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**Developing a model to predict the adoption of natural hazard risk reduction and preparatory adjustments**

*Douglas Paton,School of Psychology, University of Tasmania and IGNS; Leigh Smith,Curtin University, Western Australia; David Johnston, IGNS; Malcolm Johnston, University of Auckland; Kevin Ronan, Massey University*

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**EQC Research Project No. 01-479**

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**Douglas Paton**[1]
School of Psychology, University of Tasmania, Launceston, Tasmania, Australia
and
Institute of Geological and Nuclear Sciences, Lower Hutt, New Zealand

**Leigh Smith**
Curtin University, Western Australia

**David Johnston**
Institute of Geological and Nuclear Sciences, Lower Hutt, New Zealand

**Malcolm Johnston**
University of Auckland

**Kevin Ronan**
Massey University

[1] All correspondence regarding this report should be directed to Dr Douglas Paton

## Contents

## Abstract

Despite considerable effort and expenditure on public hazard education, levels of disaster preparedness remain low. By integrating and expanding on natural hazards and health research on protective behaviour, this research project developed and tested a social cognitive model of disaster preparedness. This model provides insights into the complexity of the preparedness process and identifies a need for risk communication and risk reduction strategies undertaken to facilitate earthquake preparedness to address a wider range of variables than has previously been the norm.

Following their critical appraisal, variables implicated at each stage are identified and their role in the preparedness process described. The model describes a developmental process that commences with factors that motivate people to prepare, progresses through the formation of intentions, and culminates in decisions to prepare. The model describes how three factors, critical awareness of earthquake issues, risk perception, and earthquake anxiety, motivate people to think about earthquake preparedness. If these variables are present at adequate levels, a person will progress to the next phase, forming intentions to adopt. The formation of intentions to prepare is influenced by the prevailing levels of a different set of variables. These are outcome expectancy, self-efficacy and action coping.

An unexpected outcome of the research was the finding of two intention factors, 'intention to prepare' and 'intention to seek information'. Only the former predicted actual adjustment adoption. Two moderator variables were identified. The perceived timing of the next damaging earthquake moderated the intention to prepare – adoption link. Perceived trust moderated the intention to seek information – adoption link.

The discrete nature of the intention variables suggests that a) preparing versus not preparing do not lie at opposite ends of a continuum and b) people's reasoning about preparedness and their reasoning about not preparing must be conceptualised and managed separately. The implications of the model for the conceptualisation and assessment of preparedness is discussed, as is its implications for risk reduction and communication strategies.

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## INTRODUCTION

Central to contemporary emergency planning is the use of risk management principles to promote resilience to natural (and other) hazards. Resilience is a multi-level construct. This project is concerned with resilience at the individual-community level. At this level, resilience describes the capacity of individuals and communities to maintain or regain prior levels of functioning following significant disruption by hazard activity and/or to adjust to changes emanating from hazard activity using resources intrinsic to these systems (Paton, 2000; Paton, Violanti, & Smith, 2003). Accordingly, at the individual-community level, natural hazard resilience can be summarised as comprising two elements.

One relates to the existence of resources capable of being drawn upon to facilitate adaptation and for dealing with the disruption and loss associated with hazard activity. The second concerns the systems, competencies and characteristics required by people and communities to actually use these resources to adapt or adjust to the circumstances posed by hazard activity. This research project is concerned primarily with developing an understanding of factors that influence the former, the adoption of household adjustment or preparedness measures. This issue is important in two general respects.

Firstly, and most importantly, the adoption of adjustments or preparatory measures (e.g., storing food & water, securing high furniture and hot water cylinders, preparing a household emergency plan) reduces the risk of loss and injury within a given household. Adjustment adoption also facilitates a capability for coping with the temporary disruption associated with hazard activity, and minimises damage and insurance costs. Secondly, substantial funds are expended annually on risk communication programs intended to facilitate hazard preparedness. From an administrative perspective, an interest in ensuring a return on investment (e.g., reduction in household members' reliance on external agencies, reduced insurance pay-outs for earthquake damage) is expected following any program that involves public expenditure. Achieving this return on investment requires that risk reduction

initiatives are effective both in promoting adjustment adoption and, given an environment characterised by infrequent hazard activity, in maintaining this state of readiness over time.

Risk communication initiatives typically assume that providing members of the public with information on hazards and how to mitigate their consequences will encourage the adoption of preparedness measures and behaviours (Smith, 1993). This assumption is, however, unfounded (Ballantyne et al., 2000; Duvall & Mulilis, 1999; Lindell & Whitney, 2000; McClure, Walkey, & Allen, 1999; Mulilis & Duvall, 1995; Paton et al., 2000). Despite considerable efforts and expenditure on public hazard education over several years, levels of preparedness remain low. Indeed, public hazard education programs may actually reduce perceived risk and levels of preparedness (Ballantyne at al., 2000; Johnston et al., 1999). Furthermore, risk perceptions per se represent a poor predictor of natural hazard preparedness (Ballantyne et al., 2000; Lindell & Whitney, 2000; McClure, Walkey, & Allen, 1999; Paton et al., 2000; Paton et al,.2001).

Recognition of this situation has highlighted a need for additional research into the factors that motivate hazard preparedness. It has also called into question the effectiveness of public education strategies based primarily on the provision of information. A core objective of this project is to increase understanding of the adjustment adoption process, and to do so in a manner capable of contributing to the development of effective risk reduction strategies. It will do so by conceptualising adjustment adoption as a social cognitive process.

### *Social cognitive processes and their role in risk reduction*

The substantial discontinuity between peoples' hazard knowledge and associated risk beliefs and their level of adoption of adjustments or preparedness measures suggests that there exist additional interpretative and motivational processes that influence whether a threat is accepted to the point where a person acts to reduce this risk (Paton, 2000). Generally, awareness-based programs fail to accommodate these influences.

Parallels between the problems evident here and those unearthed in studies concerned with promoting the adoption of health protective behaviours provide promising avenues

for further research into understanding hazard preparedness. In particular, work done on health promotion suggests that preparedness is facilitated by moving from a focus on the antecedents of behaviour (in this case risk perception) to the cognitive processes that underpin behaviour change and its maintenance over time.

Models with proven utility in predicting the adoption of preventative health behaviours, such as the theory of planned behaviour and protection motivation theory (Abraham et al., 1998; Bennett & Murphy, 1997; Jones et al., 1997), provide a theoretically robust basis for developing models of natural hazard preparedness. A theoretically rigorous approach is essential for:

- developing a framework capable of promoting individual and community resilience to and preparedness for hazard effects;
- constructing effective risk reduction intervention strategies; and
- developing key performance indicators for evaluating intervention and risk communication effectiveness.

In regard to the variables identified in health research, natural hazards research has both reinforced their potential to influence preparedness (Bishop et al., 2000; Duval & Mulilis, 1999; Lindell & Whitney, 2000; Paton, 2000; Paton et al., 2000; Paton et al., 2001), and identified several additional social cognitive variables capable of playing a role in this process. For example, Mulilis and Duvall (1995) and Duvall and Mulilis (1999), using their Person Relative to Event model (PrE - derived from protection motivation theory and Lazarus and Folkman's (1984) coping process model), demonstrated the potential benefits of more complex social-cognitive models for understanding natural hazard preparedness. Similarly, Bishop et al. (2000) and Paton et al. (2001) demonstrated the potential of models utilising social cognitive variables models to assist understanding of community preparedness and resilience to natural hazard (salinity and volcanic ash fall respectively) effects.

## OBJECTIVES

The principle objective of this project is to develop and test an instrumental model of adjustment adoption capable of assisting both future research and the formulation of

practical risk communication strategies. It will do so by modelling variables that have an established predictive validity and that are amenable to manipulation through intervention strategies at individual and community levels. In addition, hazard preparedness will be modelled as a developmental process. The principle objectives of this study are to:

1. Develop and test a model predicting personal natural hazard adjustment adoption;
2. Develop measures capable of acting as key performance indicators for assessing preparedness and evaluating intervention effectiveness; and
3. Provide guidelines for developing risk communication strategies to assist the development of risk reduction strategies that facilitate natural hazard preparedness and resilience.

## MODEL DEVELOPMENT and SELECTION OF VARIABLES

For this study, the hazard selected was earthquakes. Several factors render earthquakes an appropriate hazard for this study. First, and foremost, the fact that earthquakes occur without warning, makes high levels of preparedness of paramount importance. Secondly, the ubiquitous nature of earthquake vulnerability over large areas of New Zealand facilitates the selection of study areas with objective and comparable susceptibility to earthquakes (Table 1).

The first stage of the project involved the selection of variables that could constitute a model of the adjustment adoption process. While evidence of their influence on adjustment adoption has been furnished for each of the variables examined here separately, or in limited combination, their collective influence on preparedness remains to be determined.

### *Methodological issues*

Variables were selected on the following grounds:

1. They had demonstrated a capability to influence preparedness individually (with this study being the first to examine their collective influence), and
2. The selected variables could be used to guide intervention development at individual and household levels.

Other variables, particularly personality factors and social norms, have been implicated in this context. However, given that these variables are less amenable to change, a decision was made to focus attention initially on the development of a more instrumental model. Once a valid model is developed, the additional contribution of, for example, personality and normative variables, can then be examined. The latter variables will provide important information in regard to the manner in which risk communication messages must be tailored to accommodate individual needs and the contextual factors existing within a given area.

Several measures had been used in natural hazard research. Variables falling into this category were self-efficacy, action coping, critical awareness, response efficacy, sense of community, perceived risk, and earthquake preparedness. For measures that did not already exist, the procedure recommended by Anderson and Gerbing (1991) was used to guide development. This process began with the small-scale intensive examination of potential scale items garnered from the literature and constructed to capture the meaning of the constructs to be assessed.

Using the method suggested by Anderson and Gerbing the provisional item sets were tested for face validity and reduced to potentially unidimensional item sets. Tests of face validity were conducted using focus groups convened for this purpose. These item sets were then tested on a large-scale sample and their psychometric properties determined. Iterative confirmatory factor analysis was employed to produce psychometrically sound unidimensional measures of the constructs (Fleishman & Benson, 1987). The procedure described by Werts et al. (1978) was used to determine the unit-weighted and maximum reliabilities of these construct scales.

Measures that have not been developed specifically for natural hazard research were outcome expectancy, intention and earthquake anxiety. However, measures of "outcome expectancy" and "intention" were available from the health psychology literature (Bennett & Murphy, 1997) and were adapted for use in this study. No measure of earthquake anxiety was available and one was developed specifically for use in this study (see below). This process commenced with an examination of potential scale items from the literature. These were constructed to capture the meaning of the constructs being assessed. In

addition, demographic data on age, gender, income and geographical locality were also collected (appendix 1).

## Selection of Variables

The principle objective of this study was to develop an instrumental model of earthquake preparedness. Existing theoretical and empirical work suggests that the preparedness process will comprise variables that fall into three categories. This first concerns the factor or factors that initially motivate people to prepare (precursor variables). The second concerns the variables that lead to the formation of preparedness intentions. The third group comprises those variables that could moderate the relationship between preparatory intentions and actual preparedness.

### *Precursor variables*

Consistent with both the theoretical and empirical work upon which the present research is based, and existing approaches to public hazard education, it is proposed that risk perception represents an important precursor variable (Johnston et al., 1999; Lindell & Perry, 1992; Weinstein et al, 2000).

However, the existence of two additional precursor variables is postulated here. One is derived from the community psychology literature, and the other concerns earthquake anxiety. In the course of researching the manner in which community members respond to adverse circumstances, the concept of Critical Awareness (Dalton et al., 2001; Seedat, 2001) has been identified as an important precursor. This variable describes the extent to which people think and talk about a specific source of adversity or hazard within their environment. Lindell and Whitney (2000) advocated the inclusion of a similar variable. However, their recommendation was based on a measure of traumatic stress symptomatology, intrusiveness, that is symptomatic of the subconscious processing of discordant information following a traumatic experience. In contrast, Dalton et al. (2001) describe a process that prevails under normal, and pre-disaster, circumstances that involves conscious reasoning about issues people perceive as critical or salient. Critical Awareness, using the measure described by Dalton et al. (2001) is included as a precursor in this study.

