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North Queenslanders' Perceptions of Cyclone Risk and Structural Mitigation Intentions Part II: Cluster analysis and personas

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Executive Summary

In 2014, the Cyclone Testing Station (CTS) at James Cook University (JCU) and Suncorp began investigating cyclone resilience in North Queensland. The effort began with a review of insurance claims data from Cyclones Yasi (2011) and Larry (2006) to identify key drivers of loss in cyclones. That work led to an investigation of engineering strategies for mitigation and a cost-benefit analysis for implementing them. Although the cost-benefit of engineering strategies can be favourable, they have not been widely adopted by Queenslanders. To investigate behavioural drivers of mitigation and how adoption may be increased, the CTS partnered with Health and Behaviour Change in the Tropics (HABITT) at JCU. In 2016, the group commenced a three-year research project to examine behavioural aspects of homeowner decision-making toward cyclones and develop a decision-support tool (e.g. web or mobile app) to promote mitigation among Queenslanders. Findings from the behavioural work will be used to improve the effectiveness of messaging within the decision-support tool. The project is supported by Suncorp and Queensland Government (Advance Queensland) as part of a commitment to improve cyclone resilience in Queensland. This report is the second of two from the behavioural component of the research and details findings related to demographic and psychological factors that influence mitigation behaviours.

Past research has found that a wide variety of psychological and demographic factors can influence mitigation behaviours related to various extreme weather events (e.g., flood, earthquake, etc.). However, the understanding of these factors specifically in context of cyclones is limited. Project stakeholders wanted to understand why resilience measures are not widely adopted currently and how they can be in the future. Informed by a review of the literature, a survey was constructed to address this knowledge gap and identify factors influencing cyclone mitigation behaviour in North Queensland. The survey was distributed electronically to people living from Rockhampton to Cairns and received 550 responses (both homeowners and non-homeowners). Key findings of the analysis are provided below.

Roof Upgrade Behaviour

- **Key Finding:** People who had upgraded their roofs were more likely to be older, have no dependent children and have more knowledge about cyclones and mitigation measures.
- **Recommendation:** Roof upgrades may be considered more by people who are older and do not have any dependent children. The finding suggests that some people may not consider upgrading their roofs until their children have left home. As people without roof upgrades are particularly vulnerable to property damage, further research should focus on this smaller group to identify other barriers/facilitators of behaviour.
- **Key Finding:** Despite how costly roof upgrades can be ($10-25k), income and perceived resource costs did not differ between those with upgrades to those without.
- **Recommendation:** Reducing the cost of roof upgrades may not provide as strong of an incentive as other programs aimed at promoting the effectiveness of roof upgrades.
- **Key Finding:** People who think and talk about cyclones more are more likely to install cyclone shutters in the next 5 years.

Persona Grouping from Cluster Analysis

- Based on the survey results, people's thoughts about cyclones and mitigation measures were classified into three persona groups:
  - The 'aware' think and talk about cyclones the most and think that mitigation measures have benefits that outweigh the costs. The 'aware' persona group were the most likely

to install cyclone shutters, upgrade roller doors and perform most preparedness behaviours in the future.
    - The 'doubtful' think and talk about cyclones a moderate amount but they do not think that the benefits of mitigation measures outweigh the costs.
    - The 'unaware' think and talk about cyclones the least and perceive that mitigation measures are moderately beneficial.
- The persona groups can be identified using specific demographic/experience factors:
    - The 'aware' persona are more likely to be male, lower educated and to have experienced moderate to high levels of cyclone damage.
    - The 'doubtful' persona are more likely to be female and to have experienced moderate damage from a cyclone or no cyclone at all.
    - The 'unaware' persona are more likely to be higher educated and to have experienced a cyclone that has caused low or no damage

Shutter Install Behaviour

- **Key Finding:** People who think that cyclone shutters are effective for reducing damage and are visually appealing are more likely to install them in the next 5 years.
- **Recommendation:** Messaging about mitigation upgrades should demonstrate that installing them will reduce damage and provide (if applicable) additional utility (e.g., increased security, energy efficiency, increased real-estate value).
- **Key Finding:** The 'aware' persona group have the highest intention to install both cyclone shutters and roller door upgrades.
- **Recommendation:** To promote mitigation behaviour people should be encouraged to think about cyclones and structural upgrades like the 'aware' persona group. That is, people should be encouraged to think and talk about cyclones more often and acknowledge that the benefits of structural upgrades outweigh the costs. This recommendation is also supported by findings from the Part 1 report which suggested mitigation actions taken by others in the community have an important role in a homeowner's decisions (i.e. social influence).
- **Key Finding:** Homeowners with lower levels of education are more likely to fit the 'aware' persona than the 'doubtful' or 'unaware' personas. As education is an indicator of socio-economic status (SES) this finding suggests that people with a higher SES may be more complacent when considering cyclone mitigation. This complacency may be due to living in newer houses or specific areas and thinking that due to these factors, they are not at risk from cyclone related property damage or that they have the financial means to respond to the damage.
- **Key Finding:** Homeowners with moderate to high levels of damage experience are more likely to fit the 'aware' persona, whereas homeowners who have experienced a cyclone without damage are more likely to fit the 'unaware' persona. There is minimal differences in types of cyclone experience for homeowners who fit the 'doubtful' persona.

General Preparedness Behaviour

- **Key Findings:** People who fit the 'aware' persona are more likely to perform more difficult preparedness behaviours like putting up plywood, trimming branches and cleaning downpipes. All respondents, regardless of persona membership, have a high intention to tidy up their yard. It seems as preparedness activities become more difficult, having 'aware' persona thoughts about cyclones and mitigation actions becomes more important.
- **Key Finding:** Association between cyclone damage experience and persona groups:

    - ‘Aware’ persona respondents were more slightly likely to have experienced a cyclone causing high damage and slightly less likely to have experienced a cyclone without damage.
    - ‘Doubtful’ personas were more likely to have experienced moderate to high damage and less likely to have experienced a cyclone with minimal damage.
    - ‘Unaware’ personas were more likely to have experienced a cyclone without damage but less likely to have experienced moderate to high levels of damage.
- **Key Finding:** Association between sex and persona group membership, i.e. less ‘aware’ persona females than expected and more female ‘doubtful’ personas than expected with a similar amount of ‘unaware’ personas.
- **Key Finding:** Association between information seeking behaviour and persona group membership where more ‘aware’ persona respondents have sought out information and ‘doubtful’ personas have not.
- **Key Finding:** Association between location and persona groups. It was found that there was:
    - More ‘aware’ personas in Townsville to Home Hill, less in Cairns to Ingham.
    - More ‘doubtful’ personas in Cairns to Ingham and Whitsunday Region, less in Townsville to Home Hill.
    - More ‘unaware’ personas in Townsville to Home Hill, less in Whitsunday Region.
    - Similar amounts of each persona group from Mackay through to Yeppoon.

