ASCE

Response Efficacy Perception and Taking Action to Prepare for Disasters with Different Lead Time

Zhirui Chen[1] and Zhen Cong[2]

Abstract: This study investigated how disaster types, namely those with shorter and longer warning lead times, contextualized individuals' preparatory actions, especially those associated with their response efficacy perception (i.e., the belief that preparations are effective in risk reduction) and age. The working sample included 1,304 respondents from the 2017 US National Household Survey. Logistic regressions showed that individuals with higher levels of response efficacy perception were more likely to prepare after learning information about how to prepare. Respondents in areas prone to short lead-time disasters were less likely to prepare than those in areas exposed to longer lead-time disasters. Response efficacy perception was more important for taking action to prepare for short lead-time disasters, which was observed only among older adults but not among younger adults. These findings revealed the impacts of disaster types and response efficacy perception on disaster preparedness and older adults' unique vulnerability and resilience, which could guide policymaking and interventions to promote national disaster preparedness tailored to regional peculiarities. **DOI: 10.1061/(ASCE)NH.1527-6996.0000526.** © *2021 American Society of Civil Engineers.*

Introduction

Disaster preparedness is a state of readiness resulting from a wide range of activities and resources, in which individuals, communities, and organizations can effectively anticipate, respond to, and recover from the impacts of disasters (United Nations International Strategy for Disaster Reduction 2009). The practical significance of such preparedness has been identified in previous studies. For example, Cong et al. (2014) found that having a household emergency preparedness plan helped individuals adopt appropriate protective action in tornadoes and thus could reduce the number of individuals injured or killed by tornadoes. In addition, people who had prepared for household emergencies reported fewer worries and fears, which enabled them to stay calm and take action to increase their chance of survival during disasters (Diekman et al. 2007). However, individuals, in general, are not sufficiently prepared for disasters in the US. According to the 2017 American Housing Survey on residents' preparedness for disasters, more than 40% of the respondents did not prepare an emergency evacuation kit, identify an emergency meeting location, create a communication plan, or purchase a generator (US Census Bureau 2018). Considerable efforts and expenditure have been invested in public disaster education to promote public preparedness, but these investments could be more effective in educating how to prepare rather than motivate individuals to conduct actual preparedness behaviors because of a variety of barriers to taking precautionary action (Paton 2003; Adiyoso and Kanegae 2013; Miller et al. 2013). Therefore, recent studies have focused on factors that motivate individuals to take preparatory actions (Tang and Feng 2018; Xu et al. 2018). A noticeable knowledge gap in this area is the lack of studies across different disaster settings, such as disasters with different warning lead times that provide varied time intervals between issued warnings and disaster occurrence for people to reduce risks. Different disasters have different characteristics and present various contexts for associated social and individual behaviors (Paton 2003), but existing disaster research tends to focus on one specific type of disaster whereas our understanding of the shared and unique contexts of different types of disasters is at the forefront.

Guided by the protection motivation theory (PMT) and the Protective Action Decision Model (PADM) that examine the factors affecting individuals' preparedness actions, this study investigated how response efficacy perception could affect preparatory action-taking among different types of disasters, namely, disasters of different lengths of lead time (Rogers 1975; Lindell and Perry 2012). Besides, given the global aging and the particular vulnerability of older adults during disasters (Tuohy et al. 2014), we further examined the aforementioned relationships among different age groups following the life course perspective (Elder and Johnson 2003).

Literature Review

Response Efficacy Perception and Precautionary Actions Taking

Preparation for disasters has usually been addressed under protective/precautionary action theoretical frameworks, which includes PMT and PADM (Becker et al. 2013). Despite differences in their focuses, they have similarities and consider similar factors. One factor that both models include is subjective perception and the cognitive processes that lead to action-taking and deviation from normalcy.

Originally developed to explain how fears affect health attitudes and behaviors (Rogers 1975), PMT has now been widely used to explain self-protective behaviors in disaster contexts (Grothmann and Reusswig 2006; McCaughey et al. 2017; Tang and Feng 2018). PMT focuses on individuals' cognitive processes before taking protection actions, which includes two appraisal processes, namely

[1]Ph.D. Student, School of Social Work, Univ. of Texas at Arlington, 211 S. Cooper St., Arlington, TX 76010. ORCID: https://orcid.org/0000-0001-8228-2707

[2]Associate Professor, School of Social Work, Univ. of Texas at Arlington, 211 S. Cooper St., Arlington, TX 76010 (corresponding author). Email: zhen.cong@uta.edu; congzhenluo@gmail.com

Note. This manuscript was submitted on January 5, 2021; approved on August 23, 2021; published online on October 12, 2021. Discussion period open until March 12, 2022; separate discussions must be submitted for individual papers. This paper is part of the ***Natural Hazards Review***, © ASCE, ISSN 1527-6988.

threat appraisal (i.e., perceived probability and severity of disasters) and coping appraisal, which includes response efficacy (i.e., perception of the effectiveness of preparedness), self-efficacy (i.e., perceived ability to carry out protective actions), and response cost (i.e., perceived costs related to precautionary actions taking) (Floyd et al. 2000; Grothmann and Reusswig 2006). Similarly, PADM highlights several perceptions that are important for decision-making to take protective action; those perceptions include threat perceptions (i.e., individuals' expectations of personal impacts from disasters, such as perceived disaster consequences), protective action perceptions (i.e., hazard-related and resource-related attributes of hazard adjustments, such as effectiveness and cost), and stakeholder perceptions (i.e., the power of stakeholders over each other's decision to adopt protective actions, such as normative opinions of governments, scientists, and news media) (Lindell and Perry 2012).

In this study, we focused on the concept of "response efficacy" in PMT, and used the term "response efficacy perception" to refer to the belief that a precautionary action will be effective in protecting people from being harmed or reduce losses from the threat, e.g., the belief that making a household emergency plan may assist people in evacuating for a hurricane or the belief that installing latches and bolts on large or heavy items at home would prevent damage from an earthquake (Grothmann and Reusswig 2006). This term highlights the belief rather than the capacity that someone has and echoes the importance of individuals' perceptions in the decision-making process, as suggested by PADM.

Many studies have provided evidence for the relationship between response efficacy perception and actual preparedness actions. For example, Grothmann and Reusswig (2006) reported that coping appraisal, which included response efficacy perception, self-efficacy, and response cost, was positively related to four types of protective responses among residents at risk of flooding in Germany. Similarly, a study conducted among flood-prone German households suggested that response efficacy perception could motivate people to purchase insurance and deploy flood barriers (Bubeck et al. 2013). Response efficacy perception was also found to be a significant factor motivating homeowners who had adequate knowledge of disaster preparedness to take risk-mitigating behaviors against wildfires in the US (Martin et al. 2007). Furthermore, Tang and Feng (2018) found that after experiencing the Meinong earthquake in the Taiwan region, residents' response efficacy perception could affect their actual preparedness behaviors for future disasters through elevating preparing intentions.

The understanding of different disaster contexts will provide important guidance for policymaking and intervention development, which are particularly relevant to local social, demographic, and cultural contexts. As suggested by Paton (2003), the perception of efficacy expectations and related preparedness might vary a lot depending on the characteristics of disaster contexts, such as a disaster's nature, intensity, and destructiveness. Nevertheless, existing studies tended to examine the relationship in one certain type of disaster (e.g., flood, wildfire, or earthquake). Despite the general support of the association between response efficacy perception and precautionary action-taking, how different disaster types contextualize this relationship has rarely been examined.

