
Modelling Community Preparation for Natural Hazards: Understanding Hazard Cognitions

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This article examines how personal beliefs about hazard events interact with social context factors to influence how individuals interpret their relationship with their environment, assign meaning to natural hazards and their consequences, and make preparedness decisions. Building on earlier work applying the same theoretical model to volcanic hazard preparedness, this article examines earthquake and flood hazard preparedness. The study incorporates both quantitative and qualitative approaches to elicit more detailed information regarding the influences underlying individuals' decisions to adopt preparation activities to minimise the effects of natural hazards. Findings indicate that preparedness decisions are not made in isolation. Through community level discourse and processes importance is attached to natural hazards and protective measures. It is only when natural hazards are perceived as having greater salience than other threats that people are motivated to prepare for their effects. A major finding is a distinction between trust and distrust of civic authorities. The data suggest that preparedness decisions were strongly influenced by the relevance people attached to information provided by these civic authorities. Delivering hazard mitigation strategies involves engaging with community members in order to understand their needs and to render meaningful assistance to their preparedness decisions.

Keywords: natural hazards, earthquakes, floods, natural hazard preparation, social construction, community engagement, reasoning processes

In areas susceptible to experiencing the consequences of natural hazard activity, a key facet of risk management involves encouraging citizens to adopt measures that increase their capacity to cope with and adapt to the consequences of hazard activity (Paton, 2006a). Traditionally this process has been based on the assumption that providing information about hazards and associated protective measures will lead to people preparing. Recognition that this assumption is unfounded has stimulated a growing body of research that argues that decisions to prepare reflect people's interpretation of hazards, their consequences, and information about them rather than information per se (Lindell & Whitney, 2000; McIvor & Paton, 2007; Paton, 2008; Paton, Smith, & Johnston, 2005; Perry & Lindell, 2008). An issue with this work is that it has tended to focus on only one hazard. This article builds on one such study (Paton, 2008) to explore two issues. The first is involves exploring whether the explanatory

framework can account for differences in levels of preparedness across different hazards. If the model is to have any practical utility as a guide to risk communication it is important that it can demonstrate a capacity to predict preparedness for different hazards and communities. The second issue involves conducting a qualitative analysis of the beliefs and reasons that underpin decisions to prepare to further examine the validity of this model and explore ways in which it might be developed.

A full description of the model and its development can be found in Paton (2008) and in the Paton, Houghton, Gregg, McIvor, Johnston et al. article (2009) in this volume. The variables in the model were selected as a result of their ability to provide insights into how people deal with uncertainty and make judgements about they might deal with events that they (generally) have not experienced. The key elements only are summarised here.

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It is argued that the process commences with people's expectations about whether the outcomes (e.g., enhanced safety) proposed to ensue if they adopt the measures they are asked to perform is likely to occur. Negative Outcome expectancy describes a belief that hazard consequences are too catastrophic for any personal action to be effective. It is hypothesised that this reduces the likelihood of people preparing. If people hold positive outcome expectancy beliefs (e.g., believe that adoption will enhance safety) it is proposed that they then look to others to assess their risk and formulate ways of reducing that risk. This is captured by assessing levels of community participation and collective efficacy (problem articulation). The uncertainty associated with natural hazards increases people's reliance on civic sources (e.g., emergency management) for the information and resources they require to enact their preparedness decisions. In the next stage of the model, it is argued that whether the relationship between community members and civic agencies facilitates preparedness is a function of the degree to which people perceive that civic agencies empower them by providing information that meets their needs. If people believe they are empowered, the more likely they are to trust the source and to use the information provided to prepare. The hypothesised relationships are depicted in Figure 1.

Method

Measures developed for the initial survey (Positive and Negative Outcome Expectancy, Community Participation,

Collective Efficacy, Empowerment, Trust, Intentions (see Paton, 2008, and Paton et al., 2009, for a full description) were compiled into a questionnaire. Questionnaires were administered to members of four communities in Australia that are susceptible to major flood events (Benalla NSW, Ingham QLD, Invermay TAS, Longford TAS) and to a community in New Zealand (Napier) that is susceptible to earthquakes. This comparison provided an opportunity to examine the all-hazards utility of the model. Because it facilitates the testing of theory-based models that attempt to explain the connections between groups of variables (Byrne, 2001; Hu & Bentler, 1999), structural equation modelling was used to determine the degree of fit between the data and the hypothesised relationships between individual, community and institutional variables in each area. Preparing for earthquakes involves some measures that differ from those required to prepare for floods. To accommodate these differences a measure of behavioural intention (Paton et al., 2005) was selected as the dependent variable for this analysis.

