Strengthening community resilience through network building

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Abstract: This paper argues that individuals mimic actions taken by close neighbours when deciding what they should do to reduce uncertainty to flood risks. Thus, policy makers promoting local resilience to high-impact low-probability hazards should not patronise residents living in risk areas but create opportunities for them to interact with community members who had taken protective actions. Protective actions in this study are flood insurance, house raising, and home improvements. The decision to take these protective actions is regressed against the following variables: i) the number of neighbours taking protective actions; ii) the quality of this relationship; iii) perception over neighbours' decision; and iv) general influence that neighbours have on individual decision making. Such model is for the first time presented in the literature of disaster management. It also provides empirical evidence to guide policy making based on data collected among residents living in flood-prone areas in Southeast Queensland, Australia.

Keywords: decision making; risk perception; social networks; network building; community resilience; heuristics; risk communication.

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1 Introduction

The literature of risk management lacks empirical evidence on the role of social networks in shaping individual decision making for disaster mitigation. Some research investigated the number of people one knows and the influence it has on decision making: If so many people that I know are not doing this, why should I be concerned about that? (Hatori et al., 2004). It has also been stated that we can – or at least should – make 'rational' decisions: If taking this action is considered efficient, this is the decision I should make (Kick et al., 2011). It is also believed that perceived influence of others' actions shape our

own decision making: We are easily influenced by all the people and information around us (Ahmed, 2011). These premises have all been observed in the literature investigating human behaviour in the context of risk management (Helgeson et al., 2012).[1] Nonetheless, it is still unclear which social network factor is the most significant in determining individual decision making under uncertainty. This study models this cognitive process for decisions related to flood mitigation. The main finding is that it is possible to predict how individuals at risk make decisions by learning the quality of the relationship that a resident has with community members.[2] This finding was attained through regression analysis based on survey data collected in 2015 among householders living in flood-prone areas in Southeast Queensland, Australia.

Householders living in at-risk locations that perceived having 'close' personal relationships with their neighbours are more likely to take out flood insurance, raise or retrofit their property. These actions are meant to reduce flood impacts to their property and respective kin. By 'close' relationships, this study understands that it is the quality of a connection that exerts the main influence on individual decision making under uncertainty.[3] Thus, policy makers aiming to increase the resilience of communities to high-impact low-probability threats should design communication strategies and open up spaces that allow members of a community to meet and build interpersonal trust.[4] Policies fostering network communities would result in more individuals taking mitigatory actions in order to complement government efforts to reduce the effects of wicked societal problems (Koppenjan and Klijn, 2004).

It is worth noting two key aspects of this paper. First, the context that it is embedded in is the mitigation stage of a disaster cycle. This means that it discusses actions that reduce and eliminate long-term risks to people and property from hazards and their effects (Godschalk, 2003). The main goal of mitigating hazard risks is breaking the cycle of damage, reconstruction, and repeated damage from disasters (FEMA, 2000). Hazard mitigation actions focus on structural and nonstructural actions (Schwab et al., 1998). Examples of structural measures are engineering projects and building codes. Nonstructural actions are related to land-use planning, property acquisition and social networks (Schwab et al., 1998). Both structural and nonstructural actions are part of concerted efforts to build resilient cities (Godschalk, 2003). This paper focuses on the nonstructural aspects of urban hazard mitigation, more particularly on efforts towards building network communities. Resilient cities featuring network communities are in a better position to adapt and learn from disasters (Godschalk, 2003; Mileti and Peek-Gottschlich, 2001).

The second aspect to be noted is the concept of network building. As Blackshaw (2010) highlighted, the notion of community building has been misused in social sciences and policy discourse and it is now problematic, imprecise, and misleading. As an effort to address this conceptual issue which features policy implications, Fairbrother et al. (2013) propose the use of network building since this is a more tangible concept and is a pillar of concerted efforts towards community building. Research has shown that focusing on expanding social networks to build resilient communities is manifested in the forms of a growing sense of mutual obligation and cooperation, particularly among neighbours (Romanow and Bruce, 2006; Sundblad and Sapp, 2011; Wilkinson, 1991). This study, therefore, advocates the use of network building to add precision to public discourse and more focus to policy making.

