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Homeowner mitigation decision-making: Exploring the theory of planned behaviour approach

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Abstract

During hurricanes, flooding and wind cause property damage and loss of life. Increased coastal development and recent economic impacts of hurricanes has increased stakeholders' interest in coastal mitigation. Through the use of the Theory of Planned Behaviour, this study focuses on factors that impact the intention of homeowners to mitigate. Methodologically, surveys were sent to a random sample of 2,500 coastal North Carolina homeowners who provided insights about their hurricane and mitigation experiences. The sample was purchased from Genesys, which utilises the postal service's database to randomly select addresses. Binary logistic regression was used to compute homeowners' intention to adopt eight separate mitigation actions for their homes. The findings show limited support on the influence of emotion and risk perception on intention to mitigate. However, the findings clearly support the relationships between intention to mitigate and the influence of others and perceptions of the characteristics of the mitigation actions. The significance of the findings indicates the importance of utilising these factors in future studies to better understand mitigation decision-making and to inform future mitigation policies and programs.

KEYWORDS

household decision-making, hurricane, mitigation, theory of planned behaviour

1 | INTRODUCTION

Following the record-setting costs of recent hurricane seasons, concerns have arisen over the increasing costs to repair properties damaged during these storms. Flooding is one of the main causes of damage and loss of life during hurricanes. These storm systems induce significant coastal flooding from storm surge and inland flooding from prolonged heavy rains. As coastal development continues to expand in the United States, the economic impacts of flooding to homeowners and all levels of government have intensified. To manage these impacts, stakeholders have become increasingly concerned with how to make coastal communities resilient from flood hazards. To accomplish this, government stakeholders have become increasingly interested in expanding the prevalence of mitigation for private properties (Federal Emergency Management Agency [FEMA], 2018; Kunreuther, 2006).

Despite this interest, homeowners still fail to adopt these actions for their homes (FEMA, 2018; Kunreuther, 2006).

In an effort to better understand the effects on regional risk, this study serves as a part of a broader project modelling the hurricane mitigation action behaviours of regional stakeholders including homeowners, insurers, and the government. This work builds on the work of Kesete et al. (2014), Peng et al. (2014), Wang, Davidson, Trainor, Nozick, and Kruse (2017), and Jasour, Davidson, Trainor, Kruse, and Nozick (2018) by focusing on the homeowner dimension of the model. Specifically, this study used The Theory of Planned Behaviour (TPB) to explore the intention of hurricane-prone homeowners to mitigate (Ajzen, 1991). Theoretically, this application builds upon the recommendations of Lindell et al. (1997) and Lindell and Perry (2004) to utilise the TPB model in a hazards context. Empirically, this work contributes to the broad literature focusing on household risk decisions. Finally, it also provides applied value by offering insights into the specific factors stakeholders might target to motivate and incentivise homeowners to adopt mitigation actions for their homes. By doing so, the findings of this study help to address the concerns over the increasing costs of hurricanes, frequent disruption and damage caused by flooding during these events, and challenges to recovery efforts faced by floodplain and emergency managers. This study also provides insights about real-life constraints, which influence homeowner's decisions and ability to mitigate.

Following a brief overview of the TPB framework, six hypotheses are formulated to determine which factors influence homeowners' intentions to mitigate. Subsequent sections detail supporting evidence from the literature and provide results and discussion of how data collected from homeowners residing in the eastern half of North Carolina supports the model.

2 | THEORETICAL FRAMEWORK

TPB provides a framework for understanding how an individual's beliefs impact their intention to complete a behaviour (Ajzen, 1991; Fishbein & Ajzen, 1975). The work of Ajzen & Fishbein looks at the interaction between an individual's attitude, their beliefs, and their completion of a variety of behaviours, such as job performance, voter participation, and racial prejudice (Ajzen, 1991; Ajzen & Fishbein, 1969; Ajzen & Fishbein, 1973; Ajzen & Fishbein, 1977; Fishbein & Ajzen, 1975). As compared to other theoretical frameworks, TPB focuses on how nuanced perceptions influence intention to complete a behaviour. Given the theory's emphasis on attitude, this framework was selected because it offered the most potential to provide novel insights on this previously understudied factor in mitigation decision-making.

According to Ajzen and Fishbein (1973), a behaviour refers to the specific behavioural intentions of an individual in a well-defined situation. In this application, the focal behaviour is adoption of mitigation actions. This study focuses on a homeowner's stated intention to adopt mitigation actions. The theory states that three components influence an individual's intention to complete a behaviour: (1) attitude towards the behaviour, (2) subjective norm, and (3) perceived behavioural control (Ajzen, 1991) (Figure 1). Each of these components and their corresponding hypotheses are explained below. A nuanced understanding of these components may allow for better predictions of the behavioural intentions of homeowners to adopt mitigation actions to protect their homes from hurricanes.

2.1 | Attitudinal component

The attitudinal component is reflected by an individual's attitude towards a behaviour or specific object (Ajzen, 1991). An individual's attitude represents their personal understanding of the world and their unique evaluation of the relevant behaviour or object (Ajzen & Fishbein, 1977). The attitudinal component also reflects an individual's learned disposition to respond consistently to the behaviour or object, either positively or negatively (Ajzen & Fishbein, 1973; Fishbein & Ajzen, 1975). Based on an individual's consistent, learned dispositions, an attitude is formulated which reflects the individual's beliefs. Individuals generally link their beliefs, which have either positive or negative values, to the behaviour or object, allowing for them to form a consistent attitude towards it (Ajzen, 1991).

