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Explaining preparedness towards hydrometeorological hazards. An exploratory study in Mexico

Explicando la preparación ante riesgos hidrometeorológicos. Un estudio exploratorio en México

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Abstract

This study explores how the threat and appraisal constructs proposed by the Protection Motivation Theory affect preparedness behavior towards hydrometeorological hazards contingent to the confidence on the governmental support, the individual's social vulnerability, and his/her previous experience with a natural threat. Data from an online survey of residents of two Mexican coastal counties was used to provide empirical support to the conceptual model developed. The analytical results of structural equation modelling indicate that a high confidence in the authorities' support has a non-significant effect on preventive behaviors but negatively affects the perceived coping self-efficacy of socially vulnerable individuals. Additionally, preparedness behavior is triggered by risk or coping factors depending on the previous experience with an hydrometeorological hazard. These findings advise to 1) better manage the expectations of socially disadvantaged residents regarding the governmental assistance by improving their self-protection ability towards natural threats, and 2) offset the decreased risk perception of households who are exposed to hydrometeorological warnings regularly. The main limitation of this study is the small purposing sample used to empirically validate the model proposed. An extensive study based on a probabilistic sample of coastal communities of Mexico is recommended to confirm the findings of this exploratory research.

Keywords: Protection Motivation Theory (PMT), hydrometeorological disasters, governmental support, social-vulnerability.

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Resumen

Este estudio explora como los constructos de la Teoría de la Motivación Protectora afectan las conductas de preparación para afrontar riesgos hidro-meteorológicos condicionadas a la confianza en el apoyo del gobierno, la vulnerabilidad social del individuo y la experiencia previa con una amenaza natural. Los datos de una encuesta en línea aplicada a residentes de dos municipios costeros mexicanos se utilizaron para dar apoyo empírico al modelo conceptual desarrollado. Los resultados analíticos del modelado con ecuaciones estructurales indican que una alta confianza en el apoyo de las autoridades no tiene un efecto significante en las conductas de prevención, pero afecta negativamente la autoeficacia para enfrentar el peligro en los individuos socialmente vulnerables. Adicionalmente, las conductas de preparación son estimuladas por factores de riesgo o afrontamiento dependiendo de la experiencia previa con una amenaza hidro-meteorológica. Estos hallazgos proponen: 1) manejar mejor las expectativas de los residentes en desventaja social con relación a la asistencia del gobierno para que mejoren su habilidad para autoprotegerse en caso de un peligro natural, y 2) contrarrestar la percepción de menor riesgo de los residentes que están expuestos regularmente a advertencias de amenazas hidro-meteorológicas. La principal limitación del estudio es la muestra pequeña con fines especiales que se utilizó para validar empíricamente el modelo sugerido. Un estudio extensivo basado en una muestra probabilística de comunidades costeras de México es recomendable para confirmar los hallazgos de esta investigación exploratoria.

Palabras clave: Teoría de Motivación Protectora (TMP), desastres hidro-meteorológicos, apoyo gubernamental, vulnerabilidad social.

Introduction

A disaster, natural or man-made, is defined as "a major hazard event that causes widespread disruption to a community or region that the affected community is unable to deal with adequately without outside help" (IB Geography, definitions, p. 1). The Centre for Research on the Epidemiology of Disasters (CRED) (Emergency Events Database [EM-DAT], 2021) reported 389 natural disasters in 2020, that killed 15,080 people, affected 98.4 million of people and cost US $171.3 billion. In 2020, floods and storms were the most common type of disaster (201 events) that affected 45.5 million people and caused economic losses for US $92.7 billion. In México, hydrometeorological events hit the coast of Mexico recurrently; the most affected states are Veracruz located in the Gulf of Mexico and Oaxaca and Chiapas in the Pacific Coast (Alcántara-Ayala, 2020). During 2020 these hazards represented 83.4% of the total economic losses due to disasters (approx. US $16 millions) (CENAPRED, 2021).

Preparedness, defined as an individual's capacity to manage, adapt, respond, and recover from a disaster, is critical to reduce the potential consequences of natural

hazards. However, unless there is a sense of immediate need, instructing households about how to plan and respond to a threat is rarely a priority even in disaster-prone regions (Alexander, 2012; Lopez-Vargas & Cardenas-Aguirre, 2017; Miller, Adame, & Moore, 2013). The National System of Civil Protection (Sinaproc), the Mexican entity responsible of managing disasters and hazards, mainly acts in response to emergencies, leaving to communities, local public, and private organizations the major responsibility to perform the preparation actions that help individuals to decrease the risk of personal injury or property damage due to a hazard. Najafi et al. (2017) argued that disaster preparedness is a type of health-protective behavior, thus behavioral theories are a proper approach to understand the factors that motivate or inhibit natural disaster preparedness behaviors. From this perspective, natural disaster preparedness is explained by variables such as the adaptive capacities, the sense of social support, and the perception of risk towards the occurrence of extraordinary events (Paton & Johnson, 2001).