Results

The model analysis was conducted using the AMOS 6.0 structural equation modelling (SEM) program. SEM was used to assess both the direct and indirect relationships between the measurement variables. The model accounted for 37% and 20% of the variance in intentions for earthquakes and floods respectively.

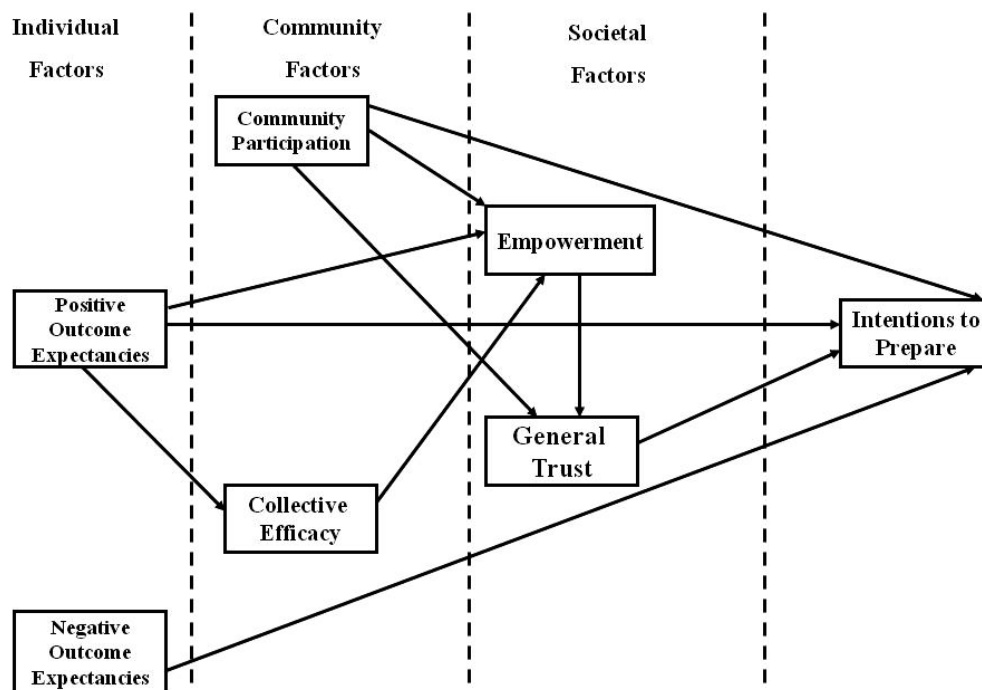


Figure 1

The hypothesised relationships.

