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Review Article

Toward a Comprehensive Behavioral Model of Hurricane Preparedness: The Protective Behavior Model

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Although literature regarding hurricanes and human behavior has been growing, there is generally a paucity of research that considers comprehensive behavioral models in a severe weather hazards context, and the question of "why do some people choose to take hurricane preparedness actions, while others do not?" remains answered only in part. With regard to explaining and predicting human behaviors, it is common in disaster studies to use generic models developed for other purposes in another field. Not having a specific model built for a particular set of protective behaviors is problematic as it overlooks many critical factors that influence people's intention to prepare for hurricanes. Consequently, the recommendations built on such incomplete models should also be questioned. This paper introduces a new comprehensive behavioral model, The Protective Behavior Model (PBM), which explains why people choose to engage in hurricane preparedness behaviors using constructs from 23 different theories in human behavior. After the PBM was initially constructed based on the review of critical literature, a Subject Matter Expert's Validation was conducted, where five expert scholars in the field agreed to review the model and make recommendations to improve it. The review process was done through multiple rounds of comments and alteration of the model until the experts were satisfied with the final model.

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1. Introduction

In a workshop organized by the National Research Council of the National Academies, they outlined the main research gaps concerning emergencies and public response. The first two gaps were warning dissemination and individual's behavior[1]. The common practice in disaster studies with regard to explaining and predicting human behaviors is to use one of the generic models or frameworks that were developed for other purposes in another field[2][3][4]. Not having a specific model that is built for a specific set of protective behaviors is problematic as it overlooks many important factors that influence people's intention to prepare. Consequently, the conclusions and recommendations built on such incomplete models should also be questioned[3][4][5]. FEMA has previously suggested that such theoretical gaps in disaster research can be a result of a complex interaction between psychological and socioeconomic factors influencing peoples' decisions to prepare[6].

In order to integrate human behavior into emergency planning in hurricane-prone areas, many studies were conducted to improve our understanding of the factors affecting people's decisions to prepare for hurricanes[2].

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[4][7][8]. In spite of the fact that literature regarding hurricanes and human behavior has been growing, there is generally a paucity of research that considers comprehensive behavioral models in a severe weather hazards context, and the question of "why do some people choose to take hurricane preparedness actions, while others do not?" remains answered only in part. Consequently, this paper is trying to fill this research gap by reviewing theories in psychology and integrating elements from 23 different theories in human behavior in one comprehensive behavioral model, The Protective Behavior Model (PBM), which explains why people choose to engage in hurricane preparedness behaviors. In this paper, we start with a critical review of literature for theories in human behavior, then we introduce the new behavioral model (PBM), and we end by explaining the guidelines for using it and reflecting on its limitations.

2. Literature review

2.1. Protective behaviors theories

The majority of theories in psychology that focused on protective behaviors were developed in a health care context, such as the Health Belief Model (HBM). This suggests that protective behavior is a function of perceived threat and outcome expectancy. In the HBM, perceived threat is a combination of two constructs; 1) Perceived susceptibility, a subjective assessment of risk likelihood, and 2) Perceived severity, a subjective assessment of risk severity and its potential consequences. Similarly, outcome expectancy consists also of two constructs; 1) perceived benefits, the personal assessment of the value of engaging in a protective behavior, and 2) perceived barriers, the personal assessment of obstacles to behavioral change. According to the HBM, perceived threat and outcome expectancy build on three main types of modifying variables; 1) Demographic variables such as age, gender, and ethnicity, 2) Psychosocial variables such as mood and personality, and 3) Structural variables such as knowledge and prior contact with the risk. In addition, The HBM presupposes that a cue or a trigger, such as receiving information from friends or media, might be necessary in some situations for engagement in a protective behavior. The model was modified later and self-efficacy was added as a contributing factor in the model after the emerging evidence in the fields of sociology and psychology about the self-efficacy role in behavior and decision-making[9].

Self-Efficacy is a theory developed by Albert Bandura in 1977, and it became the center of his social cognitive theory. Bandura distinguished two main types of goal-oriented expectations: self-efficacy and outcome expectancy. He defined self-efficacy as our belief in our own ability to accomplish a task or succeed in a specific situation, and he defined outcome expectancy as our estimation that a certain behavior will lead to specific outcomes. The beliefs that people hold regarding their power to make a change, strongly influence both their actual power to face a challenge, and the choice they are most probably to make. Bandura advanced the view that goal-oriented expectations are the most important preconditions for behavioral change, and they are the key to the initiation of coping behaviors[10].