The results from this project provide a unique insight into the drivers of cyclone mitigation behaviour. As one of the few studies with a focus on cyclone-specific mitigation behaviour, the findings have broad implications. Although this is only one study, it highlights that risk communication messaging aimed at promoting mitigation behaviour can be informed (and be more effective) by knowing and considering the psychological factors of importance to the audience. As the final output of this Advance Queensland project, the research team is currently developing a prototype decision-support tool (web and mobile app) for promoting cyclone mitigation. The findings from this report will inform development of that tool and are intended to improve its overall effectiveness relative to traditional mitigation promotion efforts.

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Limitations

The Cyclone Testing Station (CTS) and Health and Behaviour Change in the Tropics (HABITT) has taken reasonable steps and due care to ensure that the information contained herein is correct at the time of publication. CTS/HABITT expressly exclude all liability for loss, damage or other consequences that may result from the application of this report. This report may not be published except in full unless publication of an abstract includes a statement directing the reader to the full report.

1. Introduction

Individuals living in cyclone-prone areas are vulnerable to an increased potential for property damage. For example, Cyclone Debbie in 2017 caused over $1.7B in insured losses including almost 60,000 residential building and contents claims (ICA, 2018). Cyclone Marcia in 2015 incurred over $500M in insured losses, a significant proportion of which could have been avoided with appropriate mitigation upgrades before the event (Figure 1). Structural upgrades and preparedness activities have been shown to effectively reduce property damage caused by cyclones, however these activities have associated costs and adoption by homeowners is not widespread (Smith et al, 2016). To promote more widespread use of mitigation activities, it is important to understand the factors that facilitate or impede an individual's decision to upgrade property or perform preparedness activities. Past research conducted in the U.S. has found that a variety of psychological and demographic variables can predict variation in the likelihood of homeowners engaging in cyclone mitigation behaviours (i.e. cost is not the only, or even the prevailing, factor in a homeowner's mitigation decisions). Moreover, studies conducted in Europe have found that similar factors can predict a variety of behaviours aimed at mitigating flood damage. However, similar research investigating cyclone mitigation behaviour specifically for Australians is lacking.

Figure 1. Severe roofing damage from Cyclone Marcia in 2015 due to inadequate load capacity at the rafter to top-plate connection

Informed by a review of international literature, a questionnaire was constructed to measure the factors deemed important for predicting mitigation behaviour in Queensland. In 2016, a paper version of the questionnaire was piloted at an annual cyclone preparedness event in Townsville ("Cyclone Sunday"). The questions were subsequently revised into an electronic survey and distributed more broadly across North Queensland in 2017. This report (i.e. Part II)

presents the findings of cluster analyses using survey data and building on findings reported in Part I. This report is additionally supported by prior reports further detailing the methodology of the survey (Scovell et al, 2016b; Scovell et al, 2017), a review of supporting literature (Scovell et al, 2016a) and background motivation for the work stemming from analysis of insurance claims data and engineering research (Smith and Henderson, 2015a, b; Smith and Henderson, 2016).

The broader aim of this research project is to create the initial prototype version of a decision-support tool (e.g., website or mobile app) to promote cyclone mitigation behaviour. As such, it was first important to investigate the psychological factors that influence cyclone mitigation behaviours. Results presented in this Part II report are built upon findings from the Part I report with the objective of finding the strongest predictors of mitigation behaviours. This was done by segmenting respondents into persona groups to better understand how to promote behaviour for specific groups of people. Four types of mitigation upgrades are investigated:

- roof upgrades
- cyclone shutters
- roller door upgrades
- general preparedness (e.g., cleaning gutters, clearing yard, etc.)

Past behaviour, as opposed to behavioural intention, was chosen as the outcome of interest for roof upgrade status (approximately half of the respondents eligible to install this item with a pre-1982 house had already done so).

Due to a small number of people having already installed cyclones shutters and roller door upgrades, behavioural intentions were used in the analysis instead of past behaviour. Other mitigation behaviours were assessed in the broader questionnaire but were deemed inappropriate for assessing cyclone specific mitigation behaviour due to the reasons provided for engaging in the mitigation behaviour (e.g., deadlocks primarily installed for security reasons) and most of the sample had already installed them. The sample included a total of 550 respondents.

Section 2 of this report provides an overview of the survey method and demographic results (discussed further in Part I report). In Section 3, people who have upgraded their roof are compared to people who have not to see if there are differences in demographics or perceptual factors. However, personas were not generated for roof upgrades since the sample subset of those able to install roof upgrades was relatively small (n=74). Personas were developed independently for shutter/roller door upgrade intentions and general preparedness intentions since these are fundamentally different behaviours. Upgrades require more financial investment and installation when a cyclone threat is not imminent whereas general preparedness activities, like pruning trees, are low-cost and can be done immediately before landfall. Section 4 explores shutter intentions and roller door upgrades and generates the corresponding Persona Set #1. In Section 5, Persona Set #2 is generated in relation to the intentions to perform more general preparedness activities (e.g., pruning trees, etc.). Finally, Sections 6 and 7 provide conclusions and recommendations from the survey results and research.

2. Survey Method and Results

The questionnaire used in this study builds on a previously tested version. Based on a literature review, the preliminary questionnaire was developed and piloted in 2016 at the annual "Cyclone Sunday" event in Townsville. The pilot was conducted using paper surveys and received 72 responses. The intent was not to make inferences about the broader population, but rather to test appropriateness of the questions. In general, the questions were adequate but several key areas of improvement were identified including adding pictures to help describe mitigation upgrade items, skip-logic to reduce the survey length and the use of a seven-point Likert Scale rather than a five-point scale for questions that ask respondents to rate likelihoods. The revised version of the survey, which is the subject of this report, was distributed more broadly across North Queensland and made available for residents to complete between 30 June 2017 and 19 November 2017. Like the pilot version, it assessed a variety of demographic and psychological factors as well as cyclone mitigation behaviours and intentions. Information about the study was shared via North Queensland radio stations, TV news and newspaper articles. Additionally, a Facebook page was created, which provided information about the study and a link to the survey. The Facebook page was shared via pages such as Wally's Weather and the OZ Cyclone Chasers.

To provide a framework for the analysis, questions and responses were grouped to investigate five different factors that were identified in the literature as having a role in the mitigation decision process. Those factors include demographics, construction details of the home, experience with previous cyclone events, risk perception and social influence. Each factor is discussed in the Part I report. Although a total of 550 respondents were recruited for the survey, quality control procedures for the data resulted in varying sample sizes for individual questions. The applicable sample size is included in each of the sections below.

Demographic summary information for the sample is as follows:

- 171 (31%) males, 380 (69%) females.
- An average age of 45 years (SD=13), ranging from 18 to 78 years.
- Most were married (60%), homeowners (70%) and almost half of the sample (45%) had at least one dependent child.
- The median household income category was $80000 - $125000 and a Bachelor's Degree was the most commonly reported level of education (31%).