Anxiety about earthquakes has been proposed as a factor capable of reducing the likelihood that people will prepare themselves to deal with their consequences (Duvall & Mulilis, 1999; Lamontagne & LaRochelle, 2000). The finding that some 20% of a New Zealand sample responded to a survey investigating general anxieties stating some level of earthquake anxiety (Johnston, 2000) prompted the inclusion of this variable in the present study. The lack of any systematic study of earthquake anxiety and the lack of any appropriate instrument necessitated the development of a scale for this research. A preliminary set of items were developed (M. Johnston).

***Intention Formation Variables***

Models developed to explain the adoption of preventative behaviour for health related threats found that **intentions** are a key indicator of the adoption of preventative behaviour (Abraham et al., 1998; Ajzen, 1991; Ajzen, 1998; Bagozzi, 1992; Bennett & Murphy, 1997; Conner & Norman, 1996; Godin & Kok, 1996; Gollwitzer, 1993; Jones et al., 1997). Social cognitive models propose that **outcome expectancies** (perceptions of whether personal actions will effectively mitigate or reduce a problem) and **self-efficacy** (beliefs regarding personal capacity to act effectively) are prominent precursors of intention formation, and of the subsequent attainment of behavioural goals (Abraham et al., 1998; Ajzen, 1991; Bagozzi & Edwards, 1998; Bandura, 1992; Bennett & Murphy, 1997; Jones et al., 1997; Schwarzer, 1992). In addition to its role in intention formation, self-efficacy has also been implicated as a prominent influence on the effort and perseverance expended on achieving outcomes (Abraham et al., 1998; Bennett & Murphy, 1997).

In the proposed model, the relationship between motivation to act and the formation of intentions is mediated by outcome expectancy and self-efficacy judgements. Consistent with the predictions of the social cognitive approaches outlined above, it is proposed that outcome expectancy precedes efficacy judgements. Hence the model postulates that people make assumptions about whether successful outcomes are possible before forming an intention to adopt a preparatory measure. Individuals are more likely to engage in behaviours when the outcome is valued and perceived as achievable. If a favourable Outcome Expectancy is formed, whether or not a person progresses towards the formation of preparedness intentions is a function of their estimate of the level of their self-efficacy beliefs. The number and quality of action plans, and the amount of effort and perseverance

invested in risk reduction behaviours is strongly dependent on one's perceived competence and experience (Bennett & Murphy, 1997).

The inclusion of these variables within a model examining natural hazard adjustment adoption can be justified on several grounds. The inclusion of Outcome Expectancy is justified because risk reduction strategies attempt to motivate people to prepare for responding to infrequently occurring and highly destructive or disruptive hazards (e.g., earthquakes, volcanic eruptions) whose nature and intensity tend not to be perceived as lending themselves to mitigation by individual action (Spedden, 1998).

Similar arguments can be proposed for self-efficacy. Firstly, self-efficacy has been implicated as a precursor of adjustment adoption and resilience in natural hazards contexts (Bishop et al., 2000; Duval & Mulilis, 1999; Hurnan & McClure, 1997; Lindell & Whitney, 2000; Paton et al., 2001). Secondly, natural hazard effects are often perceived as uncontrollable. Self-efficacy has been identified as a significant influence on behaviour when dealing with issues perceived as less controllable (Godin & Kok, 1996).

Additional variables were included on the grounds of their being implicated as predictors of resilience or preparedness in natural hazard research in New Zealand and overseas. Paton et al. (2001) concluded that **problem-focused coping** (a predisposition to choose action directed at changing a situation) predicted resilience to volcanic hazard consequences. A prominent predictive role for problem-focused coping is also evident in the Person-Relative-to-Event (PrE) model (Duval & Mulilis, 1999; Lindell & Whitney, 2000). Because of its prior use in Australasian research, Carver et al's (1989) measure of action coping was used here.

***Moderating Variables***

The incorporation of intention formation within the model introduces a need to consider the possible existence of variables capable of moderating the conversion of intentions into actual behaviour. Natural hazard research (Bishop et al., 2000; Duval & Mulilis, 1999; Lindell & Whitney, 2000; Paton et al., 2000) has implicated several additional variables in the process of predicting preparedness. These are included in the proposed model as variables capable of moderating the conversion of intentions to preparations.

**Response efficacy** has been implicated as a predictor of adjustment adoption (Abraham et al., 1998; Lindell & Whitney, 2000; Mulilis & Duvall, 1995). This variable describes the personal capabilities and resources (e.g., time, skill, financial and physical resources, social networks) required to implement adjustments, the perceived benefits associated with adoption (the greater the uses or benefits associated with a specific strategy, the more likely its adoption), and the degree of conflict between recommended actions and other important personal goals or needs (Lindell & Whitney, 2000; Karoly, 1998; Paton et al., 2001). Here it is predicted that even if people form an intention to act, they may not convert them into actual preparedness if they judge that they do not possess the resources required to do so, or if they decide to apply their resources to other tasks or problems.

**Sense of community** (feelings of attachment for people and places) has been found to influence preparedness and the range of reduction strategies implemented (Bishop et al., 2000; Paton et al., 2000). Here it is predicted that people with strong feelings of belonging to a given area or place are more likely to convert intentions into actual preparedness. People's willingness to accept **personal responsibility** for their safety could moderate the intention-action relationship (Ballantyne et al., 2000; Duval & Mulilis, 1999; Lindell & Whitney, 2000; Mulilis & Duvall, 1995; Paton et al., 2000). In a New Zealand study, Ballantyne et al., (2000) observed that the provision of hazard information resulted in respondents becoming less concerned about volcanic hazards as a consequence of attributing responsibility for their safety to others. If people perceive others (e.g., local councils, civil defence) as being responsible for their safety, they are less likely to convert intentions to preparedness.

In contrast to health behaviour change intervention, that takes place in the context of ever-present and often highly visible problems (e.g., smoking, unsafe sexual practices), natural hazard public education takes place within a less predictable temporal context. Consequently, people's beliefs regarding the **timing** of the next hazard event could moderate the relationship between intentions and the adoption of preparedness measures (Lazarus & Folkman, Mulilis & Duvall, 1995). Recent work on identifying factors that contribute to the development and maintenance of Social Capital in Australia has highlighted the importance of **trust** in the authorities as a determinant of community action (Dillon & Phillips, 2001). Trust was included here as a moderator.

## The Model and Its Predictions

### A Summary

The process selecting variables for inclusion in the model produced the following scales:

**Precursor variables**

**Risk perception:** *Perceived threat from a hazard (Johnston et al., 1999; Lindell & Perry, 1992; Weinstein et al, 2000).*

**Critical Awareness:** *Frequency of thinking and talking about hazards (adapted from measure cited by Dalton et al. (2001)).*

**Earthquake anxiety:** *Assessed as the extent to which seismic events and information triggered anxiety.*

**Intention formation variables**

**Outcome expectancy**: *Perceptions of whether actions will reduce a problem or threat (adapted from measures cited by Bennett & Murphy, 1997).*

**Self-efficacy:** *Personal beliefs regarding capacity to act effectively (derived from Pearlin & Schooler's (1978) mastery items and adapted for Australian and New Zealand samples by Bishop et al. (2000) and Paton et al. (2001)).*

**Action Coping:** *Choosing action directed at changing a situation (assessed using the scale developed by Carver, Scheier, & Weintraub, (1989)).*

**Intentions**

**Intention/Information search** *Precursor to adjustment adoption (adapted from measures cited by Bennett & Murphy, (1997)).*

**Moderator varaibles**

**Past experience**: *Assessed whether respondents had experienced significant loss or damage from prior hazard activity.*

**Trust** In formal sources of information and assistance *(derived from a measure developed by Dillon & Phillips (2001)).*

**Response efficacy:** *Capabilities and resources held by individuals (assessed using a measure described by Lindell and Whitney (2000)).*

**Perceived responsibility** *Extent to which individuals attributed responsibility for safety to themselves (measured using a scale developed by Mulilis & Duvall, (1995)).*

**Sense of community:** *Feelings of belonging and attachment for people and places (measured with a scale used by Bishop et al. (2000) and Paton et al. (2001)).*

**Outcome (Dependent variable)**

**Adjustment adoption:** *Assessed using the Mulilis-Lippa Preparedness Scale (Mulilis et al., 1990).*

The collective incorporation of these variables in a model (Figure 1) helps explain why the expected link between risk perception (the assumed precursor of preparedness within most contemporary public education programs) and preparedness has proved elusive. For example, irrespective of the level of perceived risk, people are unlikely to formulate intentions to prepare if they perceive hazard effects as insurmountable (low outcome expectancy) or do not perceive themselves as having the competence to act (low self efficacy).

Outcome expectancy could also be influenced by a failure to perceive earthquake hazards as critical or salient issues within a community (low critical awareness – regarding earthquake hazards themselves and/or in relation to other issues such as crime or unemployment). It could also be affected because earthquake anxiety results in low levels of risk acceptance, reduced willingness to make appropriate preparations, and avoidance of information relating to risk reduction and readiness.

Even if favourable hazard preparedness intentions are formed, they may not be acted on. Several variables capable of moderating the intention-preparedness relationship were proposed. Intentions may not be acted on if people lack resources for implementation (low response efficacy). The intention-preparation link could be disrupted if people transfer responsibility for their safety (low perceived responsibility) from themselves to others.

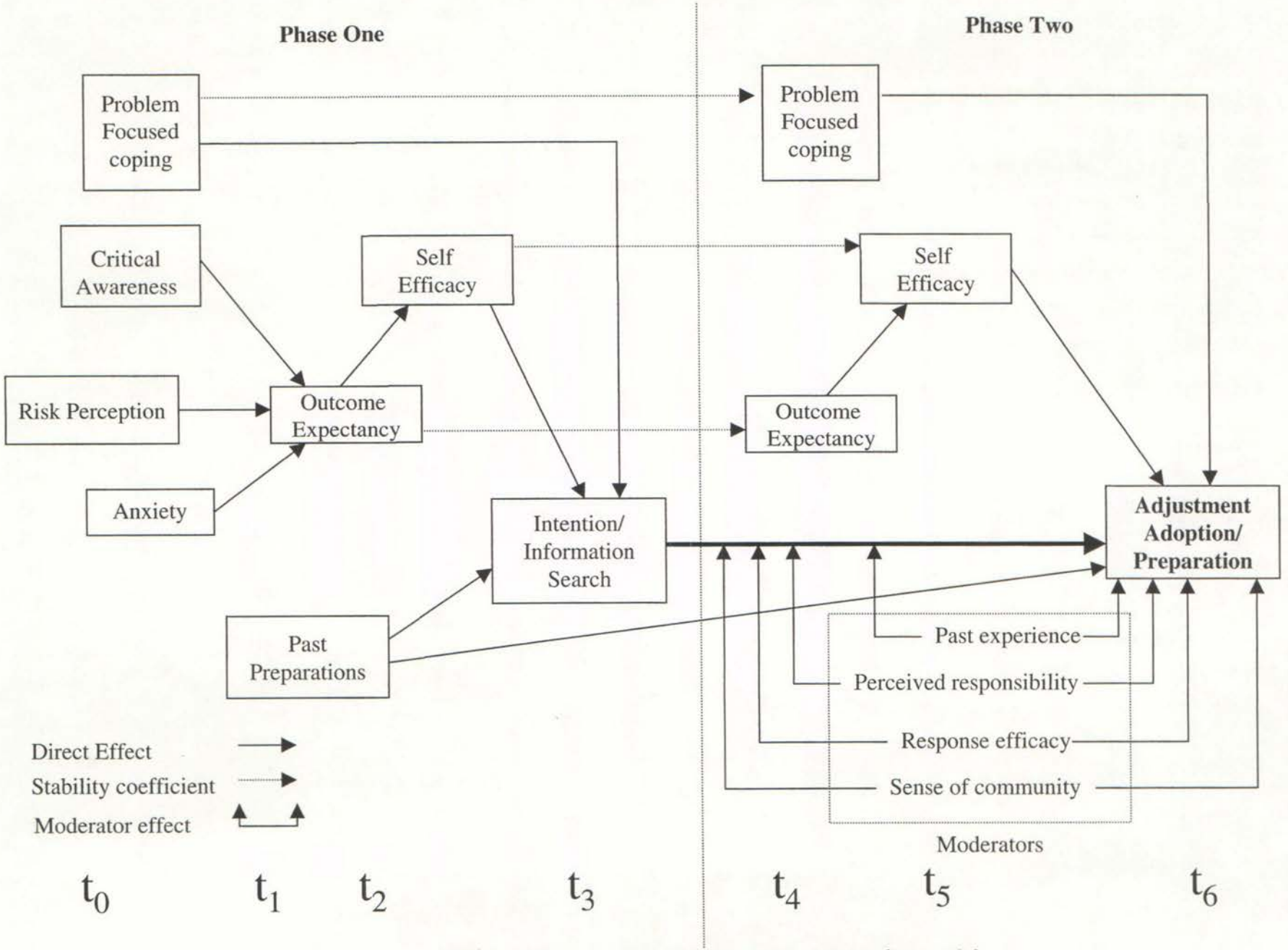


Figure 1: The proposed risk perception-preparation model

The intention-preparation link could also be moderated if people do not feel a sense of belonging (low sense of community) to the place where they live. It could be disrupted because of a lack of trust in information sources, because of a lack of consultation on other community issues, or because people do not believe that a damaging earthquake will occur within a time frame that warrants their immediate preparation.