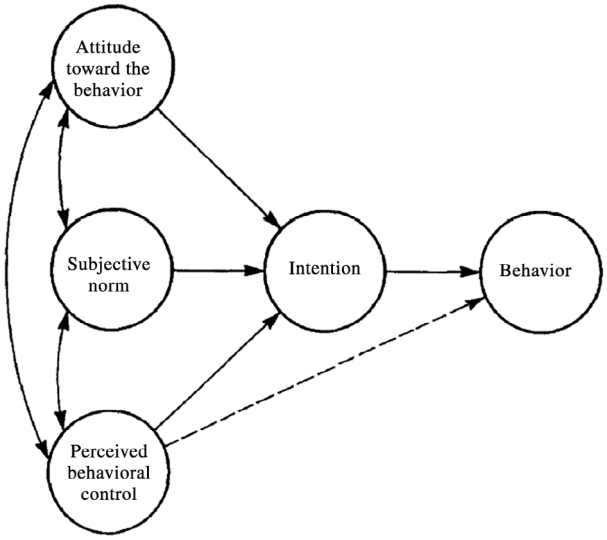

FIGURE 1 Ajzen's (1991) theory of planned behaviour

In this study, the attitudinal component incorporates the attitudes of individuals directed towards both the behaviour and the object. Regarding the attitudes towards the behaviour, individuals' perceptions regarding the cost, effort to instal, and potential resale value are explored. Regarding the attitudes towards the object, individuals' perceptions of the hurricane are studied, including both the emotions individuals feel about the hurricane events and their hurricane risk perceptions. Three hypotheses were formulated to test this component:

- **Hypothesis 1a:** *If an individual homeowner indicates that thinking about hurricanes evokes a negative or neutral response, the intention of the homeowner to adopt the hurricane mitigation action increases.*
- **Hypothesis 1b:** *As the degree that an individual homeowner's risk perception towards hurricanes increases, the intention of the homeowner to adopt the hurricane mitigation action increases.*
- **Hypothesis 1c:** *The more favourably the homeowner views the characteristics of the mitigation actions (cost, effort to install, and resale value), the intention of the homeowner to adopt the hurricane mitigation action increases.*

2.2 | Subjective norm component

The subjective norm component is the perceived social pressure from important persons in the individual's life to perform a given behaviour (Ajzen, 1991). According to Ajzen (1991), subjective norm is standardly measured by asking respondents to rate the degree of approval the important persons in their lives would rate their performance of a given behaviour (p. 195). In contrast to this approach and due to the lack of prior behaviour completion by the respondents, the subjective norm component in this study is reflected by the influence of the homeowner's family and friend's prior mitigation behaviour. Hypothesis 2 predicts the following:

- **Hypothesis 2:** *If the individual homeowner indicates that they have been influenced by family or friends who have previously adopted mitigation actions, the intention of the homeowner to adopt the hurricane mitigation action increases.*

2.3 | Perceived behavioural control component

The perceived behavioural control component reflects how easy or difficult individuals perceive it to be to perform the behaviour within the context of their lives (Ajzen, 1991). This component captures the past experiences of homeowners and also reflects any perceived challenges to completing the retrofit (Ajzen, 1991). This application captures two dimensions of the perceived behavioural control component. The first is the perceived self-efficacy of the individual to mitigate against the impacts of hurricanes. The second is the perceived response-efficacy of the hurricane mitigation actions, which are their ability to protect lives. Hypotheses 3a and 3b are formulated around these attributes:

- **Hypothesis 3a:** *The higher the individual rates their self-efficacy, the intention of the homeowner to adopt the hurricane mitigation action increases.*
- **Hypothesis 3b:** *The more favourable the individual perceives the ability of the action to protect lives, the intention of the homeowner to adopt the mitigation action increases.*

Ultimately, the following research question guides this work: *What role do attitude, the influence of others, and perceptions of efficacy have on the mitigation decision-making processes of individuals homeowners?* TPB suggests that there should be a positive relationship between these three components and an individual's intention to perform the behaviour (Ajzen, 1991). It is hypothesized that the greater the perceived behavioural control and the more positive an individual's attitude and subjective norm are, the greater the intention of the homeowner to mitigate. The significance and role that each of these components play varies based on the decision an individual needs to make (Ajzen, 1991; Ajzen & Fishbein, 1969). Unlike the other components, the perceived behavioural control component can also directly influence completion meaning that these variables could play a larger role than the other components in determining whether the behaviour is completed (Ajzen, 1991; Figure 1).

3 | LITERATURE REVIEW

Following a brief definition of mitigation, the section discusses the literature relevant to each concept from the theory: emotion, risk perception, attitude towards the action, influence of others, self-efficacy, and ability to protect lives.

3.1 | On mitigation

Mitigation actions are undertaken preimpact to reduce the risk from hazards and provide protection from their

effects to individuals and their property (Lindell & Perry, 2000). During this process, homeowners complete both protective action identification and assessment (Lindell & Perry, 1992). During protective action identification, homeowners look for an option that allows them to balance maintaining their normal activities and protecting their property and household from future hazards (Lindell & Perry, 1992). Next, homeowners undergo the protective action assessment phase in which they consider their different perceptions of the alternative mitigation actions (Lindell & Perry, 1992). Section 4 discusses the specific actions used for this study.

3.2 | Emotion

Slovic, Finucane, Peters, and MacGregor (2004) suggest it is important to understand the emotions homeowners feel about hurricanes because they play an important role in determining intention to mitigate. Measuring emotion is important since the decision-making process is unique for each individual and can vary significantly (Slovic et al., 2004). Additionally, the emotions individuals feel about hurricanes continue to influence their perceptions and decision-making long into the future (Mulligan & Scherer, 2012; Slovic et al., 2004).