Respondents were most commonly from the Townsville (31%), Cairns (19%) or Mackay (18%) regions. However, there was a spread of respondents ranging from Cairns to Rockhampton, as seen in Table 1.

Table 1: Frequency distribution of the 550 total survey respondent locations

Location Groups	***N***
Cairns to Ingham	131 (24%)
Townsville to Home Hill	190 (35%)
Whitsunday Region (Bowen to Midge Point)	82 (15%)
Mackay to St Lawrence	106 (19%)
Rockhampton & Yeppoon	41 (7%)
Total	**550**

3. Persona Set #1: Shutter and Garage Door Upgrades (N=315)

Failure of doors and windows are important drivers of loss during cyclones, often leading to additional damage by water ingress (Boughton et al, 2017; Boughton et al, 2011). Figure 2 shows a failed door hinge from Cyclone Yasi and a failed sliding glass door from Hurricane Irma in Florida due to wind-borne debris impact (Note: the issues related to doors and windows in cyclones and tornadoes are similar for US construction). Properly installed cyclone shutters and metal security screens tested to the Cyclone Testing Station standards can protect windows and doors from debris impact failure.

Figure 2. Door bolt and hinge failure from Cyclone Yasi in 2011 (left) and wind-borne debris failure of impact-resistant glass door from a tornado during Hurricane Irma in 2017 (right)

Another important shift in building construction standards occurred in 2012 for garage doors. Based on damage investigations from Cyclone Yasi (Boughton et al, 2011), the Cyclone Testing Station found that garage doors performed poorly despite wind speeds being below design level (250 km/h) in most of the affected areas. As a result, the Australian standard AS/NZS 4505 (Standards Australia, 2012) went into effect in 2012 requiring wind locks on all garage door installations. However, homes constructed prior to this most likely do not have wind locks and therefore have a higher likelihood of garage door related failures. In the current survey, 318 (83%) of 385 homeowners reported that their house was built before 2012.

3.1. Model of Shutter Intentions

Based on significant correlations and differences between groups (as seen in the Part 1 report), hierarchical multiple regression was used to find the strongest predictors of intentions to install shutters. First, significant demographic and experience factors were added into the model. Next, psychological factors were added in three blocks:

- risk related (risk perception and hazard influence)
- hazard related (visual appeal and mitigation efficacy)
- resource related factors (mitigation cost and self-efficacy)

Key Finding: As seen in Table 2, perceived visual appeal of shutters and mitigation efficacy (i.e. perceived benefits of shutters) were the strongest predictors of shutter intentions.

Additional significant predictors were information seeking behaviour (i.e., seeking information about cyclone mitigation), hazard influence (i.e., extent to which people think and talk about cyclones) and mitigation cost (i.e., perceived cost of mitigation in terms of time, effort or money).

Table 2. Predictors of shutter intentions based on a hierarchical multiple regression

Predictor variables	**β**	R^2
Block 1: Demographics		
Tenure plan	.08	
Years in location	.07	
Age	.04	
Education	-.10	
Dependent child	-.10	
Social influence	.07	
Information seeking	.18**	
Block 1 change		.09**
Block 2: Risk Factors		
Risk Perception	.05	
Hazard influence	.14*	
Block 2 change		.03*
Block 3: Hazard Factors		
Mitigation efficacy	.20**	
Visual appeal	.25**	
Block 3 change		.15**
Block 4: Resource Factors		
Mitigation cost	-.11*	
Self-efficacy	.02	
Block 4 change		.01
Total model		.27**

**p<0.05, **p<0.01*

Note: β represents the strength of a given variable in predicting shutter intentions

Recommendation: Messaging about mitigation upgrades should demonstrate that installing them will reduce damage and provide (if applicable) additional utility (e.g., increased security, energy efficiency, increased real-estate value).

3.2. Persona Development

Based on the significant psychological factors found in the shutter intentions model (Table 2), a k-means cluster analysis was used to find three different personas. To create these personas, only homeowners were selected. Figure 3 shows each persona group's standing on each variable of interest. Three personas were identified:

- *Aware* - The first group were labelled the 'aware' as they think and talk about cyclones the most and they also perceive shutters as effective at mitigating cyclone impacts and visually appealing. The 'aware' perceive a moderate amount of costs but, importantly, they perceive more benefits (mitigation efficacy) than costs.

- *Doubtful* - The second group, the 'doubtful', perceive, think and talk about cyclones a moderate amount but perceive the lowest amount of shutter efficacy and visual appeal. The 'doubtful' also perceive the highest resource costs related to shutter installation.
- *Unaware* - The last group, the 'unaware', think and talk about cyclones the least, perceive moderate benefits and visual appeal, but perceive the least amount of costs. The 'unaware' may perceive less cost as they do not think or talk about cyclones as much. As such, they have not considered the actual costs of structural upgrades.