## ETHICS APPROVAL

The proposal, the proposed methodology, the questionnaire, and subject information and consent forms were submitted to the Massey University Human Ethics Committee for approval. The project and the above documents were reviewed and approved by the Massey University Human Ethics Committee, PN Protocol 01/60.

## DATA COLLECTION

To examine the process of earthquake preparedness, geographical areas with known and comparable (objective) seismic risk were selected for study. These locations, and their associated seismic risk, are described in table 1.

| Towns | Population 1996 census | Earthquake Risk Expected PGA at 10% probability in 50 years. (Stirling et al. 2000) | Most recent events ≥ MM6 |
|---|---|---|---|
| Gisborne | 32,653 | 0.4g | 1932 (MM7) |
| Pahiatua | 2,626 | 0.5g | 1934 (MM8), 1942 (MM8) |
| Wanganui | 41,320 | 0.35g | 1897 (MM8) |
| Blenheim | 25,875 | 0.45g | 1966 (MM6) |

**Table 1: Probabilistic seismic hazard in New Zealand (Stirling, et al., 2000)**

The collection of data from communities, including a mix of urban and rural populations, distributed throughout New Zealand will facilitate the generalisability of the findings. This decision was also taken on the grounds that, if sample sizes so permitted, it would be possible, by comparing different communities, to assess whether characteristics of each community exercised direct or indirect effects upon intention formation and/or their

conversion to preparedness. This issue is important in regard to determining the extent to which risk reduction strategies need to be customised to accommodate salient local characteristics and conditions.

Given its focus on household hazard adjustment adoption, subjects were selected by random sampling of rates databases in each of the four study areas (Blenheim, Gisborne, Pahiatua, Wanaganui - see table 1). This approach was adopted to maximise the number of home owners surveyed.

The inclusion of those renting could confound the analysis in several ways. For example, irrespective of their attitude to preparedness, renters may not be in a position to instigate some of the preparedness measures recommended (e.g., fixing furniture to walls, securing hot water cylinders, making structural changes to chimneys etc) because the terms of their lease precludes such activities. Even if the latter activities were possible, renters may not do so if they perceive their tenure in a given property as temporary (e.g., looking for somewhere else to live, temporary employment within an area etc). While additional work is required to examine these propositions in more detail, these observations suggest that risk reduction strategies may be required to accommodate issues relating to housing choice (e.g., rent vs owning).

Using this approach, a sample of 600 households in each of the four study areas was generated. Consequently, 2400 questionnaires were distributed by post during September 2001. A total of 660 were returned using a reply paid envelope, giving a rate of return from Survey 1 of 27.5%. This provided a sufficient sample upon which phase one of the proposed model could be tested. For survey two, 2400 questionnaires were distributed to the same respondents used in phase one. The phase 2 survey was conducted in February 2002. Of the 2400 distributed, 640 were returned. This gave a response rate of 27%.

To comply with the ethical requirements of conducting research with human participants prescribed by the Massey University Human Ethics Committee (PN: Protocol 01/60), it was not possible to include any direct markers of identity within the questionnaire. This was to ensure respondents of the confidentiality of the research process. However, the testing of the process model required that data from the same respondents be followed over time one and time two. The marker used to assess this was date of birth

This process yielded 197 respondents from whom matched data (from survey 1 and survey 2) was collected. This represented a sufficient sample upon which the predictive capabilities of the model could be examined. Respondents had lived in the town/district sampled for, on average, 31 years, and had lived in their present house for, on average, 14 years. The demographic profile of the sample, compiled using phase 2 data, is described in table 2.

| | | |
|---|---|---|
| **Age:** | 20 or under | 1% |
| | 21 - 40 | 14% |
| | 41-64 | 50% |
| | 65 or over | 35% |
| **Gender** | Female | 42% |
| | Male | 58% |
| **Ethnicity:** | Maori | 7% |
| | Pakeha/European | 86% |
| | Pacific Islander | 1% |
| | Asian | 7% |
| **Average Household Income:** | $25,000 or less | 38% |
| | $26,000 – 44,000 | 28% |
| | $45,000 – 65,000 | 17% |
| | $66,000 and over | 18% |

**Table 2: Demographic profile of sample (Phase 2 Data).**

## DATA ANALYSIS AND MODEL TESTING

The relationship between the proposed variables and adjustment adoption is modelled in figure 1. While the variables discussed above have been implicated in this process either in limited combination or individually, their collective contribution has not been examined systematically. The principle objective of this research project was the development and testing of a model predicting personal adjustment adoption in regard to earthquakes. The model testing process and its outcomes are described in this section.

The model in figure 1 also depicts the research process and the longitudinal approach adopted here. In order to model the developmental process of the formulation of intentions and their conversion to preparedness, the study is divided into two phases of linked data collection. The first phase investigated the development of intentions. The second phase

examined the relationship between intentions and preparedness. The separation of the two phases mirrors the causal sequence proposed, and is methodologically necessary to draw such inferences.

The subdivision of data collection into two phases was important in several other respects. Firstly, it was proposed that preparedness is a process. This two-stage data collection was intended to emulate this thinking process, albeit in a condensed manner. Secondly, the distribution of the phase one questionnaire could be construed as a form of hazard preparedness education. By providing people with information about earthquake preparedness, and, at the same time, assessing their intentions, an opportunity for a more objective assessment of the subsequent relationship between intentions at time 1 (phase one data) and adjustment adoption or preparedness at time 2 (phase two data). Consequently, a more objective analysis of the predictive relationship between intentions and preparedness was made possible by the use of this approach.

***Data analysis strategy***

For this report, the strategy for analyzing the data was:

1. Examining the structure of measures and comparing these analyses with those conducted on the time-one data.
2. Examining the covariances among variables in the putative model derived from time-one data to determine whether these are of the expected magnitude and sign.
3. Testing potential moderators, suggested by theoretical considerations, among the variables in the putative model. This was undertaken by -
    a. Forming dichotomies in the data based on potential moderators and exploring whether there were significant differences between corresponding correlations.
    b. Running moderated regression analyses among relevant variables.
4. Examining relations (correlations) among variables in the model for each of the two smaller samples.
5. Cross validating the model derived from the time-one data on the time-two data.
6. Testing the core variables of the model across the two waves of data using the cases that could be identified at both time-one and time-two.

The proposed relationship between the variables described above and adjustment adoption is modelled in figure 1. Phase one data analysis focused on modelling the variables that contributed to the development of an intention to prepare for earthquake hazards. Phase two analysis focused on examining the relationship between intention and adjustment adoption, including examining the role of potential moderators.

### *Structure of the measures*

For each of the measures incorporated in the questionnaire a structural (dimensional) analysis of the indicators was undertaken. A factor analysis, using maximum likelihood estimation of the structural loadings, was applied to each set of indicators. The results of these analyses were then compared with similar analyses conducted on the corresponding measures used in the time-one questionnaire. Phase two data, using the data from the 197 respondents who completed both phase one and phase two questionnaires, were used for confirmatory factor analyses. These analyses confirmed that the psychometric properties of the scales were sufficient for subsequent analyses to proceed.

### *Surface relations*

Before a detailed analysis of causal relationships was undertaken, a preliminary check that the relations among the variables corresponded to those expected was conducted. The score for each measure was the mean of the unweighted sum of the items. Correlations were inspected for their magnitude and sign.

While correlations do not provide a definitive indication of influences among variables they ought to be consistent with the expectations of magnitude (significant or not significant) and sign (positive or negative) that can be derived from the structural model under consideration. This preliminary analysis supported the basic model and justified progression to the main and more comprehensive analysis, the structural model testing.

## Structural Model Testing

In this research structural equation modelling (SEM) was used to determine the dimensional structure of the measures derived and the structure of the relations among them (Bollen, 1987, Bollen & Lennox, 1991) and to test hypotheses regarding social-cognitive predictors of adjustment adoption. SEM is widely employed for this purpose and there are very extensive technical and empirical literatures relating to its application (Bollen & Long, 1993; Marcoulides & Schumacker, 1996). The analysis of the model was undertaken using the LISREL (LISREL 8.5) method of structural modelling (Bollen, 1987; Marcoulides & Schumacker, 1996).

In order to create useful and meaningful measures from people's responses to items that form a questionnaire scale it is necessary to be able to distinguish between the various influences on the responses. Specifically, the concern is to produce a measure where the variation in responses can be relatively unambiguously attributed to the variable of interest while the residual variation is attributable to random errors. A scale comprised of a set of items where this is possible is said to be "unidimensional" and the complement of its reliability is the proportion of error associated with the measure. The aim is to have measures derived from scales that are unidimensional with good reliability (less than 20% error variance).

SEM provides a method for testing the assumption of unidimensionality of an item set purporting to provide a measure of a variable. If the item set is not unidimensional then SEM provides the information necessary, where possible, to modify the item set by deleting items so that the remaining items form a unidimensional measure. This process was used to derive the items tested in the model. Once this goal is met it is then possible to calculate a meaningful index of reliability for the scale (Fleishman & Benson, 1987;Werts et al, 1978). These estimates of scale reliabilities were then used in the procedure for modelling the relations among the variables.

When the measures have been established as quantitative indices of the variables hypothesised to be involved in adjustment adoption the next step is to model the relations among them. The models prescribe a set of relations (paths) among variables based on the hypothesised causal ordering of their influences on each other (Figure 1). SEM

simultaneously determines the reliability of each item, hence each measure, and the magnitude of the paths specified among the structural variables. The index of fit for the model is affected by the dimensionality of measures *and* the specification of the paths.

Because some variables must be the causal precedents of others and some variables do not affect others, the hypothesised set of paths is a subset of a much larger set of possible paths. SEM provides a statistical means for testing the fit of a proposed path structure to the data. A structure that fits the data provides a plausible account of how the variables affect each other. When a model does not fit the data it can also provide information on whether it is possible to modify the path structure to fit the data. Empirical modification of a model can be useful, but like all data driven modelling exercises the results must be treated with caution and ideally tested on a new sample of respondents.

Confirmatory analysis ascertains whether a hypothesised structure (model) fits the data and thus provides a plausible explanation of the relations among the variables. The analyses began by specifying hypothetical paths between variables. The model depicted in Figure 1 illustrates the causal sequence in the development of "Intention/Information search" and its conversion to adjustment adoption/preparedness. Confirmatory testing usually has a single outcome – either the model fits acceptably or it does not. In practice confirmatory models are sometimes tweaked through empirically guided modifications, as some paths may be more tentative than others.