The appropriate allocation of ex ante and ex post budgeting for disasters is relevant in designing effective disaster policies given the burden of the non-monetary cost of human suffering and the high cost to the government of providing disaster relief and recovery after the event occurrence (ex post). If disaster prevention is appropriate, human suffering decreases, the economic activities are suspended less time, and the resilience of the population increases thus decreasing the expenditure. According to the National Center for Disaster Prevention (CENAPRED), the economic impact of damages and losses due to natural events increased 202% in 2020 (approx. US$16 million which represents 0.14% of Mexican GDP) (Forbes, 2021, CENAPRED, 2021). Although there have been advances in the efficiency of civil protection in Mexico, there is a need for multidisciplinary research to revising the current role, functionality, and effectiveness of the National Civil Protection System. From a social perspective, enhancing the understanding of the psychographic variables and environmental factors that affect the preparation behavior towards natural hazards is relevant for the design of an integral disaster management system, particularly in developing countries where socioeconomic characteristics are different to those in developed countries where theories have been originated and empirically tested (Ejeta et al., 2016; Shapira, Aharonson-Daniela, & Bar-Dayana, 2018). To close this gap in the literature, the objective of this study was to assess the influence that the constructs comprising the two processes of the Protection Motivation Theory (PMT) have on the preparedness of residents of two Mexican coastal counties that recurrently face hydrometeorological hazards. The direct and indirect effect of trust and confidence in the authorities' support on the residents' ex ante preparation behaviors, and the moderating effect of social vulnerability and previous experience were also explored. This work is organized as follows: the next section identifies the main health behavioral models used to explain/predict disaster preparedness, and describes previous works that have applied the PMT. The section ends with the explanation of the conceptual model proposed to predict preparation behaviors or preparedness. The third section describes the methods and measurement instrument used to survey residents of two coastal counties in Mexico to empirically validate the conceptual model, while the fourth section discusses the

analytical results of the partial least squares structural equation modeling (PLS-SEM). Conclusions, academic and practical implications are presented in the final section.
Several behavioral theories have been applied to explain disaster preparation behaviors at the individual level (Asnarulkhadi et al., 2019). Among the most cited are the Theory of Planned Behavior (TPB) (Ajzen & Fishbein, 2005), the Social-cognitive Preparation Model (Paton, 2003), the Health Belief Model (Sharma & Romas, 2008), the Protection Motivation Theory (Rogers, 1983), and the Extended Parallel Process Model of fear appeals (EPPM) (Ejeta, Ardelan & Paton, 2015). Except by the TPB, these theories consider the effect of risk perceptions on a range of preparedness actions towards different types of disasters (Bourque, Regan, Keally, & Wook, 2013). Risk perceptions are determined by assessing the negative consequences of a hazard, the perceived exposure or vulnerability to the event, its imminence, and the concern about the hazard (Shapira et al., 2018). These perceptions involve a cognitive and an affective component from which the affective or emotional component seems to have the major influence on disaster preparedness (Miceli, Sotgiu, & Settanni, 2008). Extant research suggests that risk perception is a necessary but not sufficient predictor of preparedness, and its effect is mediated or moderated by demographics and psychographic constructs (Bourque et al., 2013). For example, Ng (2022) found risk perceptions positively influenced preparedness intentions towards typhoons in Hong Kong, partially mediated by the TPB constructs subjective norm, attitudes, and perceived control.

This work applies the PMT, a pragmatic, well-documented, robust, and flexibly theory, that can be straightforward implemented to improve household preparedness towards a variety of natural hazards (Bamberg, Masson, Brewitt, & Nemetschek, 2017; Bubeck, Botzen, Laudan, Aerts, & Thieken, 2017). The PMT proposes people are motivated to protect themselves driven by a threat appraisal and a coping appraisal process. The threat appraisal ponders the severity and self-vulnerability towards the hazard, that is, is related with the assessment of the risk. While the coping appraisal deals with the beliefs about the effectiveness of the protective actions and the capabilities to change current behavior to enhance preparedness. For example, Westcott, Ronan, and Bambrick (2017) discuss how the PMT processes supplemented by trust in emergency services and oneself, uncertainty on the information about the hazard, prior experience, complexity of the social microclimate, and concerns about animal management affects evacuation in case of bushfires in Australia. McCaughey, Mundir, Dalya, Mahdic, & Patt (2017) also extended the PMT by exploring how the social influence (official information, disaster training, and influence of close social groups) affect different coping appraisal actions related to tsunami evacuation of buildings. Results show that social influence and the coping appraisal constructs, especially self-efficacy, significantly affect future evacuation actions.