Another well-known theory that had a major advantage over the HBM, as it looked into intention instead of actual behavior, was the Protection Motivation Theory (PMT). This theory was introduced by Dr. Rogers in 1975 to help clarify and explain the mechanisms of fear appeals. In his theory, Dr. Rogers proposes that people tend to protect themselves building on two appraisals; threat appraisal and coping appraisal. While threat appraisal has two components; the perceived severity of the event/threat, and the perceived occurrence probability of the event/threat, the coping appraisal had only one component; the perceived efficacy of a recommended preventive behavior or coping response. Dr. Rogers explains the coping appraisal as peoples' expectancy that following the recommended actions can actually solve or remove the threat[11]. In 1983, Dr. Rogers modified his theory and made it more comprehensive by merging it with the self-efficacy theory. Dr. Rogers added self-efficacy as a second component to the coping appraisal in his theory, and he believed that it was a very valuable addition because self-efficacy affects almost every area of our endeavors. After testing his new addition to the theory, Dr. Rogers found that the new component significantly influences peoples' intentions for adopting recommended coping behaviors. Moreover, he found that self-efficacy influences two other components of PMT; probability of occurrence, and efficacy of coping response[12].

A few years later, Kim Witte developed another framework, the Extended Parallel Process Model (EPPM), which attempts to predict how people react to fear and risk. Witte based her model on PMT and Dr. Roger's work on fear appeals. Witte argues that for a fear-framed campaign to be successful, it should trigger a moderate to a high amount of fear but a higher amount of response efficacy and self-efficacy. When efficacy is less than fear, research has proved that

communication is usually found ineffective. The EPPM defines four main inputs to predict the possible outcome of fear appeal communications; Self-Efficacy, Response Efficacy, Susceptibility, and Severity. These are the same factors used in Roger's protection motivation theory. Based on these four inputs, the EPPM predicts three main possible outcomes. First, Danger Control: when people perceive high severity and susceptibility of a threat, and perceive high self-efficacy and response efficacy, they most likely act to control the threat. Second, Fear Control: when people perceive low self-efficacy and response efficacy, even when they perceive high severity and susceptibility of a threat, they most likely act to control their fear. Responses of fear control are a maladaptive coping mechanism that reduces fear through defensive avoidance and psychological reactance, such as denial and surrender. Third, No Response: when people perceive low severity and susceptibility of a threat, most likely they will not act, even if they have high self-efficacy and response efficacy[13].

Building on the EPPM, Rajiv Rimal and Kevin Real introduced the Risk Perception Attitude framework (RPAF) in 2003. The RPAF is a conceptual segmentation approach that explains how to communicate about risk. Similar to the EPPM, the RPAF considered the influence of four main factors; perceived severity, perceived susceptibility, response efficacy, and self-efficacy. The new addition that Rimal and Real added in their model is that they classified people into four groups, based on the level of efficacy beliefs and perceived risk. Each of the four groups is hypothesized to be different from the other ones in terms of their behavioral and affective responses to risk[14]. First, the responsive group (high efficacy, high risk): people who engage in self-protective behaviors. Second, the avoidance group (high risk, low efficacy): people who are less motivated to engage in self-protective behaviors and experience conflicted feelings. Third, the proactive group (low risk, high efficacy): people driven by perceived risk and occasionally display an interest in engaging in such self-protective behaviors. Fourth, the indifference group (low risk, low efficacy): people who think they are not at risk and have low confidence in their own ability, and so, they are less likely to take any protective actions. Since the introduction of RPAF in 2003, there have been many other frameworks and models that looked into protective behaviors, such as the Protective Action Decision Model (PADM)[15]. Even though these newer might have different structures, they are still built on the same core elements, which are risk perception and efficacy.

2.2. Relevant concepts in other human behavior theories

Surprisingly, many of the theories in human behavior were not developed by psychologists, but economists. For example, in the 19th century, a group of economists developed a very well-known theory in human behavior called the Rational Choice Theory (RCT). Early economists writing about rationality, including William Stanley Jevons in 1860s, assumed that people make consumption choices to maximize their utility or happiness. RCT assumes that people will perform a cost-benefit analysis in order to determine which option is right for them. The concept of rationality RCT is different from everyday use of the word. We usually refer to a 'rational' behavior as sensible, thoughtful, logical, or predictable. RCT uses a more narrow definition; behavior is considered rational if it is self-driven, goal-oriented, consistent across different situations, and reflective or evaluative[16].