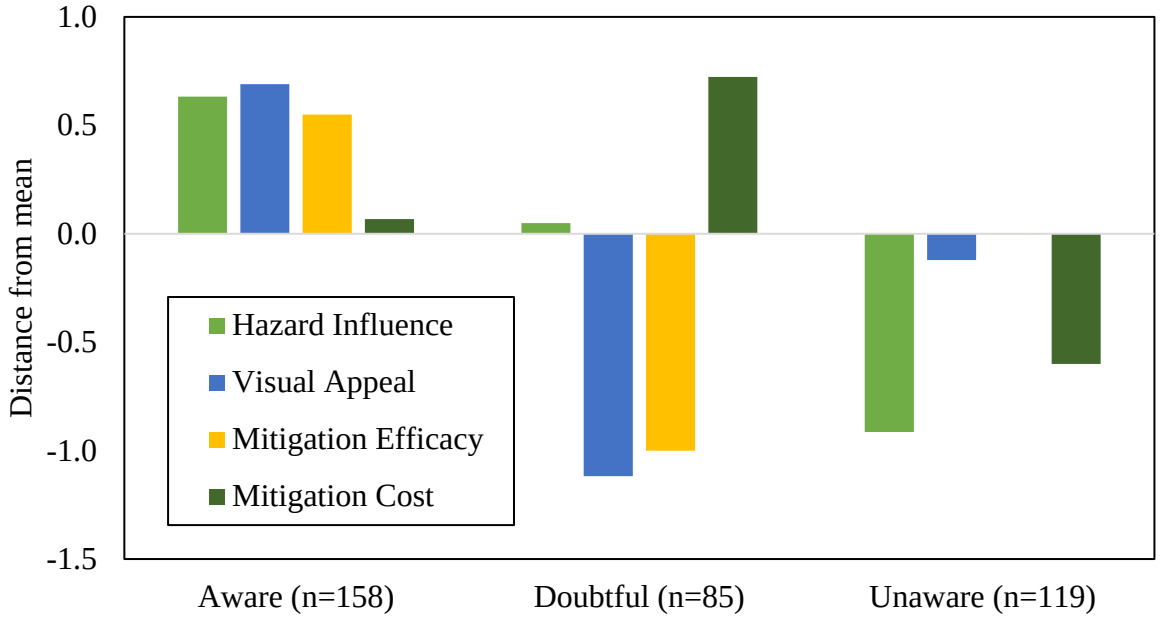

Figure 3. Persona group's relative standing on perceptual factors

3.3. Applying the Persona Groups

After defining persona groups based on variables that predicted shutter upgrade behaviour, the ability of these personas to predict behaviour for a different mitigation upgrade (roller doors) was tested. One-way ANOVA tests show a statistically significant difference in intentions to install shutters and roller door upgrades based on persona membership. Figure 4 shows the mean intentions of each persona group for both shutter intentions and roller door upgrades based on a 7-point scale where 2, 3 and 4 correspond to 'moderately unlikely', 'slightly unlikely' and 'neutral' respectively. Tukey post-hoc tests indicate that the 'aware' persona have a significantly greater intention to install both these upgrades compared to 'doubtful' and 'unaware' personas. While 'unaware' personas had a slightly higher average intention to install upgrades compared to the 'doubtful', this difference was not statistically significant.

Key Finding: The 'aware' persona group have the highest intention to install both cyclone shutters and roller door upgrades.

Recommendation: To promote mitigation behaviour people should be encouraged to think about cyclones and structural upgrades like the 'aware' persona group. That is, people should be encouraged to think and talk about cyclones more often and acknowledge that the benefits of structural upgrades outweigh the costs.

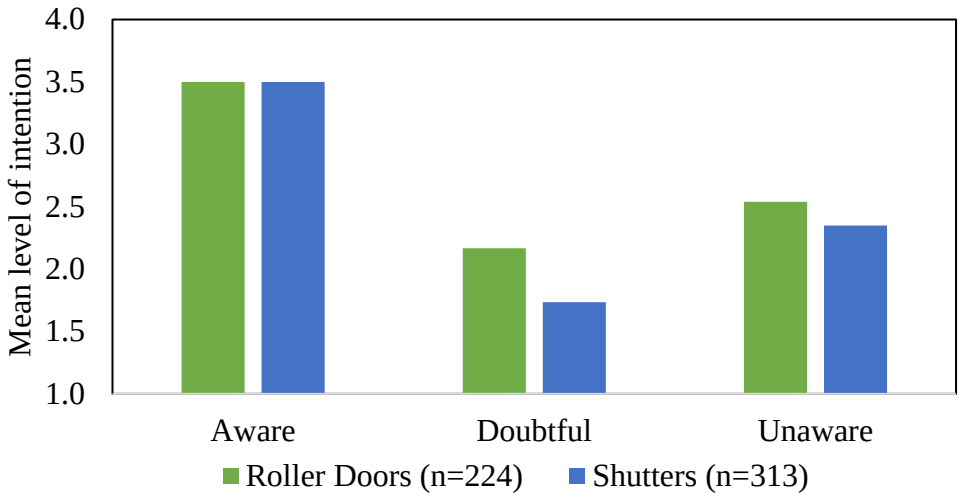

Figure 4. Mean levels of mitigation intention based on persona membership

3.4. Personas and Demographics/experience

A Kruskal-Wallis H test showed there was a significant difference in education levels between different persona groups (χ^2 (2) = 8.22, p = 0.016). The 'aware' persona had the lowest mean rank score (163.47) with 'doubtful' and 'unaware' having higher, and similar, mean rank scores (189.20 and 197.11 respectively). In this case, higher mean rank scores represent higher levels of education.

Key Finding: Homeowners with lower levels of education are more likely to fit the 'aware' persona than the 'doubtful' or 'unaware' personas. As education is an indicator of socio-economic status (SES) this finding suggests that people with a higher SES may be more complacent when considering cyclone mitigation. This complacency may be due to living in newer houses or specific areas and thinking that due to these factors, they are not at risk from cyclone related property damage or that they have financial means to respond to the damage.

Chi-squared tests were also used to find associations between persona groups and specific categorical demographic factors. A chi-squared test is used to determine if there is a significant difference between an expected count and an observed count. An association was found between persona membership of five categories of cyclone experience (χ^2 (8) =18.65, p=.017): no cyclone experience, experience without damage, experience with minimal damage, experience with moderate damage and experience with high damage. Compared to random chance, the likelihood of a respondent within each persona group also having had a certain category of cyclone experience is as follows:

- 'Aware' persona respondents were more likely to have experienced a cyclone causing moderate to high damage and less likely to have experienced a cyclone without damage.
- 'Doubtful' personas were more likely to have experienced moderate damage and less likely to have experienced a cyclone without damage.
- 'Unaware' personas were more likely to have experienced a cyclone without damage but less likely to have experienced moderate to high levels of damage.

Key Finding: Homeowners with moderate to high levels of damage experience are more likely to fit the 'aware' persona whereas homeowners who have experienced a cyclone without damage are more likely to fit the 'unaware' persona. There is minimal differences in types of cyclone experience for homeowners who fit the 'doubtful' persona.

Key Finding: There was also an association between the sex of the participant and persona group membership (χ^2 (2) =7.3, p=.026). It was found that males were more likely to fit the 'aware' persona whereas females were more likely to fit the 'doubtful' persona. There was minimal differences between the sexes in how often they fit the 'unaware' persona.

There was no association between personas and the following factors:

- Age
- Income
- Years in North Queensland
- Years in current location
- Having a dependent child
- Marital status
- Location
- Information seeking behaviour
- Social influence

Multiple correspondence analysis (MCA) was used to generate a graphical representation of the relationship between persona groups, experience, education and sex. As seen in Figure 5, there are visible associations between levels of education, experience, respondent's sex and persona groups.