Single observation periods were used to collect the data for both the phase one and the phase two analyses. As a consequence, the viability of phase one of the model was assessed within a cross-sectional framework and phase two using data collected from the same group of respondents at time two. While placing some limits on the scope of the conclusions that can be drawn regarding the developmental process, this approach makes it possible to determine whether the model is compatible with the data. It also allows a more objective test of the developmental process described by the relationship between intention formation and subsequent adjustment adoption decisions.

The structural models were tested using a single-indicator approach where the parameters were estimated using the maximum likelihood technique. This approach involves establishing unidimensional measures for each of the variables in the structural model,

determining their reliability ($\mathbf{rel_x}$) and using this information to fix the values for the error variance ($\delta$) and structural loading of the variable ($\lambda$) on its corresponding latent variable. The error variance is calculated as:

$$\delta = (1 - \mathbf{rel_x}).\mathbf{Var_x}$$ Where $\mathbf{Var_x}$ is the variance of the variable **x**.

and

$$\lambda = (\mathbf{rel_x})^{½}$$

***Preparedness measure***

For this analysis, preparedness items were selected from the Mulilis-Lippa Preparedness Scale. The decision to use a subset of the items (see below), rather than using it in its full form, was as follows. While indicative of a capability for coping with the temporary disruption associated with hazard activity, several items in standard preparedness measures may be present for reasons other than a decision to prepare for earthquakes.

While recorded as preparedness items, the presence of some items may not reflect a decision to prepare. For example, people could conflate a preparedness item like 'having three days food' with their shopping habits (i.e., they purchase groceries every few weeks for convenience). But they may not set aside food specifically for emergency use. Thus their supply of food reflects their shopping habits rather than a decision to prepare for earthquakes. Similarly, people could have a torch in case of power cuts, a battery radio because they like listening to it while gardening, and spare batteries to replace those used in electronic games and so on.

Self-report data linked to decision processes that have little or nothing to do with hazard adjustment will inflate estimates of preparedness and result in community members being more reliant on emergency resources than might have been anticipated. While important indicators of an ability to cope with temporary disruption from hazard activity, caution must be exercised in regard to automatically interpreting their presence as indicative of either their availability to deal with adverse circumstances or peoples' beliefs about the importance of preparedness.

While this is not to argue that these items do not have an adjustment role to play. They do. However, the inclusion of items in a preparedness scale linked to decision processes that have little or nothing to do with earthquake preparedness could confound analysis from the point of view of understanding the reasoning processes that underpin adjustment adoption, affecting the reliability of assessment in the process. Inflated estimates of preparedness have implications for risk perception, attention to preparedness information, receptiveness to warnings (Lopes, 2000; Paton et al., 2000).

For this reason, a decision was made to test the model using items that more accurately reflect decisions regarding earthquake preparedness. Analysis was based on responses to questions such as:

> *Are cabinet doors fastened with latches?*
> *Is the water heater fastened to the wall?*
> *Is tall furniture (e.g., bookcases) fastened to wall?*
> *Are heavy objects (e.g., mirrors, paintings) fastened to walls?*
> *Does your household have an earthquake emergency plan?*
> *If an earthquake occurred during the day, does your plan cover where the family should meet?*
> *Do you have an emergency kit containing 2 litres water (in plastic containers) per person for three days?*
> *Do you check the contents of/operation of your emergency kit every month?*

These questions assess activities likely to be undertaken with the express purpose of safeguarding the household from the loss, damage and disruption associated with earthquake activity. They thus provide a more exacting basis for investigating predictors of hazard preparedness. Preparedness was scored by summing the number of items recorded by each respondent.

## The Process of Earthquake Preparedness

### Phase One

In regard to the phase one analysis (figure 2, phase 1), the model provided a good fit for the data ($\chi^2 = 20.3$, df = 18, p=0.32). The figures adjacent to each arrow represent their independent contribution to the relationship and provide an indication of the relative weighting of each variable within the process. All relationships are significant. The data

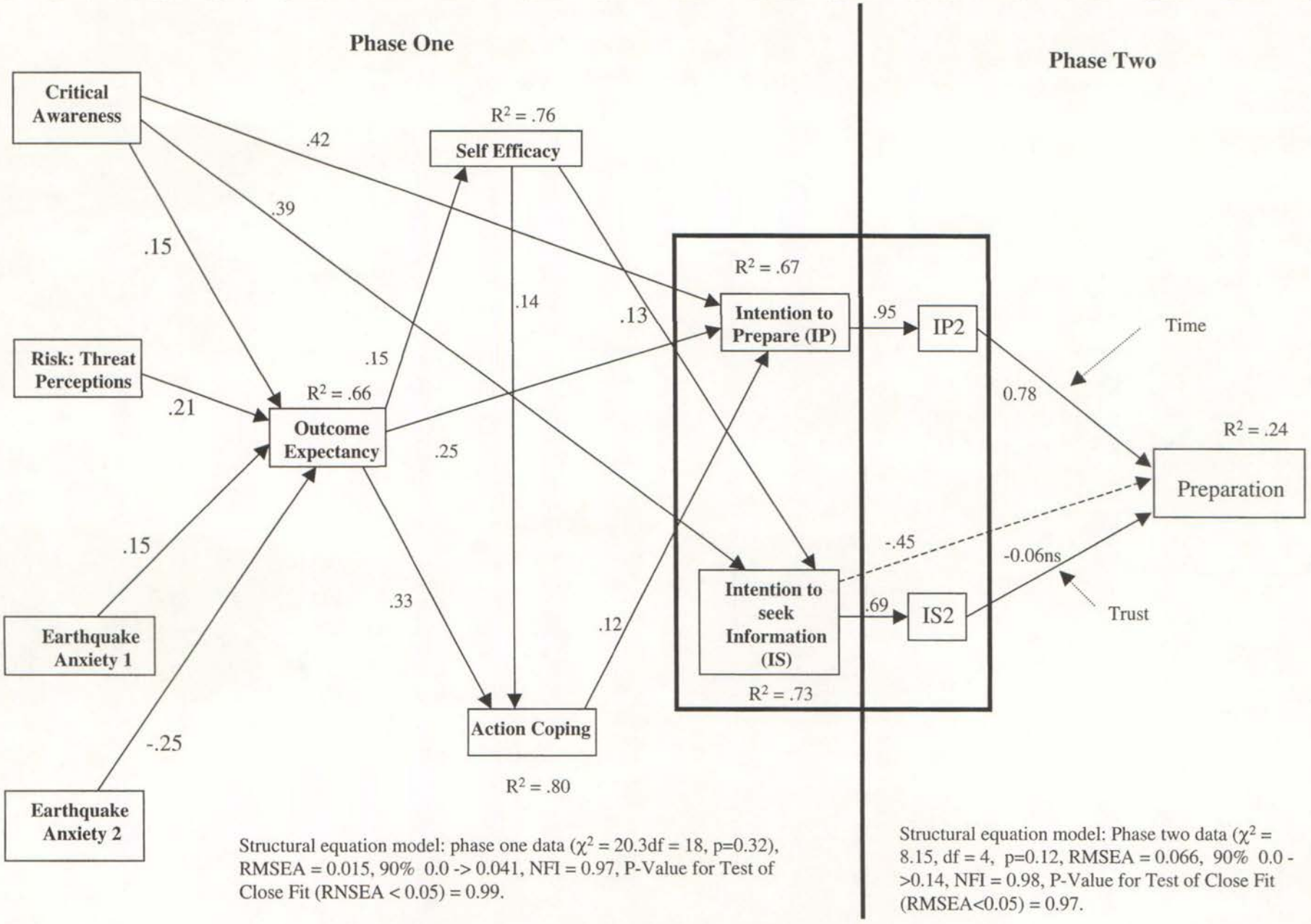


Figure 2: Combined Phase One and Phase Two Structural Models

afforded the opportunity to modify the model. This was done in a manner that was compatible with possible theoretical connections between the constituent variables, and consistent with the developmental sequences that underpins the development of intentions and their conversion to preparedness behaviours.

Phase one data supported the conclusion that risk perception constitutes a poor predictor of behavioural intentions or adjustment adoption. Consistent with the predictions of the proposed model, the perception and acknowledgment of a threat was one prominent precursor of the hazard preparedness process. A role for Critical Awareness and Earthquake Anxiety as precursors was also supported, although the nature of their relationships with outcome expectancy and intention formation was more complicated than originally envisaged. Consistent with the proposed theoretical predictions, intentions were driven by outcome expectancy, self-efficacy and action-coping judgements, with outcome expectancy preceding efficacy judgements. These relationships are depicted in figure 2 (Phase one). A more comprehensive discussion of these relationships is provided below.

**Phase Two**

Phase two structural model analysis was conducted using data from the 197 respondents who completed both questionnaires. For these respondents, analysis focused on examining the extent to which the intentions formed in phase one translated into actual preparedness or adjustment adoption at time 2.

Phase two completed the model with the analysis of the relationship between intentions and preparedness (Figure 1; Phase Two). In addition to its analysing the relationship between intention and preparedness, phase 2 analysis was also concerned with examining the extent to which this relationship was moderated by sense of community, trust, response efficacy, responsibility, and time.

In regard to the phase two analysis (figure 2, phase 2), the model provided a good fit for the data ($\chi^2 = 8.15$, df = 4, p=0.12). The figures adjacent to each arrow represent their independent contribution to the relationship. All relationships are significant (unless indicated otherwise).

## Core Elements of the Model

These data support the contention that a failure to accommodate social-cognitive processes in formulating risk communication and risk reduction strategies helps explain the:

a. generally low level of preparedness recorded in New Zealand and overseas studies, and

b. need for such strategies to canvas a wider range of variables and a more complex process than has previously been the norm.

### Precursor variables

Most conceptualisations of adjustment adoption posit that risk perception (the acceptance of a threat from earthquake hazards) represents the primary motivator or precursor. The present analysis suggests that the preparedness process is influenced by other variables. According to this analysis, both 'Critical Awareness' and 'Earthquake Anxiety' can be regarded as precursors of the preparedness process.

Critical awareness (the extent to which people talk and think about earthquakes on a regular basis) demonstrated direct and indirect relationships with both 'Intention to Prepare' and 'Intention to Seek Information'. The nature of the pathways evident here, and the strength of the relationships between critical awareness and the 'intention' variables, evinces the relative importance of critical awareness as a precursor or motivating factor in this model. Finally, the inclusion of an anxiety variable provided additional insights into the complexity of the hazard preparedness process. It was originally proposed that as earthquake anxiety increased, outcome expectancy would decline. The data revealed a more complex situation than that anticipated.

Psychometric analysis of earthquake anxiety items revealed two factors. Each factors differed in regard to the nature of its relationship with Outcome expectancy. Earthquake Anxiety (1: EA1) demonstrated a positive relationship with Outcome Expectancy. In contrast, Earthquake Anxiety (2: EA2) demonstrated a negative relationship with Outcome Expectancy. That is, the higher the level of negative anxiety, the less likely a respondent is to believe that losses and damage are amenable to reduction through individual effort. In addition, although additional research is required to clarify this, negative earthquake anxiety may be linked to avoidance of earthquake-related materials and content (e.g.,

public education), reducing the likelihood of the person attending to warnings or preparedness information, and making it less likely that they will adopt any preparedness measures.

**Intention formation variables**

Several interesting observations emerged from the psychometric analyses and the structural model testing. Of particular interest was the finding that intentions comprised two factors: 'Intention to Prepare' (intention to adopt specific behaviours or preparations) and 'Intention to Seek Information'. Thus qualitative differences in intention can be discerned in these data. Analysis of phase two data reiterated the importance of this distinction for conceptualising the preparedness process and for formulating risk communication and hazard readiness/reduction intervention strategies.

The phase-one structural equation analysis revealed a more complex relationship between 'Outcome Expectancy' and 'Intention' than was initially envisaged. 'Outcome Expectancy' had a direct relationship with 'Intention to Prepare', but not with 'Intention to Seek Information'.

Several direct and indirect relationships between 'Outcome Expectancy' and the 'Intention' variables emerged from the analysis. 'Outcome Expectancy' was linked via 'Self-Efficacy' to 'Intention to Seek Information'. However, more complex pathways were evident in regard to the relationship between 'Outcome Expectancy' and 'Intention to Prepare'.

