IDRiM(2013)3(1) ISSN: 2185-8322
DOI10.5595/idrim.2013.0050

Journal of Integrated Disaster Risk Management

Original paper

Disaster Resilient Communities: Developing and testing an all-hazards theory

Douglas Paton[1]

Received: 22/11/2012 Accepted: 16/01/2013 Published online: 01/06/2013

Abstract This paper describes the assessment of the "all-hazards" capabilities of a theory of hazard preparedness based on identifying the personal- and social-level processes (community participation, collective efficacy, empowerment and trust) that interact to facilitate decision making under conditions of uncertainty. It is argued that because hazards differ in their characteristics and behavior, and thus their implications for what people have to do to prepare, any theory of preparedness needs to be tested for its all-hazards applicability. Data from people susceptible to experiencing tsunami, earthquake, wildfire and influenza hazards that differ substantially in their respective preparedness requirements were analysed using structural equation modelling. Analyses confirmed the ability of the model to contribute to accounting for differences in levels of hazard preparedness irrespective of the hazard under consideration. The paper discusses the practical implications of the findings for the development and application of risk communication and community outreach programs used to facilitate sustained hazard preparedness.

Key words earthquake, tsunami, wildfire, pandemic, community, empowerment, trust, preparedness, all-hazard

1. INTRODUCTION

Worldwide, members of many societies live with the possibility of experiencing adverse impacts from significant environmental (e.g., volcanic, wildfire, storm, flooding, tsunami and seismic processes) and health (e.g., pandemic influenza) hazards. Recognition of this susceptibility has prompted the active pursuit of strategies to manage the associated risk. One important risk management goal in this context is encouraging people to prepare in ways that reduce or mitigate hazard consequences, enhance their capacity to anticipate what they might have to contend with and develop people's ability to cope with, adapt to, recover from and learn from hazard events (Paton 2006). This translates into risk management preparedness strategies designed to encourage people to engage in activities such as critically discussing hazard issues, storing food and water, securing the physical integrity of their home and household items, and developing household and neighbourhood emergency plans.

Preparation plays an important role in increasing community and societal resilience. For example, taking appropriate steps to physically secure the house and its contents not only reduces the risk of injury

[1] School of Psychology, University of Tasmania, Launceston, Tasmania 7250, Australia.
E-mail: Douglas.Paton@utas.edu.au

and death to its inhabitants, it also increases the likelihood of people having a habitable home to remain in or return to. Furthermore, the more people engage in activities to ensure they can return to their homes, the less will be the demand for temporary accommodation and the need to devote recovery resources to this activity, and the more likely it will be that people will remain in an area and be able to participate in activities that will contribute to social, economic and environmental recovery. Resilience is further facilitated by developing household plans, stockpiling the resources required to increase people's self-reliance during periods of disruption to normal life, and developing relationships with neighbours, community members and civic agencies in ways that can expedite the performance of local response and recovery initiatives (Paton 2006). The benefits of such preparedness are borne out by analyses that identify what people and communities identify as making pivotal contributions to their response and recovery following the experience of a disaster (Paton and Tang 2009; Paton 2012).

However, despite the evident advantages that being prepared confer on people and communities, research has consistently found that levels of preparedness are low. This has led to the development of theories to account for differences in levels of preparedness (e.g., Duval and Mulilis 1999; Paton et al., 2005; Lindell, Arlikatti and Prater, 2009). Constructing theory is essential for developing risk communication programs that facilitate the development and maintenance of hazard preparedness. To accomplish this task effectively, a theory needs to demonstrate its validity across a range of hazards that differ with respect to their characteristics and behaviours and their consequent implications for what being prepared means. That is, it is important that any theory has "all hazards" applicability. The need for theory to have this all hazards applicability has recently been highlighted by the UN-ISDR through the IRDR program (Eiser et *al.* 2012). Understanding these differences has important risk management implications. From a practical perspective, some emergency managers need to attend to multiple hazards that differ in preparedness requirements; that is, they differ with regard to what people need to know, what people are required to do, when they are required to do it, and how long they need to persist in the performance of an activity.

1.2 Practical and Theoretical Implications

From a practical perspective, the importance of accommodating all hazards applicability can be traced to the fact that risk managers in any one jurisdiction may have to facilitate preparedness for several hazards and many face the challenge of encouraging people in the same location to prepare for multiple hazards that differ in their preparedness requirements (see below). For example, risk managers responsible for the Pacific coast of Japan have to prepare people for earthquake, tsunami and typhoon hazards. In areas in eastern New Zealand, risk managers have to prepare people in the same area for earthquakes, tsunami and volcanic hazards. In some regions in south-eastern Australia, risk managers are required to facilitate community preparedness for both wildfire and tsunami hazards. Knowing the all-hazards capability of a theory and thus its ability to inform evidence-based risk communication practice for all the hazardous eventualities a risk manager may encounter is thus important.

From a theoretical position, a need to demonstrate all hazards validity derives from the importance of ensuring applicability to hazards that differ with regard to their implications for what people may have to contend with and thus prepare for. From a preparedness perspective, all hazards share certain requirements. Common to all hazard events is a need for people to, for example, stock up on food, water, essential medicines and temporary cooking resources to increase self-reliance during the initial impact period when normal societal and lifeline services are disrupted.

However, risk communication is also needed to accommodate the fact that hazards differ in their behaviours and this requires different actions to be performed if people are to be protected from diverse hazard consequences. For example, effective preparedness for earthquakes is facilitated by people taking steps to secure homes to their foundations. In coastal areas susceptible to experiencing tsunami, these earthquake preparedness activities can be complemented by elevating supporting walls and ensuring they are perpendicular to the direction from which tsunami will come. In locations that also face volcanic risk, preparedness involves including steep roofs in house design and removing guttering to limit ash damage. It also requires people to know how to prevent ash entering the home and how to remove ash safely. For earthquakes, people can be more secure if they remain in structurally sound homes. For tsunami, people must know the quickest route to high ground so they can evacuate promptly. For wildfires, people must develop a defensible space around their home. For influenza pandemics, people are required to prepare for long periods of social isolation and changes to hygiene practices. These are just a few illustrative examples of the diverse issues that are encompassed by the concept of preparedness and which could be required to be acted on by risk management professionals. What is evident is that hazards differ with regard to the knowledge required to understand their respective risk, the structural preparedness activities that offer protection, and the actions required to cope and adapt to hazard activity.