Building on RCT, Leon Festinger introduced the Cognitive Dissonance Theory (CDT) in 1957. In his theory, Festinger suggests that getting people to adopt or stop a particular behavior will trigger a state of information seeking in order to justify the behavioral change. This aims to eliminate any psychological discomfort triggered by the new information perceived clashing with the person's belief. According to CDT, when we experience internal inconsistency, we become psychologically uncomfortable, which motivates us to reduce that cognitive dissonance. We strive internally for psychological consistency to have normal mental functionality. When we have two ideas or actions that are not consistent with each other on a psychological level, we do anything to make them consistent, and this usually comes in the form of rationalization or confirmation bias[17].

Another theory that was researched by economists in late 19th century is Diffusion of Innovations (DOI), which seeks to explain why and how new ideas spread. The theory proposes that diffusion is a communication process that happens over time among different people within the same social system, where the new idea needs to be widely adopted to self-sustain. According to DOI, there are five categories of people; innovators, early-adopters, early-majority, late-majority, and laggards. The theory was popularized by a professor of communication studies, Everett Rogers, who wrote about it in his book that was first published in 1962[18]. Rogers's book inspired James Prochaska to develop an integrative theory in the 1970s called Stages of Change (SOC), also known as the transtheoretical model. SOC

grew particularly from the stages of the adoption process in the DOI. SOC looks at the behavioral change process as a cycle involving progress through a chain of stages with continuous feedback. In his theory, Prochaska breaks down behavioral change into three integrative levels: stages of change at the highest level, processes of change in the middle, and levels of change at the lowest level[19].

Around the same time, Bandura and Walters introduced another theory concerned with diffusion of behavior, the Social Learning Theory (SLT). SLT integrated cognitive and behavioral models to provide a comprehensive theory accounting for a wide range of learning experiences. SLT proposes that new behavior can be acquired by imitating and observing others. According to Bandura, learning is a cognitive process taking place in a social context, and it can occur purely through direct instruction or observation, even in the absence of direct reinforcement or motor reproduction. In addition, SLT proposes that learning can also occur through vicarious reinforcement, which is the observation of punishments and rewards[20]. Simultaneously, Bandura was working on another theory called the Self-Regulation Theory (SRT). Bandura, Dale Schunk, and Roy Baumeister are considered the main contributors to the SRT. According to the theory, self-regulation consists of three main elements stages; self-monitoring, setting realistic goals, and modification. SRT proposes that a person deliberately monitors his/her own behavior and evaluates what effect it has of them. If the desired or targeted effect is realized, the person continues with same the behavior, but if the desired or targeted effect is not realized, the person changes that behavior[21].

In the 1970s, many scholars were looking into the role that motivation played in human behavior, trying to determine the degree to which human behaviors are self-determined and self-motivated. They categorized motives into two main types; intrinsic and extrinsic motives. If the behaviors are desired because they are inherently enjoyable or exciting, then the motives behind these behaviors are described as intrinsic motives. But if the goal behind a particular behavior is an external reward that is distinct from the behavior itself, then the motives behind that behavior are described as extrinsic motives. This was the core of the Self-Determination Theory (SDT), which was formally introduced for the first time as an empirical theory in the mid-1980s[22].

Shalom Schwartz was another scholar that looked into internal motivations. Schwartz developed the Norm Activation theory (NAT) to explain altruistic behaviors such as volunteering and other pro-social behaviors. According to Schwartz, altruistic behaviors are influenced by various feelings of moral obligation to follow personally held norms. Personal norms are activated by the awareness of consequences and the acceptance of responsibility, which in turn activates behavioral intentions that directly correlates to the actual behavior[23]. Building on Schwartz's work, Florian Kaiser and Todd Shimoda introduced the Responsibility Theory to differentiate between the different kinds of responsibility and explain how they influence behavior. According to the responsibility theory, there are two main types of responsibility feelings: First, conventional responsibility feelings, which are based on the social expectations, such as social approval and fear of atonement, the readiness and willingness to fulfill these expectations. And the second type is moral responsibility feelings, which are built on guilt and personal moral obligation[24].