Disaster Type by Warning Lead Time and Disaster Preparedness

A disaster refers to a severe disruption that causes extensive human, material, economic, or environmental losses to a community or society that has conditions of vulnerability or lacks sufficient capacity to cope with consequences (United Nations Office for the Coordination of Humanitarian Affairs 2008). Therefore, a disaster is the result of the interaction between human vulnerabilities and exposure to threats (e.g., natural hazards, human-made events, and pandemics) (Thomas et al. 2013). Disasters could be categorized in many different ways. One categorization is rapid-onset versus slow-onset disasters (Staupe-Delgado 2019). Rapid-onset disasters are often difficult to predict far in advance with limited warning time (from seconds to several days), whereas slow-onset disasters refer to disasters such as droughts and famines that develop gradually to become catastrophic in months or years (Omelicheva 2011). Examples of rapid-onset disasters include earthquakes, tornadoes, floods, hurricanes, storms, wildfire, and extreme weather events. Those different disasters are often addressed from different perspectives because of the fundamental differences in their interactions with human society (Shaluf 2007).

Rapid-onset disasters are the focus of recent studies on individual preparedness (Staupe-Delgado 2019). Although these disasters are grouped as rapid-onset, their warning lead time may vary and provide distinguished contexts for disaster-related behaviors (National Research Council 1991). For instance, an earthquake may only have seconds to tens of seconds of warning time for individuals to respond (USGS 2020), whereas an early warning for a hurricane could be issued several days in advance to enable people to prepare (National Weather Service 2020). In this study, we focused on preparedness for rapid-onset disasters and differentiated them as disasters with short lead times (e.g., disasters caused by an earthquake, tornado, wildfire) and those with long lead times (e.g., disasters triggered by a hurricane, winter storm, extreme heat), and examined precautionary behaviors under these two contexts.

Different lengths of warning lead time provide an important context for individuals' disaster-related behaviors, especially those concerning preparedness and protective action-taking (Staupe-Delgado 2019). In the contexts of disasters with a long lead times, disaster management agencies and the media have enough time to activate warning dissemination and communication systems, which helps people and communities be well warned with sufficient information (Golden and Adams 2000; Golding 2009). Therefore, warnings provide people with abundant time to plan and take protective action (Thieken et al. 2007; Khan 2008; Alfieri et al. 2012). Moreover, a longer lead time was found to help reduce people's stress during disasters (Parker et al. 2007), allowing people to remain calm for appropriate action taking in a stressful situation. In contrast, during short lead-time disasters, public disaster agencies may not be able to take timely measures to optimize emergency risk communication, such as selecting optimal warning release times and broadcasting information several times to ensure as many people as possible are warned (Wei et al. 2010) given that people may have little or no time to respond. Therefore, individuals can experience substantial fear and distress, which exacerbates protective responses and leads to undesirable consequences (Thirugnanam et al. 2020).

Even though taking preparatory actions is critical to reducing losses in disasters with a short lead time without the luxury of careful planning after warnings are received as in scenarios with a long lead time (Shaw et al. 2004), many people may still remain unprepared in advance. This is sometimes explained by a mixed mindset of unrealistic optimism and fatalism (Heller et al. 2005; Becker et al. 2013). On the one hand, some individuals may optimistically believe that disasters will not happen, and even if disasters did happen, they would not be affected (Ripley 2006). On the other hand, if a catastrophic disaster occurs, they might consider that nothing can be done to stop it (Joffe et al. 2013). For example, a resident in Tehran, a city prone to earthquake, clearly shared such a mixed mindset, stating: "... why should one get prepared for something which might never happen or for something which causes so

extensive damages that it makes preparedness useless" (Najafi et al. 2018, p. 4). Similarly, in the case of tornadoes, many people tend to be blindly optimistic that it will be others rather than themselves that will be affected; additionally, they believe there is a lack of control if a tornado strikes directly due to an average 20-min lead time (Jeffrey 2011).

Disasters with longer lead times could reduce such fatalism to some extent, because a longer lead time may enable individuals to get access to prepared supplies and carry out planned actions (Kreibich et al. 2017). As reported by Kang et al. (2007), people had generally clear and accurate expectations about the time it would take them to perform some preparation tasks in response to the relatively long lead time of a hurricane warning. Therefore, individuals are more likely to gain a perception of control and thus to prepare in advance. However, it is likely that people also develop optimism bias in face of disasters with longer lead times, such as in the disasters triggered by hurricanes (Trumbo et al. 2014). Thus, individuals may refuse to prepare until they get the real warning (Becker et al. 2013). Consequently, it is not clear how exposure to different disaster types will affect people's preparatory action-taking. In this study, following influential theories of disaster preparedness, we will present tentative hypotheses with the understanding of the differences between disaster preparedness for hazards of different lead times, as the results of counterbalancing factors.

Response Efficacy Perception, Warning Lead Time, and Preparedness

Disaster type defined according to lead-time length could be an important contextual factor for the relationship between response efficacy perception and preparatory behaviors, which has important theoretical and practical implications but is yet to be examined.

Although many variables can affect individuals' disaster preparedness, fatalism is one factor that may differentiate short lead-time disasters from longer lead-time disasters concerning preparatory behaviors, as discussed earlier (Heller et al. 2005; Becker et al. 2013). Such fatalism could be associated with low levels of response efficacy perception in the context of disasters with short lead times, which could be a major barrier for people to prepare for short lead-time disasters. Once that barrier is eliminated, because of the importance of getting prepared for short lead-time disasters (Shaw et al. 2004), individuals exposed to those disasters are more likely to prepare. Thus, we generally expect that response efficacy perception is more important for preparatory action-taking among individuals exposed to short lead-time disasters than to longer lead-time disasters.

Disaster Preparedness at Different Life Stages

According to the life course perspective, individuals' life events should be examined in the context of their lifetime experiences and choices (Elder and Johnson 2003). Applied to the disaster context, this perspective can assist us in understanding how previous experiences affect individuals' coping with a similar disaster later in life (Shenk et al. 2009).

Generally speaking, we expect that older and younger adults take different preparatory actions because compared to younger adults, older adults tend to have more lifetime experiences and higher levels of vulnerabilities to disasters. But how they are different from each other could be a result of many counterbalancing factors. On the one hand, in addition to declined health, functioning conditions, lack of support and resources, and social isolation [which causes barriers for older adults in preparedness (Dostal 2015; Gershon et al. 2017)], experiences related to disasters may enable older adults to develop optimism and normalization bias with reduced perception of consequences or make them too pessimistic and powerless to prepare (Paton 2003; Heller et al. 2005; Becker et al. 2017). On the other hand, with first-hand experiences of disasters, older adults could be more aware of their vulnerability during and after disasters, the possible risks of disasters, potential damage, physical injuries, emotional threats, and the effectiveness of preparedness, which may motivate them to prepare in advance (Heller et al. 2005; Nguyen et al. 2006; Tuohy et al. 2014). Empirical evidence is not always consistent with whether older adults are more likely to prepare than younger adults (Heller et al. 2005).

When different disaster contexts are taken into consideration, the differences between older adults and younger adults are more obvious. Older adults could be especially vulnerable to short lead-time disasters, which provide little or no time to respond and thus are challenging for older adults with limited physical, cognitive, and sensory conditions to respond (Aldrich and Benson 2008; Al-Rousan et al. 2014). For example, Tuohy et al. (2014) reported that older adults failed to follow the recommended response actions, such as staying under the table during an earthquake or going to higher ground during a tsunami, due to physical limitations and fear of falls. Consequently, preparing for short lead-time disasters could be more salient for older adults, whose life experiences help them understand risks and consequences of disasters as well as their own vulnerabilities (Heller et al. 2005; Nguyen et al. 2006; Tuohy et al. 2014). Similarly, because of the salience of being prepared, response efficacy perception, i.e., belief in whether preparation would be helpful, can be more motivating for older people than for younger adults to make preparations. Because studies in this area are very limited, our reasoning will lead to tentative hypotheses to guide future research to test and validate those hypotheses.