Tang and Feng (2018) explicitly add "obstacles" (lack of preparedness knowledge, time, and economic resources) to the PMT to explain disaster preparedness intentions of Taiwanese households. Findings indicate that self-efficacy is positively and significantly related to preparedness intentions, while obstacles negatively affect the behavior. Risk perceptions did not affect disaster preparedness intentions. This unforeseen result was attributed to low-risk perceptions after experiencing a recent earthquake, and potential

interactions between risk perception with the coping appraisal constructs and obstacles. Botzen, Kunreuther, Czajkowski, & de Moel (2019) extend the PMT to explain flood preparedness decisions among New York residents who live in flood-prone areas by considering risk attitudes, time preferences, social norms, trust, and local flood risk management policies. Results reveal households living in high flood risk zones take more preparedness actions than residents of low-risk zones due to high threat appraisal. Self-efficacy, effectiveness of preparedness behavior, risk attitudes, and time preferences positively affect preparedness while the investment on preparation for flooding is negatively related with expectations of receiving federal disaster assistance.

Yoo, Lee, Yoo, & Xiao (2021) explore how the quality of the argument and the source credibility of short message disaster alerts influence the adaptive copings of individuals. The study shows the PMT constructs moderate the elaboration likelihood, that is how people process the alerts, change attitudes and consequently behavior. People with high risk and coping efficacy perceptions thoroughly think over their decision to act, that is they chose the central route. In comparison, when the threat and coping assessment are quick and fuzzy, individuals are more easily persuaded by the message and chose the *peripheral route*. Based on the empirical evidence regarding the ability of the PMT to explain disaster preparedness, the first set of research hypotheses are formulated:

H1: Higher levels of hydrometeorological hazard severity are associated with higher levels of preparedness.

H2: Higher levels of perceived vulnerability towards a hydrometeorological hazard are associated with higher levels of preparedness.

H3: Higher levels of self-efficacy to perform protective actions are associated with higher levels of preparedness.

H4: Higher levels of perceived efficacy of preparation actions towards a hydrometeorological hazard are associated with higher levels of preparedness.

Individual characteristics have been considered to explain preparedness intention. For example, Miller et al. (2013) explained individual disaster preparedness based on an extended combination of the EPPM and the vested interest theory (VIT). VIT proposes that an attitude will be a strong predictor of behavior only if it is highly vested. The concepts of salience, certainty, immediacy, and self-efficacy that the VIT incorporates predict the attitude-behavioral intention relation. Salience pertains to the perceived prominence of an attitude-object such as a natural hazard. The certainty and immediacy refer to the imminent occurrence of the event and self-efficacy to the ability to act. Individuals who have experienced the negative consequences of a disaster (increased salience) and live in an area of a high propensity toward natural disasters (increased certainty) are more likely to create vested attitudes and have stronger risk perceptions that encourage preparedness behavior (Miller et al., 2013; Terpstra, 2011).

Previous experience with hydrometeorological hazards increases preparedness depending on the nature and interpretation of the experience. Moreover, the relation

between experience, risk perceptions, and preparedness may be contingent on the number of different (direct or indirect) previous experiences, the experienced loss, and the level of concern (Becker, Paton, Johnston, Ronand, & McCluree, 2017). Bubeck et al. (2017) operationalized prior flood experience in terms of evacuation experience and found a positive relationship between hazard experience, risk perceptions, flood response efficacy, and self-efficacy. Accordingly, the following hypotheses are formulated:

H5: Prior experience with hazard events moderates the effect of risk perceptions (vulnerability and severity) on preparedness behavior.

H6: Prior experience with hazard events moderates the effect of preparation efficacy (self-efficacy and effectiveness of actions) on preparedness behavior.