2 Overarching concepts determining the selection of independent variables

The literatures of decision making, social networks and risk communication underpin the model of this study. Thus this section highlights elements of these literatures that

i substantiate the development of this model and, more importantly

ii support policy recommendations made at the end of this paper.

2.1 Decision making under uncertainty

The independent variables used in this study were deliberately formulated as heuristics. This is an attempt to understand how 'rules of thumb' capture risk perceptions and shape decision making. For instance, one could reason along these lines: "I know so many people who took out flood insurance, so I should take this action as well". However, there is no consensus in the literature about the role that heuristics play in decision making under uncertainty.

Some scholars argue heuristics increase exposure to major threats. This is because individuals cannot perceive long-term risks and resorting to few rules of thumb, such as the number of people one knows who had taken an action or not, often result in suboptimal decisions. These scholars then suggest that individuals be trained to apply the concept of regression (Kahneman and Tversky, 1973, p.237) in their decision-making processes (Slovic and Fischhoff, 1977). The expectation is that reasoning by 'the calculus of chance' will reduce the number of 'mental short cuts' leading to 'severe and systematic errors' (Kahneman and Tversky, 1973, p.237).

Marewski and Gigerenzer, however, state that "complex (e.g., regressions) models that assign optimal weights to various predictor variables" (Marewski and Gigerenzer, 2012, p.83) are unrealistic because of the complexity to compute optimal solutions. Marewski and Gigerenzer explain that people use simple strategies in searching for solutions that "are good enough with respect to an organism's goals" (Marewski and Gigerenzer, 2012, p.80). These goals, in turn, are shaped by the environment of this 'organism' or decision maker (Simon, 1991). Marewski and Gigerenzer (2012) then propose the selection of an adequate tool, or a 'simple rule', to help individuals adapt to their environment. The challenge in the rationality proposed by Marewski and Gigerenzer (2012) is identifying which heuristics is more adequately adapted to a specific environment. This study is conceptually aligned with the propositions made by Marewski and Gigerenzer (2012).

2.2 Social networks

The influence that 'relationships' have on individual risk perception, mainly under uncertain scenarios, must also be considered when evaluating decision-making processes. Anthropologists studying urbanisation in mid 1950s found that society organises itself around relationships (McIllwain, 1999). Social role, status, and position of individuals, as well as structural relations, are foundations for political and economic power (McIllwain, 1999). Knoke and Yang (2008) highlighted three underlying assumptions about patterned and structural relations. First, structural relations are often more important for understanding observed behaviours than age, gender, values, and ideology. Second, social networks affect perceptions, beliefs, and actions through a variety of mechanisms

that are socially constructed by relations among entities. For instance, networks create interests and shared identities while also promoting shared norms and values. Third, structural relations should be viewed as dynamic processes. In other words, networks are continually changing through interactions among their constituent people, groups, or organisations. The findings of these anthropological studies resonate with this paper because its main argument stresses the relevance of 'close' relationships in decision making.

Håkansson and Ford (2002) break down social networks. They explain that a network consists of nodes connected by threads. In this study, nodes are *individuals* and threads are personal *relationships*. Nodes and threads have their own particular content: their share of resources, knowledge and understanding. As Knoke and Yang (2008) highlight, the content found in each node and thread is the result of complex interactions and adaptations made over time. This content makes each node unique (Håkansson and Ford, 2002). Håkansson and Ford (2002) also explain that a network is formed by investments. In this study, investment is *effort*. The total amount of effort an individual puts into learning determines how much content was gained through relationships. It is important to note that the development of these relationships affects the amount of content an individual holds and exists in a relationship. Håkansson and Ford (2002) conclude that the development of relationships generates opportunities to individuals, but they also warn about how these relationships impose restrictions. The stronger the relationships are, the more important they will be to knowledge building but also the more these relationships will restrict the freedom of an individual to build new knowledge and eventually change (Håkansson and Ford, 2002). This restriction to change is elucidated by network paradoxes (Håkansson and Ford, 2002).[5]

Based on these paradoxes, researchers aim to design tools that help individuals adapt to their surroundings. Researchers, however, cannot predict the direction a network develops. This is because of the large number of ways participants can interact. Networks are built on variety, but they do have systemic properties (Håkansson and Ford, 2002). These properties mean that interactions depend on situation and context (Håkansson and Ford, 2002). The task of policy and decision makers then is to encourage and help individuals continuously clarify *their* understanding, *their* actions, and *their* perspectives on the dynamics of a network (Håkansson and Ford, 2002). These dynamics and the active participation of authorities in them change a locality's position by engaging in a process of learning and systematising action (Håkansson and Ford, 2002). As a result, this locality capitalises on the economy of network stability[6] (Håkansson and Ford, 2002). This breakdown of a network community serves to support the 'Discussion' of findings and guide policy making aiming to foster the number of 'close' relationships in communities at risk.