In addition to having a direct relationship with 'Intention to Prepare', 'Outcome Expectancy was also linked via 'Self-efficacy' and 'Action Coping' with 'Intention to Prepare' (Figure 2). The existence of different pathways between 'Outcome Expectancy' and each 'Intention' factor signals a need for additional analysis of intentions, particularly in regard to the nature of the reasoning and judgements underlying the development of each kind of intention.

**The link between intention and preparedness**

The analyses conducted using the phase two data confirmed the importance of the distinction between 'Intention to Prepare' and 'Intention to Seek Information'. Only

'Intention to Prepare' acted in the manner originally anticipated. That is, only 'Intention to Prepare' acted as a mediating variable in the process of earthquake preparedness.

In contrast, 'Intention to Seek Information' represented an end point, and did not, either directly or indirectly, predict preparedness. Indeed, a significant, negative correlation between 'Intention to Seek Information' at Time One and 'Preparedness' at Time Two was evident (Figure 2). The discrete nature of these stages within the adjustment adoption process indicates that the reasoning that leads to forming 'Intentions to Prepare' and that leading to forming 'Intentions to Seek Information' are qualitatively different. This is an unexpected and important finding.

These data indicate that decisions about adjustment adoption cannot be regarded as lying on a continuum, with non-adoption at one end and high levels of adoption at the other. It can be inferred from these data that two discrete processes are operating, with one leading to decisions to adopt and the other leading to decisions not to adopt. From a risk communication perspective, this means that one set of strategies is required to facilitate adoption and another is required to reduce non-adoption. In other words, a specific set of strategies will be required to counter reasoning that supports a non-adoption decision before attempting to encourage their adoption.

While it is not possible, at this stage, to identify reasons for this difference, the existence of this distinction provides additional insights into the complex nature of the context within which risk reduction initiatives are administered. It also suggests that risk communication strategies must be designed to accommodate the reasoning and judgements that comprise each process and that different risk communication strategies will be required for each group.

Additional research is required to identify the content and medium most appropriate for risk communication designed to facilitate adjustment adoption or preparedness for members of each group and, in particular, how to convert information seeking intentions into those concerned with intentions to prepare.

Differences between the proportion of variance in intentions accounted for the proportion of variance in preparedness accounted for suggests the operation of moderator variables. This was examined next.

***Tests for moderators***

It was argued (see above) that even if preparedness intentions were formed, they might not be acted on. Phase two analysis was also concerned with examining the potential of several variables to moderate the intention-preparedness link.

Several factors capable of moderating the relationship between intention to prepare and actual preparedness were proposed. Intentions may not be acted on if people lack resources for implementation (low response efficacy). This variable describes the personal capabilities and resources (e.g., time, skill, financial) available for realising strategies.

The intention-preparedness link could also be disrupted if people transfer responsibility for their safety (low perceived responsibility) from themselves to others. Prior experience of hazard effects in the period between survey one and survey two was included here as a potential moderator, particularly in regard to its consequences (e.g., whether loss or damage was sustained). However, low levels of experience of seismic events, and damage therefrom, during the period between the administration of survey one and survey two precluded any formal assessment of the implications of this variable on preparedness.

Research in community psychology has identified trust (in information sources) as an influence on response to adverse events. The role of this variable as a moderator was examined here, as was the expected timing of the occurrence of the next damaging earthquake. To test the moderating role of the latter, respondents were subdivided into those expecting the next damaging earthquake to occur within 12 months, and those who anticipated its occurrence beyond 12 months. Finally, the role of sense of community was examined. To test for the influence of moderators, two analyses were performed. One involved data partitioning, and the other used moderated regression.

**Data partitioning**

If possible it would have been ideal if the model could have been tested for separate groups based on the moderators that were identified. However, Structural Equation Modelling requires numbers of cases that exceeded those available. An alternative test of potential moderators, suggested by the theoretical account of how outcomes are affected, involves partitioning the data on the basis of a dichotomy defined by a cut-point in the potential moderator **m**. This may involve, for example, splitting the data into two groups – cases above or at the median of **m**, and cases below the median ("high" and "low" groups). Relations (correlations) are then calculated among the variables of interest for both groups and results compared. If **m** has a moderator effect then the corresponding correlations will differ between the two groups.

Group 1 > or = median **m** $[\mathbf{r_{yx}}]_1$

Group 2 < median **m** $[\mathbf{r_{yx}}]_2$

$H_0$: $[\mathbf{r_{yx}}]_1 = [\mathbf{r_{yx}}]_2$

The data partitioning analysis suggested that 'time', 'trust', 'personal responsibility', and 'response efficacy' could fulfil a moderating role. Neither a direct nor a moderating influence was found for sense of community. The ability of these variables to moderate the intention-preparedness relationship was then examined in more detail using moderated regression analysis.

***Moderated regression***

Multiple regression can also be used to check whether a selected variable moderates the relation between a set of exogenous variables and a set of endogenous variables. This method provides a more rigorous test than data partitioning, as it does not rely on an ad hoc division of a continuous variable into a dichotomous variable. In the case of two predictors $\mathbf{x_1}$ and $\mathbf{x_2}$ and an outcome variable **y**, information about any moderation by a third variable **m** is carried in the product terms $\mathbf{x_1.m}$ and $\mathbf{x_2.m}$. However, the regression of **y** on the product terms is also affected by any non-linear (power) relations between the $\mathbf{x_1}$ and **y**, and $\mathbf{x_2}$ and **y**. These non-linear effects must be partialled before any moderator effects can be reliably detected. This involves including power terms derived from the predictors. It

is generally considered adequate to limit these to squared terms $\mathbf{x_1}^2$ and $\mathbf{x_2}^2$. The analysis involves the following steps:

1. Enter the predictors $\mathbf{x_1}$ and $\mathbf{x_2}$
2. Enter the power terms $\mathbf{x_1}^2$ and $\mathbf{x_2}^2$
3. Enter the product terms $\mathbf{x_1.m}$ and $\mathbf{x_2.m}$

Significant beta-weights associated with the product terms indicate that **m** moderates the relation between $\mathbf{x_1}$ and $\mathbf{x_2}$. The sign and magnitude of the beta-weights indicate how the moderator effect operates.

There are two considerations when this type of analysis is being undertaken. The use of product terms results in variables that have low reliabilities (squared - $\mathbf{x_1}^2$ and $\mathbf{x_2}^2$, and interaction - $\mathbf{x_1.m}$ and $\mathbf{x_2.m}$). As a consequence the statistical power to detect these effects is generally substantially lower than that required to detect the main effects ($\mathbf{x_1}$ and $\mathbf{x_2}$). In addition it is necessary to centre the variables involved in this analysis before calculating the product terms. This is achieved by subtracting the mean of the variable from each score.

This analysis reduced the number of variables that could be regarded as intention-preparedness moderators. For **'Intention to Prepare'**, only **'Time'** moderated this relationship (Beta = -0.132, p=0.034). This suggests that as the anticipated time of the next damaging earthquake increases, preparedness decreases. The further into the future people project the timing of the next damaging earthquake, the less likely they are to convert intentions into actual adjustment adoption. Under these circumstances, it is possible that existing approaches to dissemination natural hazard information will have to compete with other, and more salient, demands on peoples' time and attention (e.g., crime, unemployment).

For **'Intention to Seek Information'**, only **'Trust'** moderated this relationship (Beta = 0.434, p=0.05). As the level of trust in administrative agencies, so to does preparedness.

Differences between them in regard to variables that moderate their relationship with preparedness reiterates the need for further research into the distinction between "Intention to Prepare" and "Intention to Seek Information".

The more rigorous moderated regression analyses failed to confirm a moderating role for sense of community and response efficacy. This analysis also revealed that 'Personal Responsibility' did not, as originally predicted, act as a moderator, it had a direct influence on preparedness, accounting for an additional 5% of the variance in preparedness. More research into the nature and role of this variable is called for.

## ASSESSING LEVELS OF HOUSEHOLD PREPAREDNESS

Having demonstrated that the model represents a valid representation of the preparedness process, it is possible to proceed to meet the second objective of this study; the development of measures capable of acting as key performance indicators for assessing resilience and preparedness. The structural equation modelling analysis described above provided measures of adequate reliability to proceed with this stage. Given that the phase one survey provided the raw data upon which items were modified to suit local conditions, this process is illustrated by using the scores obtained from phase 2 survey as indicators of the levels of each variable.

Given that the model supports preparedness as a process, the relevant data are described here in a corresponding sequence (i.e., as precursor, intention formation, or moderating variables). The mean score for each measure is presented. Such scores could act as key performance indicators for each item in the adjustment adoption process. While, as a consequence of its being based on analysis of covariance, structural equation analysis is less susceptible to sample bias, the same cannot be said for the mean scores described here.

The data in table 2 indicate that the sample here cannot, in regard to factors such as ethnicity and income, be considered as representative of the New Zealand population as a whole. Consequently, the data is presented here to illustrate the potential of this approach to assist the assessment of reasons for non-adoption and to provide guidance for planning adjustment adoption strategies, particularly in regard to the allocation of mitigation or reduction resources. For example, if scores on risk perception were found to be high, but those on critical awareness low, the direction of limited resources towards increasing the latter would represent a more efficient and effective use of resources.

*Levels of adjustment adoption*

This section commences with the object of risk reduction initiatives in this context, promoting adjustment adoption. It focuses on those items selected to represent more objective indicators of preparedness (see above). This should not be taken to imply that other items should be excluded from the assessment process. The levels of adjustment adoption reported by respondents are recorded in table 3.

Overall, levels of these items were reported at low to moderate levels, and considerable scope for improvement in levels of adoption is evident. In light of Lopes' (2000) findings, some caution in interpreting these data is required. In other words, emergency management agencies should, in conjunction with surveying adjustment adoption, conduct an audit of adoption that can be used as a measure of the reliability of self-report accounts of adoption.

| **Adjustment adoption** | |
|---|---|
| Is the water heater fastened to the wall? | 40% |
| Are cabinet doors fastened with latches? | 39% |
| Does your household have an earthquake emergency plan? | 37% |
| Are heavy objects (e.g., mirrors, paintings) fastened to walls? | 37% |
| Do you have an emergency kit containing 2 litres water (in plastic containers) per person for three days? | 35% |
| Is tall furniture (e.g., bookcases) fastened to the wall? | 25% |
| If an earthquake occurred during the day, does your plan cover where the family should meet? | 24% |
| Do you check the contents of/operation of your emergency kit every month? | 9% |

**Table 3: Levels of adjustment adoption (survey 2 data)**

The remainder of this section focuses on analysing the scores recorded for the process variables to illustrate potential reasons for the low levels of preparedness. This discussion commences with a review of data from the analysis of precursor variables.

*Precursor variables*

The means and standard deviations of scores reported for each precursor variable, critical awareness, risk perception, and anxiety are recorded in table 4.

| Precursors | Scale | Mean | SD |
|---|---|---|---|
| Critical Awareness | 5 = Weekly to 1 = Never (2 - 10) | 5.72 | 1.75 |
| Risk Perception | 5 = S. Agree to 1 = S. Disagree (3 – 15) | 12.26 | 2.12 |
| Earthquake Anxiety 1 | 5 = Great Deal to 1 = Not at all (5 - 25) | 12.36 | 4.02 |
| Earthquake Anxiety 2 | 5 = Great Deal to 1 = Not at all (3 - 15) | 4.48 | 2.38 |

**Table 4: Means and standard deviations of precursor variables (survey 2 data). Range in parenthesis.**

These data provide additional insights into why risk perception may not represent an effective predictor of preparedness. Risk perception was reported here at high levels (table 4). If perceived threat was the principle determinant of adjustment adoption, the latter, given the level of threat afforded by respondents to earthquake hazards, would be expected to be higher. These data also suggest that, for this sample, risk communication programs that focus on perceived threat do not represent an efficient use of resources. The data in table 4 suggest that agencies interested in facilitating adjustment adoption should direct their attention to other precursor variables, with critical awareness and earthquake anxiety (1) being prime candidates in this regard.