In the mid-1980s, Richard Petty and John Cacioppo introduced a very important psychological model with a well-defined structure called the Elaboration Likelihood Model (ELM). According to the model, when someone encounters a form of communication, he/she will process this communication with different levels of elaboration, where the likelihood of elaboration is determined by their motivation, presented opportunities, and ability to evaluate the communication and the argument within. The ELM proposes two main elaboration routes: First, the central route, where persuasion results from thoughtful and careful consideration of the actual merits of the available information. And second is peripheral route, where persuasion results from making a simple inference about the merits of information presented, taking less logical factors in making the final decision, such as production quality of advertisement or attractiveness of the message sources[25]. Building on ELM and Bandura's theory of self-efficacy, Charles Snyder introduced his Hope theory. In his theory, Snyder considers goals as abstract mental targets guiding human behaviors, and he emphasizes goal-oriented thinking, where an individual uses pathways thinking and agency thinking to reach a particular goal. Pathways thinking refers to the ability to identify several routes or strategies for goal achievement, while agency thinking refers to the motivation and perceived capacity of using those routes[26].

Another theory with a well-defined structure that became one of the most popular theories in human behavior is Theory of Planned Behavior (TPB) by Icek

Ajzen. The theory proposes that three core components shape our behavioral intentions; attitude, subjective norms, and perceived behavioral control. The purpose of TPB was to improve the predictive power of the original theory; Theory of Reasoned Action (TRA), which was introduced by Martin Fishbein and Ajzen in 1980. According to TRA, if a person evaluates a certain behavior as positive (the attitude component), and if he/she believes that important people in their life want them to perform that behavior (the subjective norm component), the intention to perform the behavior becomes greater and they will be more likely to do it[27]. Since behavioral intention does not necessarily lead to actual behavior, Ajzen believed that behavioral intention should not be the exclusive determinant of our behaviors, especially that our control over behaviors is incomplete. As a result, Ajzen improved the predictability of TRA by adding a new component, the perceived behavioral control, which grew out of Bandura's theory of self-efficacy. The perceived behavioral control suggests that we are more likely to intend to do something when we feel that we can do it successfully. According to TPB, the formation of behavioral intentions is guided by three types of beliefs: behavioral, normative, and control beliefs. Behavioral beliefs produce a negative or positive attitude toward a certain behavior, subjective norms result from normative beliefs, and control beliefs produce the perceived behavioral control. Consequently, when someone has enough actual control over that particular behavior, he/she is expected to carry out their intention when the opportunity arises[28].

Unlike TPB and ELM, many well-known theories in human behavior did not necessarily have a well-defined structure, such as theory of Significant Life Experiences (SLE), the Knowledge Deficit Model (KDM), and the Effects of Direct and Indirect Experience Theory. In 1980, Thomas Tanner introduced SLE to explain human behavior and identify the development of values. SLE proposes that we have impactful experiences that lead us toward certain outcomes by supporting a cohesive life narrative. According to Tanner, when adults were asked to reflect on paths they have taken to where they are currently in life, their responses often involved a recounting of life experiences that had a special impact on them[29]. Also in the 1980s, the KDM was proposed by social scientists researching science communication. KDM is based on two assumptions; 1) the peoples' skepticism and uncertainty towards a certain idea are caused foremost by a lack of adequate knowledge about that idea, 2) providing sufficient information to overcome this knowledge deficit, peoples' opinion will change, as well as their behavior[30]. Around a decade later, Murray Millar and Karen Millar published a theory, the Effects of Direct and Indirect Experience, which looks into the relationship between attitudes and behavior. Based on the theory, direct experiences produce stronger attitude evaluation than indirect experiences, and the stronger the attitudes are, the greater predictive power they have, especially when they are more accessible from memory, which makes them strong influencers on behavior[31].

Instead of developing a new theory, some scholars tried to combine numerous theories together in order to achieve one comprehensive framework that can better predict and explain human behaviors. For example, Paul Stern developed an explanatory theory of a variety of behavioral indicators that builds on other theories, including value theory, responsibility theory, and norm-activation theory, and he named it value-belief-norm (VBN) theory. The VBN theory proposes that behavior is built on a chain of variables: personal values, general beliefs, and personal norms. According to Stern, values such as altruism and selfishness influence behavior via beliefs and personal norms, where beliefs have three components; worldview, awareness of consequences, and sense of responsibility, while personal norms are represented by a sense of obligation to take action[32].