Several studies conclude that the individual's economic and demographic characteristics may determine their endurance towards disasters. For example, Annear, Otani, Gao, & Keeling (2016) identified that older residents with low socioeconomic background living alone were disproportionately affected by the 2011 earthquake in Japan. Additionally, the limited access of the elder segment to information and social networks contributed to increasing its vulnerability. Studies in the USA indicate ethnic minorities, women, older adults with physical disabilities, and households with poor English proficiency and lower socioeconomic status are the most vulnerable segment to hurricanes (Cutter, Boruff, & Shirley, 2013; Zoraster, 2010). Meanwhile, Shapira et al. (2018) found that older individuals with higher socioeconomic and educational levels, married with children, and residents in private homes are more prone to perform preparedness actions in case of earthquakes. Social vulnerability is defined as "the susceptibility of social groups to the impacts of hazards such as suffering disproportionate death, injury, loss, or disruption of livelihood; as well as their resiliency, or ability to adequately recover from the impacts" (Martin, 2015, p. 53). Tapsell McCarthy, Faulkner, and Alexander (2010) reviewed the literature on social vulnerability towards natural hazards in Europe and identified research gaps in how it is assessed. Vulnerability is a complex multi-dimensional concept comprising three general dimensions: physical fragility (e.g. living in irregular settlements), socioeconomic fragility (e.g. low income), and community resilience. The socioeconomic dimension is of major interest because it refers to the societal conditions that determine the accessibility to resources to respond to disasters (Álvarez-Gordillo & Tuñón-Pablos, 2017). Minorities, children, elderly, and disabled individuals are more socially vulnerable because they tend to live in more exposed areas and do not have enough resources to anticipate, respond, resist, and recover from a disaster.

A variety of proxies have been used to measure social vulnerability, including sociodemographic (for example, income), biological (for example, disabilities), psychographic (for example, risk aversion), and socio-political (for example, public policies) indicators (García-Castro & Villerías-Salinas, 2016). Understanding how risk perceptions and coping responses to natural events, especially self-efficacy, differs between socially vulnerable groups is a research gap (Álvarez-Gordillo & Tuñón-Pablos, 2017; Bubeck et al., 2017) addressed in the subsequent hypotheses:

H7: Social vulnerability moderates the effect of risk perceptions (vulnerability and severity) on preparedness behavior.

H8: Social vulnerability moderates the effect of preparation efficacy (self-efficacy and anticipatory actions) on preparedness behavior.

Governmental authorities are expected to develop policies, mitigation strategies, make an objective assessment of the risk of natural hazards and inform communities under threat, instruct the population about how to act, perform disaster relief operations, and provide the governance and financial support to re-establish public services, economic, and social activities. Extant research suggests that individuals will likely rely on the government for preparedness planning, especially when they lack knowledge about coping with a hazard (Col, 2007). Terpstra (2011) concludes that citizens that trust public flood protection actions have lower risk perceptions and less proclivity to take preemptive measures. DeYoung (2014) explored the effect of confidence in the disaster management capabilities of local government on preparedness. Results suggest a complex relationship between confidence in government and preparedness because of the suppressor effect of overconfidence in government on self-efficacy. Then, the last research hypotheses are formulated as follows:

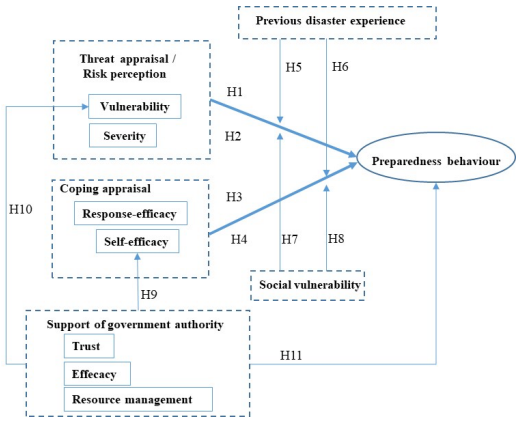
H9: Confidence/trust in government support has an indirect effect on disaster preparedness mediated by self-efficacy. High levels of confidence/trust in government support reduce the perceived self-efficacy of households.

H10: Confidence/trust in government support has an indirect effect on disaster preparedness mediated by vulnerability. High levels of confidence/trust in government support reduces the perceived vulnerability towards a hazard.

H11: Confidence/trust in government support has a direct negative effect on preparedness behavior.

The research hypotheses are integrated into the model of Figure 1.

Figure 1. Conceptual model. Source: Own elaboration.



Materials and methods

Exploratory research was used to provide a better understanding of how social vulnerabilities and expectations of government assistance modify the appraisal and coping processes. Thus, the results of the study will enable to set a stronger model that includes only the critical variables.

The measurement instrument consists of validated scales designed to assess the theoretical constructs of the model of Figure 1. Most of the scales were adapted from Kievik and Gutteling (2011), Miller et al. (2013), and Lin, Shaw, and Ho (2007) and modified according to the socioeconomic profile of the people who participated in the study. The scales were translated to Spanish and back-translated to ensure their original meaning was not lost.