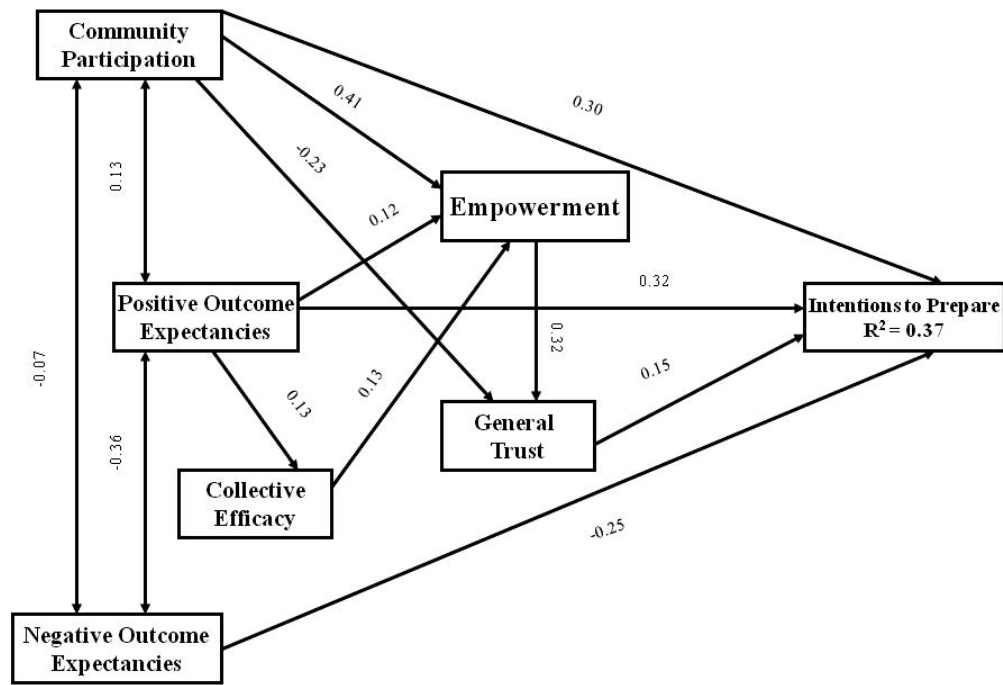


Figure 2

Social predictor model of intentions to prepare for earthquakes.

In Napier, a total of 256 cases were available for analysis. The analysis of the earthquake model is summarised in Figure 2. This provided an adequate fit for the data, ($\chi^2(7) = 6.757$, $p = 0.455$, $GFI = 0.99$, $AGFI = 0.97$, $NFI = 0.97$, $RFI = 0.93$, $RMSEA = 0.0001$, 90% 0.0001 – 0.075, P – value for closeness of fit ($RMSEA < 0.05$) = 0.790). All paths shown in the model are significant and the one way arrows indicate linear dependencies. For example positive outcome expectancies leads to intentions to prepare for natural hazards indicating that intentions depend, in part, on positive outcome expectancies.

Data from the flood-affected locations (Benalla, Invermay, Longford and Ingham) were combined and analysed together, providing some 264 cases for analysis. For the data to fit the model it was necessary to include a direct path from positive outcome expectancies to general trust. This path can be justified by arguing that holding positive beliefs about the efficacy of preparing motivates people to seek out relevant information, with trust mediating the relationship between this belief and intention to prepare (Paton, 2008).

With the inclusion of this additional path, the model (Figure 3) provided an adequate fit for the data, $\chi^2(6) = 9.583$, $p = 0.143$, $GFI = 0.99$, $AGFI = 0.95$, $NFI = 0.97$, $RFI = 0.90$, $RMSEA = 0.048$, 90% 0.0001 – 0.101, P – value for closeness of fit ($RMSEA < 0.05$) = 0.462). All paths shown in the model are significant.

Discussion

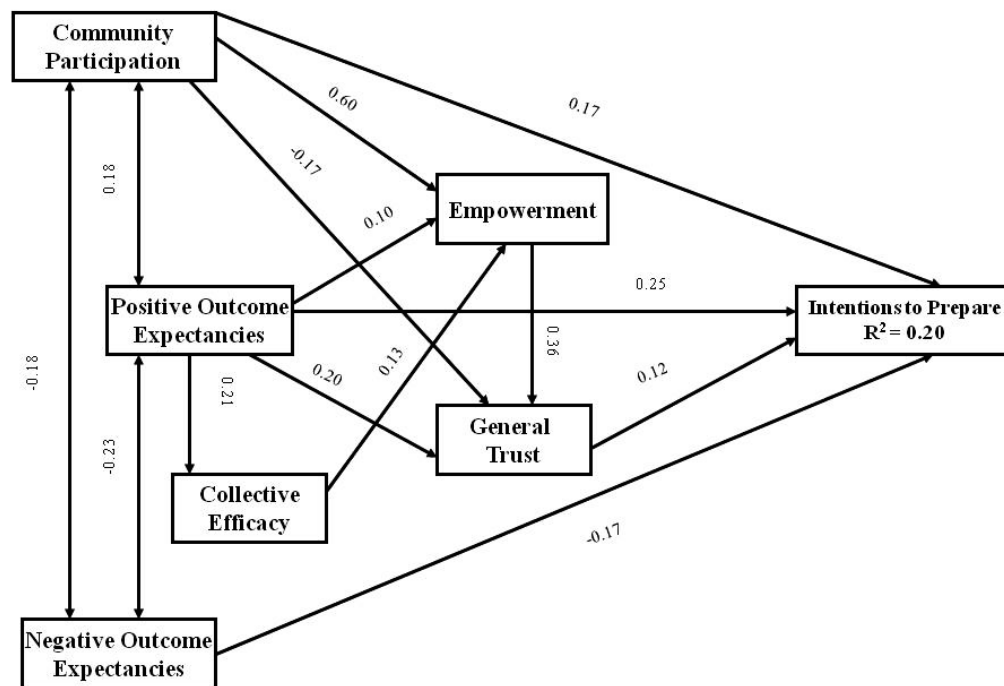
The data provide a good level of fit and the model was moderately successful in accounting for differences in