3. Protective Behavior Model (PBM)

Hurricane preparedness is a set of protective actions taken by a person or a group which increases their ability to efficiently respond to hurricanes[33][34]. This set of protective actions can be divided into two main types; first, protective actions meant to be taken at the beginning of the hurricane season, such as preparing an emergency supply kit, having an evacuation plan, or developing a communication plan. Second, protective actions meant to be taken when a hurricane is approaching, such as fueling vehicles and generators, boarding up windows, removing or securing outdoor items including lawn furniture, potted plants, grills, etc. [35][36]. The PBM is built to explain each one of these behaviors individually.

In the PBM, the chart flows from left to right (see Figure 1). According to the SOC theory, behaviors go through multiple stages that feedback to each other[19]. This was integrated into the PBM which has three distinct stages. The first stage starts from the person's *Background*, which is divided into three main components; *Psychological Characteristics* (Construct 1), *Demographic*

Characteristics (Construct 2), and *Significant Life Experiences* (Construct 3). The last one refers to the person's previous experiences with severe weather hazards, such as surviving a severe storm or losing a beloved one in a hurricane. Construct 1 & 2 were integrated from HBM[9], and Construct 3 was integrated from the SLE theory[29].

The person's background then shapes their *Values and Beliefs* (Construct 4), which shapes in return a set of perceptions towards a specific severe weather hazard such as hurricanes. Construct 4 was integrated from the VBN theory[32]. The first critical perception that affects a person's protective behavior is the *Risk Perception*. In the PBM, the risk perception is divided into two constructs; 1) *Severity of the Threat* (Construct 5), also known in other theories as perceived severity, which refers to a subjective assessment of hurricane severity and its potential consequences, and 2) *Probability of the Threat* (Construct 6), which can be found in other theories under perceived susceptibility, referring to a subjective assessment of the likelihood for a hurricane event. Construct 5 & 6 were integrated from several theories built on risk perception, including PMT, EPPM, RPAF[11][13][14].

The second critical perception that influences a person's protective behavior is their sense of *Responsibility*, which is also divided into two constructs; 1) *Moral Responsibility* (Construct 7), which are built on guilt and personal moral obligation to take hurricane preparedness actions, and 2) *Conventional Responsibility* (Construct 8), which relates to our social image and driven by the desire to be perceived by others as a responsible person when taking hurricane preparedness actions. Construct 7 and 8 were integrated from NAT and the responsibility theory[23][24], but also they relate to SDT[22]; moral responsibility can be seen as an intrinsic motive, while conventional responsibility is more of an extrinsic one. And this is the end of the first stage of the PBM.

Our values and beliefs shape the first construct in the second stage of the PBM, *Subject Norms* (Construct 9), which are concerned with the influence that our social circles, such as family, friends, and coworkers, have on us. Construct 9 was integrated from TRA and the social cues in PADM[15][27]. Risk perception and sense of responsibility shape our *Attitude* (Construct 10), which refers to the degree to which we have an overall favorable or unfavorable evaluation for a specific hurricane preparedness action. Construct 10 was integrated from TPB[28].

The second stage of the PBM requires a *Cue to Action* (Construct 11), which is a trigger for engagement in hurricane preparedness. This can be a reminder from the city, school, or family to take necessary hurricane preparedness actions. *Cue to Action* depends on the message format, whether the emergency message creates a sense of urgency or not at the receiver end, and the message source, which refers to the degree to which a person trust the source of the message and view it as competent[8]. Construct 11 was integrated from HBM and PADM[9][15].

When executed right, *Cue to Action* triggers a state of *Knowledge Seeking* (Construct 12) in order to justify the adaptation of the new behavior[36]. *Knowledge Seeking* occurs through different thinking paths or cognitive routes. The first possible thinking pathway is the Central Route, and that is a cognitively demanding route and takes thoughtful and careful consideration of information and self-education about how to prepare for the hurricane season properly. The second possible thinking pathway is the Peripheral Route, which is less demanding on a cognitive level, such as observing how people around us prepare for the hurricane season and adopting their behaviors. Construct 12 was integrated from CDT, ELM, RCT, KDM, and the Hope theory[16][17][25][26][30].