If it is to offer the evidence base required to develop risk communication programs to prepare people for diverse and infrequently-occurring hazard consequences, it is important to test whether any theory of hazard preparedness can explain differences across the kind of diversity of preparedness needs (see previous paragraph) that arises in multi-hazard environments. This kind of systematic testing has been limited by studies focusing on theory testing for single hazards. While this does not negate their broader applicability, focusing on one hazard reduces the applicability of a theory (Eiser et *al*. 2012). So, a theory must be able to predict the adoption of very different actions. For example, a theory must be able to explain differences in the adoption of actions to prepare for wildfire hazards (e.g., knowledge of why and how ember attack occurs and the consequent need for a defensible space) and explain differences in people's adoption of the very different actions required to safeguard a property against volcanic hazards (e.g., safeguarding against ash fall whose impact will change with such things as rainfall and wind direction).

If different knowledge bases and different physical actions are required to prepare effectively, then it becomes important to ensure that a theory retains its predictive validity across this range of knowledge and action parameters (Paton and McClure 2013). To do so, a theory needs to be tested for its ability to predict preparedness for different hazards. This paper discusses an approach to developing an all hazards theory by focusing on how people deal with a common characteristic of natural hazards; their implicit uncertainty.

Focusing on how people deal with uncertainty is useful because it represents a common denominator in people's experience of the hazardous environments in which they are being asked to make preparedness decisions. Uncertainty is evident in, for example, predicting when a hazard event will occur, what the magnitude or intensity will be should it occur, how long it will last, where specifically a hazard event will occur, and what will actually happen if a hazard event occurs (e.g., because what will happen will depend on the specific, unpredictable mix of factors such the time of day the event occurs, its intensity, duration etc.). Furthermore, people experience difficulties readily clarifying the uncertainties associated with hazards and/or what the most effective measures are that they can implement to protect themselves from hazard consequences (Paton and McClure 2013). Thus, understanding how people make choices under conditions of uncertainty represents one valuable approach to developing a theory with all hazards applicability.

When faced with uncertainty, people turn to others to help them reduce their uncertainty and help them decide what to do to manage their risk (Marris et *al*. 1998; Rippl 2002). These others can be civic agencies (e.g., emergency management), but they can also be family members, neighbours and members of the communities (e.g., workplaces, social and sporting clubs, churches etc.) with whom people interact regularly. Consequently, both civic and community sources have the potential to make contributions to the interpretative processes people use to make sense of uncertain hazardous circumstances. What binds civic agencies and community members together in ways that facilitates action under conditions of uncertainty is trust.

1.3 Trust

Given the complexity and infrequency of hazard events, and peoples' lack of experience of them resulting in their inability to clarify uncertainty via their own experience, people become particularly reliant on other people and expert sources to acquire the information they need to build their knowledge and to make decisions about how to mitigate hazard consequences and how to protect themselves. This means that people's attempts to interpret uncertainty in ways that allow them to make meaningful decisions is influenced by the quality of their relationships with other people and with the civic agencies from whom risk and preparedness information can be obtained. . An important influence on the quality of the relationship between people and sources of information when dealing with costly, threatening and uncertain events is trust.

Trust is an important determinant of the quality of any relationship in which information is exchanged, appraised and decisions made. Trust influences perception of other's motives, their competence and the credibility of the information they provide (Earle 2004; Kee and Knox 1970; McAllister 1995). Trust functions to reduce the uncertainty and complexity that people encounter when faced with novel events (Siegrist and Cvetkovich 2000). As uncertainty increases, so does the importance people attribute to their general trust beliefs about, and their past trust experiences with, the sources of information they turn to or have to rely on (Siegrist and Cvetkovich 2000; Paton 2008).

This makes trust a construct of considerable importance when attempting to understand how to communicate and interact with people dealing with unfamiliar, infrequent and complex environmental hazards. Thus, peoples' willingness to use information to guide their actions under conditions of uncertainty will be influenced by the degree to which they trust the source of information.

This paper examines whether a theory of community engagement built around trust and its social antecedents developed to predict preparedness for a single hazard can be used for all hazards preparedness. The following section summarizes this theory to set the scene. In essence, the theory proposes that personal beliefs and informal and formal social network characteristics interact to influence the extent to which people trust the sources of information they rely on or turn to deal with the uncertainty surrounding natural hazards (e.g., inability to accurately predict return periods, intensity of a given future event, etc.) and then use this information to prepare for natural hazard events. Full details of the development of the theory can be found in Paton (2008)

2. THE COMMUNITY ENGAGEMENT THEORY

The theory being examined in this paper suggests that an interpretive process at the person level (outcome expectancy) of analysis interacts with social (community participation, collective efficacy) and societal relationship (empowerment, trust) factors to predict preparedness (Paton 2008).

2.1 Individual Beliefs

The theory being used to frame the analysis discussed in this paper, Paton's (2008) community engagement theory, proposes that the principle antecedent of preparedness behaviour concerns people's uncertainty regarding the effectiveness of preparing. Understanding such beliefs is especially pertinent when people have to make their decisions in the absence of regular experience of the events they are being asked to prepare for and lack experience of and/or opportunity to test the accuracy of information advising of what they should do that is usually provided via public education programs.

Public education programs essentially advise people that if they adopt a particular behaviour the *outcome* will be a reduction of their risk or an increase in their safety. However, in the uncertain environment of hazard preparedness, people interpret this information and its recommendations (e.g., in light of their pre-existing beliefs about the magnitude and controllability of hazard events, exposure to media coverage that has typically emphasized how catastrophic hazard consequences are etc.) to estimate whether they believe or *expect* that *outcome* (i.e., increased safety, reduced damage, etc.) to occur. The 'outcome expectancy' construct describes this interpretive process (Bennet and Murphy 1997). Outcome expectancy can be further subdivided into negative and positive outcome expectancy (NOE or POE).

Negative outcome expectancy reflects a belief that hazard consequences are too catastrophic for personal action to make any difference to peoples' safety. Holding this belief reduces the likelihood that people will prepare. In contrast, if people hold positive outcome expectancy beliefs, they are more likely to believe that personal actions can enhance personal safety and/or mitigate hazard consequences. However, a belief that preparing can be effective does not necessarily equate with knowing what to do or how to prepare. Before they act, people typically need confirmation and additional guidance to deal with their uncertainty, and thus, they look first to what other community members say and do (Paton 2008).