2.3 Risk communication

Risk perception, as an essential predictor of decision making under uncertainty, is determined by risk communication: external and internal factors. This section briefly explains these factors and highlights its importance in the context of decision making.

The literature of risk communication acknowledges that risks are likely to be reduced if a diversity of opinions is brought into communication that is sensitive to residents' needs and perceptions (Lazarsfeld et al., 1948; Rogers, 2003). This diversity is divided into two broad categories: external and internal (Weick, 1979). Externality has to do with

messages coming from experts and internal messages derive from relatives and friends (Lazarsfeld et al., 1948; Rogers, 2003). These two sources of risk communication contribute to shape individual decisions made under uncertainty.

In the disaster management literature, attention is mostly placed on external risk communication. The core of external risk communication is the persuasiveness of experts' advice and the willingness of people to yield to this advice (Heath et al., 2009). These authors argue that it is the degree of concern toward a particular threat that affects willingness to receive and interpret information as well as personal action (Dillard et al., 2007). The degree of concern depends on how much information individuals can receive, understand, evaluate, and remember (Dillard et al., 2007). Kasperson (1992) called this information gathering and processing as social amplification of risks. This amplification process is determined by how willing individuals of a community are to receive and process information relevant to a risk based on the type and amount of media coverage – and individual discussion – that this risk has generated.

Building on Kasperson's theory (1992), other scholars have focused on studying internal risk communication factors; for instance, the role that communities play when it comes to reacting to risks (Palenchar and Heath, 2007). These scholars assume that a functioning society knows the risks and develops plans tailored to community conditions (Scherer and Cho, 2003). They argue that community members know these risks because of the messages they exchange survive experiences and conversations through transparent communication platforms. These authors stress that adding multiple voices into a communication platform makes it more valuable because it increases the likelihood that concerns will be heard and given regard (Hon and Brunner, 2000; Weick, 1979, 1995). Peguero (2006:5), for example, found that "Latino homeowners prefer to utilise friends and family as sources of disaster preparation information".[7] The model of this study assesses internal communication factors shaping risk perception and how these factors shape decisions in communities facing high-impact low-probability disasters.