Negative emotions experienced towards flood-related hazards have been shown to increase intentions to complete protective actions (Ge, Peacock, & Lindell, 2011; Terpstra, 2011). A study conducted by Zaalberg, Midden, Meijnders, and McCalley (2009) also found that homeowners who felt negative emotions about hurricanes were more likely to appraise the effectiveness of the protective action to be higher. Similarly, Slovic (2000) found that the more individuals dreaded a technological risk, the more they wanted actions and regulations to be taken to reduce said risk. These findings suggest the importance of including negative emotions in a model of intention to mitigate.

3.3 | Risk perception

Studies assessing the hazard risk perception of respondents have consistently found the presence of positive relationships with preparedness behaviour. In studies assessing flood risks, higher perceived probability of flood risk was shown to increase both willingness to pay for flood insurance and mitigation actions (Botzen & van den Bergh, 2012; Ge et al., 2011; Peacock, 2003). Studies assessing seismic risk perception provide further support for the hypothesized positive relationship. Several studies found significant positive relationships between perceived probability of earthquake risk and both intention to and adoption of mitigation actions (Asgary & Willis, 1997; Becker, Paton, Johnston, & Ronan, 2013; Lindell, Arlikatti, & Prater, 2009; Lindell & Whitney, 2000).

However, other findings question the positive relationships between risk perception and mitigation behaviour. In their review of earthquake mitigation studies, Lindell and Perry (2000) found that generally, but not universally, were risk perception and adoption of seismic mitigation actions correlated. This finding was also later confirmed in reviews conducted by Solberg, Rossetto, and Joffe (2010) and Lindell (2013). Additionally, the work of Bubeck, Botzen, and Aerts (2012) questions the positive relationships between risk perception and mitigation behaviour found in the literature. Similar to the other reviews, Bubeck et al. (2012) finds limited empirical and theoretical evidence supporting these positive relationships. To overcome the current methodological challenges in assessing the influence of risk perception on mitigation behaviour, the authors recommended measuring intention to mitigate instead (Bubeck et al., 2012). Given this study's usage of intention as the dependent variable, the findings support Bubeck et al. (2012)'s recommendation (Section 5.1.1).

3.4 | Attitude towards the action

Limited research focuses on the influence of the attitude towards the characteristics of the protective actions on mitigation behaviour. Regarding the influence of perceived cost, three studies have included this measure. While Russell, Goltz, and Bourque (1995) found a significant negative relationship between perceived cost and adoption of seismic hazard mitigation actions, neither Lindell and Prater (2002) nor Lindell and Whitney (2000) found cost to be significantly correlated with intention or adoption. In the only study to assess the influence of perceived effort to instal mitigation actions, Russell et al. (1995) found the measure to be negatively related to adoption. Given the limited inclusion in the existing literature, it is evident that the usage of these variables in this study can provide additional insights on the role these perceptions play in the mitigation decision-making process.

3.5 | Influence of others

As suggested by the TPB, the influence of others is shown to significantly influence intention to mitigate. In a study of coastal Florida homeowners, Peacock (2003) assessed the impact of the neighbours' storm shutter coverage on

the homeowner's purchase of mitigation actions. The results of the study indicated there was a significant, positive relationship present. Zaalberg et al. (2009) assessed the impact of social support from family, friends, and neighbours on preparedness actions. Social support had a negative impact on intention to take preventive actions to reduce the effects of future floods. These mixed results suggested the need to include the variable in this study to clarify the role of the influence of others on intention to mitigate.

3.6 | Self-efficacy

Several studies have explored the impact of self-efficacy on the completion of preparedness and mitigation actions (Becker et al., 2013; Grothmann & Reusswig, 2006; Whitney, Lindell, & Nguyen, 2014; Zaalberg et al., 2009). In these studies, self-efficacy was measured as a self-report of the individual's ability to complete either a preparedness activity or hazard mitigation action. Findings show that the impact of self-efficacy is mixed. Grothmann and Reusswig (2006) found self-efficacy to be positively, significantly correlated with completing both preparedness and mitigation actions. Becker et al. (2013) also found self-efficacy to encourage and increase seismic preparedness actions. However, Whitney et al. (2014) and Zaalberg et al. (2009) did not find self-efficacy to be significantly related to the adoption of seismic mitigation actions nor hazard prevention measures. The variability in findings show the need to include self-efficacy in additional hazard mitigation studies in order to provide clarity on the impact of this variable.

3.7 | Perceived ability to protect lives

Limited research has explored the effects of measures of response efficacy, such as the perceived ability to protect lives, on mitigation decision-making. Three studies have found positive, significant relationships between perceived effectiveness of the mitigation action and intention to adopt the mitigation action (Lindell & Prater, 2002; Lindell & Whitney, 2000; Weinstein & Nicolich, 1993). Like the work of these scholars, this study hypothesizes that the perceived ability to protect lives will increase the intention to adopt the mitigation action.

4 | METHODS

Data was collected through a mailed survey on households' attitudes, risk perceptions, prior experiences, perceptions of mitigation actions, and sociodemographic characteristics. Eight individual statistical analyses were then conducted to test the hypothesized relationships between the independent variables and intention to adopt the mitigation actions. For each analysis, one of the eight specific mitigation actions were used, together with the corresponding perception variables (e.g., intention to instal hurricane shutters and perception of hurricane shutters). The specific mitigation actions are: (1) wind resistant shingles, (2) special foam adhesive under the roof, (3) hurricane shutters, (4) impact resistant windows, (5) hurricane straps/ties, (6) elevated appliances, (7) water resistant siding, and (8) home elevated on piles. These actions were selected because of their ability to protect homes against hurricanes, their frequency of use nationwide, and their inclusion in the Insurance Institute for Business & Home Safety FORTIFIED Home Hurricane Program Gold Standards (Malik, Brown, & York, 2013). Notably, some mitigation actions are easier and more cost-effective to install during construction or extensive renovation of the home (i.e., hurricane straps/ties or wind resistant shingles). While it is possible for homeowners to intend to install mitigation actions at any moment in time, practitioners should encourage mitigation when homeowners plan to build, renovate, or complete home improvements such as replacing roofs or windows.