2.2 Social context influences on interpretation

Peoples' perception of risk and how they might mitigate it is influenced by information from others who share their interests and values (Earle 2004; Lion et *al.* 2002; Paton and Bishop 1996; Poortinga and Pidgeon 2004). Paton and Buergelt (2012) describe how discussion with "like minded" others not only provided information about risk, it also helped people work out what they should do to mitigate their risk and how they should do it. Thus interactions with others in regular social contexts (community participation) performed a problem solving function that assisted people to, for example, determine what consequences they could face, work out what would be an effective response, and then consider what information and resources they would require to enact their mitigation strategies. One construct that encapsulates community members' ability to assess their capabilities and resource needs in the context of the community in which they live, and formulate plans to use resources to confront challenging tasks, is collective efficacy (Duncan et *al.* 2003; Paton et *al.* 2008b). Consequently, "community participation" and "collective efficacy" were included in the theory.

In the process of deliberating about hazard preparedness issues it is conceivable that people could identify information and resource needs that cannot be met within existing community contexts. For example, they could need expert input to identify how risk associated with factors such as the chemical composition of volcanic ash affects health or how to remove ash from roofs and vehicles to prevent damage. Or, when faced with wildfire hazards, people may need expert advice on how vegetation types or slope characteristics influences risk management options or how to identify the appropriate size of a defensible space. The theory argues that when people turn to expert sources for this specialised information, their beliefs about the trustworthiness of the <u>source</u> of information (that is independent of the information they provide per se) influences whether they use the information to guide their preparing (Paton 2008). To assess the degree of trustworthiness it is thus important to consider the characteristics of the relationship that exists between people and civic risk management agencies.

2.3 The community-agency relationship

Levels of risk acceptance and people's willingness to take responsibility for their own safety is increased, and decisions to take steps to actively manage their risk more likely, if people believe that their relationship with formal agencies is fair and empowering (e.g., agencies are perceived as trustworthy, as acting in the interest of community members) (Lion et *al.* 2002; Paton and Bishop 1996; Poortinga and Pidgeon 2004). When this relationship is not perceived as fair, the consequence is a loss of trust in the agency (i.e., the source of information).

 ISSN: 2185-8322

In summary, the theory (Paton 2008) proposes that if people hold negative outcome expectancy beliefs, their likelihood of preparing is reduced. If people hold positive outcome expectancy beliefs, they will either proceed to prepare, or, if lacking the information they require to proceed, the relationship between positive outcome expectancy and empowerment will be mediated by the social structural processes (community participation and collective efficacy) used to articulate community members' needs and expectations. Next, the theory proposes that empowerment mediates the relationship between structural factors and trust, with intentions mediating the relationship between trust and hazard preparedness. The intention measure comprised items that assessed people's intention to acquire hazard knowledge, increase actual preparedness, and to work with other people/civic agencies to develop knowledge and capability (Paton et *al.* 2005). The wildfire analysis also included a measure of place attachment. Paton et *al.* (2006b) reviewed studies that suggest that place attachment (the degree to which people feel that they are embedded within their physical environment) increases people's emotional investment in their community. This sense of emotional investment could provide people with an impetus to prepare for hazards in order to protect salient facets of a place one values. If community members share feelings of geographic attachment, then this sense of attachment could represent another predictor of hazard preparedness. A sense of place attachment may be more likely to influence preparedness for wildfire hazards if the source of the hazard, living in proximity to woodland, has influenced people's decision to live in an area of high wildfire risk. A full list of variables is given in Table 1.

Table 1 Variables and average reliability scores

Scale	α	**Source**
Negative Outcome Expectancy	.69	Bennet and Murphy (1997)
Positive Outcome Expectancy	.70	Bennet and Murphy (1997)
Community Participation	.90	Eng and Parker (1994)
Collective Efficacy	.95	Zaccaro et *al.* (1995)
Place attachment	.73	Bishop et *al.* (2000)
Empowerment	.89	Speer and Peterson (2000)
Trust	.95	Dillon and Phillips (2001)
Intentions	.90	Paton et *al.* (2005)

Given the need to demonstrate the utility of a theory by demonstrating its capacity to predict preparedness across a range of hazards (Eiser et *al.* 2012), this paper applies the theory outlined above to predict preparedness across three environmental hazards (tsunami, earthquakes, and wildfire) and one health hazard (influenza pandemic). A health hazard was included to extend the scope of comparison as widely as possible. Collectively, preparing for these hazards encompasses a diverse range of beliefs, plans and actions that cover immediate and longer term issues. If the theory can account for differences in preparedness across these hazards, it will provide support for the all-hazard utility of the thesis. Information about the location of each study and the associated sample size is listed in Table 2.

3. METHODS

The variables identified above as playing a crucial role (see Table 1) were compiled into a questionnaire. All questionnaires were distributed as mail surveys (to people living in areas identified by local risk management, public health and fire service agencies as having comparable level of risk) with the exception of the pandemic study which involved a telephone survey (See Figures 1-4). The dependent variable, the measure of preparedness, was developed for each hazard (based on the measured recommended by local risk management, public health and fire service agencies). The predictions derived from the relationships hypothesized above were tested and analysed using structural equation modelling in order to examine whether the proposed model could account for differences in levels of preparedness. Because it can estimate multiple and inter-related dependence relationships simultaneously, structural equation modelling allows statistics to be calculated to test the model as a whole and to show how well the data fit the hypothesised model (Goodness-of Fit) (Byrne 2001; Tabachnick and Fidell 2007). In structural equation modelling, the objective is to find non-significant differences between the predicted and actual model. This is measured by the Chi Squared (χ^2) statistic. The hypothesised relationships between personal, community and civic variables were analysed using the AMOS structural equation modelling program.

Table 2 Location/type of hazard and sample sizes

Location	Hazard	N
Alaska	Tsunami	344
New Zealand	Earthquake	229
Australia	Wildfire	482
New Zealand	Influenza Pandemic	400

4. RESULTS

The results for the surveys listed in Table 1 are presented in Figures 1-4 respectively. All paths shown are significant. The Goodness-of-Fit statistics for each analysis are described in Table 3. The non-significant values obtained indicate that the actual model is a close fit to the hypothesised model. This is supported by the other fit indices all of which have values ranging from 0 (poor fit) to 1 (perfect fit). The goodness of fit indices and statistics indicate that the data are a good fit for the hypothesised model

(Arbuckle 2006) and that the model can account for differences in observed levels of preparedness between people for each hazard. Values of 0.90 and over for the Goodness-of-Fit Index (GFI) indicate a good fit. Values of the Normed (NFI) and Comparative (CFI) Fit Indices above 0.95 are indicative of a good fit. RMSEA values of less than 0.05 are also indicative of a good fit.