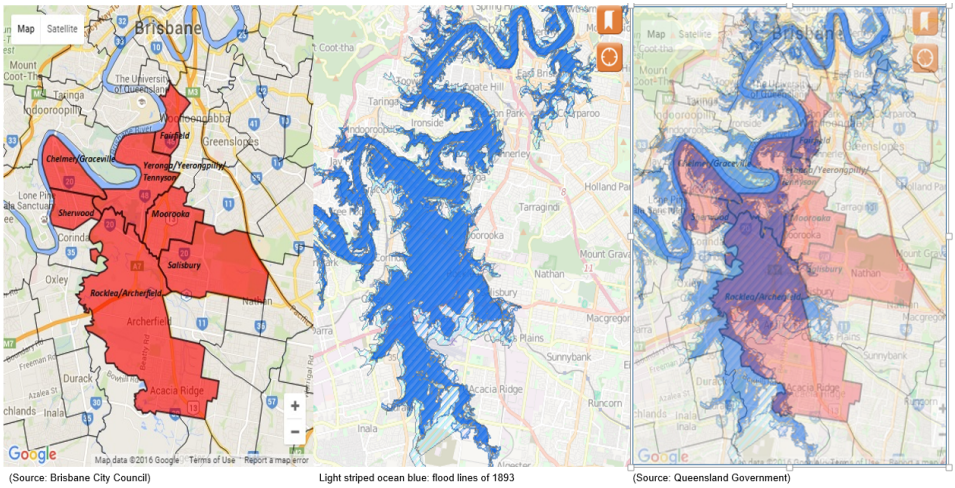
3 Method

3.1 Location

The city of Brisbane has been affected by low-probability high-impact disasters (Figure 1). The last two disasters were particularly damaging. The major flood that occurred in 1974 caused insured losses of about $2.3 billion (van den Honert and McAneney, 2011). It led to the construction of the Wivenhoe Dam in 1984 (Bohensky and Leitch, 2014), which reinforced the popular belief that Brisbane was 'flood proofed' (Pittock, 2011, p.2). The construction of this massive engineering structure, however, was not able to eliminate flood risks. Two other major events happened between late 2010 and January 2011. The first flash flood, described by Queensland Premier as an inland tsunami, affected the city of Toowoomba and then farther downstream in the rural Lockyer Valley (Bohensky and Leitch, 2014). The second major flood impacted the downstream cities of Ipswich and Brisbane. These two events affected 14,100 properties including the inundation of 1203 houses and 2436 businesses (QFCI, 2012). Public and private river infrastructure was also severely damaged (Bohensky and Leitch, 2014). This event became known as the 2011 Brisbane flood and turned out as the most expensive natural disaster in Australia's history (van den Honert and McAneney, 2011; QFCI,

2012). Responsibility for the losses caused by the 2011 disaster has been the object of judicial debates between flood-affected residents and the state and local governments. A class action lawsuit has been currently reviewed by the Supreme Court of New South Wales.

Figure 1 Flood maps (see online version for colours)



(Source: Brisbane City Council)

Light striped ocean blue: flood lines of 1893
Striped blue: flood lines of 1974
Continuous blue: flood lines of 2011

(Source: Queensland Government)

3.2 Sample

This study used a questionnaire for data collection. This questionnaire was personally delivered to 1796 householders. The number of residents who mailed back their surveys was 469 (26% return rate). Questionnaires and reminders were delivered between late spring and early summer of 2015. No flood warnings or any other weather issues were in effect during that time. The residents that participated in this study were distributed across eleven suburbs (Figure 1). Residents from these suburbs were selected because they have either direct or indirect experience with flood damage (Figure 1). The selection of residents living in these suburbs also increases the variability of data collected since participant households feature different distances to the Brisbane River, demographics, and flood risks (Uehara, 2018). The variability of this data contributes to generalisations deriving from model results.

3.3 Regression

This study uses logistic regression to assess the relationship between dependent and independent variables. Logistic regression assesses the probability of two results (Wilson and Lorenz, 2015, p.33). The results of dependent variables were coded as either zero (no action) or one (action). The assumptions of logistic regression are met in this study (see Laerd, 2013 for an in-depth overview of these assumptions). The assumptions of logistic regressions are that:

i the dependent variable has only two categories

ii there is one or more independent variables that are either continuous (infinite number of possible values) or categorical (when a variable can take only one value of a limited number of possible values)

iii there are independence of observations and each dependent variable is mutually exclusive and exhaustive (i.e., a home is either raised or not)

iv there is a minimum of fifty cases per explanatory variable, as Cox (2016) recommends, because "larger samples are needed for linear regression because maximum likelihood coefficients are large sample estimates".

As for independent variables, they were measured using a scaling method. Likert-scales are ordinal variables consisting of a rank or a rating. The limitation to this type of measurement is that the researcher cannot be assured of the preciseness of a measurement. For instance, '5' on a Likert scale is higher than '4' but it is not very precise because it does not show how much higher '5' is if compared to '4' or whether the difference between '5' and '4' is the same as the difference between '4' and '3' (Wilson and Lorenz, 2015). However, Norman (2010, p.631) argues that Likert scale data, even when featuring small sample sizes and unequal variances with non-normal distributions, can still be used for parametric statistics without fear about the robustness of the data or researchers 'coming to the wrong conclusion'.

3.4 Model

The three dependent variables in this study are

i flood insurance

ii house raising

iii home improvements.

These response variables were selected because they are the most common protective actions that householders living in Brisbane take against flood risks. The definition of dependent variables can be found on Table 1.

As for independent variables, they measure

i the 'number' of neighbours one knows

ii how 'close' one perceives being to neighbours

iii how 'effective' is the decision made by neighbours

iv to what extent one believes to be 'influenced' by decisions made by neighbours to take out flood insurance, raise their property or make home improvements (see Tale 2 for the 'distribution' and 'frequency' of these variables).