Critical awareness is an important precursor variable (figure 2). It had a direct impact and an indirect effect, through outcome expectancy and action coping, on 'intention to prepare'. Low to moderate levels of this variable (table 4) suggest that improvements in adjustment adoption could be facilitated by directing attention towards strategies that encourage the perception of earthquake topics as critical or salient (assessed in regard to the frequency with which people think and talk about them) issues amongst community members.

According to the model (figure 2), a positive relationship was evident between earthquake anxiety 1 (EA 1) and outcome expectancy. In other words, as levels of EA 1 increase so to does outcome expectancy. According to the data in table 4, levels of EA 1 are present at

low levels. This suggests that the process of adjustment adoption could be stimulated using strategies that increase arousal to a level that facilitates action.

In contrast, an inverse relationship between earthquake anxiety 2 (EA 2) and outcome expectancy was recorded (figure 2). The data presented here (table 4) indicate low levels of EA 2, suggesting that, for the present sample, no additional attention to influencing levels of this variable is warranted. Of course, by its very nature, those scoring high on EA 2 would be highly unlikely to respond to a survey on an issue that is a source of fear or anxiety for them. At this stage, it is impossible to assess the prevalence of EA 2 within the population. The detrimental effect of negative earthquake anxiety upon adjustment adoption should be the subject of additional research.

Overall, these data allow an evaluation of the status of respondents in regard to the factors that motivate their thinking about adjustment adoption. Data on precursor variables suggests that risk reduction initiatives for this sample should focus on increasing critical awareness. That is, on encouraging community members to talk and think about earthquake hazards.

***Intention formation variables***

Data on the means and standard deviations of intention formation variables, outcome expectancy, self-efficacy, and action coping is recorded in table 5.

| Intention Formation | Scale | Mean | SD |
|---|---|---|---|
| Outcome Expectancy | 5 = S. Agree to 1 = S. Disagree (7 - 35) | 23.90 | 3.45 |
| Self Efficacy | 5 = S. Agree to 1 = S. Disagree (6 - 30) | 15.90 | 2.90 |
| Action Coping | 4 = Do a lot to 1 = Don't do at all (4 - 16) | 12.26 | 3.17 |

**Table 5: Means and standard deviations of intention formation variables (survey 2 data). Range in parenthesis.**

The data from this sample suggest that outcome expectancy (the belief that threats or problems are amenable to mitigation through individual action) is present at moderate levels (table 5). This suggests that risk reduction initiatives intended to encourage

adjustment adoption could profit by focusing on strategies designed to increase community members' beliefs in the fact that many hazard consequences can be reduced (which is not the same thing as advising them of what they could or should do).

According to table 5, levels of self-efficacy and action coping in this sample are present at low to moderate levels. This observation suggests that risk reduction initiatives should include strategies designed to increase self efficacy and to facilitate the adoption of coping strategies that encourage the confrontation of problems.

*Intentions*

Data on the means and standard deviations of 'intention to prepare' and 'intention to seek information' is recorded in table 6.

| Intentions | Scale | Mean | SD |
|---|---|---|---|
| Intent to Prepare | 3 = Definitely to 1 = No (2 - 6) | 3.57 | 1.23 |
| Intent to Seek Info. | 3 = Definitely to 1 = No (3 - 9) | 4.09 | 1.54 |

**Table 6: Means and standard deviations of intention variables (survey 2 data). Range in parenthesis.**

Consistent with the low levels of preparedness recorded above (table 3) and the identification of problems in regard to level of precursor (critical awareness and earthquake anxiety 1: table 4) and intention formation (self efficacy and action coping: table 5) variables, intentions to prepare were recorded at low levels.

A positive factor, for this sample, were the moderate levels of 'intention to seek information' recorded. This suggests that agencies responsible for risk communication could focus their attentions, albeit not exclusively, on increasing 'intention to prepare', so increasing the likelihood of adjustment adoption. Further insights into the low levels of adjustment adoption recorded here can be gleaned from an examination of the moderator scores.

*Moderator variables*

The means and standard deviations of moderator variables, response efficacy, sense of community, trust, and time are described in table 7. Although not identified as a moderator in this study, data on responsibility is included in this section.

While sense of community and response efficacy were not found to play a moderating role in the present study, their influence on adjustment adoption cannot be ruled out. Reasons for this are discussed below. Consequently, 'sense of community' and 'response efficacy' scores are included in table 7. Both were present at low to moderate levels.

| Moderators | Scale | Mean | SD |
|---|---|---|---|
| Response Efficacy | 5 = Great Deal to 1 = Not at all (5 - 25) | 12.54 | 4.22 |
| Sense of Community | 5 = S. Agree to 1 = S. Disagree (6 - 30) | 15.62 | 2.15 |
| Trust | 5 = S. Agree to 1 = S. Disagree (3 - 15) | 10.72 | 2.42 |
| Responsibility | 5 = S. Agree to 1 = S. Disagree (2 - 10) | 7.80 | 1.76 |

**Table 7: Means and standard deviations of moderator variables (survey 2 data). Range in parenthesis.**

Should subsequent research conclude in favour of their anticipated role, these data suggest that risk reduction initiatives should include strategies designed to increase both community members' feelings of belongingness and the availability of the resources required for adjustment adoption activities.

The results of the moderated regression analysis indicated that trust moderated the relationship between intention to seek information and adjustment adoption. Levels of trust were recorded at moderate to high levels (table 7), indicating that, for the present sample, that this does not act as an impediment.

Time was identified as a moderator of the relationship between intention to prepare and adjustment adoption. Only 6% of respondents (table 8) reported an expectation that the next damaging earthquake would occur within the next 12 months. These data suggest that risk reduction initiatives should include strategies designed to encourage a sense of immediacy. In this regard, it would appear that public education strategies that include the

"not if, but when" message should complement this with strategies designed to encourage a "sooner rather than later" belief.

| Moderators | Scale | % |
|---|---|---|
| Time | *Within 12 months* | **6%** |
| | *More than 12 months* | **94%** |

**Table 8: The timeframe within which respondents anticipate a damaging earthquake**

## FOCUS GROUPS

During the period between the administration of each survey, several focus group meetings were conducted. The objective of these meetings was to elicit additional information on community members' beliefs about earthquake preparedness. The participation rate was low. Despite some 80 invitations being issued, only 12 people participated in four groups. Some 50% of those who participated in the focus group discussions were Civil Defence volunteers. There comments are presented in a way that mirrors the process model described above (figure 2).

### *Precursor factors*

The relevance of critical awareness in this regard was indicated by the fact that several participants reported that discussions about earthquake issues was an important factor in the maintenance of their preparedness. This was particularly likely when discussion took place with community members who were perceived as knowledgable about hazards, their implications and what to do about them. This perceived expertise was based on their past experiences, not only of earthquakes, but also of flooding. Other focus group participants mentioned the importance of discussions about hazard issues. However, the others stated that such discussions tended to take place only with other family members.

These comments reiterate the importance of critical awareness. It also signals the importance of another issue evident in the community psychology literature regarding community response to change and adversity, the importance of a change agent or

community leadership. In the present study, the latter took the form of community members who had both standing in the community and who were perceived, based on their previous experience of hazard effects, as having expertise. While additional work is required to explore this issue in more detail, this observation suggests that risk reduction strategies could be built on this foundation.

When asked to comment of the information or activity they thought would motivate people to prepare for earthquakes, participants expressed the unanimous view that the occurrence of a damaging earthquake was the only thing likely to encourage people to prepare. Respondents were also unanimous in stating the belief that preparedness was low because most people in their communities assumed that a damaging earthquake was just not going to happen. These observations reiterate the need to focus less on what might happen and more on encouraging beliefs in the imminence of a damaging earthquake.

***Moderator variables***

Some respondents expressed the opinion that public discussion about hazards was important in making people feel part of the community. Comments regarding the role of sense of community were also expressed, and, despite evidence of its role being lacking in the present study, these comments reiterate the need for more searching conceptual and empirical analysis of the role of this construct in preparedness and resilience research.

Consensus regarding low levels of preparedness was evident in regard to the time frame within which a damaging earthquake was expected. It was generally believed that, irrespective of the level of acknowledgment of the potential threat posed by seismic hazards, they were unlikely to occur within a time frame (weeks to months) that rendered them salient or critical, so reducing any urgency in regard to the perceived need for preparedness.

One participant reported that a lack of trust in the source of information, the local council, as a problem. The reasons cited for this was their perception that the information provided was often incomplete and inconsistent (based on their own independent search for information).

***Information and preparedness***

Focus group participants were asked to comment about the source, content, and media of information they thought would encourage preparation. All participants felt that the only "source" likely to encourage preparedness would be the occurrence of a damaging earthquake.

Participants held mixed view regarding the quality of information available from local councils. Most people, they thought, turned to their local council, rather than emergency management agencies per se, for information. Some respondents felt that, in general, the quality of information made available was inadequate. Reasons for this included: providing inaccurate information, inconsistencies in content, providing limited information or not giving all the information required for understanding earthquake issues, and the unscientific nature of the information made available. Some respondents felt that the quality of information suffered as a consequence of a lack of consultation with community members, particularly those with extensive knowledge of the area and its history (note: this comment was made in relation to flooding). The manner in which risk information was disseminated was also described as being difficult to interpret (e.g., what the term 'hundred year event' meant?).

Two participants were of the opinion that emergency management information was not updated regularly enough. The lack of public discussion of issues was cited as a problem, as was the lack of active council and civil defence leadership within the community. Infrequent disaster exercises was also cited as another reason for the lack of public acceptance of the need for preparation.

While it probably reflected their civil defence involvement, two participants stated that they preferred to seek out information for themselves from published sources, with the internet being described as a very useful resource. However, they also stated that, because it required their performing deliberate searches, and because not everyone had access to it, the internet should not be regarded as a preferred medium for the dissemination of hazard information to the community as a whole. One respondent stated that, because search strategies could be organised, schools should use the internet as a medium for receiving hazard information. All participants expressed the view that the distribution of pamphlets

was problematic, primarily because they were likely to be tossed into the bin with other junk mail.

Particpants also expressed views regarding the content of the information made available. These concerned the need to distribute information on the specific actions that should be considered in plans (not just telling people to have a plan) and that this information should cater for different eventualities (and not just a notional earthquake). Information on conditions that would lead to evacuation and its implications was requested. It was also suggested hat information on the economic impacts of earthquakes for different sectors of the community and for employment could be made available.

## A FRAMEWORK FOR INTERVENTION STRATEGIES

The final objective of the present study was using the constituents of the model to guide the development of risk reduction strategies capable of supporting adjustment adoption. The data support the operation of a model of the preparedness process that comprises variables that fall into three categories: precursor variables; variables that support the formation of preparedness intentions; and variables that moderate the relationship between preparatory intentions and actual preparedness.

Conceptualising adjustment adoption as a developmental process has implications for risk communication. Firstly, it suggests that mirroring this process can enhance the effectiveness of the risk communication process. Secondly, the existence of this process provides several intervention points (see above). Thirdly, because no one approach will be equally effective in changing all component variables, the content of risk communication strategies should be designed to optimise their ability to instigate change in each of the component parts of the model. As a consequence, risk communication strategies must be designed in a manner that facilitates their ability to motivate people to prepare (precursor variables), to encourage the formation of intentions (intentions formation variables), and then to ensure the conversion of intentions to preparedness (moderator variables). In other words, given that the factors that motivate people, that drive intention formation, and that facilitate the conversion of intentions into actions are different, intervention strategies must be developed accordingly.

Consequently, promoting effective risk reduction through household preparedness will require the development of interventions whose nature (e.g., public education, community development) and content (e.g., hazard characteristics, their implications for salient personal and community functions, readiness activities etc) and media are designed to emulate the stages of the preparedness process (and their constituent variables). The diversity of the nature and content of variables at each stage of the process provide additional insights into the reasons for the poor performance of public education strategies based primarily on the dissemination of information.