The structured questionnaire has seven sections. The items of five of sections (A-D and G) are in a five-point Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree. Thus, low values on the scale indicate high levels of the construct. Table 1 details the number of items comprising the multi-scales and the references used to design them.

Table 1. *Description of the structured questionnaire used for data collection*

Section	Construct	Number of items	References used to design the multi-scale
A	Self-efficacy	8	DeYoung (2014), Kievik and Gutteling (2011), Miceli et al. (2008).
B	Effectiveness of responses	6	DeYoung (2014), Miller et al. (2013),
C	Severity or prominence of event risk	8	Lin et al. (2007), Miceli et al. (2008), Miller et al. (2013)
D	Vulnerability or hazard-susceptibility	8	Lin et al. (2007), Miceli, et al. (2008).
E	Social vulnerability	11	Cutter, Boruff, and Shirley (2003), Cutter et al. (2013), Martin (2015), Rufat et al. (2015).
F	Preparedness	9	DeYoung (2014), Lin et al. (2007), Terpstra (2011).

G	Government support	8	Lin et al. (2007), Terpstra (2011), Wei, Sim, and Han (2019).

Source: Own elaboration

Trust on government support includes three components (Terpstra, 2011): perceived competence or expertise of government in disaster management based on past interventions, perceptions that enough resources are assigned to assist the affected region, and general trust on the Mexican governmental institutions responsible of disaster management (Secretaría de la Defensa Nacional [SEDENA], Secretaría de Marina, Guardia Nacional, Protección Civil, Centro Nacional de Prevención de Desastres [CENAPRED]). Sections E and F use dichotomous scales with options Yes or No; for example, if the household has a family's survival emergency kit. The social vulnerability multi-scale (E) was mainly based on the Social Determinants of Vulnerability Framework developed by Martin (2015). The multi-scale includes eight pre-incident socioeconomic factors at the household level: family with small children ($\leq$ 5 years) and old adults (> 65 years old), family members with disabilities, chronic or acute medical illness, single-women household, low income, low educational level, and lack of a vehicle. The three post-incident items include lack of access to health services, loss of employment, and insufficient funds for recovery.

Preparedness behaviors may vary depending on the time, place, and type of natural hazard, but in general they include two elements: preparing an emergency kit and making an emergency plan (Ng, 2022). The emergency kit is a package of items for survival including food, water, and first-aid supplies while the emergency plan refers to practices for handling unexpected situations such as knowing what the warning and emergency signals for the community are (e.g. emergency alert system broadcasts), identification of meeting points, shelters, and evacuation routes. A third element related to property safeguarding (strengthening residential structures, protecting windows and doors) was also considered.

Hurricanes and cyclones hit Mexico's Pacific coast each year, causing recurrent floods, economic losses, and human damages. The states of Michoacán and Oaxaca are continuously affected by these events that sometimes require evacuating the area severely affecting the residents and business activities. For example, the interruption of the economic activities of the Port of Lazaro Cárdenas, one of the most important Mexican ports located in the state of Michoacán, and the damage to its facilities due to a natural event represents economic losses of approximately USD $300 million (De León and Loza, 2019). Additionally, the tourism in Mexico which accounts for 8.5% of GDP (Statista, 2022) is one of the main economic activities in the coastal areas of the state of Oaxaca that accounts for approximately two thirds of the economic income of the state and considerably contributes to its socioeconomic development (H. Congreso del Estado Libre y Soberano de Oaxaca, 2020). These data put forward the significant

negative effects the hydrometeorological hazards have on the economy of both states and the welfare of their inhabitants. Accordingly, it looks appropriate to empirically test the conceptual model of Figure 1 using survey data from households of these two states.

Students enrolled in two major public universities located in the coastal area of these two states were invited by their professors to ask their families to answer the survey, after providing a short verbal explanation of the research project. The survey was posted online using Google Forms and students asked to invite and assist their parents to answer the survey using their cell phones or computers. A video of about 2 minutes long was included at the beginning of the survey to explain the purpose of the research project, invite households to participate, and assure anonymity. A total of 181 complete and usable questionnaires responded by the head of the family were obtained after two months. The data were downloaded to an Excel file and analyzed with SmarPLS software, Professional version 3.

Results

The PLS-SEM technique was selected because of the method's flexibility and the objective of the research, predicting preparedness which is the outcome of all the psychographic constructs (Hair et al., 2019). Following the assessment process of a reflective measurement model, the indicator loadings were first examined (Hair et al., 2019). Most of them were greater than the recommended 0.5 bound, indicating that the constructs explain more than 30% of the indicator's variance. Indicators with non-significant loadings and below the 0.55 threshold were eliminated to purify the scales.