Table 3 Goodness of Fit Indices and Scores

Fit Indices	**Alaska Tsunami**	**New Zealand Earthquake**	**Australia Wildfire**	**New Zealand Pandemic**
$\chi 2$	8.905	126.50	8.30	14.8
df	9	124	5	13
p	0.446	.070	0.138	0.32
RMSEA (90%)	0.000 (0.00 - 0.06)	0.03 (0.00 - 0.052)	0.037 (0.0 - 0.080)	0.037 (0.0 - 0.07)
NFI	0.989	0.88	0.983	0.97
CFI	0.992	0.98	0.971	0.976
GFI/AGFI	0.99/0.97	0.98/0.966	0.995/0.972	0.99/0.973
R^2	0.30	0.42	0.39	0.24

The model accounted for 30%, 42%, 39%, and 24% of the variance (R^2) in levels of preparing for tsunami, earthquake, wildfire and flu pandemic hazards respectively. It is important to note that a better fit for the wildfire analysis (see below) was obtained by excluding empowerment and trust and including a measure of place attachment (Figure 3).

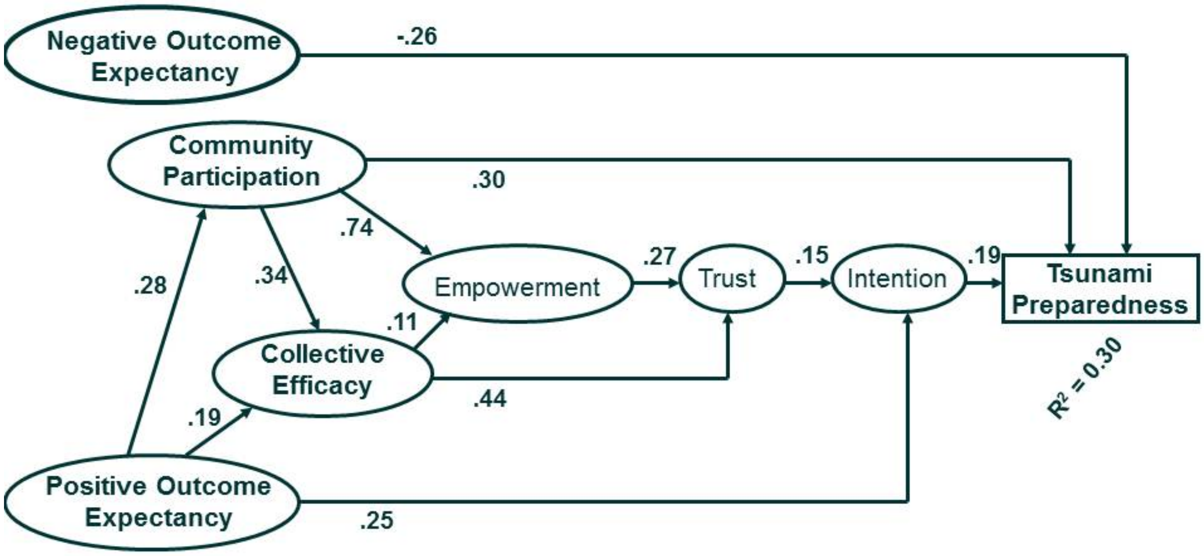

Figure 1 Summary of SEM analysis for Alaska tsunami preparedness (adapted from Paton et al. 2008b)

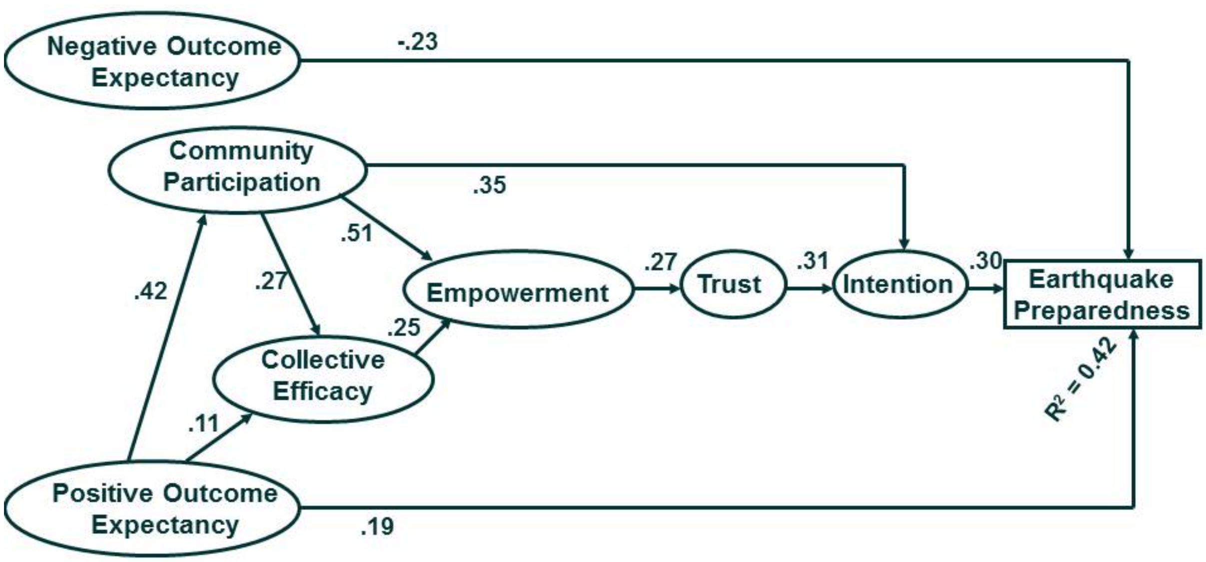

Figure 2 Summary of SEM analysis for New Zealand earthquake preparedness (Paton and Becker, unpublished)