While additional work is required to develop a more comprehensive set of strategies, it is possible, at this stage, to speculate on the basic kinds of strategy that will be required to facilitate change at each level of the model. Strategies must thus be designed specifically for each phase of the process (precursor, intention formation, moderators), and contain elements designed to increase each component (e.g., outcome expectancy, self-efficacy). An outline of strategies with the potential to facilitate change in each variable is described in table 9.

| Stage of Model | Element | Basic Strategy |
|---|---|---|
| **Precursor** | Risk/threat perception | Communication & Public education |
| | Critical Awareness | Empowerment |
| | Anxiety | Communication and clinical intervention |
| **Intention Formation** | Outcome expectancy | Communication and empowerment |
| | Self-efficacy | Empowerment |
| | Action Coping | Empowerment |
| **Moderator** | Time | Communication |
| | Trust | Empowerment |

**Table 9: Possible strategies to facilitate change in model variables**

The contents of table 9 indicate a need to expand the range of intervention strategies envisaged for risk reduction and communication. In addition to using high quality communication strategies (Tierney, Lindell, & Perry, 2001), it will also be necessary to include those based on community development and empowerment principles (Dalton etal., 2001; Paton, 2002; Paton & Bishop, 1996).

## DISCUSSION

This project has achieved the objectives outlined earlier. Firstly, a valid social-cognitive model of adjustment adoption was developed and tested. Secondly, component variables provide measures capable of assisting several emergency management processes: assessing household predispositions (e.g., levels of outcome expectancy) for adoption and evaluating intervention effectiveness. Finally, components of the model can be used to guide intervention design. However, the study has also raised several issues that will benefit from further consideration and research.

### *The role of community context on preparedness*

In the original submission, an examination of the relationship between features of the communities from which the data were drawn and the variables in the model was proposed. One useful outcome of such analyses would be the potential to determine whether any of the characteristics of the local environment exercise either a direct or a moderating effect on the formation of intentions for the adoption of adjustments.

From both a theoretical and a practical perspective, it is useful to know about such level-two effects. Factors that differentially affect subgroups of people, such as the normative characteristics and functions of the communities, are level-two effects. Unfortunately, the small sample size obtained here precluded proceeding with this analysis. Additional research designed for this express purpose should be included in future research agenda.

In addition to its theoretical relevance, such analyses can identify whether, and to what it extent, it is necessary to develop risk reduction strategies customised to accommodate the characteristics of each community. If this proves to be the case, these level-two analyses will

provide information essential to the process of tailoring risk communication strategies to the characteristics and needs of individual communities.

***Personality and normative influences***

Further work should also focus on examining the additional contribution of, for example, personality and normative factors within the context of the model developed here. The latter variables will provide important information in regard to the manner in which risk communication messages must be tailored for individual needs.

***Variables not supported by the data***

Several variables found to be influential in previous studies did not play a similar role in the present study. Although previously linked to effective adaptation and to the number of reduction measures developed and adopted (Bishop et al., 2000), sense of community had neither a direct nor an indirect influence on preparedness in the present study. One possible explanation for this concerns the fact that previous studies involved communities faced with an immediate, shared and on-going threat (e.g., salinity, toxic waste pollution). It is possible that, in these previous analyses, the sense of shared fate engendered by a common, highly salient and continuing problem provided contextual pressure for its importance. In the absence of a similar context, the measure may be less salient, or critical, as a predictor.

While not playing a role in the preparedness process here, this does not constitute adequate grounds for the exclusion of this variable in future work. Sense of Community may be less influential when assessing individuals during periods of hazard quiescence. It may, however, be important for predicting preparedness during warning periods (e.g., for volcanic crises) when individuals are faced with an actual or possible shared threat. Sense of Community may also be influential when researching or instigating adjustments that require cooperation or collective action (e.g., ensuring that flammable materials around all homes is removed to reduce the risk of post-earthquake fire or to minimise bushfire risk), particularly when such action m must be sustained over prolonged periods of time. The examination of the utility of this construct under these circumstances should be included in future research agenda.

Another variable that did not exert its expected influence was response efficacy. While correlational analysis using median split supported its role as a moderator, this role was not

supported when the more exacting multiple regression analysis was used. Since no unambiguous conclusion can be drawn in regard to the role of this variable, additional work is required to more clearly articulate its role. One explanation relates to the hypthesised mediating role of this variable. Duvall and Mulilis (1995) demonstrated a potential for this variable to moderate the relationship between problem-focused coping and adjustment adoption. An examination of this relationship should be included in subsequent tests of the model.

***Housing choice***

A focus on household preparedness also raised the issue of those renting as deserving special consideration in relation to risk communication strategies. It was argued that renters, as a consequence of such things as leasing issues or temporary tenure within an area, may constrain their ability to implement important preparedness measures (e.g., fixing furniture to walls, securing hot water cylinders, making structural changes to chimneys etc). Additional work on this issue is required. This possibility provides additional justification for the inclusion of an intention variable in the assessment process. Its inclusion allows assessment of people's predisposition to prepare in circumstances where adoption may be precluded by factors over which a person has no control.

***Preparedness measures***

Additional attention should also be given to the measures used to assess preparedness. In the present study, a decision to use a subset of the Mulilis-Lippa Preparedness Scale items, rather than using it in its full form, was made on the grounds that several items in standard preparedness measures may be present for reasons other than a decision to prepare for earthquakes. For example, people could conflate their shopping habits with adjustment adoption (but not set aside food specifically for emergency use). Similarly, people could have a torch in case of power cuts, a battery radio because they like listening to it while gardening, and spare batteries because they regularly use items for other reasons and so on, but not have these set aside within an emergency kit for use specifically in the event of an emergency.

The inclusion of items in a preparedness scale that could be linked to decision processes that have little or nothing to do with earthquake preparedness will inflate estimates of the extent peoples' underlying reasoning leads them to decisions specifically to prepare for

earthquakes or other hazards. Furthermore, data based on different reasoning (e.g., grocery shoping behaviour) could result in emergency management agencies overestimating the ability of people within their area to cope with disruption. If this happens, they may reduce their efforts to promote preparedness, and it could result in their having to deal with unexpected response demands. If households overestimate their preparedness, it can have consequent implications for risk perception, attention to preparedness information, and receptiveness to warnings (Ballantyne et al., 2000; Lopes, 2000; Paton et al., 2000).

This is not to say that these items (e.g., food, torch, spare batteries etc) should not be included in assessment schedules for adjustment adoption. These items remain important indicators of a person's ability to cope with the temporary disruption that will accompany a large earthquake. However, caution must be exercised in regard to assumptions regarding either their presence (in self-report questionnaires) being indicative of their being available to deal with adverse circumstances or as indicators of peoples' beliefs and attitudes about disaster preparedness.

Caution in regard to the interpretation of self-report data is also warranted on other grounds. Lopes (2000) found that people would overestimate their preparedness by inferring a level of current preparedness of the basis of their prior levels of preparedness rather than from checking their preparedness objectively. On asking people to physically check their preparedness responses, Lopes found discrepancies between peoples' expectations and their actual levels of preparedness.

This is an important issue for emergency management agencies. This suggests that, particularly for high availability items (e.g., food, torch, batteries etc) it would be prudent for emergency management agencies to conduct periodic audits of preparedness in order to assess the reliability of self-report data. This problem is particularly likely for the kinds of items described above, but less likely for items whose adoption is more likely to reflect decisions taken with the specific objective of preparing for earthquakes (e.g., securing furniture, preparing a household emergency plan for earthquakes). This point reiterates the need for further consideration to be given to the choice of items used to evaluate levels of adjustment adoption. In the absence of independent audits to provide estimates of reliability, it may be prudent to focus on those whose adoption can be more clearly aligned to decisions to prepare for earthquakes.

The conceptualisation of adjustments is often oversimplified by assumptions regarding the functional equivalence of items. However, items can be differentiated in this regard. For example, items such as securing furniture help safeguard household members from immediate injury, items such as having an earthquake plan facilitate an ability to adjust to disruptive activity, and the availability of food and water are required to realise the benefits of such a plan. The implications of staying in a house or leaving should also be accommodated in such inventories.

Items can also be differentiated in regard to their ease of adoption. For example, storing water is likely to be perceived as easier than securing furniture and hot water cylinders. The latter may be perceived as easier than cooperating with others to develop community plans or to coordinate neighbourhood plans to ensure that gardens are cleared of combustible material to reduce the risk of the post-earthquake fires spreading.

The fact that adjustment items can be differentiated across several dimensions suggests a need to examine this issue systematically and to explore the implications of each dimension for modelling adjustment adoption. This issue also has significant practical implications.

The ability to assess preparedness on each dimension could enhance the quality of the planning process. For example, rather than making global assessments of preparedness, such an approach would allow emergency management agencies to assess the community in regard to home safety, the ability of community members to meet their own needs during the recovery phase, and to evaluate the ease with which collective activities within a neighbourhood could be undertaken.

***Intentions and preparedness***

An important outcome of this project was the finding that decisions to prepare and decisions not to prepare did not lie at opposite ends of a continuum. Rather they appear to represent discrete reasoning processes. The existence of this dichotomy provides additional insights into the complex nature of the context within which risk reduction initiatives are administered.

Whilst differences between 'Intention to Prepare' and Intention to Seek Information' could be discerned in regard to their constituent paths within the model (Figure 2), the fact that critical awareness exhibited direct relationships with both makes it difficult to elucidate the content of the reasoning processes that contribute to each outcome (prepare versus not prepare). Additional research is required to identify the reasoning that underpins each outcome and to describe the content and medium best suited to risk communication strategies designed to facilitate change in each dimension.

## CONCLUSIONS

In this section, the conclusions of the study are summarised.

1. a. Earthquake adjustment adoption or preparedness can be conceptualised as a social-cognitive process.

   b. Risk perception does not hold a direct relationship with preparedness, but it does represent a motivating or precursor factor within the preparedness process. This means that only providing people with information about the threat posed by a hazard will not increase preparedness unless appropriate levels of other process variables are present.

   c. Critical Awareness and Earthquake Anxiety were also identified as important precursor or motivating variables. Critical awareness (the extent to which people talk and think about earthquakes) was identified as an important precursor. It exercised both a direct and an indirect influence on intention formation.

   d. Intention was confirmed as an important mediating variable in the preparedness process. This suggests that people first formulate intentions to prepare before deciding to adopt specific adjustments. A mediating role for intention also suggests that intention formation and their conversion to preparedness are separate phases within the preparedness process. Differences between these phases in regard to their constituent variables highlights the need to develop risk reduction strategies for each phase.

   e. The role of Outcome Expectancy, Self Efficacy, Action Coping and Critical Awareness in predicting preparedness is mediated by Intention.

   f. The relationship between 'intentions to prepare' and adjustment adoption was moderated by the perceived timing of next damaging earthquake.

g. The relationship between 'intention to seek information' and adjustment adoption was moderated by trust in sources of information.

2. Psychometric analysis and structural equation modelling identified and supported a distinction between 'Intention to Prepare (IP)' and 'Intention to Seek Information (IS)'.

3. This distinction is important in several respects:

   a. IP and IS are influenced by different pathways in the model. This difference indicates that decisions to adopt and decisions not to adopt adjustments represent the operation of discrete reasoning processes. It can be inferred from this that preparing and not preparing do not represent opposite ends of a continuum. Consequently, strategies required to increase the likelihood of adjustment adoption will be qualitatively different from those required to reduce intentions that involve seeking information (decision not to prepare). In other words, emergency management agencies must conceptualise efforts to facilitate adjustment adoption in ways that acknowledge these discrete processes.

   b. Only IP predicts actual preparedness.

   c. IS did not predict preparedness (there was a significant negative relationship between IS at time 1 and preparedness). Differences in their respective relationships with actual preparedness makes further analysis of these processes an important research goal.

   d. The fact that the relationship between IS (Time) and IP (Trust) and preparedness was moderated by different factors reiterates the importance of additional research into the preparedness process.

The subdivision of the population into two groups, one that formulates preparatory intentions and one that formulates Information Seeking intentions (which are not linked to adoption), is a significant and unexpected finding. This observation reiterates the need to conduct a more searching analysis of the reasoning, judgements and perceptions that

underpins decisions to adopt adjustment and to understand how they differ from those that characterise decisions not to adopt adjustments.