Hypotheses

Four hypotheses were put forward based on the preceding discussions:

Hypothesis 1 (PMT and PADM): Individuals with higher levels of response efficacy perception are more likely to take steps to prepare for disasters caused by natural hazards.

Hypothesis 2: Individuals living in the areas prone to disasters with short lead times have a lower likelihood of taking steps to prepare in advance, compared with those in the regions prone to longer lead-time disasters.

Hypothesis 3: Response efficacy perception is more important for preparation action-taking among those exposed to disasters with short lead times than those exposed to disasters with longer lead times.

Hypothesis 4 (life course perspective): The relationship proposed in Hypothesis 3 is stronger for older adults than for younger adults.

Methods

Data Source and Study Sample

The 2017 National Household Survey (NHS) was used for this study. This national sample survey was conducted by the US Federal Emergency Management Agency (FEMA), to track individuals' disaster preparedness, behaviors, attitudes, and motivations (FEMA 2020). A nationally representative sample was randomly approached via landline or mobile telephone in English and Spanish, together with hazard-specific oversampling including earthquake, tornado, wildfire, flood, winter storm, hurricane, and extreme heat

(FEMA 2020). In total, there were 5,042 adult respondents who were English or Spanish speakers in the 2017 NHS. FEMA classified regions based on the historical records of the most likely type of disaster triggered by natural hazards in different counties, namely, regions of either tornadoes, floods, hurricanes, extreme heat, wildfires, earthquakes, or winter storms. Respondents provided the names of the county they lived in and then were asked questions concerning their preparedness for the disaster that is most likely in that region. For example, FEMA regarded respondents living in Oklahoma County, OK, as residents living in the region prone to disasters triggered by tornadoes because tornadoes are the most frequent natural hazard that causes disasters there according FEMA's records. Respondents were then asked questions concerning their preparedness for tornadoes. Among the whole sample, 1,704 respondents provided valid answers regarding whether they took any steps to prepare for the primary disaster identified in their regions after receiving the information about how to get better prepared for the primary disaster in their regions. The respondents from regions prone to flooding were excluded ($N = 190$), because we cannot identify whether they faced a flood with a general lead time of more than 15 days (Li et al. 2017) or a flash flood that has a short lead time, which will affect the accuracy of disaster categorization and analyses. Therefore, the working sample in this study included 1,304 out of the 1,514 respondents who answered whether they took actions to prepare for a disaster caused by one of the aforementioned hazards after learning about how to prepare, with missingness of 13.87% [i.e., $(1{,}304 - 1{,}514)/1{,}514$], which mainly occurred in variables of race and homeownership.

Measures

The dependent variable was action-taking to prepare for disasters. There was a screening question ["In the past six months, have you read, seen, or heard any information about how to get better prepared for a specific disaster in your living section (i.e., Tornado/Hurricane/Extreme heat/Wildfire/Earthquake/Winter storm)"]. Those who answered "Yes" to this screening question were further asked: "After receiving the information about how to get better prepared, did you take any steps to prepare for a Tornado/Hurricane/Extreme heat/Wildfire/Earthquake/Winter storm," where 0 = no and 1 = yes. A total of 1,514 respondents provided valid answers to this question.

The independent variable, response efficacy perception, was individuals' perception of preparedness actions that can effectively reduce risks, which was assessed by the question: "How much would taking steps to prepare, such as creating a household emergency plan, developing an evacuation and shelter plan, signing up for alerts and warning systems, or stocking up on supplies help you get through a Tornado/Hurricane/Extreme heat/Wildfire/Earthquake/Winter storm." The options included: 0 = not at all, 1 = very little, 2 = somewhat, 3 = quite a bit, and 4 = a great deal.

Disaster type defined by the length of lead time was an important contextual variable, i.e., moderator. As mentioned earlier, FEMA classified regions into those prone to disasters caused by tornadoes, hurricanes, extreme heat, wildfire, earthquakes, or winter storms. Disaster preparedness was examined under those different contexts of exposure. In this study, disasters caused by hurricanes, extreme heats, and winter storms were classified into disasters with longer lead times, whereas disasters triggered by earthquakes, tornadoes, and wildfires were classified as disasters with short lead times. Thus, disaster type context was categorized into 0 = disasters with a long lead time, and 1 = disasters with a short lead time.

Age was also a moderator, dichotomously measured as 0 = younger adults aged between 18 and 64 and 1 = older adults who were 65 or older. Control variables included respondent's gender, race, ethnicity, educational level, previous disaster exposure, homeownership, disability, perceived risk, self-efficacy, money cost, and time cost. Gender was measured by 0 = male and 1 = female. Race was coded as a dummy variable (0 = other races, 1 = White). Ethnicity was assessed by asking: "Are you of Hispanic, Latino, or Spanish origin—such as Mexican, Puerto Rican, Cuban, or other Spanish origin?" (0 = no, 1 = yes). Educational level was measured on a six-point scale with 0 = less than high school diploma, 1 = high school degree or diploma, 2 = technical/vocational school, 3 = some college, 4 = college graduate, and 5 = postgraduate work or degree. Previous disaster exposure was measured by asking: "Have you or your family ever experienced a Tornado/Hurricane/Extreme heat/Wildfire/Earthquake/Winter storm)" (0 = no, 1 = yes). Homeownership was coded as 0 = rent a home and 1 = own a home. Disability condition was a dichotomous variable, measured by asking: "Do you have a disability or a health condition that might affect your capacity to respond to an emergency situation?" (0 = no, 1 = yes).

Based on the PMT, perceived risk, self-efficacy, and response cost are considered as important factors that affect disaster preparedness, and thus were controlled in this study. Perceived risk was assessed by the question: "Thinking about the area you live in, how likely or unlikely would it be for a Tornado/Hurricane/Extreme heat/Wildfire/Earthquake/Winter storm to happen?" (0 = unlikely, 1 = likely). Self-efficacy was measured by asking: "How confident are you that you can take the steps to prepare for a Tornado/Hurricane/Extreme heat/Wildfire/Earthquake/Winter storm." This question was answered on a five-point Likert scale from 0 = not at all confident to 4 = extremely confident. Response cost (money) was measured by asking: "How important is doing what it takes to be prepared would cost too much money in your decision to prepare for disaster." The options ranged from 0 = not at all important to 4 = extremely important. Similarly, response cost (time) was assessed by rating the importance of "doing what it takes to be prepared would take time away from other activities" from 0 = not at all important to 4 = extremely important.

Data Analyses

Univariate analyses were conducted to describe the key variables and control variables. Subsequently, logistic regressions with three models were conducted for the whole sample to examine the relationship between response efficacy perception and preparatory action-taking (Model 1), the two-way interaction between response efficacy perception and disaster type (Model 2), and the three-way interactions among response efficacy perception, disaster type, and age (Model 3). Finally, logistic regressions were conducted separately for younger adults and older adults to investigate the associations between response efficacy perception and precautionary action-taking as well as the moderating effect of disaster type for different age groups. These analyses were performed using Stata 15.