4.1 | Sample

The sample was purchased from Genesys, which utilises the United States Postal Service's database system to select random addresses for research purposes (Marketing Systems Group, 2018). Two thousand five hundred addresses were purchased which were screened to include only single family, owner-occupied homes located in the eastern half of North Carolina from the coastline inland to the capital city of Raleigh. In an effort to increase response rates, the survey was distributed following the Dillman (2007) procedures. These procedures included the development of a respondent-friendly survey, four contacts through first-class mail, stamped return envelopes, personalization of correspondence, and prepaid financial incentives. The four contacts through first-class mail consisted of an initial contact postcard informing homeowners their participation in a research study was requested. One week later, the first wave of surveys was mailed with a one dollar bill incentive included in each envelope. Two weeks later, the second wave of surveys was mailed and the final, third wave of surveys was mailed 2 weeks after that. In order to participate, respondents had to be at least 18 years old, own and

live in the home the survey was mailed to and contribute to the household's property insurance and home improvement decision-making processes. Two hundred and thirty-four completed surveys were returned.

Compared to the demographics for the population of the state of North Carolina, the sample was similar in terms of educational attainment and percentage of respondents living in single-family homes (Table 1). However, the sample was notably older and whiter than the population of the eastern half of North Carolina. One reason for this difference can be attributed to the high number of retired respondents (44%).

Table 2 shows the calculated American Association for Public Opinion Research (AAPOR) 1 values. AAPOR 1 values represents the most conservative estimates. The 10% response rate is not optimal; however, the low contact rate shows what is driving the low rates. Given the low contact rate, Table 1 is able to provide an overview of the representativeness of the sample. When available, county-level data was utilised to represent the counties from which the sample resides. If unavailable, state census data was able to provide a comparison to the sample demographics. Low response rates are a persistent concern in survey methods. Upon reflection, it seems likely the survey's length and the unfamiliar nature of its contents to participants are likely driving factors for the low response rate. Future researchers should consider limiting the lengths of mailed surveys and providing additional information on unfamiliar topics.

TABLE 1 Demographic characteristics

	County-level data	**Sample (n = 234)**
Median age (years)	37.9	61
White (%)	65.9	80.8
Black (%)	25.5	10.3
Hispanic (%)	9.9	2.7
Gender (%)	48.8 male 51.2 female	48.2 male 51.8 female
	State census data	**Sample (n = 234)**
Employed (%)	61.5	47.6
High school graduates (%)	86.3	98.7
Residing in single-family homes (%)	87.9	88.3

Sources: North Carolina Office of State Budget and Management [NCOSBM], 2017a; NCOSBM, 2017b; United States Census Bureau, 2016.

TABLE 2 AAPOR calculations

Response rate
AAPOR 1
10.00%
Refusal rate
AAPOR 1
1.07%
Contact rate
AAPOR 1
16.80%
Cooperation rate
90.35%

Source: Daves, 2018.

4.2 | Measures

Based on the raw data from the survey, a number of measures were recomputed to be used to test the hypotheses (Table 3). Eight separate models were computed which only differed in terms of the focal mitigation action and the respective perceptions of the characteristics for the eight mitigation actions.

4.2.1 | Dependent variable measures

The dependent variable for this study is intention to adopt hurricane mitigation actions. The survey asked respondents to indicate their intention to adopt each of the eight hurricane mitigation actions. The survey asked, 'For this question, we would like you to imagine that you moved to a new home that did not have any of the following features. With that assumption, tell us if you would add each feature within 5 years'. The response set for each of the hurricane mitigation actions was 'Yes', 'No', and 'Not Sure'. Eight measures for the dependent variable were computed to represent the intention to adopt each of the eight mitigation actions. These measures were coded as 0 = Intends to adopt action and 1 = Does not intend to adopt action. Respondents who indicated 'Not Sure' were excluded from analysis.

4.2.2 | Independent variables and control variables measures

Table 3 shows the measures, questions from the survey, and the coding used in the analyses for the independent and control variables. Eighteen measures were used to represent the attitudinal component during analysis. The

TABLE 3 Description of measures used in analyses

Attitudinal component independent variables		
Measure name	**Survey question**	**Coded**
Negative and neutral emotional responses	Which of the following emotions do you feel when you think about hurricanes? (Select all that apply.) Angry, Anxious, Calm, Capable, Exhilarated, Indifferent, Repulsed, Resigned, and Scared	0 = Only negative (Angry, Anxious, Repulsed, Scared) and Neutral (Indifferent, Resigned) responses 1 = All other responses
Likely damage and injury	If a hurricane affects North Carolina, how likely is it to cause... a. significant damage to your home? c. an injury or the death of someone close to you?	0 = Perceives damage or injury to be likely 1 = Does not perceive damage or injury to be likely
Perceived cost and effort to install	The cost of this feature is too high. Yes or no This feature requires too much effort to install. Yes or no	0 = Negative perception of both cost and effort 1 = Mixed perception of cost and effort 2 = Positive perception of both cost and effort
Perceived potential resale value	This feature would add value if I sell my home. Yes or no	0 = Negative perception of value 1 = Positive perception of value
Subjective norm component independent variables		
Variable name	**Survey question**	**Coded**
Influence of family and friends' prior behaviour	Family or friends strengthened their homes—Have you ever had this experience? Did having this experience make you consider buying more insurance or strengthening your home to protect it from hurricanes?	0 = No, not influenced by this experience 1 = Yes, influenced by this experience
Perceived behavioural control independent variables		
Variable name	**Survey question**	**Coded**
Self-efficacy	Do you believe that your actions matter in determining how much a hurricane will damage your home? Strongly disagree, disagree, neutral, agree, strongly agree	0 = Negative perception of self-efficacy 1 = Positive or neutral perception of self-efficacy
Perceived ability to protect lives	This feature would protect lives. Yes or no	0 = Positive perception of ability to protect lives 1 = Negative perception of ability to protect lives

first two measures represent the attitude directed towards the object. The first measure represents the emotions experienced by respondents about hurricanes. The second measure reflects the respondents' risk perception about the likely damage and injury a hurricane could cause. The final 16 measures represent the attitude directed towards the behaviour. For each of the eight mitigation actions, respondents were asked to identify their perceptions of the characteristics of the action: cost, effort to install, and potential resale value.