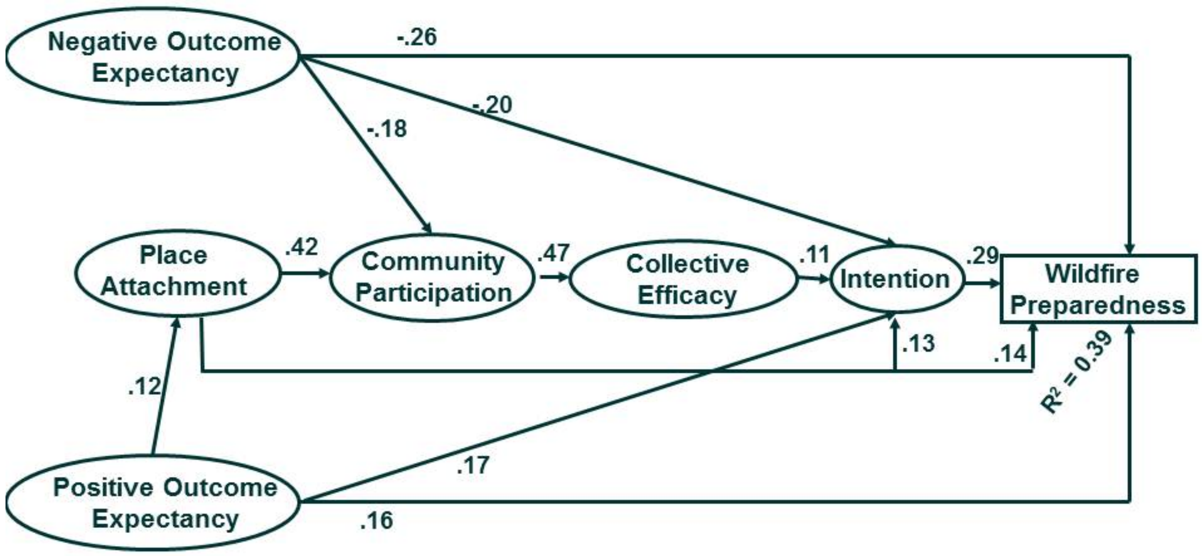

Figure 3 Summary of SEM analysis for Australia wildfire preparedness (adapted from Paton et *al.* 2008a).

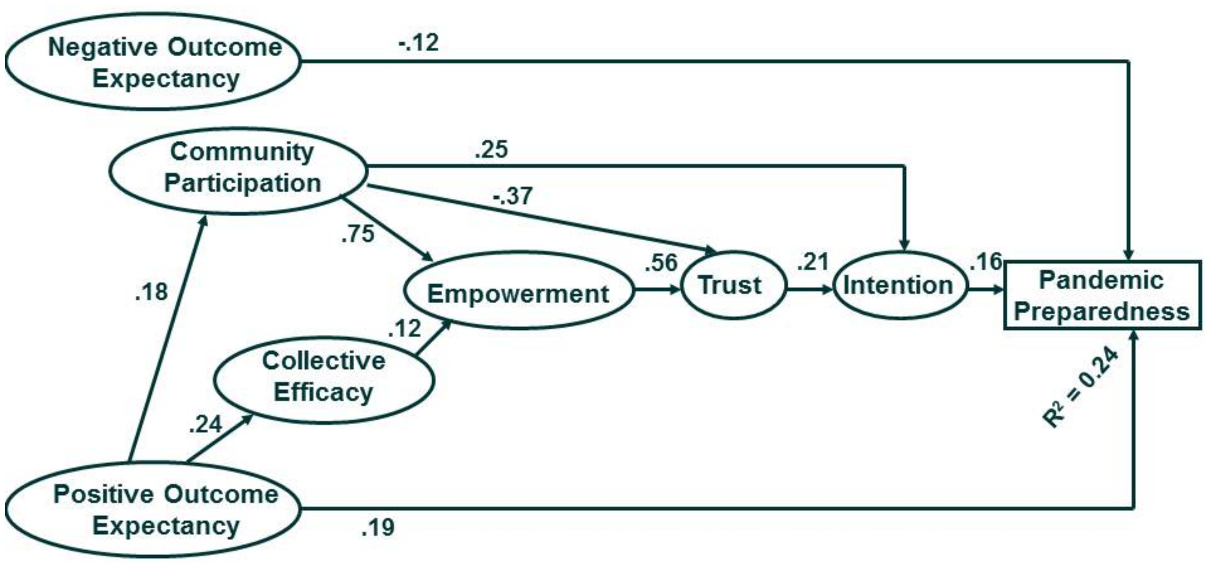

Figure 4 Summary of SEM analysis for New Zealand pandemic preparedness (adapted from Paton et al. 2008c)

5. DISCUSSION

The fit indices for all four hazards (Table 3) offer support for the view that the model is a good fit to the data for each hazard. This, in conjunction with its ability to account for differences in levels of people's hazard preparedness means that the theory can assist explaining differences in levels of hazard preparedness. Sheeran's (2002) meta-analysis of 422 studies concluded that accounting for 28% of the variance in behaviour would confer upon findings derived from using social cognitive models a medium to large effect size. Accordingly, the studies accounting on average 34% for the variance across four different hazards present a medium to large effect size suggesting that the theory is sufficiently robust to be used to guide risk communication planning. The implications of the model for risk communication are described below.

In addition, both the variables and the order of the variables in four different locations in three different countries, with only minor differences in path relationships being evident across the hazards analysed (Figures 1-4), lends further weight to the argument for comparability across hazards. , The analyses thus support the contention that this theory does offer a means of predicting all hazards preparedness.

The importance of being able to demonstrate generalizability across hazards derives from the fact that each of the hazards examined differs with regard to, for example, the content of preparedness and the relative weighting of preparedness items in the respective preparation inventories. For example, one preparation activity for earthquakes involves securing homes to foundations. Once this is done, it does not need to be done again. For wildfires, an important preparedness item is creating a defensible space around the home. However, once done this needs to be done repeatedly and maintained annually. For earthquakes, developing collaborative links with neighbours increases people's capacity for recovery post-event. For wildfire hazards, developing collaborative links with neighbours is required both to mitigate risk (all neighbours need to remove and/or control vegetation levels if their collective risk is to be effectively managed – if only one neighbour does so, risk reduction is minimal) and to facilitate community recovery. For volcanic preparedness, activities include understanding how to perform actions (e.g., safe removal of ash from buildings and vehicles, disposal of ash). This knowledge and the associated actions are required after the hazard has occurred and people need to be prepared to do so over periods that may be measured in months. The ability of the theory to account for differences in preparedness illustrates how it affords the means of accounting for differences in the adoption of preparedness measures that differ with regard to, for example, physical actions (e.g., secure building to foundations versus create a defensible space versus removing ash from a building), the frequency of performance (e.g., house integrity versus defensible space), the need to be performed before, during and after hazard events, and that differ in the period of time over which activities need to be maintained.

These examples represent only a few of the different preparedness activities that become evident when hazards are compared (most studies only focus on a single hazard when differences in preparedness requirements are less evident). Understanding these differences has important risk management implications. From a practical perspective, some emergency managers need to attend to multiple hazards that differ in preparedness requirements; that is, they differ with regard to what people need to know, what people are required to do, when they are required to do it, and how long they need to persist in the performance of an activity. The analyses described in this paper identifies that the same process can be used and only the content needs to be changed to accommodate different hazards. The theory derives this all hazards capability because it focuses on understanding how people deal with uncertainty rather than a specific hazard per se.