Results

Table 1 summarized the sample characteristics. 58.36% of respondents took precautionary actions after understanding how to get better prepared. Among them, 69.56% believed that preparedness could provide quite a bit or a great deal of help. 46.32% of respondents were exposed to disasters with short warning lead times (i.e., disasters triggered by earthquake/ tornado/wildfire). 29.14% of the respondents were older adults aged over 65. Females accounted for approximately half of the sample. More than three-quarters of the respondents were White (81.52%), non-Hispanic

Table 1. Sample characteristics ($N = 1{,}304$)

Variables	N	Percentage (%)
Preparatory action-taking		
No	543	41.64
Yes	761	58.36
Response efficacy perception		
Not at all	74	5.67
Very little	69	5.29
Somewhat	254	19.48
Quite a bit	297	22.78
A great deal	610	46.78
Disaster type		
Disasters with long lead time	700	53.68
Disasters with short lead time	604	46.32
Age		
18–64	924	70.86
65+	380	29.14
Gender		
Male	638	48.93
Female	666	51.07
Race		
Non-white	241	18.48
White	1,063	81.52
Ethnicity		
No	1,173	89.95
Yes	131	10.05
Educational level		
Less than high school diploma	48	3.68
High school degree or diploma	146	11.20
Technical/vocational school	60	4.60
Some college	344	26.38
College graduate	390	29.91
Postgraduate work or degree	316	24.23
Previous disaster exposure		
No	303	23.24
Yes	1,001	76.76
Homeownership		
Rent	373	28.60
Own	931	71.40
Disability		
No	1,031	79.06
Yes	273	20.94
Risk perception		
Unlikely	198	15.18
Likely	1,106	84.82
Self-efficacy		
Not at all confident	7	0.54
Slightly confident	39	2.99
Somewhat confident	123	9.43
Moderately confident	355	27.22
Extremely confident	780	59.82
Money cost		
Not at all important	432	33.13
Not very important	308	23.62
Somewhat important	279	21.40
Very important	170	13.04
Extremely important	115	8.82
Time cost		
Not at all important	429	32.90
Not very important	269	20.63
Somewhat important	264	20.25
Very important	222	17.02
Extremely important	120	9.20

(89.95%), and had some college education or more education (80.52%). 76.76% of them reported that they or their family experienced a disaster in their lifetime, 71.40% of the respondents owned their homes, and 20.94% of them had disabilities or a health condition. Over 80% of respondents believed that a disaster was likely to happen. Their self-efficacy for disaster preparedness was high, with 87.04% of them were moderately or extremely confident in their ability to prepare. More than half of the sample regarded money and time as not very or not at all important in their decision to prepare.

Table 2 presented the logistic regressions for the whole sample. Model 1 showed that respondents with a higher level of response efficacy perception were more likely to get prepared [Odds ratio (OR) $= 1.47$, $p < 0.001$] after receiving information about how to prepare. Individuals living in regions prone to disasters with short lead times were less prepared than those in regions prone to disasters with long lead times (OR $= 0.57$, $p < 0.001$). For control variables, respondents who had previous disaster exposure and higher levels of risk perception were more likely to prepare. Homeowners and people with higher educational levels were less likely to take steps to prepare. Model 2 included the interaction term between response efficacy perception and disaster type and it was found that response efficacy perception was more important for those in short lead-time disasters areas to get prepared than for those in long lead-time disasters areas (OR $= 1.32$, $p < 0.05$). Fig. 1 illustrated the moderating effect between response efficacy perception and disaster type among the whole sample. Model 3 included three-way interactions among response efficacy perception, disaster type, and age group to test whether the difference between younger adults and older adults was statistically significant. But the result did not show a statistically significant difference between younger and older adults concerning the two-way interactive impact of response efficacy perception and disaster type.

Table 3 illustrated the results of the logistic regressions conducted separately among younger adults and older adults. For younger adults, Model 1 showed that response efficacy perception (OR $= 1.38$, $p < 0.001$) and disaster type (OR $= 0.58$, $p < 0.001$) were significant predictors to precautionary action-taking. Model 2 demonstrated that disaster type did not significantly moderate the association between response efficacy perception and precautionary action-taking among younger adults. Fig. 2 exhibits this moderating effect among younger adults, which was not significant.

For older adults, Model 1 showed that response efficacy perception (OR $= 1.65$, $p < 0.001$) significantly increased the likelihood of taking steps to prepare and being prone to disasters with a short lead time (OR $= 0.54$, $p < 0.05$) reduced the likelihood. In Model 2, the interaction term between response efficacy perception and disaster type was significant (OR $= 1.60$, $p < 0.05$), which meant that higher levels of response efficacy perception were more motivating for those who were exposed to short lead-time disasters to prepare, compared to those exposed to longer lead-time disasters among older adults. Fig. 3 presented such moderating effect for older adults and showed that when response efficacy perception was low, there was a substantial gap between short and long lead-time disasters in older adults' preparatory action, whereas when the response efficacy perception was at its highest level, there was a very small difference between these two types of disasters. However, because the three-way interactions among response efficacy perception, precautionary action-taking, and age did not reach statistical significance in Table 2, it is suggested that caution should be taken when interpreting the different results observed among younger and older adults.

Discussion

This study used a nationally representative sample in the US to examine how different disaster types, defined by the differences in

Table 2. Logistic regression on precautionary actions taking ($N = 1{,}304$)

Variables	Model 1 OR	Model 2 OR	Model 3 OR
Gender (*ref* = male)[a]	1.18	1.17	1.17
White (*ref* = non-white)	0.80	0.81	0.80
Hispanic (*ref* = no)	0.92	0.90	0.90
Educational level	0.91*	0.90*	0.90*
Previous disaster exposure (*ref* = no)	1.62**	1.61**	1.58**
Home ownership (*ref* = rent)	0.67**	0.68**	0.68**
Disability (*ref* = no)	1.04	1.05	1.05
Risk perception	1.51*	1.44*	1.45*
Self-efficacy	1.13	1.10	1.10
Money cost	1.04	1.05	1.04
Time cost	0.97	0.97	0.97
Response efficacy perception	1.47***	1.32***	1.29**
Short lead-time disaster (*ref* = disasters with long lead time)	0.57***	0.24***	0.31**
Older adults (*ref* = 18–64)	1.06	1.07	0.86
Response efficacy perception × short lead-time disaster	—	1.32*	1.22
Older adults × response efficacy perception	—	—	1.07
Older adults × short lead-time disaster	—	—	0.51
Older adults × response efficacy perception × short lead-time disaster	—	—	1.27
Model fit			
LR Chi-square	171.58	177.87	180.80
Degree of freedom	14	15	18
Pseudo R^2	9.69%	10.04%	10.21%
p value	<0.001	<0.001	<0.001

Note: $^{*}p < 0.05$, $^{**}p < 0.01$, and $^{***}p < 0.001$.
[a]Reference category in parentheses.

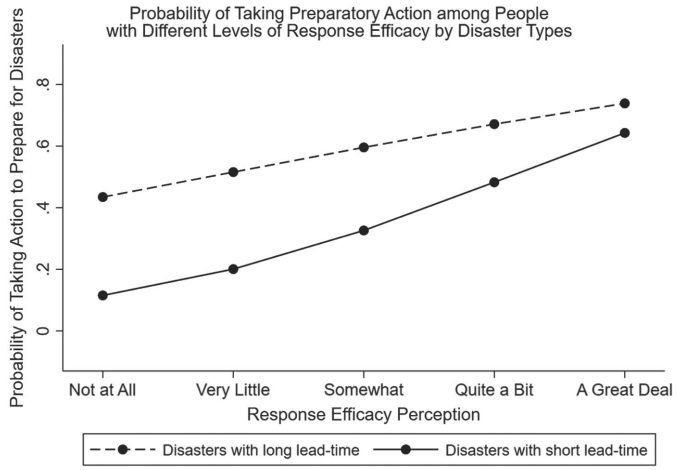

Fig. 1. Probability of taking preparatory action among people with different levels of response efficacy by disaster types.

lead time, contextualize the association between individuals' response efficacy perception and the likelihood of taking steps to prepare after they understood how to get better prepared. This study also paid attention to differences between younger and older adults in the process.