The next step of the model assessment process was analyzing the internal consistency of the measures. The Cronbach alpha value reported in the first column of Table 2 is above 0.7 for all constructs except by the preparation behaviors. However, this could be a result of the use of dichotomous items on the scale. Composite reliability (CR), an alternative and less biased reliability measure, was also computed. All indexes were between the recommended limits of 0.7 and 0.9. The values of the average variance extracted (AVE) were above the acceptable 0.5 bound except again by preparedness (Hair et al., 2019). The CR and AVE values reported in Table 2 support the convergent validity of the measurement model.

Table 2. *Reliability indexes*

	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Self-efficacy	0.850	0.882	0.495
Response-efficacy	0.871	0.898	0.596
Government-authority	0.876	0.902	0.537

Preparedness behaviour	0.631	0.722	0.428
Severity	0.735	0.755	0.501
Vulnerability	0.874	0.888	0.502

Source: Own elaboration.

The discriminant validity of the measurement model was assessed through the heterotrait-monotrait ratio (HTMT). According to the HTMT criterion, values smaller than one indicate that the two constructs' true correlation differs. Bootstrapping (n = 5000) was used to build confidence intervals. None of the intervals included 1, thus providing evidence of discriminant validity.

Once the measurement model's assessment was completed, the conceptual model of Figure 1 was evaluated. First, the Variance Inflationary Factors (VIF) were examined to assure there is no bias in the regression results; all VIF' were highly satisfactory (VIF <2). The standard criteria for evaluating the structural model include the coefficient of determination (R^2), the blindfolding-based cross-validated redundancy measure Q^2, the residual mean square root (SRMR), and the statistical significance of the path coefficients. The R^2 range from 52.5 per cent to 72.8 per cent depending on the groups (high/low vulnerability, experienced/non-experienced previous disasters), which indicates the model has a moderate to high prediction power on the preparedness-behaviour of households of coastal areas. The Q^2 combines in-sample explanatory power and out-of-sample prediction after removing data points for all variables. Q^2 for the fundamental endogenous construct of preparedness ranged from 0.004 to 0.041 depending on the group. These values indicate a "small" effect size but support the predictive relevance of the PLS-SEM model. The RMSR = 0.087 was below the recommended bound of 0.1, thus supporting the good fit of the model.

Finally, the significance of the path coefficients was determined by using full bootstrapping (n=5000 samples). A multigroup analysis was applied to empirically test the moderating effect of social vulnerability and previous disaster experience on the relations between the PMT constructs and preparedness (hypotheses H5-H8). Table 3 shows the multigroup results; the bold font is used to identify coefficients significant at least at the 10% significance level.

Table 3. *Results of the bootstrapping of the Multigroup Analysis*

	Path Coefficients			
Relation	Non-socially vulnerable segment/ non-	Non-socially vulnerable segment/	Socially vulnerable segment/	Socially vulnerable segment/

	experienced (n=51)	Experienced (n=29)	non-experienced (n=72)	Experienced (n=29)
Severity -> Preparedness	-0.49 (P = 0.200)	-0.481 (P = 0.275)	-0.150 (P = 0.697)	1.043 (P = 0.174)
Vulnerability -> Preparedness	-0.42 (P = 0.254)	0.034 (P = 0.893)	**-0.413** (P = 0.100)	-0.135 (P = 0.672)
Self-efficacy -> Preparedness	-0.04 (P = 0.864)	-0.299 (P = 0.252)	-0.279 (P = 0.221)	**-0.855** (P = 0.099)
Response-efficacy -> Preparedness	0.166 (P = 0.551)	0.031 (P = 0.852)	0.324 (P = 0.163)	0.000 (P = 0.997)
Government-authority -> Self-efficacy	0.245 (P = 0.353)	0.373 (P = 0.175)	**0.364** (P = 0.013)	**0.552** (P = 000)
Government-authority -> Preparedness	0.022 (P = 0.930)	-0.17 (P = 0.513)	-0.007 (P = 0.972)	0.011 (P = 0.973)
Government-authority -> Vulnerability	0.349 (P = 0.447)	0.439 (P = 0.423)	0.069 (P = 0.77)	0.499 (P = 0.135)

Source: Own elaboration.

According to the entries of Table 3, after the sample is stratified by previous disaster experience and social vulnerability, the only significant coefficients correspond to the socially vulnerable groups. There are also differences between the significant paths depending on the previous exposition of socially vulnerable respondents to disasters as proposed by H5 and H6. The preparedness behavior of the non-socially vulnerable segment is not explained by the PMT constructs, previous experience with a disaster, or the confidence in the government humanitarian support. Therefore, the moderator effect of social vulnerability and disaster experience on the relationship between PMT constructs and preparedness is supported.