When people have enough knowledge about a certain behavior, *Efficacy* is shaped. *Efficacy* in the PBM is divided into two constructs; 1) *Self-Efficacy* (Construct 13), which is our belief in our own ability to take a specific hurricane preparedness action, and 2) *Outcome Expectancy* (Construct 14), and this is our estimation that a particular behavior will lead to specific outcomes, for example, believing that having an emergency supply kit would be the reason for our survival when a hurricane hits. Construct 13 & 14 were integrated from theory of Self-Efficacy[10]. Adding Efficacy to Attitude and Subjective Norms creates *Intention* (Construct 15), which is the strongest indicator of behavioral adaptation and was integrated from TPB[28]. In some cases, *Significant Life Experiences* (Construct 3) can be very strong and influence intention directly without going through any of the constructs in the first and second stage of the PBM (see Figure 1). And this is the end of the second stage of the PBM.

When the *Intention* is strong enough, and there are no obstacles or situational impediments, the change in behavior should take place. When a person adopts a *Behavior* (Construct 16), they start a new chain of behavioral diffusion for the people around them. When we prepare for the hurricane season, people around us

observe our behavior, and that will influence their knowledge and efficacy, affecting their intention to adopt the new behavior. We refer to this as *Diffusion of Behavior* (Construct 17), which was integrated from SLT, DOI, and the effects of direct and indirect experience theory[18][20][31].

Simultaneously, when we adopt a new behavior, we go through a direct experience with the behavior, and that immediately triggers on a subconscious level a state of self-regulation, which is divided into two constructs in the PBM; *Self-Monitoring* (Construct 18), and *Behavior Modification* (Construct 19), which feeds back in the behavior itself as we learn from our direct experience with the behavior. This was integrated from SRT[21]. Finally, when we adopt a new hurricane protective behavior, and we experience a hurricane directly, that affects many elements in the PBM, such as our *Risk Perception*, *Attitude*, and *Efficacy*. This is why the third stage feeds back into the first and second stages in the PBM, knowing that these feedback loops were integrated particularly from the SOC theory[19].

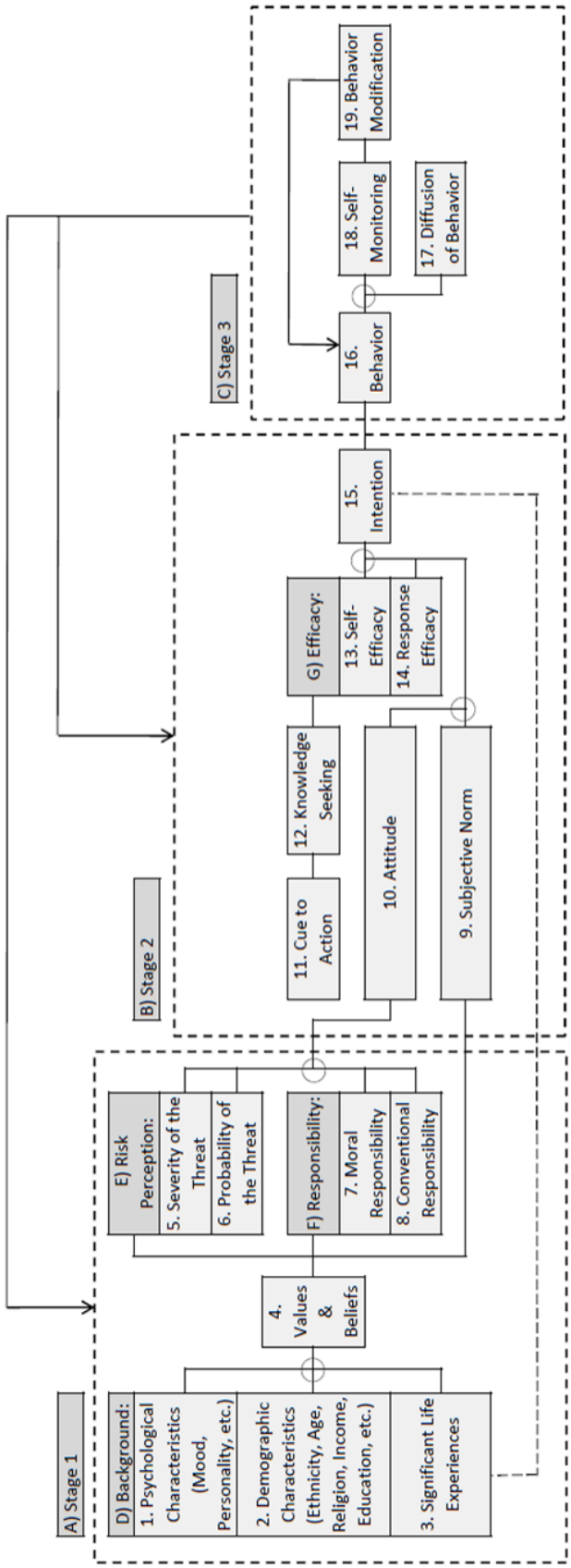

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Figure 1. Protective Behavior Model (PBM)