Hypothesis 1 was supported. Respondents who reported higher levels of response efficacy perception were found to be more likely to take steps to prepare, which was consistent with the PMT, PADM, and previous empirical studies (Grothmann and Reusswig 2006; Lindell and Perry 2012; Bubeck et al. 2013; Tang and Feng 2018). In addition, this finding has two immediate implications. First, the earlier literature provided empirical evidence on the importance of response efficacy perception in motivating preparatory action in specific disasters (e.g., wildfire, earthquake), and this study further reveals that response efficacy perception was important across regions prone to different types of hazards, including tornadoes, hurricanes, extreme heat, wildfire, earthquakes, and winter storms, and thus provides stronger evidence for the importance of response efficacy perception in motivating preparatory actions. Second, this study showed that even after individuals learned how to prepare, response efficacy perception differs among them based on whether actual preparation efforts were made. Public education can teach people the importance of preparedness and provide them with the relevant knowledge to get prepared, but it might not directly result in action-taking (Paton 2003; Miller et al. 2013). It is important to overcome barriers for individuals to get prepared, and response efficacy perception is an important factor to be considered in policy making and interventions to motivate actual preparedness behaviors (Cong et al. 2021).

Hypothesis 2 was also supported. This study suggested that individuals living in regions prone to disasters with short lead times were less likely to take steps to prepare than those in regions prone to disasters with long lead times. We suspect that this might be associated with the perception of fatalism, which is different from many other factors (e.g., risk perception, optimism bias) whose impacts on individuals' preparedness may not be distinctly different due to the length of warning lead time (Becker et al. 2013). Fatalism could be stronger in disasters with short lead times out of the belief that nothing can be done to prevent disasters and no preparation would be useful because short lead times allow little time to get access to prepared items (Joffe et al. 2013; Najafi et al. 2018). In contrast, individuals exposed to disasters with a long lead times might have a better perception of control because the longer warning and lead time could enable their preparedness to be effective and useful (Kreibich et al. 2017), which in turn can motivate them to take steps to get prepared. How the differences in warning lead time contextualize disaster preparedness is an understudied area,

Table 3. Logistic regression on precautionary actions taking among younger adults ($N = 924$) and older adults ($N = 380$)

	Young adults ($N = 924$)		Older adults ($N = 380$)	
	Model 1	Model 2	Model 1	Model 2
Variables	OR	OR	OR	OR
Gender (*ref* = male)[a]	1.20	1.20	1.13	1.09
White (*ref* = non-white)	0.73	0.74	1.16	1.17
Hispanic (*ref* = no)	0.98	0.97	0.65	0.63
Educational level	0.89*	0.89*	0.92	0.90
Previous disaster exposure (*ref* = no)	1.58*	1.59*	1.60	1.51
Home ownership (*ref* = rent)	0.67*	0.68*	0.61	0.62
Disability (*ref* = no)	0.92	0.93	1.18	1.19
Risk perception	1.58*	1.52	1.42	1.33
Self-efficacy	1.17	1.15	1.04	1.00
Money cost	1.03	1.03	1.10	1.09
Time cost	0.95	0.95	1.01	1.01
Response efficacy perception	1.38***	1.30**	1.65***	1.38*
Short lead-time disaster (*ref* = disasters with long lead time)	0.58***	0.34*	0.54*	0.13**
Response efficacy perception × short lead-time disaster	—	1.19	—	1.60*
Model fit				
LR Chi-square	101.64	103.29	74.53	80.01
Degree of freedom	13	14	13	14
Pseudo R^2	8.14%	8.28%	14.29%	15.34%
p value	<0.001	<0.001	<0.001	<0.001

Note: * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.
[a]Reference category in parentheses.

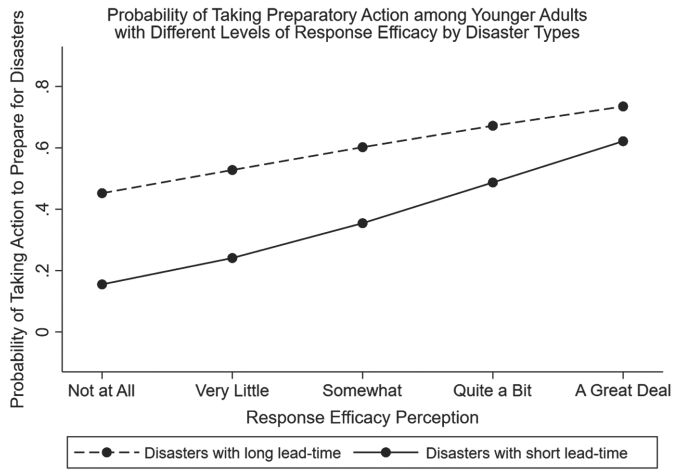

Fig. 2. Probability of taking precautionary actions among younger adults with different levels of response efficacy by disaster types.

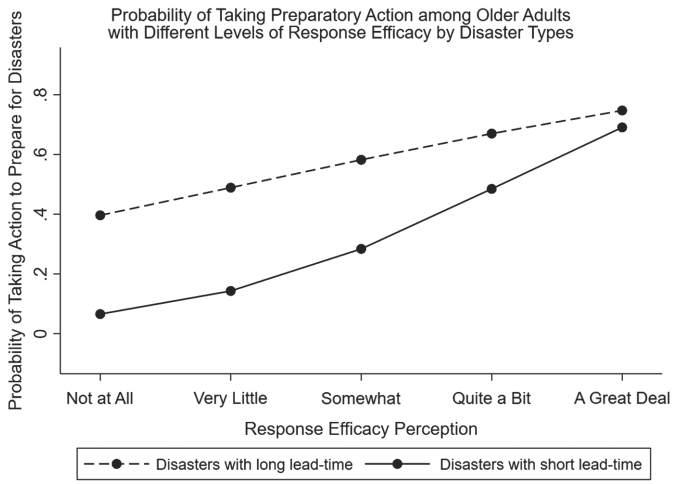

Fig. 3. Probability of taking precautionary actions among older adults with different levels of response efficacy by disaster types.

and there future studies can consider exploring additional reasons that can explain the preparedness for disasters with different lead times.

Hypothesis 3 was supported by our finding that response efficacy perception was more important for individuals in regions prone to short lead-time disasters to take steps to prepare than for those in long lead-time disaster areas, as shown in Model 2 in Table 2. Results showed that short lead times could become a barrier for people to get prepared, and higher response efficacy perception helped to overcome those barriers. As suggested by Shaw et al. (2004), effective preparedness seems to be the only way to reduce risks within limited warning lead time, which also highlights the importance of response efficacy perception in short lead-time disasters. Fig. 1 showed that with the increase of response efficacy perception, there is a decrease in the disadvantage of short lead-time disasters in preventing more preparatory action relative to longer lead-time disasters. Thus, response efficacy perception could reduce the gap between disasters with different lead times, possibly by reducing fatalism and overcoming relevant barriers to getting prepared.