One measure, influence of family and friends' prior behaviour, was used to represent the subjective norm component. This measure is indicative of how the behaviour of important persons in the respondent's life influences their own mitigation decision-making.

Nine measures were used to represent the perceived behavioural control component. The self-efficacy measure asked respondents to indicate their perceived ability to protect their homes against potential hurricane damage. For each of the eight mitigation actions, respondents were also asked to indicate their perception of the action's ability to protect lives.

5 | RESULTS

Given the dichotomous nature of the dependent variables, binary logistic regression was selected for analysis (Bachman & Paternoster, 1997). Using this method made it possible to create models which explained the effects of multiple independent variables on dichotomous dependent variables. Binary logistic regression provides an estimate for the probability of an event occurring (Bachman & Paternoster, 1997). Thus, the models

provide an estimate for the probability of a homeowner intending to adopt a mitigation action.

In order to select the most appropriate measures for inclusion in the regression, bivariate correlations were conducted for each model (Supplementary Material). The correlations across the eight models were compared and then variables which were consistently, highly inter-correlated were excluded from further analyses. Variables, such as prior damage and proximity to the coast, were excluded due to repeated, high inter-correlations. The inclusion of these variables into the regression would have reduced the overall explanatory power of the eight models. The bivariate correlations also showed the need to create combined measures for two sets of variables that were highly correlated: perceived cost and effort to instal and ability to protect lives and property. Next, chi-square tests were used to explore the associations between different potential measures of the concepts. The cut-off threshold used for inclusion was $\acute{\alpha} = .15$ (Afifi, May, & Clark, 2012a). Using this threshold, 11 measures were identified and explored as potential representations of the core concepts.

At this point, one measure was selected to represent each concept. These selections were made based on considerations relevant to each variable's inter-correlation, association with each of the eight dependent variables, and missing cases. Due to a lack of association, two variables, locus of control and income, were also excluded from the regression. Based on the performance of these measures across the eight models, seven were selected as the final representations of the core concepts for the regression analyses. It was at this point that the decision was made to select ability to protect lives and exclude ability to protect property. While theoretically both were important concepts, the ability to protect lives had stronger associations and greater statistical significance in the models. For each model, the independent and dependent variables were tested for and met the assumptions of linearity and no interaction between the independent variables (Harrell, 2015).

The remainder of this section discusses the results of these eight models in greater detail with a focus on each of the components of the TPB. Table 4 shows the complete results of the statistical analyses. The section concludes by discussing the overall fit of the eight models.

5.1 | Attitudinal component results

5.1.1 | Emotion

Emotion was measured as the homeowner's experience of negative and/or neutral emotions directed towards hurricanes. The results indicated the presence of negative relationships with intention to adopt the eight mitigation actions. For the wind resistant shingles, emotion was found to have a negative effect on intention to adopt the action (Table 4). No relationships were present between negative and/or neutral emotions and intention to install hurricane straps/ties, water resistant siding, and to elevate appliances or the home on piles.

The direction of the significant relationships was also contrary to the relationship predicted in Hypothesis 1a and the findings of the literature. Both Ge et al. (2011) and Terpstra (2011) suggest that negative emotions experienced towards flood-related hazards should increase intention to mitigate. However, findings from Slovic (2000) and Siegrist and Gutscher (2008) provide additional clarity to our results. Slovic (2000) suggests that dread of a technological risk increases the desire of respondents to want actions and regulations to be taken to reduce the risk. However, as the results of Slovic (2000) suggest that does not mean the respondents themselves would be the ones to take the preventive action. This finding provides one possible explanation for the lack of support for Hypothesis 1a.

Siegrist and Gutscher (2008) also suggest that the presence of an emotional response is not enough to persuade residents of flood-prone areas to mitigate. Similar to the results of this study, Wei and Lindell (2017) found affective response was not predictive of lahar preparedness of Mt. Rainier area residents. In contrast, Lindell et al. (2016) found significant correlations between affective responses and immediate evacuation when earthquake shaking was occurring. These differences suggest that affective responses are more relevant, and thus more likely to be predictive of, responses to imminent threats. Ultimately, the results of this study suggest that emotion is not the only relevant predictor of adoption of mitigation actions. This supports Ajzen and Fishbein's (1977) argument that while a person's attitude does influence their response to an object, that response may not be sufficient to ultimately predict or influence their completion of a behaviour.