The comparison of the low versus high socially vulnerable segments shown in Table 4 indicates the percentage of socially vulnerable individuals who have taken disaster preparedness actions is greater than the corresponding percentage of non-socially vulnerable people, as well as the mean confidence in government humanitarian aid (mean socially vulnerable group = 2.88, mean of the non-socially vulnerable group = 3.12, t-Student = -1.9, P = 0.03). This unexpected result may be explained in terms of

resources available to acquire the supplies/services required during and after the emergency, the family's mobility, and the own coping and adaptive capacities of less vulnerable households that result in a minor demand for governmental assistance in comparison with the socially vulnerable segment (Rufat, Tate, Burton, & Maroof, 2015; World Health Organization [WHO] Europe Regional Office, 2002).

Table 4. *Comparison of socially vulnerable segments according to the adoption of disaster preventive practices*

Behaviour	Low social vulnerability (%)	High social vulnerability (%)	Total of individuals (%)	Chi-square (P)
Emergency flashlight and extra batteries	55.00	69.31	62.98	**3.919 (P = 0.048)**
First aid kit	31.25	38.61	35.36	1.059 (P = 0.303)
Portable stove, can opener and other basic kitchen tools	20.00	32.67	27.07	**3.632 (P = 0.057)**
Pack with basic medicines	77.50	77.23	77.35	0.002 (P = 0.965)
At least 3-day supply of non-perishable food	42.50	52.48	48.07	1.779 (P = 0.182)
Cell phone with chargers and a backup battery	22.50	28.71	25.97	0.896 (P = 0.344)
At least 3-day supply (per person) of water	20.00	23.71	22.10	0.367 (P = 0.545)
Preparation of house to hurricanes	21.25	43.56	33.70	**9.948 (P = 0.002)**
Fire extinguisher, wrench, and pliers	5.00	11.88	8.84	**2.623 (P = 0.105)**
Identification of safe meeting points (for example shelters and relative's houses)	16.57	37.62	37.57	000 (P = 0.986)

Source: Own elaboration.

The PMT proposes the threat appraisal is a crucial determinant of protection motivation. However, several studies on flood mitigation fail to confirm this relationship, find a weak or even negative relationship between perceived disaster risk and preparedness (Bubeck, Botzen, & Aerts, 2012). Results about the effect of a specific component of risk perception, vulnerability, on protection intentions are also contradictory (Rufat et al., 2015). In this research, vulnerability positive and significantly affects the preparedness

actions of socially vulnerable individuals who have not experienced a hydrometeorological disaster (low values on the scale indicate high vulnerability while high scores on preparedness imply more preparation actions are adopted, that is why the path coefficient is negative). In contrast, individuals who previously experienced floods (t-Student = 3.1, P = 0.000 for the difference between residence means = 3.6 years) seem to underestimate their vulnerability toward floods maybe because they have longer times of residence in the region and have experienced only mild events (Rufat et al., 2015; Wei et al., 2019).

For the sub-segment of disaster-experienced socially vulnerable individuals, the construct that positively influences preparedness is self-efficacy; the higher the perceived self-efficacy, the larger the number of protective actions taken. This result suggests that people who have faced the consequences of a hazard go through a gradual process of self-assurance that decreases their risk perceptions but makes them recognize that their own efforts, preparation, and abilities can protect them from future harm (Babcicky & Seebauer, 2019). However, the relationship between disaster experience and risk depends on the severity of the experienced damage, and none of the respondents reported suffering excessive losses or severe injuries (Ohman, 2017). Therefore, an interesting extension to this research is to segment socially vulnerable individuals according to their previous hazard experiences and explore how risk perceptions vary accordingly with the severity of the experience.

Finally, the results of Table 3 indicate that the perceived self-efficacy to execute disaster preventive actions among socially vulnerable individuals is negatively affected by their confidence in government support. This effect is highly significant for the two socially vulnerable sub-segments, individuals who have experienced or not the effect of a hydrometeorological disaster. Contrary to studies that conclude community's expectations in government support, trust in public flood planning and infrastructure protection negatively affect preparedness intentions, in this research the confidence in authorities' disaster support had no direct or indirect effect on individual preparedness (Basolo et al., 2009; Terpstra, 2011).

More recent research (Wei et al., 2019) shows that a higher degree of confidence in authorities increases the likelihood to perform preparedness actions, but not necessarily the actual demonstration of each behavior. Then, a possible explanation of our findings is that we explicitly ask participants if they have already taken preparedness actions. Table 5 summarizes results regarding the empirical support to the relationships proposed in the research hypotheses.