levels of intentions to prepare for earthquake and flood hazards and that personal beliefs interact with social context factors to influence this outcome. Comparison of the data for each hazard provides some support for the all-hazards applicability of the model as a means of predicting intentions to prepare for natural hazard consequences. However, the relationship between positive outcome expectancy and community participation suggests that more detailed examination of how personal beliefs influence collective activities is warranted. This issue is explored in the next section, which examines preparedness from the perspective of those being asked to prepare.

Providing support for the cross-hazards utility of the model provides emergency management planners with a planning resource that can be used to make more efficient decisions regarding public education (Alexander, 2005; Dufty, 2008). However, the analyses also reveal that much of the variance in levels of intentions remains to be explained. This suggests scope for the further development of the model. In order to identify ways in which the model could be developed, interviews with community members in each area were conducted in order to explore their views on preparing for hazards. This process is discussed in the next section.

Qualitative Analysis

To conduct this analysis, it was necessary to identify a methodological approach that is sensitive to the contextual aspects of the preparedness process. Means-end chain analysis was used to both examine the degree to

**Figure 3**

Social predictor model of intentions to prepare for floods.

which people's accounts of their preparedness behaviour confirmed could confirm the validity of the model and identify areas for the further development of the model. Central to Means-End Chain Theory is the role of intentionality and the fact that reasoning and decision-making are inherently social activities constructed through public conversations and thinking about issues (Bagozzi & Dabholkar, 2000; Hardin & Higgins, 1996; Harre, 1998). That is, Means-End Chain Theory argues that reasoning and decision making find representation in what and in how people communicate with one another. The consistency (i.e., both afford central roles to discussion and intentions) between it and the social-cognitive model introduced above renders Means-End Chain Theory an appropriate basis for conducting coherent and theoretically rigorous analyses of peoples' reasoning and decision making in regard to natural hazard preparedness.

When applied to the analysis of natural hazard preparedness, means-end chain theory argues that the decision making process progresses from concrete thoughts to higher level goals that satisfy an individual's enduring and long-term values (Mort & Rose, 2004). It proposed that beliefs exist at one of three (interrelated) levels. The three levels are 'attributes', 'consequences' and 'values'. These are connected, in that the lower levels of abstraction provide the foundation upon which higher levels, values, are achieved (Gutman, 1997, Mort & Rose, 2004). When interpreting the analyses described in this section, it is important to bear in mind that the elements describe people's beliefs, and the relationship between

these beliefs, about the nature and outcome of their preparedness behaviour.

A total of 45 participants were interviewed (15 each from Napier in New Zealand, Benalla in Victoria and Invermay in Tasmania). Participants were selected via the consent forms distributed with the earthquake/flood preparedness questionnaires. Telephone interviews were conducted from April to December 2007. Because of space, only the Napier data are discussed in detail here.

Means End Chain Analysis

Although attainment of values is the end point in a means-end chain, its connection with an attribute is revealed only through a succession of consequences associated with the activity under investigation. In order to understand how individuals translate attributes into meaningful values a laddering technique of interviewing developed by Reynolds and Gutman (1988) was used to guide data collection. The laddering technique facilitates identifying the sequence of mental activities that culminates in articulating the values that support preparedness decisions. Thinking is an inherently social activity, ingrained in the use of both public and private language (Bagozzi & Dabholkar, 2000). Entering into a discourse with the participants enabled an analysis of the reasoning processes that underpinned their decision-making. This approach provides a structured framework for eliciting more detailed information from participants about their decision making process regarding the adoption, or non-adoption, of preparation activities.