5.1.2 | Risk perception

The risk perception items asked respondents to consider perceived likely damage to their property and perceived likely injury from a future hurricane event. There was a statistically significant, positive relationship with intention to instal hurricane straps/ties (Table 4). However, given the limited significance of this independent variable and the lack of support for Hypothesis 1b, much still remains unclear about the role that risk perception plays for homeowners deciding to adopt mitigation actions for their homes. The findings of this study support those of

TABLE 4 Results of binary logistic regression

Component	Variable name	Wind resistant shingles		Special foam adhesive under the roof		Hurricane shutters		Impact resistant windows		Hurricane straps/ties		Elevated appliances		Water resistant siding		Home elevated on piles	
		β	*p*	*β*	*p*	*β*	*p*	*β*	*p*	*β*	*p*	*β*	*p*	*β*	*p*	*β*	*p*
Attitudinal	Negative and neutral emotional responses	−2.35*	.04	−1.53	.19	−1.40	.28	−1.44	.05	−20.20	.99	−18.52	.99	−22.16	.99	−19.00	.99
	Likely damage and injury	0.10	.80	−0.14	.80	0.92	.10	0.20	.58	0.99*	.03	1.19	.12	−0.70	.12	1.76	.06
	Perceived cost and effort (1)	−1.07*	.02	−1.28**	.03	−3.41**	<.001	−1.12*	.01	−2.09**	.001	−1.78	.06	0.33	.48	−1.71	.12
	Perceived cost and effort (2)	−1.98**	.002	−0.33	.64	−1.53**	.01	−0.61	.21	−0.61	.27	−0.95	.28	−0.12	.85	−0.73	.52
	Perceived resale value	0.70	.11	0.96	.08	2.12**	<.001	1.15**	.008	0.88	.06	2.36**	.003	1.92**	<.001	2.82**	.003
Subjective norm	Influence of family and friends prior behaviour	1.34**	<.001	0.86**	.02	1.12**	.004	0.73*	.02	0.41	.23	0.69	.11	1.47**	<.001	1.00*	.03
Perceived behavioural control	Self-efficacy	0.19	.65	−0.07	.90	1.39*	.02	−0.13	.75	0.10	.85	0.78	.29	−0.46	.32	1.41	.11
	Perceived ability to protect lives	0.80	.06	1.53**	.003	1.96**	.005	1.978	.01	1.72**	.002	0.68	.36	0.68	.11	1.24	.20
Constant value		−1.37**	0.005	−2.43**	<0.001	−3.85**	<0.001	−2.36**	0.009	−2.77**	<0.001	−4.23**	<0.001	−2.20**	<0.001	−5.89**	<0.001

*Correlation is significant at the .05 level (2-tailed).
**Correlation is significant at the .01 level (2-tailed).

Lindell and Perry (2000), Solberg et al. (2010), Bubeck et al. (2012), and Lindell (2013) who question the significance of risk perception as a variable capable of explaining mitigation decision-making of homeowners.

5.1.3 | Perceived cost and effort to install

The perceived cost and effort to install measure reflects if a respondent believes it was too costly or would take too much effort to install each of the eight mitigation actions. Of the eight actions, five had statistically significant relationships: intention to install wind resistant shingles, special foam adhesive under the roof, hurricane shutters, impact resistant windows, and hurricane straps/ties (Table 4). These five relationships supported H1c, which predicted a negative relationship between unfavourable views of cost and effort to install with intention to mitigate. These results also support the findings of Russell et al. (1995) who found negative perception of the cost and effort it takes to complete an action to decrease adoption of seismic hazard mitigation actions.

5.1.4 | Perceived resale value

The potential resale value measure indicates the homeowner's perception of the mitigation action's impact on their property's resale value. The results indicate positive, statistically significant relationships for five models: intention to install hurricane shutters, impact resistant windows, elevate appliances, water resistant siding, and elevate the home on piles (Table 4). These significant results provide additional support for Hypothesis 1c. Additionally, they suggest that potential resale value is a factor that really matters for mitigation actions adopted to either the exterior or elevation of the home. Intuitively, this is unsurprising given that the visibility of these mitigation actions is likely to impact the design of the home and its perceived curb appeal. Considering that this was the first known inclusion of potential resale value in a mitigation study, it is evident that this measure should be included in future studies given its predictive ability.

5.2 | Subjective norm component results

5.2.1 | Influence of others' prior behaviour

The measure for the subjective norm component represents how homeowners have been influenced by the prior mitigation behaviour of their family and friends. Of the eight models, this measure had positive, statistically significant relationships with the intention to install wind resistant shingles, special foam adhesive under the roof, hurricane shutters, impact resistant windows, water resistant siding, and home elevated on piles (Table 4). These results support the prediction in Hypothesis 2 that having friends and family who previously mitigated would increase the intention of homeowners to do the same.

Two studies in the literature explored this concept and their findings conflicted (Peacock, 2003; Zaalberg et al., 2009). The results of this study support the findings of Peacock (2003), in which neighbour's storm shutter coverage positively, significantly influenced the homeowner's adoption of envelope and shutter coverage.

5.3 | Perceived behavioural control component results

5.3.1 | Self-efficacy

The self-efficacy measure shows the homeowner's perception of their own ability to prevent damage to their property in the event of a hurricane. Of the eight models, this measure was only significant for the intention to install hurricane shutters model (Table 4). In this model, self-efficacy had a positive, statistically significant relationship with intention to mitigate. This result supports the findings of Grothmann and Reusswig (2006) and Becker et al. (2013) who found self-efficacy to be positively related to mitigation and preparedness actions.

Similar to Whitney et al. (2014) and Zaalberg et al. (2009), the other seven models in this analysis were not statistically significant. As such, Hypothesis 3a cannot be supported. This lack of statistical significance suggests that a homeowner's perceived self-efficacy may not play a significant role in the mitigation decision-making process.

5.3.2 | Perceived ability to protect lives

The ability to protect lives measure captures the homeowner's perception of the action's ability to protect the lives of its inhabitants in the event of a future hurricane event. Four models had positively, statistically significant coefficients for the ability to protect lives measure: special foam adhesive under the roof, hurricane shutters, impact resistant windows, and hurricane straps/ties (Table 4). These results provide partial support for

Hypothesis 3b, which predicted that a positive perception of the action's ability to protect lives would increase intention to mitigate. The results of this study also provide support for the limited findings which have shown the presence of positive relationships between perceived effectiveness and intention to mitigate (Lindell & Prater, 2002; Lindell & Whitney, 2000; Weinstein & Nicolich, 1993).