These variables were selected because preliminary field observations and interviews indicated that these variables were the most common social network variables among

interviewees living in flood-prone areas in Southeast Queensland. The definition and frequency of these predictor variables can be found on Table 2 and Figure 2 respectively.

Table 1 Dependent variables

Dependent variables	*Definition*
House raising	The elevation of a home to recommended official levels against major floods
Flood insurance	An insurance policy that covers damage caused by floods
Home improvements	Retrofitting a home (inside and outside) to sustain and reduce the impact of floods

The statistical software used for regression analysis and graphical visualisations is *R* version 3.5.1.[8]

Table 2 Independent variables

Independent variables	*Definition*	*Likert-scale*
Number	How many neighbours do you know have taken the following protection measures to reduce flood damage to their property?	0 (1), 1–2 (2), 3–4 (3), 5–10 (4), >11 (5)
Close	How close do you think you are (personal relationship) with the neighbours that had taken the following protection measures to reduce flood damage to their property?	Not close at all (1)… Extremely close (5)
Effective	To what extent do you believe the protection measures taken by neighbours to reduce flood damage to their property are 'effective'?	Not effective at all (1)… Completely effective (5)
Influence	To what extent do you think that protection measures taken by neighbours influence your decisions to take the following protection measures to reduce flood damage to your property?	Not influence at all (1)… Completely influence (5)

4 Results

The *p*-Value adopted for this study is 0.05.[9] The independent variable measuring how 'close' a respondent feels to a neighbour who had taken a specific action is significant and positive in all models. These results indicate that it is more likely a respondent to take out flood insurance, make home improvements or raise a property when this individual believes to have a close relationship with a neighbour who had already taken one of these measures. Also, insurance is the most popular protective action taken by the participants of this study (Figure 3) and its model features the lowest 'null deviance', which is a measure of good of fitness of the model.

Figure 2 Frequency of independent variables

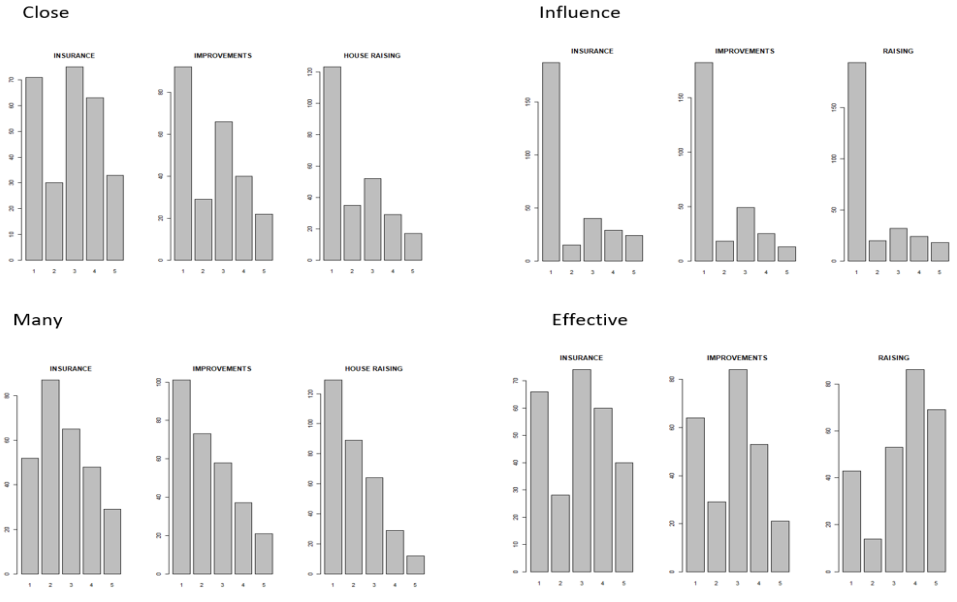
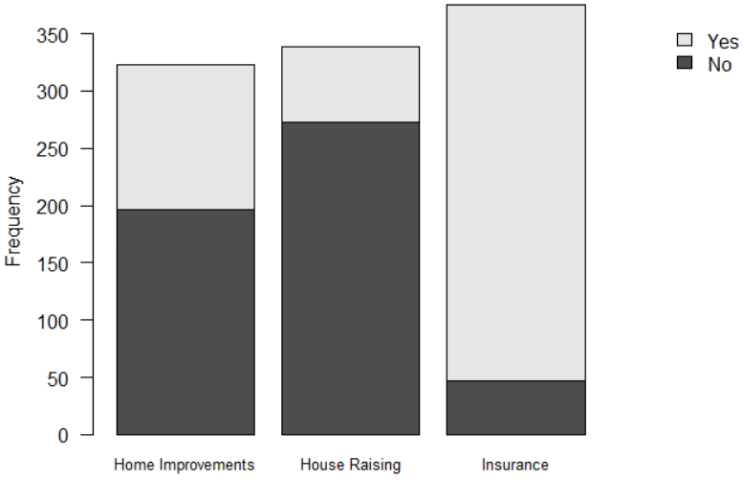