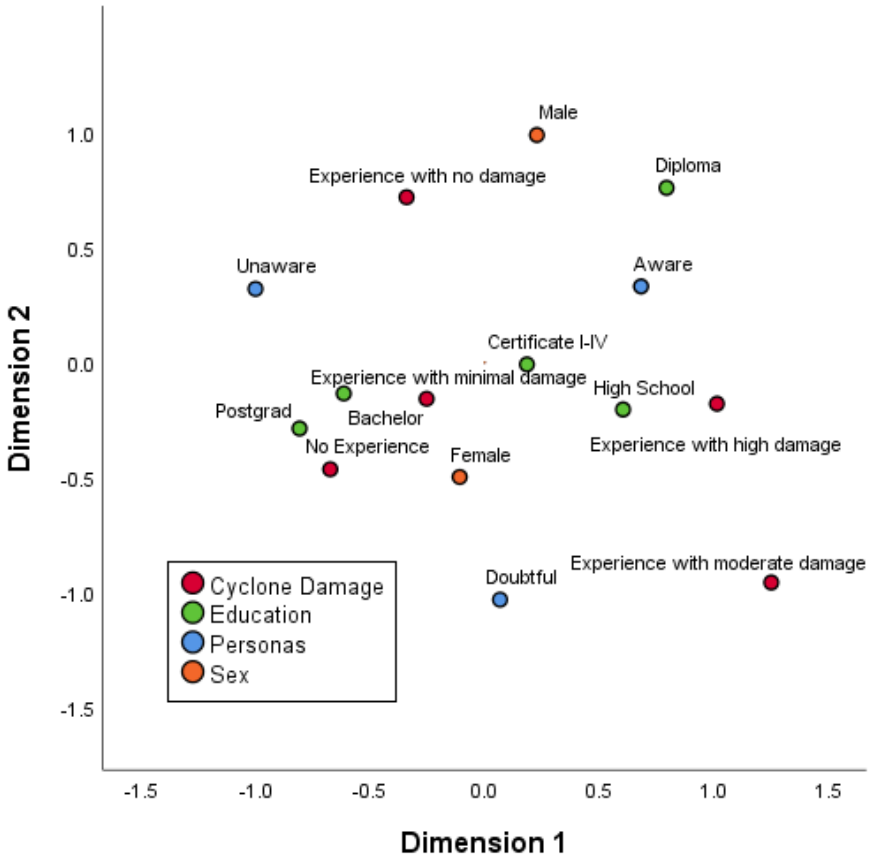

Figure 5. Multiple correspondence analysis with personas and demographic/experience variables. Note: the distance of experience, sex or education variable bubbles from the persona squares provides an indication of the relative likelihood of the persona including that demographic

4. Persona Set #2: General Preparedness Behaviour (N=485)

An additional k-means cluster analysis was used to find three different personas related to preparedness behaviour. A key difference between the previous set of personas (Figure 3) and the general preparedness personas is the replacement of the visual appeal variable with a self-efficacy variable. This is because it was identified as an important factor from past research and visual appeal does not apply to preparedness behaviour. Figure 6 shows each persona group's standing on each variable of interest. Similar to the previous personas, the three groups are as follows:

- *Aware* - The first group were labelled the 'aware' as they think and talk about cyclones the most. They also perceive shutters as effective at mitigating cyclone impacts and they have the ability to get them installed. The 'aware' persona perceive the highest amount of costs but, importantly, they perceive more benefits (mitigation efficacy) than costs.
- *Doubtful* - The second group, the 'doubtful', perceive, think and talk about cyclones a moderate amount but perceive the lowest amount of shutter efficacy and a moderate amount resource costs related to shutter installation. The biggest difference with the 'doubtful' is they do not perceive they have the ability to get shutters installed.
- *Unaware* -The last group, the 'unaware', think and talk about cyclones the least, perceive moderate benefits and self-efficacy, but perceive the least amount of costs. 'Unaware' probably perceive less cost as they do not think or talk about cyclones as much. As such, they have not previously considered the actual costs of structural upgrades.

NOTE: as mentioned above, people's attitudes towards cyclone shutters were used to assess the variables used to create the preparedness personas. It is, therefore, assumed that attitudes towards preparedness behaviour would be similar to attitudes towards cyclone shutters.

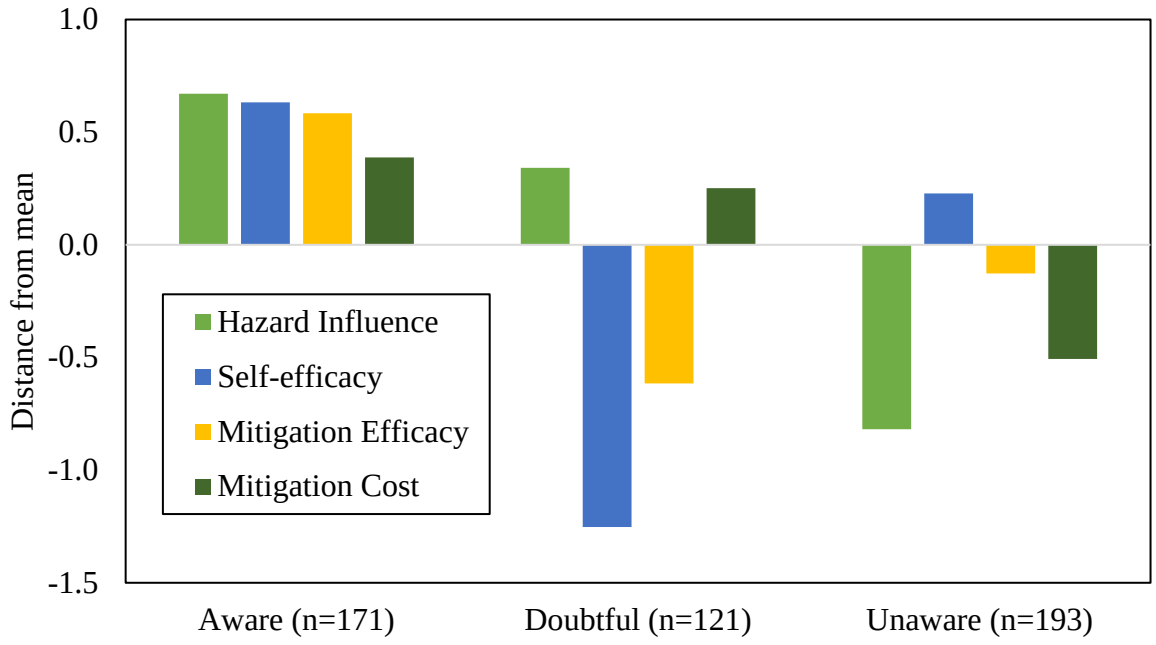

Figure 6. Persona group's relative standing on perceptual factors for preparedness behaviour

4.1. Differences in Intentions

Using principle components analysis, eight preparedness behaviours were reduced to three different types of preparedness behaviour: *general preparedness*, *tidy yard* and *put up plywood*. The *general preparedness* factor was created by summing and averaging intentions to trim trees, clean downpipes and check property for any structural weakness (e.g., roof, walls and fencing). *Tidying yard* was created by summing intentions to secure outdoor furniture and clean up yard. Respondents' intentions to *put up plywood* on windows was unrelated to the other preparedness behaviours so was kept as a separate preparedness behaviour.

Results from a one way analysis of variance showed a significant difference between persona groups and intentions to perform types of preparedness behaviours: *general preparedness* ($F(2,391) = 10.37$, $p<.001$) and *put up plywood* ($F(2,398) = 4.79$, $p=.009$). Tukey post hoc tests showed that the 'aware' persona had a significantly higher intention to perform *general preparedness* behaviours and *put up plywood* compared to the 'unaware' persona but not compared to the 'doubtful' persona. There was, however, no significant difference in intentions to *tidy yard.* Figure 7 shows the difference in mean levels of intention for each persona group.