Responses were coded and grouped into attributes, consequences and values to better represent the hierarchical progression from concrete thoughts (attributes) associated with natural hazard preparing to attainment of personal goals and values. From the coding process 37 elements were identified that represented the stages involved in the reasoning process. To facilitate the development of an overall hierarchical model of the reasoning process and the identification of the dominant perceptual elements the laddering procedure outlined by Reynolds and Gutman (1988) was followed.

Reasoning ladders were constructed from each individual's interview. The ladders from all respondents were then combined into a matrix that allowed quantification of the number of times one element led to another element (which element precedes another in the same ladder). Two types of relationships can be illustrated in this manner, direct and indirect relations. Assessing these types of relationships allows for examination of inferred relationships among adjacent elements as well as indirect relationships among elements that would not have been revealed through examination of direct relationships alone (Reynolds & Gutman, 1988). Each item is assessed for direct and indirect relationships and from this a chain is gradually constructed.

Table 1 summarises both the direct and indirect relationships that were identified between all the elements for Napier participants. Direct relations are expressed on the left of the colon and indirect relations on the right. For example, Table 1 shows that sources of information lead directly to an adjacent element 21 times and indirectly lead to other elements 41 times. Table 1 also shows that other elements lead directly to sources of information on 18 occasions while indirect paths from other elements number two. For inclusion in the map the number of relationships between variables needed to number at least three direct relationships (Reynolds & Gutman, 1988). To construct the map the first element in the implication matrix is consulted. The row is followed until a cut off level is reached. These two elements become the first two links in the chain. To find the next link the row of the second element is followed until a cut off value is reached, thus three elements in the chain are revealed. This process is continued until a chain is completed. The process is then repeated.

The pattern of 'To' and 'From' elements (Table 1) reflects depth of thinking. Attributes represent the ultimate level of belief. They represent beliefs that motivate the preparedness process. As such, they are dominated by links 'To' other elements, particularly the consequence and value levels of analysis. Values represent the proximate reasons for preparing and describe why people think preparing is important. This level of analysis is thus dominated by links 'From' other elements. Consequences can be conceptualised as playing a mediating role. They represent the process issues that link

Table 1

Summary of Direct and Indirect Relationships for Napier

| Element | To another element | | From another element | |
|-----------------------------|--------------------|----------|----------------------|----------|
| | Direct: | Indirect | Direct: | Indirect |
| Values | | | | |
| Peace of mind | 1:0 | | | 9:25 |
| Survival | 2:0 | | | 9:28 |
| Responsibility to others | 1:0 | | | 10:28 |
| Return to normal | 0:0 | | | 5:09 |
| Protection | 1:0 | | | 13:39 |
| Protection of possessions | 3:01 | | | 4:09 |
| Consequences | | | | |
| Trust | 1:0 | | | 8:11 |
| Distrust | 1:0 | | | 6:06 |
| Transferring responsibility | 0:0 | | | 2:07 |
| Shelter | 6:0 | | | 5:05 |
| Self-sustaining | 3:0 | | | 11:18 |
| Physical protection | 4:05 | | | 13:20 |
| Unprepared | 2:01 | | | 15:16 |
| Reticence in talking | 0:0 | | | 6:10 |
| Lack of motivation | 1:0 | | | 7:08 |
| Uncertainty | 4:01 | | | 4:06 |
| Community Involvement | 12:01 | | | 13:18 |
| Confident | 3:01 | | | 3:08 |
| Discussing issues | 7:01 | | | 15:16 |
| Thinking about issues | 6:07 | | | 21:13 |
| Attributes | | | | |
| Active preparing | 21:17 | | | 32:20 |
| Awareness of preparing | 7:05 | | | 5:04 |
| Reticence | 2:0 | | | 1:0 |
| Influence of others | 8:12 | | | 1:02 |
| Inconvenience | 3:02 | | | 2:0 |
| Fatalism | 5:03 | | | 4:01 |
| Sources of information | 21:41 | | | 18:02 |
| Individual responsibility | 5:08 | | | 0:0 |
| Salience | 32:37 | | | 10:04 |
| Relevance | 24:44 | | | 1:0 |
| Belief in preparing | 11:20 | | | 8:02 |
| Ease of preparing | 3:03 | | | 1:02 |
| Shared experiences | 2:03 | | | 2:01 |
| Early warning | 1:03 | | | 0:0 |
| Hazard knowledge | 42:71 | | | 1:0 |
| Previous experience | 21:51 | | | 1:0 |

attributes and values. Hence they include links 'To' and 'From' other elements.