Figure 3 Frequency of dependent variables



4.1 Insurance

The only significant correlation out of the Insurance model (Table 3) is with the independent variable "how close the respondent is to neighbours who had taken out flood insurance".

Table 3 Insurance

	Estimate	*Std. error*	*t value*	*Pr*(>|t|)
(Intercept)	0.9360	0.0706	13.26	0.0000
NEIGHBOURS_INSURANCE	–0.0175	0.0207	–0.84	0.4007
CLOSE_NEIGHBOURS_INSURANCE	0.0422	0.0196	2.15	0.0329
EFFECTIVE_NEIGHBOURS_INSURANCE	–0.0198	0.0174	–1.14	0.2557
INFLUENCE_NEIGHBOURS_INSURANCE	–0.0262	0.0169	–1.55	0.1219

(Dispersion parameter for Gaussian family taken to be 0.08998785).

Null deviance: 17.070 on 186 degrees of freedom.

Residual deviance: 16.378 on 182 degrees of freedom.

(264 observations deleted due to missingness).

4.2 House raising

Respondents are more likely to have their property raised when they believe to have a close relationship with neighbours who had also elevated their houses. Another significant correlation out of this model (Table 4) is the one that shows that respondents are more likely to have their house raised when they disclose that knowing that neighbours had raised their properties influenced their decisions to take the same action.

Table 4 House raising

	Estimate	*Std. error*	*t value*	*Pr(>|t|)*
(Intercept)	–0.0269	0.0958	–0.28	0.7791
NEIGHBOURS_RAISING	0.0186	0.0317	0.59	0.5569
CLOSE_NEIGHBOURS_RAISING	0.0650	0.0270	2.40	0.0174
EFFECTIVE_NEIGHBOURS_RAISING	–0.0133	0.0274	–0.49	0.6277
INFLUENCE_NEIGHBOURS_RAISING	0.0571	0.0259	2.20	0.0290

(Dispersion parameter for Gaussian family taken to be 0.1568821)

Null deviance: 28.286 on 167 degrees of freedom

Residual deviance: 25.572 on 163 degrees of freedom

(283 observations deleted due to missingness).

4.3 Home improvements

Respondents are more likely to have their properties retrofitted when they claim that neighbours ‘close’ to them had done the same (Table 5). These respondents also revealed that the number of neighbours who had retrofitted their properties also has an influence on their decision to retrofit their own homes.

Table 5 Home improvements

	Estimate	*Std. error*	*t value*	*Pr(>|t|)*
(Intercept)	–0.0898	0.1026	–0.88	0.3828
NEIGHBOURS_IMPROVEMENTS	0.0850	0.0350	2.43	0.0162
CLOSE_NEIGHBOURS_IMPROVEMENTS	0.0804	0.0300	2.68	0.0081
EFFECTIVE_NEIGHBOURS_IMPROVEMENTS	0.0251	0.0330	0.76	0.4484
INFLUENCE_NEIGHBOURS_IMPROVEMENTS	0.0197	0.0319	0.62	0.5388

(Dispersion parameter for Gaussian family taken to be 0.2079716).

Null deviance: 40.390 on 163 degrees of freedom.

Residual deviance: 33.067 on 159 degrees of freedom.

(287 observations deleted due to missingness).