Key Findings: People who fit the 'aware' persona are more likely to perform increasingly difficult preparedness behaviours like putting up plywood, trimming branches and cleaning downpipes. All respondents, regardless of persona membership, have a high intention to tidy up their yard. It seems as preparedness activities become more difficult, having 'aware' persona thoughts about cyclones and mitigation actions becomes more important.

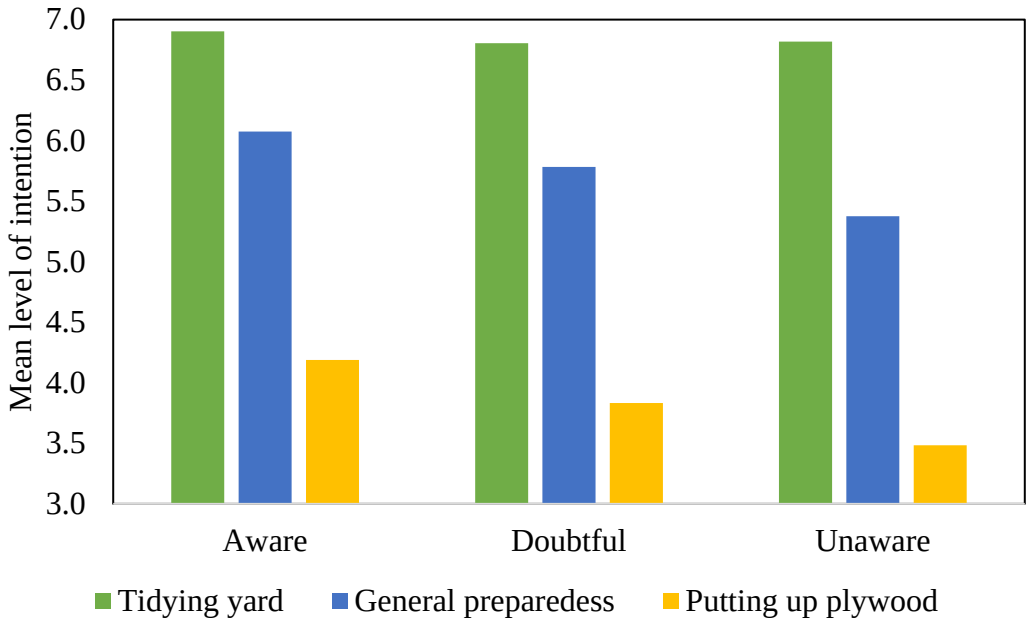

Figure 7. Mean level of preparedness intention for each persona group

4.2. Preparedness Personas and Demographics

From a chi squared tests, an association between persona groups and levels of cyclone experience, sex, information seeking behaviour and location was determined.

Key Finding: Association between cyclone damage experience and persona groups (χ^2 (8) =34.15, p<.001):

- 'Aware' persona respondents were slightly more likely to have experienced a cyclone causing high damage and slightly less likely to have experienced a cyclone without damage.
- 'Doubtful' personas were more likely to have experienced moderate to high damage and less likely to have experienced a cyclone with minimal damage.
- 'Unaware' personas were more likely to have experienced a cyclone without damage and less likely to have experienced moderate to high levels of damage.

Key Finding: Association between sex and persona group membership (χ^2 (2) =21.02, p<.001), i.e. less 'aware' persona females than expected and more female 'doubtful' personas than expected with a similar amount of 'unaware' personas.

Key Finding: Association between information seeking behaviour and persona group membership (χ^2 (2)=12.48, p= .002) where more 'aware' persona respondents have sought out information and 'doubtful' personas have not.

Key Finding: Association between location and persona groups (χ^2 (8)=40.4, p<.001). It was found that there was:

- More 'aware' personas in Townsville to Home Hill, less in Cairns to Ingham.
- More 'doubtful' personas in Cairns to Ingham and Whitsunday Region, less in Townsville to Home Hill.
- More 'unaware' personas in Townsville to Home Hill, less in Whitsunday Region.
- Similar amounts of each persona group from Mackay through to Yeppoon.

No association was found between personas and following factors:

- Age
- Having a dependent child
- Marital status
- Education
- Income
- Homeownership
- Years lived in current location
- Years lived in North Queensland
- Number of cyclones experienced
- Social Influence

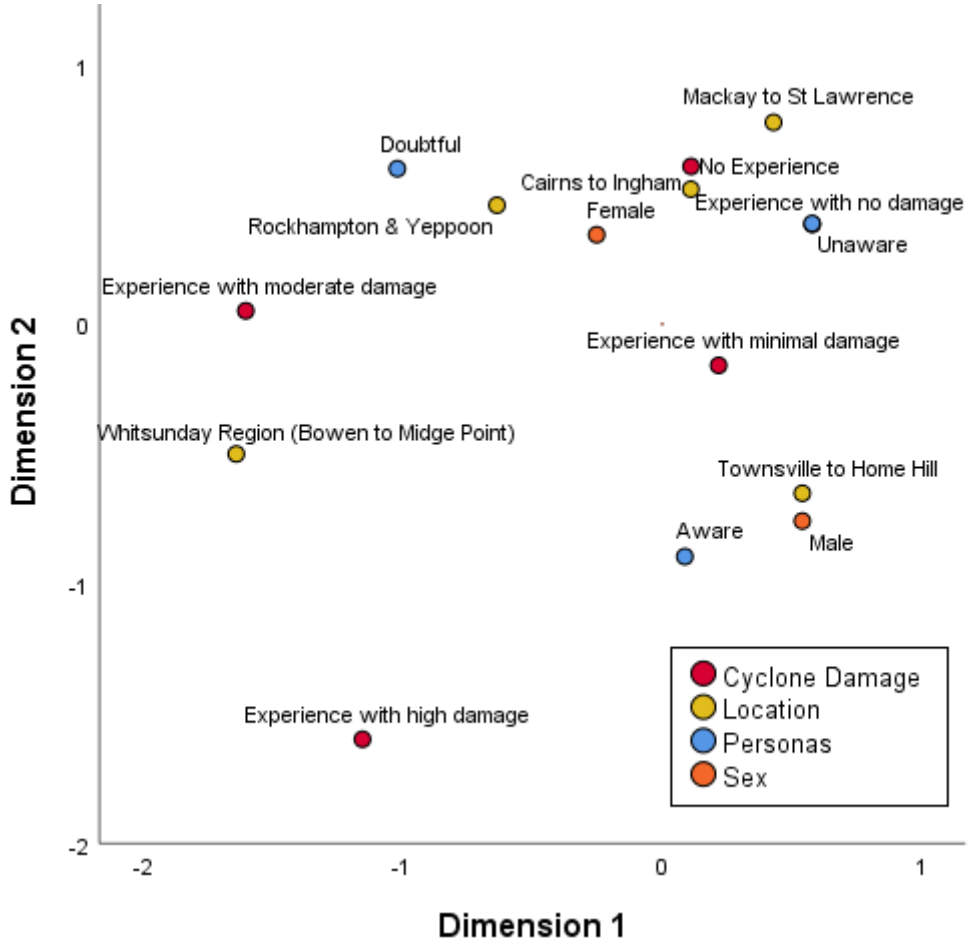

Figure 8. Multiple correspondence analysis with personas and demographic/experience variables. Note: the distance of experience, sex or education variable bubbles from the persona squares provides an indication of the relative likelihood of the persona including that demographic