This component of the analysis had two objectives. The first concerned whether people's accounts of their preparedness behaviour were consistent with the variables included in the model. If the contents of people's accounts mirrored the contents of the model, the validity of the later would be strengthened.

Model Confirmation

Analysis of people's accounts of the reasons for their preparing, or not preparing, identified several elements that mirrored the variables in the model (Figures 2 & 3). The elements 'Relevance' and 'Source of Information' reflect the empowerment and empowerment-trust variable and link in the model respectively (Figures 2 & 3). 'Influence of Others' and 'Shared Experience' are representative of the community participation variable. The element 'Belief in Preparing' reflects positive outcome

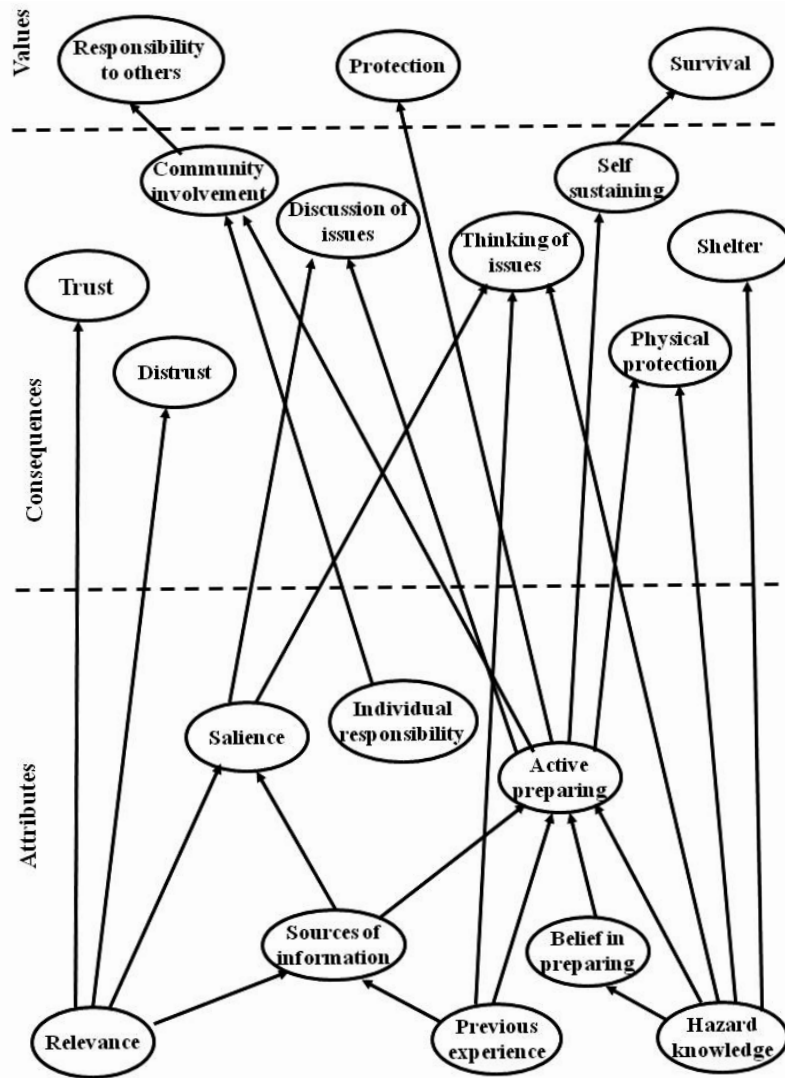


Figure 4
Reasoning map for Napier residents.

expectancy, and the elements ‘Fatalism’ and ‘Inconvenience’ are representative of the content of the negative outcome expectancy variable. Evidence that the model is tapping into relevant variables can also be gleaned from the Consequences level of belief. ‘Being Unprepared’ and ‘Reticence’ reflect processes that reduce the likelihood of not preparing. ‘Community Involvement’ and ‘Discussing Issues’ mirror the role of community participation and collective efficacy in the model. A role for trust was also implicated in the qualitative analysis. However, the emergence of ‘Distrust’ as a unique belief was not anticipated. An important finding arising from the data was the distinction people made between trust and distrust in authority. Schul, Mayo and Burnstein (2004) have suggested trust and distrust could be representative of separate reasoning processes. A distinction between these constructs was not anticipated in

the original model and needs to be accommodated in its future iterations.