5 Discussion

This study demonstrated the importance of network communities to decision making under uncertainty. *Endogenous rationales elaborated from perceived 'close' personal relationships, or internal risk communication,* influence the decisions that at-risk individuals make to mitigate the impacts of high-impact low-probability hazards to their property and families.[10] Building social networks *guided by mutual obligation and cooperation at the community level* is a mitigation strategy considered to be less costly and as efficient as engineering structures to mitigate the impacts of black swan[11] type of events.[12] *Fostering residents to connect and share resources, knowledge, and understanding with their neighbours creates a conducive environment for the development of shared norms and identities that end up influencing collective risk perception and decision making under uncertainty.* This study focused particularly at the 'soft' aspects of mitigation efforts; that is, at the individual level of the decision-making process.

This study provided evidence that network communities are the foundation of resilience (NRC, 2011). This happens because network communities feature social capital in the form interpersonal trust (Dekker et al., 2008; Hutton, 2012; Murphy, 2007; Peterson and Besserman, 2010). Interpersonal trust allows individuals to accomplish greater things than they could by isolated efforts (Patterson et al., 2010). However, building interpersonal trust *requires effort, is voluntary and only effective if supported during the preparatory stage of disasters* (Scholtens, 2008). Authorities need to foster the creation of network communities to ensure the success of risk management policies and programs (COAG, 2011). *Officials reinforce patterned and structured relationships, and might nudge the direction of decisions deriving from shared beliefs and values, by actively listening to the concerns of residents and providing incentives for participation and meaningful information that help mitigate the risks of a threat.* For instance, Botzen and van den Bergh (2008) suggest, at the organisational level, a partnership between insurers and the public sector to speed up recovery processes and contribute to overall economic resilience against natural hazards. *At the community level, insurers could work closely with the network of residents to collaborate on plans that reduce uncertainty to flood risks.*

As Fairbrother et al. (2013) noted, networks are the building blocks for an increased sense of connection to residents. Authorities play important roles in supporting the creation of these relationships by developing informal gatherings where residents can meet and connect.[13] It is during these informal gatherings where householders build close rapport and disseminate information.[14] As a result, individuals feel that they are acting toward a collective response to a common threat shared with their close network. As for key nodes in a network, these are the individuals who are active in local organisations. They are the key nodes in a network because they have developed broader perspectives on their localities (Putnam, 1993, 1995). Through these individuals, the network also identifies new forms of cooperation that otherwise would not be possible (Gilchrist, 2009). By promoting these social interactions, these key figures also support capacity building in the context of community diversity and social inclusiveness (Morgan and Cooke, 1998; Cuthill and Fien, 2005; NRC, 2011).

6 Conclusion

Two policy recommendations are suggested.[15] First, local authorities need to design risk communication strategies that taps into the heuristics of bringing neighbours together.[16] For instance, the promotion of social norms alters cognitive environments by nudging residents to explore opportunities that help them exchange 'content' and build interpersonal trust[17] bounded by a framework. This trust is then expected to empower residents over their position in the network and shape their perceived capacity to manage residual risks from major threats.[18] Interpersonal trust also plays a key role when it comes to generating information in situations of uncertainty.[19] Second, it is suggested that the private and public sectors work together to identify, promote, and increase the number of local policy entrepreneurs. Prater and Lindell (2000) explain that these individuals are champions who sponsor an issue and make sure it stays on the agenda (de Bruijn et al., 2015, p.666). These local champions also mobilise community support for relevant policies (Berke and Beatley, 1992; Olson and Olson, 1993). In the context of this study, it recommends the Brisbane City Council to work closely with community centres, such as the Yeronga Community Centre, a non-profit organisation serving the residents participating in this study, to promote local resilience strategies through the strengthening of network communities.

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Notes

[1]See Sunstein and Thaler (2008) for 'nudging' behaviour by manipulating people's choice environment. The expectation of this strategy in public policy is to minimise costs related to the effort of changing collective behaviour while encouraging individuals to behave in ways that are perceived to be more beneficial to both themselves and society.

[2]This finding emerges from a model that also included i) number of relationships, ii) perceived efficiency of others' actions and iii) perceived influence of others' decisions.

[3]It is important to stress that decision making under uncertainty falls into the category of complex decisions. That is, individuals in these situations engage in an 'endogenous process' (Hauser, 2011, p.8) before making a decision. This paper argues that in this self-reflection process, individuals rely on the information they receive from trusted neighbours before deciding which action they should take. In opposition to this scenario, recognition-based heuristics are more prevalent in routine decisions. That is, individuals are more likely to make decisions that do not involve significant risks based on how easy they recognise a particular stimulus (Hauser, 2011, p.9).