Hypothesis 4 was partially supported. When separated by age, the moderating effect supported in Hypothesis 3 was only significant for older adults and not for younger adults. Although this difference did not reach statistical significance in the three-way interaction, the finding provided some support to the differences between the younger and older adults. According to the life course perspective, older adults have more experiences than younger adults in disasters exposure and disaster preparedness, which could enable some older adults to be more aware of the risks of disasters, the importance of being prepared especially for disasters with short

lead times, as well as their own elevated level of vulnerability in disaster contexts due to their limited conditions and ability (Heller et al. 2005; Nguyen et al. 2006; Aldrich and Benson 2008; Al-Rousan et al. 2014; Tuohy et al. 2014). However, the other side of the coin is that previous experiences may also help develop optimism and normalization bias that hinder preparedness among other older adults (Heller et al. 2005; Becker et al. 2017). Consequently, response efficacy perception could differentiate those different older adults in their disaster preparedness in response to short lead-time disasters. Because of the small sample size of older adults and reduced statistical power associated with their interactions, it is challenging for the three-way interaction to be statistically significant. Thus, despite the lack of significance of the three-way interaction, the findings provide preliminary evidence of the age differences and the importance of taking a life course perspective in examining disaster preparedness, given the lack of empirical evidence and a guiding research framework in this area.

Among control variables, risk perception and previous disaster exposure were positively associated with preparedness behaviors, which is consistent with PMT, PADM, and previous studies (Grothmann and Reusswig 2006; Lindell and Perry 2012; McCormick et al. 2014; Wang et al. 2018). People with higher educational levels were less likely to take precautionary actions, which may be because they tend to have more threat-appraisal barriers (i.e., risk perception) in preparation, i.e., perceiving lower levels of risk probability and potential consequence (Cong et al. 2021). Interestingly, homeownership was negatively related to taking steps to prepare in this study. In previous studies, homeowners were found to be better prepared because they were more worried about the damage to their homes caused by disasters and were better able to make structural upgrades to houses than tenants (Grothmann and Reusswig 2006). Because what we examined in this study was action-taking, i.e., whether any steps were taken to prepare after receiving information about how to get better prepared, it is possible that homeowners have already been prepared before receiving the information. Thus, this finding does not necessarily conflict with findings that homeowners are generally better prepared for disasters. Actually, the finding is consistent with studies showing that homeowners may be less likely to take precautionary or emergency actions as a result of a belief that their houses had already been built well to protect them from disasters (Ripley 2006). In other words, homeowners may be better prepared or feel better prepared, but not necessarily more likely to take more preparation action after learning how to prepare.

There are three primary limitations of this study. First, we had to exclude the respondents living in regions prone to flood because we were not able to clearly distinguish whether respondents' disaster preparedness was referring to the context of a flash flood that has a short lead time or a flood with a longer lead time, because FEMA's disaster preparedness questions did not differentiate between these two types of floods. But we performed two supplemental analyses that included floods either in the long lead-time category or in short lead-time category, and the results were consistent in that the main effect of disaster type and its moderating effect in the relationship between response efficacy perception and precautionary action-taking in both analyses were similar to the results presented in this study. Second, according to PMT and PADM, other important factors such as perceived consequences can affect individuals' actual preparedness behaviors (Grothmann and Reusswig 2006; Han et al. 2017), but we were not able to include the perceived consequences in analyses because of missing variables in secondary data. Likewise, fatalism was suspected to be an underlying reason for the role that response efficacy perception plays in contextualizing disaster preparedness for disasters of different lead times, but we did not have a direct measure of fatalism. Third, the outcome variable we examined was a highly contextual variable, i.e., it measured whether individuals took any steps to prepare for disasters if they received information regarding how to get better prepared in the past six months. This screened out those who had not received relevant information in the past six months and limited the sample to a selected group of people. Thus, what we have examined is not a static preparedness status but a measure of action taking among those who recently received preparation-related information, which could be different from other indicators of preparedness.

Despite those limitations, this study has several important theoretical and practical contributions. This study tested PMT and PADM across different disaster settings by their warning lead time, which addresses an important knowledge gap in shared characteristics across different disasters. It also integrated the life course perspective that was widely used in human development and gerontology into the PMT and PADM to examine underlying age differences, which has significant implications in a fast-aging society. This study also brought up the practical implications that public disaster education by itself is not sufficient to directly result in preparedness behaviors. Response efficacy perception is an important factor to consider, especially for regions prone to short lead-time disasters and among older adults. More importantly, the differences between regions prone to short lead-time disasters and long lead-time disasters were revealed in this study. Policy makers and practitioners in those different regions should take those differences into consideration to design effective programs to increase individuals and communities' preparedness to disasters. For example, in addition to educating how to prepare, predisaster services and workers can focus on enhancing individual's perception that preparations are useful in risk reduction (i.e., response efficacy perception) by presenting data and case studies (e.g., Cong et al. 2014) and sharing skills in obtaining prepared supplies or implementing plans especially within a short warning lead time. Such information about the effectiveness of preparedness from public disaster education is also more likely to be accepted given that individuals usually have difficulty independently verifying their perceived response efficacy (Lindell et al. 2009). Older adults, particularly those with declined health or functioning conditions, have more difficulties following instructions to protect themselves from disasters with short lead times (Tuohy et al. 2014); thus public disaster management should provide specific guides or tips that take the special needs of older adults into account, such as including medications, medical equipment, and written information on treatment in an emergency kit.

COVID-19 has resulted in a dramatic loss of human life worldwide, and its overlap in time and place with some disasters caused by natural hazards presents an additional challenge to public health and disaster management (Quigley et al. 2020). Such a multihazard scenario should be considered in research and practice regarding disaster preparedness. COVID-19 may affect people's response efficacy perception for different preparedness activities. For instance, individuals would doubt the effectiveness of evacuation plans in risk reduction (i.e., response efficacy perception) due to the concerns about COVID-19 transmission on evacuation routes or in shelters (Garcia 2020; Jenkins 2020); In contrast, they may tend to store disaster supplies that are more useful when they are quarantined at home. Therefore, researchers should examine people's different levels of response efficacy perception for different preparedness activities in a multihazard scenario and its impact on actual preparedness action-taking. In addition, public disaster management can consider improving individuals' preparedness by enhancing their response efficacy perception levels in preparing for concurring hazards. For example, online disaster education can highlight the

usefulness of some preparations for disasters during COVID-19, such as preparing a kit with hand sanitizer and disinfectant wipes and adding safety precautions in evacuation plans. Public shelters can also share their specific plans for ensuring human safety and health during the pandemic through website or social media to reduce people's concerns about whether evacuations are effective in reducing risk.

Conclusion

Guided by the PMT and PADM, this study suggested that response efficacy perception was positively associated with individual's precautionary actions taking in contexts of different disasters, and that people living in regions prone to disasters with short lead times may face more barriers to prepare than those in long lead-time disaster areas. Interestingly, the increase of response efficacy perception, especially for older adults, can help close the gap of disaster preparedness between people exposed to disasters with long lead times and those exposed to disasters with short lead times, which the life course perspective can help explain. These findings innovatively highlight the significance of response efficacy perception in different disaster contexts and the uniqueness of older adults, based on which policy and intervention strategies can be developed to complement current public disaster preparedness education and better promote individuals' actual preparatory actions.

Data Availability Statement

All data used during the study are available in a repository online in accordance with further data retention policies (FEMA 2020).

Acknowledgments

This work is partially supported by the National Science Foundation (CMMI 1839516).

References

Adiyoso, W., and H. Kanegae. 2013. "Effectiveness of disaster-based school program on students earthquake-preparedness." *J. Disaster Res.* 8 (5): 1009–1017. https://doi.org/10.20965/jdr.2013.p1009.