5. Roof Upgrade Behaviour (N=74)

The age of construction for a home is often used to estimate construction features (and therefore vulnerabilities) when more detailed information is unavailable. The most well-defined shift in construction features came in the aftermath of Cyclone Tracy which resulted in at least 100 fatalities and extreme damage to housing in Darwin in December 1974. Major changes to design and building standards of houses were implemented during the reconstruction, with the resulting Queensland Home Building Code (HBC) introduced as legislation in 1982. By the mid-1980s it is reasonable to presume that houses in the cyclonic region of Queensland were being fully designed and built to its requirements. However, an estimated 30-40% of homes in North Queensland are built prior to modern building codes and therefore are not at the current life safety standards for Australian housing. One particular area of concern for these older homes is the strength of roofing connections. It is therefore recommended that older homes have their roofing connections upgraded to the current building code standards.

The development of persona groups for roof upgrade behaviour was not possible due to the small number of respondents for which it was applicable. Although 550 Queenslanders were surveyed overall, roof upgrades were not relevant to many respondents because they either had a home built after the 1980s or already had a roof upgrade. Instead, independent samples statistical t-tests were used to see if there were differences (psychologically and demographically) between people who had installed upgrades compared to those who had not. In this analysis, the 34 people who had completely upgraded their roof were compared to the 40 people who had not upgraded their roof. Chi-squared statistical tests were also conducted to explore the associations between roof upgrade status and other categorical factors. The following was found:

Key Finding: People with upgraded roofs perceived that they had more knowledge about cyclones and mitigation strategies compared to people without upgraded roofs.

Key Finding: It was found that roof upgrade status was related to having a dependent child. That is, compared to what was expected, there were more people who had upgraded their roof who also had no dependent children.

Key Finding: People with upgraded roofs were significantly older with a mean age of 52 (standard deviation = 9.01), compared to those without upgraded roofs who had a mean age of 45 (standard deviation = 12.56).

Recommendation: Roof upgrades may be considered more by people who are older and do not have any dependent children. The findings suggest that some people may not consider upgrading their roofs until their children have left home, possibly due to the financial cost of having dependents. As people without roof upgrades are particularly vulnerable to property damage, further research should focus on this smaller group to identify other barriers and facilitators of this behaviour.

There was no associations between roof upgrade status and the following factors:

- Sex
- Marital status
- Location
- Income
- Education
- Number of cyclones experienced

- Years in location
- Years in North Queensland
- Cyclone damage experience
- Risk perception
- Information seeking behaviour (i.e., seeking information about cyclone mitigation)
- Social influence (i.e., knowledge of someone who has installed cyclone mitigation)
- Hazard influence (i.e., extent to which people think and talk about cyclones)
- Mitigation efficacy (i.e., perceived efficacy and utility of structural mitigation)
- Mitigation cost (i.e., perceived cost of mitigation in time, effort or money)
- Self-efficacy
- Social Influence (i.e., knowledge of someone who has installed cyclone mitigation)

Key Finding: Despite how costly roof upgrades can be ($10-25k), income and perceived resource costs did not differ between those with upgrades to those without.

Recommendation: Reducing the cost of roof upgrades may not provide as strong of an incentive as other programs aimed at promoting the effectiveness of roof upgrades.

6. Conclusions

Results suggest that how North Queenslander's think about cyclones and mitigation strategies helps to explain why they prepare. Most importantly, North Queensland needs to be encouraged to think more about cyclone threats and to appreciate the importance of mitigation behaviours. Another main finding is that people have different thoughts about cyclone mitigation and will therefore respond to risk communications in different ways. The results suggest that promoting cyclone mitigation relies on presenting people with tailored information based their own personal circumstances. The following section highlights the main findings of this study and provides recommendations on how to encourage cyclone mitigation behaviours in North Queensland.

Promoting roof upgrades

Key Finding: It was found that people with an upgraded roof were older, did not have any dependent children and perceived they were more knowledgeable compared to people without a roof upgrade. The influence from age could be explained by the fact that older people have had more time to consider upgrades. Age also explains why having a dependent child had an influence. Older people, if they do have children, are less likely to have their child living at home.

Key Finding: An interesting finding is the influence from cyclone knowledge. As a complete upgrade is one of the most expensive and time-consuming mitigation behaviours, having knowledge about cyclones and how they can damage roofs may be an important factor to motivate behaviour. Further, despite how costly roof upgrades are, income and perceived resource costs did not differ between those with upgrades to those without.

Recommendation: Homeowners with houses older than 1982 should be provided with information to help them identify if their roof is built to code. Getting a roof upgraded should also be made easier for homeowners with dependent children. It seems that homeowners are more likely to install roof upgrades when their children have left home suggesting that there are additional barriers when a child is still as home (e.g., less disposable income, greater disruption to lifestyle). Furthermore, reduced roof upgrade cost may not provide as strong of an incentive as other programs aimed at promoting roof upgrades.

Promoting cyclone shutter installation

Key Finding: Controlling the influence from other variables, visual appeal and perceived mitigation efficacy were the strongest predictors of shutter intentions. That is, people that think shutters are visually appealing and think that shutters are effective for reducing damage, promoting safety, increasing property value and have utility for other purposes had a greater intention to install shutters. Of these factors, reducing damage and visual appeal seem to be the most important when considering installing cyclone shutters.

Recommendation: Messaging about cyclone shutters should demonstrate that installing them will reduce damage and provide (if applicable) additional utility (e.g., increased security, energy efficiency, increased real-estate value). Homeowners should also be made aware of the different types of window protection available. Whilst traditional cyclone shutters are a permanent installation, there are other removable options available. Homeowners who dislike the look of traditional shutters may be more likely to install removable styles of window protection.

Key Finding: Perceived higher resource costs (e.g., time, effort, financials), knowledge and skill requirements had a negative effect on intentions to install shutters but the influence was

small compared to visual appeal and perceived benefits of installing shutters. Another factor which predicted intentions was information seeking behaviour and hazard influence. It seems people who think and talk about cyclone more frequently, as well as actively seek information about cyclones, have a greater intention to invest in cyclone shutters.

Recommendation: It is important to get people to think and talk about cyclones with other members of their households. While efforts already exist to get people thinking and talking about cyclones during the cyclone season (e.g., Cyclone Sunday), it is also important to remind people during the off season period. As most structural upgrades can take a long time to install, messaging should focus on getting people to think about and talk about cyclones year round.