However, before proceeding to discuss the implications of this all-hazards comparability for designing risk communication programs, it is important to discuss possible reasons why a better fit for the wildfire analysis was obtained by excluding empowerment and trust, and why the measure of place attachment

DOI10.5595/idrim.2013.0050

was important in this study but not others, including other wildfire preparedness studies conducted using the same theory.

The finding that a better fit was obtained for the wildfire analysis when empowerment and trust were removed is consistent with the theory (Paton 2008). Paton's theory developed from theories of trust that propose that the importance of trust in managing uncertainty is inversely related to the degree of familiarity people have with a situation (e.g., it can be hypothesized that the higher the frequency of hazard occurrence the less trust in external sources will be important) (Earle and Cvetkovich 1995; Luhmann 1979; Mayer et *al.* 1995; Siegrist and Cvetkovich 2000). As hazard frequency increases, so does the likelihood of people having direct (e.g., being affected by fire) or indirect (e.g., witnessing fire in close proximity to their community, knowing friends and family who have been affected) experience of the events they are being asked to prepare for. That they were familiar with wildfire hazards is evident in finding that respondents to the wildfire study were three times more likely to discuss wildfire issues every month compared with their counterparts living in high earthquake risk areas (Paton 2008). This means that more information will be directly available to people and/or accessible from within their community, negating the need to acquire and evaluate information from other sources.

Note that this does not mean that the information available to people, or that they selectively attend to, is accurate or capable of motivating action. Paton et *al.* (2005) found that the sources of local knowledge available to people could lead to their deciding not to prepare. What familiarity means is that people have access to information that influences their interpretation of hazards and the choices they make about managing their risk. Clearly, risk communication needs to accommodate this and ensure that people are basing their choices on accurate information.

Increased familiarity with wildfires reduces reliance on external sources and thus, under this circumstance, it could be postulated that empowerment and trust (the variables that link people and agencies) becomes less salient as influences on people's preparedness decisions. Dependence on external sources through empowerment and trust is therefore rendered unnecessary when people are able to make direct evaluations of the costs and benefits of preparing based on their personal accumulation of knowledge. This suggestion remains tentative until a more searching investigation of the nature of familiarity and how it can be assessed and tested is undertaken.

In contrast, in the unfamiliar or novel situations, that better describes the situation prevailing in the areas from which the data from the tsunami, earthquake and influenza hazards were obtained; reliance upon external expert sources would be correspondingly greater. Hence the significance of empowerment and trust as predictor variables in the tsunami, earthquake and influenza analyses in which people faced uncertainty and were reliant on others to help them deal with this uncertainty.

The wildfire analysis also differed from the other analyses with regard to a better fit being obtained when a measure of place attachment was included in the model. Place attachment was not supported for other hazards used to develop the theory (Paton 2008). A role for place attachment in the wildfire analysis could reflect the fact that the majority of the population from whom this data set was collected chose to live in close proximity to woodland and bush for lifestyle reasons. This could have made their sense of attachment to this environment an important influence on their preparedness. That the inclusion of place attachment reflects a characteristic of this population, and not a variable which need be included in all locations, is supported by it not being found in a study of wildfire preparedness in Portugal (Paton, Tedim and Shand 2012). The source of wildfire hazards, the forest, is thus linked to people's sense of attachment to the place from which these data were obtained, with this sense of attachment to place potentially influencing their motivation to prepare (Paton et *al.* 2006a).

5.1 Confirmation of All Hazards Applicability: Theoretical and practical implications

The finding of some level of cross hazard applicability provides the opportunity to offer suggestions for the design of risk communication and public education strategies across different hazards and enhance risk communication and education more effectively in areas that face risk from multiple hazards. The model suggests that these strategies must address information content (e.g., outcome expectancy), social context (community participation, problem solving), and agency (empowerment, trust) factors. The next section summarizes the practical implications of this work for developing intervention strategies that develop outcome expectancy, community participation, collective efficacy and empowerment. While trust is influenced directly, as it is the outcome of the transactions that occur over time, trust will be developed as a consequence of developing its antecedents (i.e., outcome expectancy, community participation, collective efficacy and empowerment). Further information on intervention can be found in Paton and McClure (2013) and Paton and Wright (2008).

Risk communication programs should aim to reduce negative outcome expectancy (NOE) and increase positive outcome expectancy (POE) beliefs. For each hazard, an inverse relationship between negative outcome expectancy (NOE - people believe that the severity of hazard consequences render personal actions futile) and preparing was evident (Figures 1-4). From a practical perspective, this identifies a need to distinguish people disinclined to act because they do not believe that preparing will be effective from others whose preparedness level is low because they need additional guidance to facilitate their preparedness. These differences need to be considered when planning community hazard outreach programs.

NOE beliefs can be countered by providing information that helps people differentiate between uncontrollable causes (e.g., earthquakes that cause ground shaking, wildfires that create embers) and controllable consequences (e.g., securing a house to its foundations can limit the effect of ground shaking, a defensible space offers protection from ember attack). This can be done directly by providing information that emphasises the distinction between causes that can't be controlled and the consequences that can be managed (Paton et *al.*, 2006b). NOE beliefs can also be countered by framing messages in ways that invite people to consider what could be done for more vulnerable (e.g., children at school, residents in a home for the elderly) members of society. By coming up with strategies that could assist people perceived as being more vulnerable than themselves, their NOE beliefs are more likely to break down (Paton et *al.*, 2006b).

However, reducing NOE will not, in itself, motivate preparing. For this to occur, risk communication must also encourage the development of positive outcome expectancy beliefs (POE). POE beliefs can be increased by increasing peoples' hazard knowledge and their understanding of how hazard consequences arise and can be prevented or reduced (Paton and Wright 2008). This can be done by providing specific information about how each protective action reduces risk and/or contributes to safety (e.g., increasing household supplies increases ability to cope with disruption as a result of food not being delivered to stores, how a defensible space reduces the risk of embers from a fire front reaching a home).

POE beliefs are also more likely to develop when people are presented with a small number of items to consider at any one time (normal practice is to present comprehensive lists). When presented with large lists, people focus on the most difficult or expensive and this focus can reduce the likelihood of their acting at all. Presenting a small number of items, and starting with relatively easily adopted items and introducing progressively more complex tasks over time, people are less likely to be overwhelmed by the task before them. By presenting information on preparedness measures progressively over time, sustained adoption is more likely (Paton and Wright 2008) and the potential to leverage preparedness for multiple hazards is increased (Paton and McClure 2013).