5.4 | Overall fit of the models

Hosmer and Lemeshow tests determine the goodness-of-fit for binary response models. This test determines if the given model is a correct fit for the included measures, or if it necessary to add interaction terms or non-linearities to the model (Allison, 2014). For a model to be a good fit, the Pearson's Chi Square must not have a $p < .05$ (Allison, 2014). All eight models are good fits to represent the intention to mitigate (Table 5).

6 | DISCUSSION

The results discussed in Section 5 indicate several key findings of this study. Notably, the results do not provide clear support that either emotion or risk perception influence a homeowner's intention to mitigate. As such, neither H1a nor H1b can be supported. However, there is clear evidence that perceived cost and effort to install the mitigation action is a predictor of intention to mitigate. Negative perceptions of cost and effort it would take to install a mitigation action are a negative predictor of intention to mitigate. These findings support H1c, which hypothesized unfavourable views of cost and effort would negatively impact intention. H1c is further supported by the five statistically significant positive relationships between perceived resale value and intention to mitigate.

The influence of others' prior mitigation behaviour was another factor shown to predict intention to mitigate. The six significant relationships provide considerable support for H2 and indicate how important it is for policymakers to consider this factor going forward. On the other hand, the results of this study do not support H3a, which means the influence of self-efficacy on the intention to mitigate is not clear. Additional studies are needed to explore the influence of this factor. The last key finding from this study is the predictive ability of perceived ability to protect lives. Given the four positive significant relationships, it is evident that the action's perceived ability to protect lives is influential in a homeowner's intention to mitigate. This finding provides partial support for H3b. Table 6 depicts a summary of the support for the study's hypotheses.

The goal of this study was to understand the applicability of the TPB to a hazard mitigation context. The findings of this study show clear support that the subjective norm and perceived behavioural control components are predictive of intention to mitigate. However, this study does not provide clear support that the attitudinal component predicts intention to mitigate. Given the significance of the subjective norm and perceived behavioural control components, future studies should adopt this theory to test its applicability. It is recommended that future studies should use non-dichotomous measures and separate survey questions for participants to indicate their positive and negative emotional responses.

When considering the results for each mitigation action, several findings emerge. For the four actions which mitigate the effects of wind damage, perceived cost and effort is a significant predictor for intention to adopt all four actions. The influence of others' prior behaviour was also related to intention to mitigate for three of these wind-related actions. Of interest to the readership of this journal, the influence of others' prior behaviour was significantly related to all four actions which mitigate the effects of water damage. Additionally, perceived resale value was a significant predictor for three actions. These findings suggest that the influence of others is pertinent for intention to adopt any of the mitigation actions,

TABLE 5 Hosmer and Lemeshow test results

Mitigation action	*n*	Missing cases	$\chi 2$	*p*
Wind resistant shingles	172	62	5.04	.75
Special foam adhesive under the roof	159	75	11.48	.18
Hurricane shutters	168	66	9.35	.31
Impact resistant windows	172	62	9.11	.33
Hurricane straps/ties	166	68	6.90	.44
Elevated appliances	161	73	7.26	.51
Water resistant siding	162	72	7.18	.41
Home elevated on piles	165	69	1.49	.99

TABLE 6 Summary of findings

Hypothesis	Predicted direction	Results
1a—Negative or neutral emotion	Positive	*Not supported*: Negative relationship w/wind resistant shingles
1b—Risk perception	Positive	*Not supported*: Positive relationship w/hurricane straps/ties
1c—Perceived cost, effort to Install, resale value	Negative	*Supported*: Negative relationships w/wind resistant shingles, special foam adhesive under the roof, hurricane shutters, and hurricane straps/ties
2—Influence of others	Positive	*Supported*: Positive relationships w/wind resistant shingles, special foam adhesive under the roof, hurricane shutters, impact resistant windows, water resistant siding, and home elevated on piles
3a—Self-efficacy	Positive	*Not supported*: Positive relationship w/hurricane shutters
3b—Perceived ability to protect lives	Positive	*Partial support*: Positive relationships w/special foam adhesive under the roof, hurricane shutters, and hurricane straps/ties

whereas perceived cost and effort is more significant for wind actions and perceived resale value for water actions.

6.1 | Policy implications

The findings of this study have several noteworthy policy implications. Most importantly, government stakeholders should be educated on the significant factors of this study—perceived cost and effort to install, perceived resale value, influence of others' prior behaviour, and perceived ability to protect lives. In doing so, these stakeholders will be better equipped to plan and implement future mitigation policy and programs.

For each of the significant factors, novel, potential program recommendations are proposed to incorporate the findings in future policy. The significant relationship with perceived cost to install suggests that policymakers promoting incentive programs should emphasise the cost range of mitigation actions, instead of only sharing the monetary discount available to homeowners. By doing so, policymakers will create a more positive perception of potential cost for the adoption of the mitigation actions. Additionally, engagement initiatives and public information campaigns targeting coastal homeowners should clearly outline the mitigation process to alleviate effort to install for the homeowners and make the process more comprehensible. Questions to be addressed include: How should homeowners begin this process? Who should they contact in their area? What local companies are approved mitigation partners? To maximise the impact of such programs, state level government should create these outlines, share with local partner agencies, and update them on a regular basis.

The significant relationship between perceived resale value and intention to mitigate indicates that these factors need to be incorporated into government-run educational programs for real estate and construction stakeholders. Trainings for real estate agents should focus on increasing the awareness of prior flood damaged properties and emphasising the benefits of the mitigated homes that may be on the market. Partnerships should be made with construction companies and they should be offered incentives for adopting mitigation actions for homes and using hurricane-proof products. This idea would also simultaneously decrease the perceived effort to install for the homeowner.