4. PBM Guidelines and Limitations

The PBM was initially constructed based on the review of critical literature and had constructs from 18 different theories in human behavior. The PBM Face Validity was established by conducting a Subject Matter Expert's Validation[37], where five expert scholars with Ph.D. degrees and similar research interests from our available academic networks agreed to review the model and make recommendations to improve it. The review process was done through multiple rounds of comments and alteration of the model. At the end of the third round, the five experts were satisfied with the final model, which includes constructs from 23 theories in human behaviors. However, the PBM is yet to be empirically tested.

The PBM can be tested using survey instruments. All questions in the survey should be short and direct, such as Likert and Rising Scales, and the use of the free-response answer format should be very limited to minimize confusion and to facilitate the quantitative analysis of the data[38]. The commonly recommended practice in similar behavior-based surveys is to measure each construct with 3-6 direct and indirect questions using Likert or Rising Scales[5][39][40]. The PBM is a very comprehensive model with 19 distinguished behavioral constructs. In order to test it through a survey instrument, the size of the survey can become overwhelming very fast, especially when more than one behavior is being investigated. Incentives might be necessary to encourage people to participate in the survey. Moreover, in order to use the PBM, the behaviors should be predefined in advance, and they should have very specific definitions. When looking at more than one protective behavior with regard to hurricanes, questions in the survey about the first stage in the model, including *Background, Values and Beliefs, Risk Perception, and Responsibility*, can be general for all behaviors that are being considered; however, questions about the different constructs in the second and third stage should be specific for each behavior.

The survey face validity should be established by consultation with other scholars who are experts and familiar with the research topic. These scholars should be asked to read through the questionnaire to evaluate whether the questions capture the topic being investigated and to check the survey for common errors such as leading questions, confusion, and double-barreled[37]. After achieving the face validity, the survey should be pilot tested to make sure it is free from typos and format un-clarity. The responses from the pilot testing should be analyzed, and the Split Half Reliability (SHR) and Cronbach's Alpha (CA) are recommended to check internal consistency for the responses gathered. Based on the analysis, the survey should be modified one last time and sent back for a final face validity check. The approved version of the survey should be the final version of the survey that will be used on the study sample. According to other similar studies[3][4][5], to ensure an adequate sample size, it is recommended to use a minimum confidence level of 95%, and a maximum confidence interval of 5 when using the Z factor formula to determine the sample size for such a study[38].

Using R, Excel, and SPSS software packages, different statistical approaches, such as ANOVA, Linear Regression, can be used to uncover patterns and quantify variables through usable statistics based on generating numerical data, in a way that it can quantify behaviors and generalize them[37]. As mentioned before, each construct should be measured through a set of questions in a Likert or Rising scales format. The answers can be translated into percentages, for example, Strongly Disagree (0.0%), Disagree (25%), Neutral (50%), Agree (75%), and Strongly Agree (100%). The average percentage of the questions' set for each construct will be assigned as the construct's final score, which will be later used in the rest of the analysis. Moreover, linear equations can be generated through linear regression to measure the correlation strength between variables, where () is an absolute value between 0 and 1, where 0 means No-Correlation, while 1 is the highest possible value of any correlation[38]. The correlation strengths can be divided into six groups; Weak (less than 0.20), Medium/Weak (0.20 - 0.45), Medium (0.46 - 0.55), Medium/Strong (0.56 - 0.7), Strong (0.71 - 0.90), and Very Strong (0.91 - 1).

Finally, the PBM was specifically built to explain hurricane protective behaviors. However, it can be used to explain other protective behaviors related to similar severe weather hazards, such as tornados and thunderstorms. With some modification, the model can be used to explain other protective behaviors in

different disaster contexts, such as volcanic and seismic activities. Moreover, the PBM, under careful consideration of the constructs, can be used altered and used to predict other protective behaviors outside the field of disaster studies, such as vaccination decisions and mental health[41]. Even though the PBM was built to explain human behavior, it might be used to predict it under certain circumstances, depending on what context the model is being used in and what alterations are being made on it.

Declaration of interests

The authors also declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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