While increasing POE beliefs can generate the belief in the benefits of preparedness, the findings suggests that whether or not this belief is converted into preparedness is a function of a) how regularly people interact with others in their environment and b) how people interpret the trustworthiness of the information source, the information, their circumstances and the preparedness measures. These findings imply that the effectiveness of public education and risk communication thus becomes a function of two factors. The first factor is the degree to which strategies encourage community members to discuss hazard issues and identify the resources and information they need to deal with the consequences a hazard event would pose for them. The second factor concerns the degree to which risk management agencies empower community members.

Confirmation of a role for community participation supports the contention that social interaction with others who share similar beliefs and values (community participation) influences how people make decisions regarding how they might manage their risk (Earle 2004; Lion et *al.* 2002; Paton et *al.* 2005). The analyses also support the argument (Paton 2008) that the level of planning and problem solving competence (as evinced by confirming the role of collective efficacy in the analyses) amongst community members makes an additional contribution to the process (Figures 1, 2 & 4).

With the exception of the wildfire analysis (see above), empowerment played a vital role by mediating the relationship between community characteristics and competencies (participation and collective efficacy) and trust (Figure 1, 2 & 4). This supports the argument that people's perception of the degree to which agencies empower them influences the level of trust in sources of information and the likelihood of preparing (Earle 2004; Eng and Parker 1994; Paton et *al.* 2006b; Siegrist and Cvetkovich 2000). The analyses reiterate the important role that engaging with community members, understanding their needs, and relating to them in ways that empower them has within a risk management strategy.

The final prediction, that trust mediated the relationship between empowerment and intentions, and subsequently actual preparation, was supported in all but the wildfire analysis (Figure 3). That finding indicates that the more citizens are able to formulate their needs and perceive their needs as having been met in the past by civic agencies, the more likely they are to trust them and the information they provide, and to use the information to prepare to respond to hazard events. These findings have additional implications for risk communication, specifically with regard to the potential to leverage risk communication off more mainstream community engagement processes.

The analyses demonstrating that mainstream community processes and competencies influence hazard preparedness highlights the benefits that could accrue from integrating risk communication and community development processes rather than conceptualizing risk communication as a stand-alone process delivered independently from other community initiatives (Paton 2008). The social context (community participation, collective efficacy, empowerment and trust) variables used in the analyses tapped into pre-existing community characteristics and competencies and patterns of community-agency relationships that reflect people's day-to-day experiences. Thus, the community competencies that influenced preparedness in the analyses discussed here derived from working on challenges and opportunities with others over time can make significant contributions to explaining differences in levels of preparedness across a range of hazards. Consequently, integrating risk management and community development activities in ways that specifically encourage discussion of hazard issues, develop community members' problem solving competencies, and encouraging agencies to engage with communities in ways that empower them could increase the likelihood of people preparing (Paton 2008).

Public education could include inviting representatives of community groups (e.g., community boards, Rotary, religious and ethnic groups etc.) to review hazard event scenarios and identify the implications and risk mitigation strategies appropriate for them. This process would provide the information and resource requirements necessary for community-led mitigation strategies that are consistent with the diverse beliefs, values, needs, expectation, goals and systems within a community. The effectiveness of these activities can be increased by working with community leaders and training them to provide information and advice pertinent to the needs of their communities. The full benefits of developing these community competencies only accrue when complemented by empowerment.

One approach to empowering communities would involve risk management agency representatives acting as consultants to communities (e.g., facilitators, resource providers, change agents, coordinators) rather than directing the change process in a top down manner (Paton and Bishop 1996). Through this process, they could assimilate and co-ordinate the needs and perspectives derived from community consultation, and, as far as possible, seeking to provide the information and resources necessary to empower community groups and sustain self-help and resilience. By mobilising resources intrinsic to a community, sustained preparedness is more likely to ensue. Other approaches to promoting empowerment can be found in Fetterman and Wandersman (2004).

6. CONCLUSION

For people who have to co-exist with potentially hazardous circumstances, their resilience is influenced by the degree to which they are prepared to respond to hazard events that could occur with no or little warning. Risk communication strategies must accommodate the role of the social context in determining the relevance and meaning of information and thus whether it is used, as intended, to facilitate sustained preparedness in circumstances in which people are required to make risk management choices under conditions of uncertainty. To do so, it is first important to encourage community members to discuss hazard issues, identify the resources and information they need to deal with the consequences a hazard would pose for them, and to ensure that communities possess the competencies required to use information to plan how best to act in ways that reduce their risk. Secondly, it is important to ensure that the community-agency relationship is complementary and empowering. The theory discussed here accommodated these social processes and demonstrated a capacity to account for differences in levels of preparedness across hazards that differ in preparedness requirements. While not presenting all possible variables that could be included, it represents a sound foundation for the future development of preparedness theory.

REFERENCES

Arbuckle, J. L. (2006) *Amos 6.0 User's Guide.* Chicago IL: SPSS.

Bennet, P., and Murphy, S. (1997) *Psychology and health promotion*. Buckingham: Open University Press.

Bishop, B., Paton, D., Syme, G., and Nancarrow, B. (2000) Coping with environmental degradation: Salination as a community stressor. *Network,* 12: 1-15.

Byrne, B. M. 2001. *Structural equation modelling with AMOS: Basic concepts, applications, and programming.* New Jersey: Lawrence Erlbaum.

Dillon, J. and Phillips, M. (2001) Social capital. Curtin University: Perth, Western Australia

Duncan, T. E., Duncan, S. C., Okut, H., Strycker, L. A., and Hix-Small, H. (2003) A multilevel contextual model of neighbourhood collective efficacy. *American Journal of Community Psychology*, 32: 245-252.

Duval, T. S. and Mulilis, J. P. (1999) A Person-Relative-to-Event (PrE) Approach to negative threat appeals and earthquake preparedness: A field study. *Journal of Applied Social Psychology,* 29: 495-516.

Earle, T. C. (2004) Thinking aloud about trust: A protocol analysis of trust in risk management. *Risk Analysis,* 24: 169-183.

Earle, T. C., and Cvetkovich, G. T. (1995) *Social trust: Towards a cosmopolitan society*. Westport, CT: Praeger.

Eiser, J. R., Bostrom, A., Burton, I., Johnston, D. M., McClure, J., Paton, D., van der Pligt, J., and White,

M. P. (2012) Risk interpretation and action: A conceptual framework for responses to natural hazards. *Journal of Disaster Risk Reduction*, 1; 5-16.

Eng, E., and Parker, E. (1994) Measuring community competence in the Mississippi Delta: The interface between program evaluation and empowerment. *Health Education Quarterly*, 21: 199-220.

