148-2963(89)9008-8.

Tippett, M.K., 2018. Extreme weather and climate. Clim. Atmos. Sci. 1, 1–2. doi:10.1038/s41612-018-0057-1.

Topa, G., Moriano, J.A., 2010. Theory of planned behavior and smoking: meta-analysis and SEM model. Subst. Abuse Rehabil. 1, 23–33. doi:10.2147/SAR.S15168.

van de Mortel, T.F., 2008. Faking it: social desirability response bias in self-report research. Aust. J. Adv. Nurs. 25 (4), 40–48.

Vinnell, L.J., 2020. Why Do People Prepare For Natural hazards? An application of the Theory of Planned Behaviour to Household Preparation. [Doctoral thesis, Victoria University of Wellington]. ResearchArchive http://hdl.handle.net/10063/9157.

Vinnell, L.J., McClure, J., Milfont, T.L., 2017. Do framing messages increase support for earthquake legislation? Disaster Prev. Manag. 26, 28–40. doi:10.1108/DPM-06-2016-0127.

Vinnell, L.J., Milfont, T.L., McClure, J., 2018. Do social norms affect support for earthquake strengthening legislation? Comparing the effects of descriptive and injunctive norms. Environ. Behav. 51, 376–400. doi:10.1177/0013916517752435.

Vinnell, L.J., Orchiston, C., Becker, J., Johnston, D., 2019. Pathways to earthquake resilience: learning from past events. Australas. J. Disaster Trauma Stud. 23 (2), 35–40.

Wallemacq, P., House, R., 2018. Economic losses, Poverty & disasters: 1998-2017. United Nations Office for Disaster Risk Reduction.

Webb, T.L., Sheeran, P., 2006. Does changing behavioral intentions engender behaviour change? A meta-analysis of the experimental evidence. Psychol. Bull. 132, 249–268. doi:10.1037/0033-2909.132.2.249.

George, D. (2017, March 24). Major earthquake could split Wellington region into 'seven islands'. Stuff. Retrieved from https://www.stuff.co.nz/national/nz-earthquake/90790889/major-earthquake-could-split-wellington-region-into-seven-islands

Wellington Region Emergency Management Office. (n.d.). Earthquake planning guide [PDF file]. Retrieved from https://wremo.nz/assets/Publications/Earthquake-Planning-Guide.pdf

White, K.M., Smith, J.R., Terry, D.J., Greenslade, J.H., McKimmie, B.M., 2009. Social influence in the Theory of Planned Behaviour: the role of descriptive, injunctive, and in-group norms. Br. J. Social Psychol. 48, 135–158. doi:10.1348/014466608x295207.

Wolf, E.J., Harrington, K.M., Clark, S.L., Miller, M.W., 2013. Sample size requirements for structural equation models: an evaluation of power, bias, and solution propriety. Educ. Psychol. Meas. 76, 913–934. doi:10.1177/0013164413495237.