Table 5. *Summary of hypotheses testing results*

Research hypothesis	Proposed relationship	Results
H1	Severity (event risk prominence) → Preparedness	Unsupported

H2	Vulnerability (hazard-susceptibility) → Preparedness	Partially supported. Weak support (P = .100) only for the socially vulnerable non-experienced segment
H3	Self-efficacy → Preparedness	Partially supported. Weak support (P = .101) only for socially vulnerable experienced segment
H4	Efficiency of preemptive actions → Preparedness	Unsupported
H5	Disaster experience moderates the relationship of risk perceptions on preparedness	Partially supported. Socially vulnerable individuals without disaster experience perceived as more vulnerable.
H6	Disaster experience moderates the relationship of preemptive actions' efficacy on preparedness	Partially supported. Socially vulnerable individuals with disaster experience have stronger self-efficacy perceptions.
H7	Social vulnerability moderates the relationship of risk perceptions on preparedness	Partially supported. Only the vulnerability component of risk perceptions influences the preparedness of the socially vulnerable segment.
H8	Social vulnerability moderates the relationship of self-efficacy on preparedness	Supported
H9	Confidence in government support indirectly affects preparedness via self-efficacy.	Supported
H10	Confidence in government support indirectly affects preparedness via vulnerability.	Unsupported
H11	Confidence in government support → Preparedness	Unsupported

Source: Own elaboration.

The main limitation of the results is that they are based on a small sample size comprising only residents of two coastal counties. Despite this limitation, the study offers important insights about how to modify the conceptual model of Figure 1 to improve household preparedness to reduce the adverse effects of hydrometeorological events on individuals, economic activities, and public expenditure on humanitarian aid.

Babcicky and Seebauer (2019) propose that the dependence on public flood protection qualifies as a non-protective response rather than a determinant of protective behavior. By applying the PMT they conclude that two separate paths emerge: a protective route from coping appraisal to flood preparedness behaviors and a non-protective route from threat appraisal to the non-protective response. Although self-efficacy was not considered by Babcicky and Seebauer (2019) as a component of the coping appraisal process, their research suggests self-efficacy leads to preparedness but only for socially vulnerable individuals who have previously experienced the effects of a flood. The comparison between the groups that have experienced, or not previous hazards agrees with the proposal of Babcicky and Seebauer (2019) about two protection behavioral routes. This work suggests the protective route is selected by individuals who have experienced a hydrometeorological hazard while individuals without the experience follow the non-protective route. Therefore, another extension to this study is to explore how the protective and non-protective routes function but considering that overconfidence in governmental support can transfer to public organizations the responsibility of taking preparedness actions among socially vulnerable individuals.

Results indicate that less socially vulnerable individuals are less likely to adopt preparedness practices and have lower confidence in governmental humanitarian assistance. These results may be explained in terms of resource availability (economic, external aid, disaster management knowledge) and capabilities to respond to a disaster's consequences without public assistance.

Finally, authors such as Cohen et al. (2013) argue that preparedness is more related to local leadership and authority than to federal disaster programs. Assessing the effect of trust/confidence of local authorities on preparedness for a representative sample of disaster-prone individuals is another extension of this exploratory research.

Conclusions

Mexico is a developing country with a large coastal area hit by hurricanes and cyclones yearly, causing mild to severe floods. These circumstances make it necessary to increase the resilience of shore regions through several actions, among them increasing household preparedness. This work contributes to the disaster management literature by providing insights about how the variables -social vulnerability, previous experience with a hydrometeorological warning, and confidence in government's support- indirectly influence household preparedness by modifying the risk perceptions and the perceived self-efficacy of endorsing a coping response. The number of studies that have jointly explored the effect of the previously cited factors and the PMT constructs on preparedness behavior in developing countries is limited. Therefore, this work adds to

the understanding of how to influence the preparedness practices of residents of disaster-prone regions in Mexico to reduce public expending on humanitarian aid and the cost of the disruption of the economic activities in areas affected by hydrometeorological events.

Several recommendations can be proposed based on this research. First, education and communication on preparedness must be part of the government risk disaster strategy. According to the survey, most of the participants were unaware if authorities organize meetings to instruct the community about how to proceed in case of a disaster. Second, disaster-prone communities need to collaborate with authorities to increase their resilience. Government authorities must demonstrate leadership to strengthen the community protective capabilities and resources. Third, the self-efficacy of socially vulnerable individuals must be increased to encourage individuals to take the protective route.

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