4. The fact that adjustment adoption is a developmental process comprising several social-cognitive variables has significant implications for risk communication and preparedness strategies. Specifically it suggests that:

    a. The content of risk communication/preparedness strategies should be consistent with the preparedness process described in the model.

    b. Strategies must be designed specifically for each phase of the process (precursors or motivating factors, intention formation variables, and moderators).

    c. Differences in the nature of each variable and the manner in which they are developed and sustained precludes the ability of any single intervention technique to facilitate change in all the variables identified. The content of strategies must be designed to facilitate change in each component (e.g., outcome expectancy, self-efficacy).

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Appendix

## QUESTIONNAIRE

1. Demographic Information (please circle a response as appropriate)

**Age:**

| | |
|---|---|
| 20 or under | 1 |
| 21 - 40 | 2 |
| 41-64 | 3 |
| 65 or over | 4 |

**Ethnicity:**

| | |
|---|---|
| Maori | 1 |
| Pakeha/European | 2 |
| Pacific Islander | 3 |
| Asian | 4 |
| Other | 5 |

**Average Household Income:**

| | |
|---|---|
| $25,000 or less | 1 |
| $26,000 – 44,000 | 2 |
| $45,000 – 65,000 | 3 |
| $66,000 and over | 4. |

**Gender:** Male Female

**2. How long have you lived in this town/district _____years**

**3. How long have you lived in your present house _____years**

4. Please describe how much you:

| | Once a week or more | Once a Month | A few times a year | Rarely | Never |
|---|---|---|---|---|---|
| Think about earthquakes | 5 | 4 | 3 | 2 | 1 |
| Talk about earthquakes | 5 | 4 | 3 | 2 | 1 |

5. Please describe the extent to which you agree or disagree with each of the following statements:

| | Strongly agree | Agree | Neither Agree nor disagree | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| An earthquake could pose a threat to **your** personal safety | 5 | 4 | 3 | 2 | 1 |
| An earthquake could pose a threat to **your** daily life (e.g., work, leisure) | 5 | 4 | 3 | 2 | 1 |
| An earthquake could pose a threat to **your** property. | 5 | 4 | 3 | 2 | 1 |

**6. The most likely time within which a damaging earthquake that could affect me is:**

**(Please tick one of the following)**

within the next 3 months ___
within the next 12 months ___
within the next 5 years ___
within the next 10 years or longer ___

| 7. | **Have you experienced:** | **Yes** | **No** |
|---|---|---|---|
| (a) | an earthquake in the past six months | 1 | 2 |
| (b) | If yes, did you experience damage/loss (*i.e., requiring repairs/insurance claims*) | 1 | 2 |

**8. Please describe the extent to which you agree or disagree with each of the following statements:**

| | Strongly agree | Agree | Neither Agree nor disagree | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| Earthquakes are too destructive to bother preparing for | 5 | 4 | 3 | 2 | 1 |
| A serious earthquake is unlikely to occur during your lifetime | 5 | 4 | 3 | 2 | 1 |
| Preparing for earthquakes will significantly reduce damage to my home should an earthquake occur | 5 | 4 | 3 | 2 | 1 |
| Preparing for earthquakes will improve my everyday living conditions | 5 | 4 | 3 | 2 | 1 |
| Preparing for earthquakes will improve the value of my house/ property | 5 | 4 | 3 | 2 | 1 |
| Preparing for earthquakes will significantly improve my ability to deal with disruption to family/ community life following an earthquake | 5 | 4 | 3 | 2 | 1 |
| Preparing for earthquakes is inconvenient for me | 5 | 4 | 3 | 2 | 1 |

**9. In regard to the issues and problems that you deal with in your *everyday life*, please describe the extent to which you agree or disagree with each of the following statements:**

| | Strongly agree | Agree | Neither Agree nor disagree | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| I have considerable control over What happens in my life | 5 | 4 | 3 | 2 | 1 |
| I can solve most of the problems I Have by myself | 5 | 4 | 3 | 2 | 1 |
| What happens to me in the future mostly depends on me | 5 | 4 | 3 | 2 | 1 |
| I can do a lot to change many of the important things in my life | 5 | 4 | 3 | 2 | 1 |
| I can do just about anything if I really set my mind on it | 5 | 4 | 3 | 2 | 1 |
| I rarely feel helpless in dealing with the problems of life | 5 | 4 | 3 | 2 | 1 |

**10. In regard to responsibility for earthquake preparedness, please describe the extent to which you agree or disagree with each of the following statements.**

| | Strongly agree | Agree | Neither Agree nor disagree | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| I feel responsible for preparing for a Major earthquake | 5 | 4 | 3 | 2 | 1 |
| The council (local/regional) and and/or civil defence is responsible for making sure that I am prepared for the occurrence of a major earthquake. | 5 | 4 | 3 | 2 | 1 |

**11.** In regard to dealing with problems in your *everyday life*, please describe on a scale from 1 (I usually don't do this at all) to 4 (I usually do this a lot) how much of each of the following you do

| | **I usually don't do this at all** | | | **I usually do this a lot** |
|---|---|---|---|---|
| I try to come up with a strategy about what to do | 1 | 2 | 3 | 4 |
| I make a plan of action | 1 | 2 | 3 | 4 |
| I think hard about what steps to take | 1 | 2 | 3 | 4 |
| I think about how I might best handle the problem | 1 | 2 | 3 | 4 |

**12. In the next month or so, do you intend to (please circle as appropriate):**

| | **No** | **Possibly** | **Definitely** |
|---|---|---|---|
| Check your level of preparedness for earthquakes | 1 | 2 | 3 |
| Increase your level of preparedness for earthquakes | 1 | 2 | 3 |
| Become involved with a local group to discuss how to reduce earthquake damage or losses | 1 | 2 | 3 |
| Seek information on earthquake risk | 1 | 2 | 3 |
| Seek information on things to do to prepare | 1 | 2 | 3 |

**13. In regard to living in this *community* generally, please describe the extent to which you agree or disagree with each statement**

| | Strongly agree | Agree | Neither Agree nor disagree | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| I feel like I belong in this community | 5 | 4 | 3 | 2 | 1 |
| I believe my neighbours would help me in an emergency | 5 | 4 | 3 | 2 | 1 |
| Even if I had the opportunity I would not move out of this community | 5 | 4 | 3 | 2 | 1 |
| I feel loyal to the people in my community | 5 | 4 | 3 | 2 | 1 |
| I often have friends over to my house to see me | 5 | 4 | 3 | 2 | 1 |
| I plan to remain a resident of this Community for a number of years | 5 | 4 | 3 | 2 | 1 |

**14. The following are things that can be done to minimise damage and disruption if an earthquake occurs. In regard to your household, please record whether you currently do each item (Spittal, 2002).**

| | | |
|---|---|---|
| I have considered the risk of a major earthquake when deciding to live in the house that I do now | Yes | No |
| I have fastened tall furniture to the wall | Yes | No |
| I have fastened my hot water cylinder | Yes | No |
| I have either strengthened my chimney, or satisfied myself that it will not fall down in a major earthquake | Yes | No |
| I have either strengthened my house to increase its earthquake resistance, or satisfied myself that it will probably not fall down in a major earthquake | Yes | No |
| I have ensured that my roof will probably not collapse in a major earthquake | Yes | No |
| I have arranged the cupboards so that heavy objects are stored at ground level | Yes | No |
| I have securely fastened cupboards with latches | Yes | No |
| I have ensured that objects that contain water have not been stored on top of electrical equipment (e.g., a pot plant or fishbowl on top of the television) | Yes | No |
| I have ensured that heavy objects are stored on the floor | Yes | No |
| I have put aside spare plastic bags and toilet paper for use as an emergency toilet | Yes | No |
| I have accumulated enough tools to make minor repairs to the house following a major earthquake | Yes | No |
| I have a supply of essential medicines for illness or allergies | Yes | No |
| I have secured moveable objects in my home (e.g., TV, computer) | Yes | No |
| I have a household earthquake emergency plan | Yes | No |
| My plan covers where the family should meet if an earthquake occurred during the day | Yes | No |
| I have an emergency kit containing: | | |
| - Flashlight/torch | Yes | No |
| - Batteries for flashlight/torch | Yes | No |
| - Transistor radio | Yes | No |
| - Batteries for transistor radio | Yes | No |
| - Spare batteries | Yes | No |
| - First aid kit | Yes | No |
| - 2 litres water (in plastic containers) per person for three days | Yes | No |
| - 3 days supply of dehydrated or canned food | Yes | No |
| - A portable stove or barbecue for cooking | Yes | No |
| I check the contents/operation of my emergency kit every month | Yes | No |
| I have a fire extinguisher | Yes | No |
| I know how to operate a fire extinguisher | Yes | No |
| I have checked my property to minimise fire risk (e.g, garden rubbish near fences) | Yes | No |

**15. The following activities help minimise disruption to a *community* if an earthquake occurs. Please record whether they currently apply to your community (circle those that apply).**

| | Yes | No |
|---|---|---|
| Have you or any family members been involved in meetings on earthquake preparedness | | |
| at school | 1 | 2 |
| in the local community | 1 | 2 |

| | Yes | No |
|---|---|---|
| Have you discussed the need for earthquake preparedness with: | | |
| your neighbours | 1 | 2 |
| the Council | 1 | 2 |

**16. Please rate (from 1 = not at all prepared to 5 = very prepared) the extent to which you perceive each of the following is prepared to deal with an earthquake**

| | Not at all prepared | | | | Very prepared |
|---|---|---|---|---|---|
| How prepared do you think you are for a major earthquake? | 1 | 2 | 3 | 4 | 5 |
| How well prepared do you think other members of your community are for a major earthquake | 1 | 2 | 3 | 4 | 5 |
| How well prepared do you think your local Council is for a major earthquake | 1 | 2 | 3 | 4 | 5 |

**17. In regard to your general feelings about living in this *community*, please describe the extent to which you agree or disagree with each statement.**

| | Strongly agree | Agree | Neither Agree nor disagree | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| I trust my Local Council to respond to meet the needs of its residents | 5 | | 4 | 3 | 2 | 1 |
| I trust the community leaders in my community | 5 | | 4 | 3 | 2 | 1 |
| I trust my Local Council to do what is necessary should an earthquake occur | 5 | | 4 | 3 | 2 | 1 |

**18. To what extent might each of the following prevent you preparing for earthquakes? Please rate the impact of each factor from 1 (not at all) to 5 (a great deal).**

| | Not at all | | | | A great deal |
|---|---|---|---|---|---|
| The cost | 1 | 2 | 3 | 4 | 5 |
| The Skill or knowledge required | 1 | 2 | 3 | 4 | 5 |
| Time to do them | 1 | 2 | 3 | 4 | 5 |
| Other things to think about | 1 | 2 | 3 | 4 | 5 |
| Need for co-operation with others | 1 | 2 | 3 | 4 | 5 |

**19. Please read each of the following statements and describe (on a scale from 1 = not at all to 5 = A great deal) the extent to which they apply to you**

| | **Not at all** | | | | **A great deal** |
|---|---|---|---|---|---|
| When I am in a building and it shakes a little, my first thought is, "is it an earthquake?" | 1 | 2 | 3 | 4 | 5 |
| I get nervous when a building I am in shakes, even though I know it is only a truck going by. | 1 | 2 | 3 | 4 | 5 |
| I would be never move to a town where there was a higher risk of earthquakes. | 1 | 2 | 3 | 4 | 5 |
| When the earthquake ads come on TV, I change the channel or make a cup of tea. | 1 | 2 | 3 | 4 | 5 |
| I avoid things that remind me of earthquakes | 1 | 2 | 3 | 4 | 5 |
| On humid days I think, "this is earthquake weather" | 1 | 2 | 3 | 4 | 5 |
| If I think there might be an earthquake, I make sure I am close to a safe place | 1 | 2 | 3 | 4 | 5 |
| I avoid thinking about earthquakes. | 1 | 2 | 3 | 4 | 5 |