The findings surrounding the influence of others' prior behaviour clearly indicate that people who have mitigated already are an invaluable resource that government stakeholders should not ignore. To capitalise on this resource, a future incentive program should offer either money or tax incentives to mitigated homeowners who successfully recruit others to mitigate. Finally, the significant relationship between intention to mitigate and the perceived ability to protect lives highlights an area of opportunity for future public information campaigns. It is well known that flooding is the greatest risk to life. Future public information campaigns should incorporate these findings by highlighting the potential life-saving benefits of mitigating coastal properties.

6.2 | Limitations

Several limitations of this study must be acknowledged. The first is the failure to include hazard intrusiveness as a measure. Hazard intrusiveness is a psychological factor based on how frequently and in what ways individuals think about hazards (Ge et al., 2011; Lindell et al., 2009). Like emotion, hazard intrusiveness is a measure of an individual's perception of and affective response to a hazard. Both Lindell et al. (2009) and Ge et al. (2011) found hazard intrusiveness to have large, positive effects on the mitigation adoption expectations of their participants. The inclusion of this concept in the survey could have helped shed additional light on the role emotion plays in the decision-making process. It also could have provided some insight on how the frequency of emotional response directed towards a hurricane influences intention, which is also currently missing from this analysis.

The second limitation of this study is the number of missing values in the dataset. This can be attributed to the low number of respondents whom previously mitigated, a lack of familiarity with the mitigation actions, and the length of the survey instrument. Due to the missing values, complete case analysis was utilised meaning only the cases with no missing values were included for analysis (Afifi, May, & Clark, 2012b). Using this approach meant a loss of information from excluding incomplete cases and different sample sizes for each model (Afifi et al., 2012b). For the eight separate analyses, the *n* values range from 159 to 172 cases, which accounts for approximately 68% of the data. In the future, it is possible to consider a full range of imputation methods to account for these missing values. While imputation does provide the benefit of a complete data set, it also comes with several disadvantages. One disadvantage is the unknown effect of the imputation on the results of the statistical analyses (Afifi et al., 2012b). Though imputation was considered, the study team decided that the unknown effect on the results outweighed any benefits of imputation.

The third limitation of this study involves the measurement of concepts. Questions in the survey were developed based on common techniques used in disaster research. However, the TPB has long been employed by health researchers (Armitage & Christian, 2003). While the majority of measures were dichotomous, the components of the TPB have more commonly been measured with a Likert scale (i.e., Weinstein, 2000). Though several concepts were measured in such a way, they were recoded to be dichotomous due to the low number of survey responses. With more data and more sophisticated measurement, future studies may show different results that provide greater evidence of the applicability of the TPB to explain the mitigation decision-making processes of individual homeowners.

A fourth limitation of this study is that the models only predict intention to mitigate, not a homeowner's actual adoption of the mitigation action to their home. Theoretically, the lack of inclusion of this component means this was not a comprehensive test of Ajzen's (1991) TPB in a hazards context. Due to the nature of the dataset, it was not possible to include adoption in this analysis because respondents were not asked to provide perceptions related to any mitigation actions they may have previously adopted. Understanding adoption would provide invaluable insights on how to motivate and incentivise other homeowners to mitigate. However, multiple studies have shown that measuring intention is complementary to measuring actual behaviour completion (Fishbein & Ajzen, 1975; Lindell & Whitney, 2000; Weinstein & Nicolich, 1993). In a seismic hazards context, Lindell and Whitney (2000) argue that intention to mitigate will be significantly correlated with actual adoption of mitigation actions meaning that studies focusing only on intention to mitigate still provide invaluable insights on what mitigation actions homeowners are likely to adopt. For practitioners then, it is worthwhile to understand factors which motivate homeowners' intention to mitigate and integrate these factors in new mitigation policies and programs.

7 | CONCLUSION

Given the low prevalence of mitigated properties nationwide, this study aimed to determine if a different theoretical framework, Ajzen's (1991) TPB, would provide new insights for researchers and stakeholders on mitigation decision-making. As shown throughout Section 5, some dimensions of the eight models were consistently more significant, such as influence of others, perceived cost and effort, and perceived resale value, whereas others were less likely to be (i.e., emotion, risk perception, and self-efficacy). Regardless, the findings support TPB as a valuable framework for future mitigation studies. The findings also suggest that the significant factors need to be utilised by government stakeholders. Specifically, these factors can inform future educational programs for real estate and construction stakeholders, incentive programs for homeowners who mitigate, and public information campaigns to educate and motivate homeowners.

The results of these analyses provide additional contributions to the broad literature available on household risk decisions. The significant positive relationships between intention to mitigate and the influence of others' prior mitigation behaviour provides clarification to the

conflicting findings of the existing literature. Most notably, these findings show how important it is to consider homeowners' perceptions of the characteristics of mitigation actions, such as perceived cost and effort to instal, perceived resale value, and perceived ability to protect lives. These significant findings support the suggestion of Lindell et al. (2009) to include these factors in future hazard mitigation studies.

The predictive ability of the eight models indicates specific factors for stakeholders to target in order to motivate and incentivise homeowners to adopt mitigation actions for their homes against flood and wind hazards. By identifying specific factors that influence mitigation decision-making, this study helps to address current concerns over the increasing costs of disruption and damage caused by hurricanes. Given the impacts of climate change and increase in severe weather events, it is important to increase buy-in from homeowners to mitigate. The application of these factors in future mitigation research and policy endeavours will ultimately help stakeholders prevent losses for homeowners and minimise economic impacts.

DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are available in the supplementary material of this article.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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