Aldrich, N., and W. F. Benson. 2008. "Disaster preparedness and the chronic disease needs of vulnerable older adults." *Preventing Chronic Dis. Public Health Res. Pract. Policy* 5 (1): 1–7.

Alfieri, L., P. Salamon, F. Pappenberger, F. Wetterhall, and J. Thielen. 2012. "Operational early warning systems for water-related hazards in Europe." *Environ. Sci. Policy* 21 (Aug): 35–49. https://doi.org/10.1016/j.envsci.2012.01.008.

Al-Rousan, T. M., L. M. Rubenstein, and R. B. Wallace. 2014. "Preparedness for natural disasters among older US adults: A nationwide survey." *Am. J. Public Health* 104 (3): 506–511. https://doi.org/10.2105/AJPH.2013.301559.

Becker, J. S., D. Paton, D. M. Johnston, and K. R. Ronan. 2013. "Salient beliefs about earthquake hazards and household preparedness." *Risk Anal.* 33 (9): 1710–1727. https://doi.org/10.1111/risa.12014.

Becker, J. S., D. Paton, D. M. Johnston, K. R. Ronan, and J. McClure. 2017. "The role of prior experience in informing and motivating earthquake preparedness." *Int. J. Disaster Risk Reduct.* 22 (Jun): 179–193. https://doi.org/10.1016/j.ijdrr.2017.03.006.

Bubeck, P., W. J. Botzen, H. Kreibich, and J. C. Aerts. 2013. "Detailed insights into the influence of flood-coping appraisals on mitigation behaviour." *Global Environ. Change* 23 (5): 1327–1338. https://doi.org/10.1016/j.gloenvcha.2013.05.009.

Cong, Z., Z. Chen, and D. Liang. 2021. "Barriers to preparing for disasters: Age differences and caregiving responsibilities." *Int. J. Disaster Risk Reduct.* 61 (Jul): 102338. https://doi.org/10.1016/j.ijdrr.2021.102338.

Cong, Z., D. Liang, and J. Luo. 2014. "Family emergency preparedness plans in severe tornadoes." *Am. J. Preventive Med.* 46 (1): 89–93. https://doi.org/10.1016/j.amepre.2013.08.020.

Diekman, S. T., S. P. Kearney, M. E. O'neil, and K. A. Mack. 2007. "Qualitative study of homeowners' emergency preparedness: Experiences, perceptions, and practices." *Prehospital Disaster Med.* 22 (6): 494–501. https://doi.org/10.1017/S1049023X00005318.

Dostal, P. J. 2015. "Vulnerability of urban homebound older adults in disasters: A survey of evacuation preparedness." *Disaster Med. Public Health Preparedness* 9 (3): 301–306. https://doi.org/10.1017/dmp.2015.50.

Elder, G. H., and M. K. Johnson. 2003. "The life course and aging: Challenges, lessons, and new directions." In *Invitation to the life course: Toward new understandings of later life*, 49–81. New York: Routledge.

FEMA. 2020. "National household survey." Accessed May 1, 2020. https://www.fema.gov/about/openfema/data-sets/national-household-survey.

Floyd, D. L., S. Prentice-Dunn, and R. W. Rogers. 2000. "A meta-analysis of research on protection motivation theory." *J. Appl. Soc. Psychol.* 30 (2): 407–429. https://doi.org/10.1111/j.1559-1816.2000.tb02323.x.

Garcia, S. 2020. "Carson officials ask Metro to suspend transit service throughout LA County." Accessed May 19, 2021. https://abc7.com/city-of-carson-suspended-transit-service-prevent-spread-covid-19/6071422/.

Gershon, R. R., E. Portacolone, E. M. Nwankwo, Q. Zhi, K. A. Qureshi, and V. H. Raveis. 2017. "Psychosocial influences on disaster preparedness in San Francisco recipients of home care." *J. Urban Health* 94 (5): 606–618. https://doi.org/10.1007/s11524-016-0104-3.

Golden, J. H., and C. R. Adams. 2000. "The tornado problem: Forecast, warning, and response." *Nat. Hazards Rev.* 1 (2): 107–118. https://doi.org/10.1061/(ASCE)1527-6988(2000)1:2(107).

Golding, B. 2009. "Long lead time flood warnings: Reality or fantasy?" *Meteorol. Appl.* 16 (1): 3–12. https://doi.org/10.1002/met.123.

Grothmann, T., and F. Reusswig. 2006. "People at risk of flooding: Why some residents take precautionary action while others do not." *Nat. Hazards* 38 (1–2): 101–120. https://doi.org/10.1007/s11069-005-8604-6.

Han, Z., X. Lu, E. I. Hörhager, and J. Yan. 2017. "The effects of trust in government on earthquake survivors' risk perception and preparedness in China." *Nat. Hazards* 86 (1): 437–452. https://doi.org/10.1007/s11069-016-2699-9.

Heller, K., D. B. Alexander, M. Gatz, B. G. Knight, and T. Rose. 2005. "Social and personal factors as predictors of earthquake preparation: The role of support provision, network discussion, negative affect, age, and education." *J. Appl. Soc. Psychol.* 35 (2): 399–422. https://doi.org/10.1111/j.1559-1816.2005.tb02127.x.

Jeffrey, K. 2011. "Getting out of danger's way: Why we're not prepared for twisters." Accessed November 18, 2020. https://science.time.com/2011/05/23/getting-out-of-dangers-way-why-were-not-prepared-for-twisters/.

Jenkins, L. M. 2020. "Considering COVID-19 makes people less inclined to seek community help, shelter during a natural disaster." Accessed May 19, 2021. https://morningconsult.com/2020/06/15/natural-disasters-coronavirus-shelters-community-resources-poll/.

Joffe, H., T. Rossetto, C. Solberg, and C. O'Connor. 2013. "Social representations of earthquakes: A study of people living in three highly seismic areas." *Earthquake Spectra* 29 (2): 367–397. https://doi.org/10.1193/1.4000138.

Kang, J. E., M. K. Lindell, and C. S. Prater. 2007. "Hurricane evacuation expectations and actual behavior in Hurricane Lili." *J. Appl. Soc. Psychol.* 37 (4): 887–903. https://doi.org/10.1111/j.1559-1816.2007.00191.x.

Khan, M. S. A. 2008. "Disaster preparedness for sustainable development in Bangladesh." *Disaster Prev. Manage. Int. J.* 17 (5): 662–671. https://doi.org/10.1108/09653560810918667.

Kreibich, H., M. Müller, K. Schröter, and A. H. Thieken. 2017. "New insights into flood warning reception and emergency response by affected parties." *Nat. Hazards Earth Syst. Sci.* 17 (12): 2075–2092. https://doi.org/10.5194/nhess-17-2075-2017.

Li, J., Y. Chen, H. Wang, J. Qin, J. Li, and S. Chiao. 2017. "Extending flood forecasting lead time in a large watershed by coupling WRF QPF with a

distributed hydrological model." *Hydrol. Earth Syst. Sci.* 21 (2): 1279–1294. https://doi.org/10.5194/hess-21-1279-2017.

Lindell, M. K., S. Arlikatti, and C. S. Prater. 2009. "Why people do what they do to protect against earthquake risk: Perceptions of hazard adjustment attributes." *Risk Anal. Int. J.* 29 (8): 1072–1088. https://doi.org/10.1111/j.1539-6924.2009.01243.x.

Lindell, M. K., and R. W. Perry. 2012. "The protective action decision model: Theoretical modifications and additional evidence." *Risk Anal. Int. J.* 32 (4): 616–632. https://doi.org/10.1111/j.1539-6924.2011.01647.x.