[4]de Bruin et al. (2015, p.664) point out that it was the inclusion and active involvement of many stakeholders with different interests that allowed the successful completion of a very complex mitigatory project such as the 'Room for the River' in the Netherlands.

[5]The first paradox states that individuals within a network are not free to act according to their own aims. Individuals' actions must be understood within a structure of relationships. This means that the structure of existing relationships influences what can be done and how it can be done (Anderson et al., 1994). The network of existing relationships is also a severe limitation on a single individual. This limitation affects the costs of making a change in a network for both those involved in the change and may have effects elsewhere in the network. The second paradox has to do with influence. The interconnection between relationships and individuals determine each other. Individuals have no value or function for each other without relationships. And a relationship has no value if that individual has no special capability. Thus, developing an individual always involves developing its relationships, and a relationship cannot be developed without affecting the individuals to whom they are connected to. The third network paradox is about the effort of each individual to position itself in the network as an attempt to influence the knowledge and understanding of other individuals. The more successful a single individual is in forcing its thinking onto the network, the more it and those around it are likely to encounter long-term problems. If the development process becomes directed from one centre, it will become more integrated and may have fewer overt conflicts, but the network may cease to exist and become more of a hierarchy. A uni-directed network will have less ability to embrace relationships that are not compatible with each other, or which are developing in different directions. These may subsequently be important in ways that were impossible to forecast beforehand (Wilkinson and Young, 2002).

[6]Bellair (2006) and Hipp et al. (2013) suggest that well-developed local network structures reduce crime by increasing informal control. And Granovetter (1973) suggests that weak ties strengthen community organisation by creating important linkages across networks.

[7]Narratives, however, need to be integrated into a dominant one. 'Organisational effectiveness is maximised when internal variability keeps pace with external variability' (Weick, 1979, p.313). A dominant organisation narrative is the sum of all narratives (Heath, 1994). It is this integration process, shaped by collaborative engagement, that creates risk information that is more likely to be sensitive to individuals who need information before making a decision (Heath, 1994).

[8]Codes for regression analysis and graphical visualisations can be found here.

[9]p-Value of .05 indicates that there is only a 5% chance that results observed would have come up in a random distribution, so there is a 95% probability of being correct that the variable is having some effect and as a result we can reject null-hypotheses. The null-hypotheses in this study are that dependent variables are not significantly correlated with independent variables.

[10]See Fairbrother et al. (2013) for similar results in the context of bushfires in Victoria, Australia.

[11]See Taleb (2007).

[12]See Boin and ‘t Hart (2010, p.367).

[13]Richardson (1994) highlight that the type of public leadership required to foster network communities are ‘the learning organisation facilitator’. This leader facilitates productive learning within an organisation and acts in and/or enables self-organising, networked, learning communities’’ to evolve strategic developments largely under their own volition (and in the absence of tight central controls).

[14]Khan et al. (2011) stress that these spaces need to be beyond the online space so that i) they do not exclude those individuals with no access to this technology and ii) they create opportunity for more effective political activity and discourse. This approach to create physical spaces for socialisations also address the modern issues of individualisation and social fragmentation. It is important, however, that these newly physical spaces are not hierarchically structured but follows an online structure of being horisontally differentiated and polycentric.

[15]The scope of these recommendations is the main limitation of this study. These recommendations are empirically supported by data provided by residents living in the selected areas in Southeast Queensland. Future research is encouraged to test this model in other locations.

[16]Heuristics have been widely researched among business scholars to understand the relations between marketing communication strategies and consumer decisions. See Hauser (2011), Guercini et al. (2014) and Hauser (2014) for more information on this research field.

[17]However, nudging strategies, or attempts to plug behaviour insights into policy interventions also present issues if they neglect the complexity of a social issue. See more in Moseley and Stoker (2013).

[18]Abroms and Maibach (2008, p.228) stress that mass communication strategies fail when aiming to change individual behaviour rather than changing public behaviour by targeting improvements in the ‘large social system’.

[19]Muljono (2016) provides empirical evidence that interpersonal communication among trusted parties is more efficient to promote behaviour change than information that public mass communication strategies.