Fetterman, D. M., and Wandersman, A. (2004) *Empowerment evaluation principles and practice*. New York: Guilford Publications.

Kee, H., and Knox, R. T. (1970) Conceptual and methodological considerations in the study of trust and suspicion. *Journal of Conflict Resolution*, 14: 357-365.

Lindell, M. K., Arlikatti, S., and Prater, C. S. (2009) Why do people do what they do to protect against earthquake risk: Perception of hazard adjustment attributes. *Risk Analysis*, 29: 1072- 1088.

Lion, R., Meertens, R. M., and Bot, I. (2002) Priorities in information desire about unknown risks. *Risk Analysis*, 22: 765-776.

Luhmann, N. (1979) *Trust and power*. Chichester: Wiley.

Marris, C., Langford, I. H., and O'Riordan, T. (1998) A quantitative test of the cultural theory of risk perceptions: Comparisons with the psychometric paradigm. *Risk Analysis*, 18: 635-647.

Mayer, R. C., Davis, J. H., and Schoorman, F. D. (1995) An integrative model of organizational trust. *Academy of Management Review*, 20: 709-734.

McAllister, D. J. (1995) Affect- and cognition-based trust as foundations for interpersonal cooperation in organizations. *Academy of Management Journal*, 38: 24-59.

Paton, D. (2006) Disaster Resilience: Integrating individual, community, institutional and environmental perspectives. In D. Paton & D. Johnston (Eds.), *Disaster Resilience: An integrated approach.* Springfield, Ill., Charles C. Thomas: 305-318.

Paton, D. (2007). *Measuring and monitoring resilience in Auckland* (GNS Science Report 2007/18). Wellington, New Zealand: GNS Science.

Paton, D. (2008) Risk communication and natural hazard mitigation: How trust influences its effectiveness. *International Journal of Global Environmental Issues*, 8: 2-16.

Paton, D. (2012) *MCDEM Christchurch community resilience project report: Part 1*. Ministry of Civil Defence and Emergency Management. Wellington, New Zealand.

Paton, D., and Becker, J. (unpublished) Social predictors of earthquake preparedness in Canterbury, New Zealand. Unpublished research data.

Paton, D., and Bishop B. (1996) Disasters and communities: Promoting psychosocial well-being. In D. Paton and N. Long (Eds.), *Psychological Aspects of Disaster: Impact, Coping, and Intervention*Dunmore Press, Palmerston North, New Zealand.

Paton, D., and Buergelt, P. T. (2012) Community Engagement and Wildfire Preparedness: The influence of community diversity. In D. Paton and F. Tedim (Eds.*), Wildfire and Community: Facilitating preparedness and resilience.* Springfield, Ill., Charles C. Thomas.

Paton, D., Buergelt, P. T., and Prior, T. (2008a) Living with bushfire risk: Social and environmental influences on preparedness. *Australian Journal of Emergency Management*, 23: 41-48.

Paton, D., Houghton, B. F., Gregg, C. E., Gill, D.A., Ritchie, L. A., McIvor, D., Larin, P., Meinhold, S., Horan, J., and Johnston, D. M. (2008b) Managing tsunami risk in coastal communities: Identifying predictors of preparedness. *Australian Journal of Emergency Management*, 23: 3-9.

Paton, D., Kelly, G., and Doherty, M. (2006a) Exploring the Complexity of Social and Ecological

DOI10.5595/idrim.2013.0050

Resilience to Hazards. In D. Paton & D. Johnston (Eds.), *Disaster Resilience: An integrated approach.* Springfield, Ill., Charles C. Thomas.

Paton, D., and McClure, J. 2013 (in press). Preparing for Disaster: Building household and community capacity. Springfield, Ill., Charles C. Thomas.

Paton, D., McClure, J., and Buergelt, P. T. (2006b) Natural hazard resilience: The role of individual and household preparedness. In D. Paton & D. Johnston (Eds.), *Disaster Resilience: An integrated approach*. Springfield, Ill., Charles C. Thomas.

Paton, D., Parkes, B., Daly, M., and Smith, L. M. (2008c) Fighting the flu: Developing sustained community resilience and preparedness. *Health Promotion Practice*, 9 (4) Suppl.: 45S-53S.

Paton, D., Smith, L. M., and Johnston, D. (2005) When good intentions turn bad: Promoting natural hazard preparedness. *Australian Journal of Emergency Management*, 20: 25-30.

Paton, D. and Tang, C.S. (2009) Adaptive and Growth Outcomes Following Tsunami: The Experience of Thai Communities following the 2004 Indian Ocean Tsunami. In Edward S. Askew and James P. Bromley (Eds). Atlantic and Indian Oceans: New Oceanographic Research. New York: Nova Science Publishers.

Paton, D., Tedim, F and Shand, H. (2012). The social dimensions of forest fire: Community contributions to sustainable, integrated wildfire risk management in Portugal. In D. Paton & F. Tedim (Eds.), Wildfire and community: Facilitating preparedness and resilience (pp. 228-240). Springfield, Ill: Charles C. Thomas.

Paton, D., and Wright, L (2008) Preparing for bushfires: The public education challenges facing fire agencies. In J. Handmer and K. Haynes (Eds.), *Community Bushfire Safety*. Canberra: CSIRO Publishing.

Poortinga, W. & Pidgeon, N. F. (2004). Trust, the asymmetry principle, and the role of prior beliefs, *Risk Analysis,* 24: 1475-1486.

Rippl, S. (2002) Cultural theory and risk perception: A proposal for a better measurement. *Journal of Risk Research,* 5: 147-165.

Siegrist, M., and Cvetkovich, G. (2000) Perception of hazards: The role of social trust and knowledge. *Risk Analysis,* 20: 713-719.

Sheeran, P. (2002) Intention-behaviour relations: A conceptual and empirical review. In W. Stroebe and M. Hewstone (Eds.), *European review of social psychology*. Chichester, England: Wiley.

Speer, P. W., and Peterson, N. A. (2000) Psychometric properties of an empowerment scale: Testing cognitive, emotional and behavioural domains. *Social Work Research,* 24: 109-118.

Tabachnick, B. G., and Fidell, L. S. 2007. *Using multivariate statistics* (5th ed.). Boston: Allyn & Bacon.

Zaccaro, S. J., Blair, V., Peterson, C., and Zazanis, M. (1995) Collective efficacy. In J.E. Maddux (Ed.), *Self efficacy, adaptation, and adjustment: Theory, research, and application*. New York: Plenum Press.