The second objective of this component of the analysis was to determine whether analysis of people’s accounts of hazard preparedness could offer insights into how the model might profitably be developed. Answers to the latter question were sought from examining the hierarchical nature of the organization of beliefs. This is illustrated graphically in Figure 4. In the next section, the specific implications of this analysis are discussed.

Attributes

At the level of Attributes (Table 1), key beliefs were ‘Hazard Knowledge,’ ‘Saliency,’ ‘Relevance,’ ‘Active Preparing,’ ‘Previous Experience,’ and ‘Sources of Information’. While further research will be required to test these ideas, these data allow the tentative suggestion that if the content of outreach strategies is inconsistent

with these beliefs they are unlikely to motivate people to prepare. Of particular interest are the relevance and salience elements. Consistent with the tenets of the theoretical model (Figures 2 and 3), the former issues underline the need to ensure that outreach strategies complement community needs and activities (i.e., empower recipients and acknowledging that perceived relevance is in the eye of the beholder). The role of salience highlights a need to consider hazard outreach in the context of other life demands. In this instance, the importance of 'Previous Experience' as an attribute reflects how the 1931 earthquake has passed into the cultural fabric of the community. Some 12 of 15 interviewees specifically mentioned this as an influence on their reasons for preparing. While all of these elements have been recognised as having an influence on preparing (Hurnen & McClure, 1997; Paton, Smith, Daly, & Johnston, 2008; Perry & Lindell, 2008; Sumer, Karanci, Berument & Gunes, 2005), this analysis suggests that issues such as the perceived salience, or relative importance, of hazards relative to other life demands and the perceived relevance of information need to be afforded more prominent roles within the risk communication process than has hitherto been the case. The prominence of salience in this process further underlines the need for risk communication and community development strategies to be more closely related (Paton, 2006b).

Consequences

An important consequence of being aware of the hazards associated with natural events is thinking and talking about natural hazards (Paton et al., 2005). Thinking and talking about issues associated with hazard issues played prominent roles in people's decision making (Table 1). The importance people attribute to 'Discussion' reiterates the important role that people's social context plays in formulating preparedness decisions. A belief in 'Active Preparing' underpinned the belief that people could be 'Self sustaining' in the event of a hazard event. As Figure 4 illustrate, a belief in self sustainability supported people's belief that they and their families could survive in the aftermath of an earthquake. Survival, along with protection and responsibility to others, represent the end point of the reasoning chain. These elements are the goals that people value with respect to the adoption of hazard preparation activities.

Values

Values represent the end point of the hierarchy as theorised by means end chain theory, the goals that individual's desire. Means end chain theory argues for a link between the goals that are desired and the actions that people perform (Mort & Rose, 2004; Gutman, 1982). The values that people desire invest the consequences and actions with positive or negative feelings. In other words behaviour and consequences are more likely

to be repeated if it results in desired goals. The finding that 'Protection' and 'Survival' are important was not surprising. The finding that people differentiate between protection of family and protection of possessions suggests that these need to be dealt with separately in outreach strategies. The finding that 'Responsibility to Others' represented a significant value was unexpected.

Conclusion

Collectively, the quantitative and qualitative analyses add support to a literature that increasingly points to the fact that facilitating sustained preparedness involves more than just providing people with information. It involves understanding how people construe the relationship between themselves, the hazard and the protective measures available to them and assisting their protective decision making within this socio-ecological context. The findings support the contention that effective outreach not only involves community engagement but also ensuring that information is consistent with people's beliefs and facilitates their ability to achieve outcomes that are consistent with their values. Although the qualitative analysis did provide some confirmation of the validity of the model, it also identified ways in which it could be revised. For example, the qualitative analysis suggests that including measures of salience and distrust as predictors may provide beneficial. Additional analysis of the relationship between personal beliefs (e.g., positive outcome expectancy and community participation) is warranted, as is a more detailed analysis of the relationship between the perceived relevance of information and empowerment. Finally, the analysis suggests that a role for social responsibility as a predictor should be included in a revised model.

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