Martin, I. M., H. Bender, and C. Raish. 2007. "What motivates individuals to protect themselves from risks: The case of wildland fires." *Risk Anal. Int. J.* 27 (4): 887–900. https://doi.org/10.1111/j.1539-6924.2007.00930.x.

McCaughey, J. W., I. Mundir, P. Daly, S. Mahdi, and A. Patt. 2017. "Trust and distrust of tsunami vertical evacuation buildings: Extending protection motivation theory to examine choices under social influence." *Int. J. Disaster Risk Reduct.* 24 (Sep): 462–473. https://doi.org/10.1016/j.ijdrr.2017.06.016.

McCormick, L. C., J. Pevear III, A. C. Rucks, and P. M. Ginter. 2014. "The effects of the April 2011 tornado outbreak on personal preparedness in Jefferson County, Alabama." *J. Public Health Manage. Pract.* 20 (4): 424–431. https://doi.org/10.1097/PHH.0b013e3182a45104.

Miller, C. H., B. J. Adame, and S. D. Moore. 2013. "Vested interest theory and disaster preparedness." *Disasters* 37 (1): 1–27. https://doi.org/10.1111/j.1467-7717.2012.01290.x.

Najafi, M., H. R. Khankeh, H. Elmi, and N. Pourvakhshoori. 2018. "Behavioral, normative and control beliefs about earthquake preparedness: A deductive content analysis study." *PLoS Curr.* 10. https://doi.org/10.1371/currents.dis.20fbad29d53fb164ac2699dc2736d804.

National Research Council. 1991. *A safer future: Reducing the impacts of natural disasters*. Washington, DC: National Academies Press.

National Weather Service. 2020. "Hurricane and tropical storm watches, warnings, advisories and outlooks." Accessed November 20, 2020. https://www.weather.gov/safety/hurricane-ww.

Nguyen, L. H., H. Shen, D. Ershoff, A. A. Afifi, and L. B. Bourque. 2006. "Exploring the causal relationship between exposure to the 1994 Northridge earthquake and pre-and post-earthquake preparedness activities." *Earthquake Spectra* 22 (3): 569–587. https://doi.org/10.1193/1.2219108.

Omelicheva, M. Y. 2011. "Natural disasters: Triggers of political instability?" *Int. Interact.* 37 (4): 441–465. https://doi.org/10.1080/03050629.2011.622653.

Parker, D., S. Tapsell, and S. McCarthy. 2007. "Enhancing the human benefits of flood warnings." *Nat. Hazards* 43 (3): 397–414. https://doi.org/10.1007/s11069-007-9137-y.

Paton, D. 2003. "Disaster preparedness: A social-cognitive perspective." *Disaster Prev. Manage. Int. J.* 12 (3): 210–216. https://doi.org/10.1108/09653560310480686.

Quigley, M. C., J. Attanayake, A. King, and F. Prideaux. 2020. "A multihazards earth science perspective on the COVID-19 pandemic: The potential for concurrent and cascading crises." *Environ. Syst. Dec.* 40 (2): 199–215. https://doi.org/10.1007/s10669-020-09772-1.

Ripley, A. 2006. "Why we don't prepare for disasters." Accessed November 21, 2020. http://docs.msl.mt.gov/Central_Services/Safety/Articles/dontprepare.pdf.

Rogers, R. W. 1975. "A protection motivation theory of fear appeals and attitude change." *J. Psychol.* 91 (1): 93–114. https://doi.org/10.1080/00223980.1975.9915803.

Shaluf, I. M. 2007. "An overview on disasters." *Disaster Prev. Manage. Int. J.* 16 (5): 687–703. https://doi.org/10.1108/09653560710837000.

Shaw, R., K. S. H. Kobayashi, and M. Kobayashi. 2004. "Linking experience, education, perception and earthquake preparedness." *Disaster Prev. Manage. Int. J.* 13 (1): 39–49. https://doi.org/10.1108/09653560410521689.

Shenk, D., B. Ramos, K. J. Kalaw, and I. Tufan. 2009. "History, memory, and disasters among older adults: A life course perspective." *Traumatology* 15 (4): 35–43. https://doi.org/10.1177/1534765609359729.

Staupe-Delgado, R. 2019. "Progress, traditions and future directions in research on disasters involving slow-onset hazards." *Disaster Prev. Manage. Int. J.* 28 (5): 623–635. https://doi.org/10.1108/DPM-11-2018-0358.

Tang, J.-S., and J.-Y. Feng. 2018. "Residents' disaster preparedness after the Meinong Taiwan earthquake: A test of protection motivation theory." *Int. J. Environ. Res. Public Health* 15 (7): 1434. https://doi.org/10.3390/ijerph15071434.

Thieken, A. H., H. Kreibich, M. Müller, and B. Merz. 2007. "Coping with floods: Preparedness, response and recovery of flood-affected residents in Germany in 2002." *Hydrol. Sci. J.* 52 (5): 1016–1037. https://doi.org/10.1623/hysj.52.5.1016.

Thirugnanam, H., M. V. Ramesh, and V. P. Rangan. 2020. "Enhancing the reliability of landslide early warning systems by machine learning." *Landslides* 17 (9): 2231–2246. https://doi.org/10.1007/s10346-020-01453-z.

Thomas, D. S., B. D. Phillips, W. E. Lovekamp, and A. Fothergill. 2013. *Social vulnerability to disasters*. Boca Raton, FL: CRC Press.

Trumbo, C., M. A. Meyer, H. Marlatt, L. Peek, and B. Morrissey. 2014. "An assessment of change in risk perception and optimistic bias for hurricanes among Gulf Coast residents." *Risk Anal.* 34 (6): 1013–1024. https://doi.org/10.1111/risa.12149.

Tuohy, R., C. Stephens, and D. Johnston. 2014. "Older adults' disaster preparedness in the context of the September 2010–December 2012 Canterbury earthquake sequence." *Int. J. Disaster Risk Reduct.* 9 (Sep): 194–203. https://doi.org/10.1016/j.ijdrr.2014.05.010.

United Nations International Strategy for Disaster Reduction. 2009. "2009 UNISDR terminology on disaster risk reduction." Accessed May 22, 2021. https://www.preventionweb.net/files/7817_UNISDRTerminologyEnglish.pdf.

United Nations Office for the Coordination of Humanitarian Affairs. 2008. "Glossary of humanitarian terms." Accessed May 17, 2021. https://www.who.int/hac/about/reliefweb-aug2008.pdf?ua=1.

US Census Bureau. 2018. "How ready are we?" Accessed November 22, 2020. https://www.census.gov/library/visualizations/2018/comm/how-ready-are-we.html.

USGS. 2020. "ShakeAlert." Accessed November 22, 2020. https://www.usgs.gov/natural-hazards/earthquake-hazards/shakealert.

Wang, F., J. Wei, and X. Shi. 2018. "Compliance with recommended protective actions during an H7N9 emergency: A risk perception perspective." *Disasters* 42 (2): 207–232. https://doi.org/10.1111/disa.12240.

Wei, J., D. Zhao, F. Yang, S. Du, and D. Marinova. 2010. "Timing crisis information release via television." *Disasters* 34 (4): 1013–1030. https://doi.org/10.1111/j.1467-7717.2010.01180.x.

Xu, D., L. Peng, S. Liu, and X. Wang. 2018. "Influences of risk perception and sense of place on landslide disaster preparedness in southwestern China." *Int. J. Disaster Risk Sci.* 9 (2): 167–180. https://doi.org/10.1007/s13753-018-0170-0.