Tailoring information based on personas

Persona groups presented in this report, both for structural mitigation and preparedness intentions, are supported by established health psychology literature. That is, people who perceive enough risk, and in this case, think and talk about cyclones, as well as perceiving the benefits of a response as outweighing the costs, are more likely to act proactively. How to motivate specific persona groups to pursue cyclone mitigation behaviour will differ based on their perceptual characteristics.

Aware
Identified by: More likely to be male, lower educated and to have experienced moderate to high levels of cyclone damage.

The 'aware' persona group had perceptions that related to the highest mitigation and preparedness intentions. However, their average intention is still 'somewhat unlikely' to 'neither unlikely/likely' for installing structural upgrades.

Recommendation: To promote structural mitigation for people of this persona, providing appropriate cues to action would be a suitable motivating tool. As they already have perceptions that relate to behaviour, cues to action may provide relevant technical information about specific mitigation measures and how to get them installed. This involves making it easy for people to contact the necessary businesses to get cyclone mitigation measures installed and to explain why mitigation is necessary sooner rather than later.

Key Finding: Due to the influence of education, homeowners with a lower socio-economic status may be more likely to fit the 'aware' persona. This finding suggests that people with a higher socio-economic status may be more complacent when considering cyclone mitigation. This complacency may be due to living in newer houses or specific areas and thinking that due to these factors, they are not at risk from cyclone related property damage. It could also be that they believe they have the financial means to respond to the damage. The findings also suggest that firsthand experience with the damage potential of cyclones makes people more likely to appreciate the benefits of mitigation behaviour.

Recommendation: Getting higher educated people to become 'aware' may involve explaining to them that cyclone damage goes beyond monetary costs and can potentially keep them out of their home for weeks while damage is being repaired.

Doubtful
Identified by: More likely to be female and to have experienced moderate damage from a cyclone or no cyclone at all.

Recommendation: The 'doubtful' persona think that the benefits of mitigation behaviour do not outweigh the costs. For this group it is important to change some of their perceptions towards mitigation behaviour. Based on psychological theory (Rogers, 1975), perceiving benefits as outweighing cost will promote mitigation behaviour. This group should be provided with information about the benefits of cyclone mitigation and how it may save them time, effort and money in the future. For structural mitigation, information from the Cyclone Testing Station could be distributed to these people to help them understand the benefits. For example, information about the efficacy of structural mitigation for reducing damage and how this may save resource costs would be useful to provide.

Key Finding: People who fit the 'doubtful' persona are more likely to have experienced moderate damage or no damage at all. These findings suggest that people may become 'doubtful' from their own experience with damage or, if they have not experienced a cyclone, information provided by others (e.g., media, neighbours or friends). Through this experience, they may think there is nothing they can do to protect themselves from cyclone damage.

Unaware
Identified by: More likely to be higher educated and to have experienced a cyclone that has caused low or no damage. A relatively even amount or males and females fit this persona.

Recommendation: The 'unaware' persona think and talk about cyclones the least. People with these perceptions should be encouraged to think about cyclone risks and discuss these risks with their families more regularly. For example, prompting questions could be provided in their insurance correspondence to get them thinking about cyclone risk all year round. Furthermore, encouraging and making it easy for these people to attend community events like Cyclone Sunday may help them to think about cyclones more regularly.

Key Finding: People who fit the 'unaware' persona are more likely to have experienced low or no cyclone damage. People who live in areas that have frequent cyclone warnings without actually experiencing strong winds may be more likely to become 'unaware'. That is, they have experience with what they define as cyclones, without experiencing negative effects and damage. Experiencing damage seems to help people to understand the importance of mitigation.

Recommendation: It is important to get more people thinking in proactive ways before they experience damage. Interventions like virtual reality or 360 videos that show how cyclone damage can occur may help those without damage to better appreciate the benefits of cyclone mitigation behaviours.

The results from this project provide a unique insight into the drives of cyclone mitigation behaviour. As one of very few studies with a focus on cyclone-specific mitigation behaviour, the findings have broad implications. Firstly, risk communication messaging aimed at promoting mitigation behaviour can now be better informed by knowing the psychological factors of importance. This messaging can also be targeted more effectively by providing different information to different groups based on how they think about cyclones. The distribution of this information will be greatly aided by the continued cooperation between insurers, government and hazard mitigation researchers.

As with any research project, the findings also raise additional questions. One direction for future research is to focus specifically on roof upgrade behaviour. Although homeowners with pre-1908s housing are a smaller portion of the population, these houses without roof upgrades are particularly vulnerable to cyclone damage. As such, future research should use a more exploratory research design to identify why homeowners do or do not upgrade their roofs. Future research should also aim to test innovative risk communication tools (e.g., smartphone apps and virtual reality) for their ability to change behaviour.

Glossary

Experience

Emotional Experience. The extent to which cyclones in the past have caused feelings of stress, fear, helplessness, depression or dread. Response scale: 1 to 4 (none to high) to be consistent with previous research.

Risk Perception Factors

Dual Process Risk. Perceived cognitive risk (how people think about cyclone risk) and emotional risk (how people feel about cyclones). Response scale: 1 to 7 (strongly disagree to strongly agree).

Risk Perception. Perceived likelihood of a cyclone damaging property, affecting life, ability to work or physical/mental health. Response scale: 1 to 7 (extremely unlikely to extremely likely).

Cyclone Likelihood. Perceived likelihood of all category cyclones occurring in the next five years. Response scale: 1 to 7 (extremely unlikely to extremely likely).

Cyclone Damage Severity. Perceived extent of damage to property if three types of cyclones were to occur next week (Category 1-2, Category 3-4 or Category 5). Response scale: 1 to 7 (extremely low to extremely high).

Psychological Factors

Response Efficacy. Perceived efficacy of shutters for reducing damage, increasing family safety and increasing property value as well as the utility of shutters for other purposes. Response scale: 1 to 7 (Strongly disagree to strongly agree).

Response Cost. Perceived cost of shutters in terms of money, time and effort, knowledge/skill required and cooperation from others required. Response scale: 1 to 7 (Strongly disagree to strongly agree).

Self-efficacy. Perceived ability of the respondent (or a family member) to organise the installation of shutters. Response scale: 1 to 7 (Strongly disagree to strongly agree).

Hazard Influence. Extent to which people think and talk about cyclones. Response scale: 1 to 7 (Strongly disagree to strongly agree).

Cyclone Knowledge. Knowledge about cyclone risks, damage types and protective actions. Response scale: 1 to 7 (Strongly disagree to strongly agree).

Reliance on Government. Perceived likelihood of government financial assistance for homeowners who have received cyclone related property damage. Response scale: 1 to 7 (extremely unlikely to extremely likely).

Information Seeking. Has the respondent actively looked for information about cyclone risks since living in North Queensland? Responses: Yes or No.

Social Influence. Does the respondent know of any friends, family or neighbours that have installed cyclone mitigation upgrades? Responses: Yes or No.

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