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ORIGINAL ARTICLE

# Are you prepared for the next storm? Developing social norms messages to motivate community members to perform disaster risk mitigation behaviors

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**Abstract**

Preparing for natural disasters and adapting to climate change can save lives. Yet, minimal research has examined how governments can motivate community members to prepare for disasters (e.g., purchasing flood insurance or installing water barriers in homes for floods and hurricanes). Instead, studies have focused on how to communicate actions individuals should take during disasters, rather than before disasters. This study develops messages targeting social norms, which are promising approaches to motivate community members to adopt disaster risk preparedness and mitigation behaviors. Specifically, we developed a variety of messages integrating descriptive norms (i.e., what others do), injunctive norms (i.e., what others believe should be done), and a social norms-based fear appeal, or social disapproval rationale (i.e., a negative social result of [not] taking behaviors). Then, we tested these messages through two between-subject factorial online experiments in flood- and hurricane-prone U.S. states with adult samples ($N = 2{,}286$). In experiment 1 (i.e., purchasing flood insurance), the injunctive norms message using weather forecasters and the social disapproval rationale message significantly increased social norms perceptions, which in turn influenced behavioral intentions. In experiment 2 (i.e., installing water barriers), the injunctive norms message using weather forecasters, the injunctive norms message using neighbors, and the social disapproval rationale message significantly increased social norms perceptions, which in turn influenced mitigation intentions. However, the descriptive social norms message was not effective in increasing social norms perceptions. We provide some of the first empirical evidence on how organizations' risk communication can empower community members to prepare and mitigate the impact of disasters.

**KEYWORDS**
climate change adaptation, disaster risk reduction, nudge, risk and crisis communication, social norms, disaster preparedness

## 1 | INTRODUCTION

Every year, extreme weather events increase in frequency and scale with climate change, resulting in loss of life, property damage, and environmental destruction (IPCC, 2022; NOAA, 2022). Governments can save lives and mitigate costs of extreme weather events if they employ risk communication to motivate community members' preparedness behaviors before disasters occur (Multihazard Mitigation Council, 2017; Thieken et al., 2016). However, most risk communication research has focused on disaster warnings rather than mitigation and preparedness messages (e.g., Rahn et al., 2020; Wood et al., 2018).

Another gap is research testing risk communication using experiments to establish causal relationships (Kellens et al., 2013; Scovell et al., 2021). Doing so is especially important

for scientists in the weather domain who report a lack of risk communication knowledge (Liu et al., 2020). Among many promising psychological factors that can be integrated into disaster mitigation and preparedness messaging (e.g., risk perception, self-efficacy, response efficacy), messages that incorporate social norms are especially promising for changing behaviors (Bubeck et al., 2018; Lim, 2022; Slotter et al., 2020).

Social norms are "a common behavior or practice" and "an average outcome or output standard" (Miller & Prentice, 2016, p. 240), which can impact individuals' perceptions of social expectations and behaviors (Ajzen, 2011; Cialdini, 2012). In the disaster warning literature, observing others' behaviors (i.e., social norms) is predictive of message compliance (Lindell & Perry, 2012; Wood et al., 2018). To date, researchers have not examined how a variety of social norms can be integrated into messages to motivate individuals' disaster mitigation behaviors. From the broader literature, we know that descriptive norms (i.e., how common and prevalent behaviors are among group members), and injunctive norms (i.e., whether a social group commonly approves or disapproves of behaviors) are two social norms that, when integrated into risk messages, can encourage individuals to engage in behaviors (Goldstein et al., 2007; Nolan et al., 2008). From the literature, we also know that social norms-based fear appeals (e.g., social disapproval rationale in messages about a negative social result of not taking behaviors) can motivate individuals to engage in behaviors (Pechmann et al., 2003; Vermeir et al., 2017). Social norms messages have been suggested in health and environment contexts to reduce excessive alcohol use (Neighbors et al., 2010), motivate smoking cessation (Record et al., 2017), and increase organ donation (Park & Smith, 2007), water preservation (Liang et al., 2018), climate adaptation and disaster risk reduction (Lim, 2022), and pro-environmental behaviors (Byerly et al., 2018; Goldstein et al., 2007).

This study is the first to test a variety of social norms messages, including interaction effects using a factorial design, in the weather and climate disaster mitigation context. In doing so, we develop messages that can be applied to flood and hurricane risk communication to better prepare communities for disasters. We develop and test four social norms messages to motivate community members' disaster preparedness behaviors by using two between-subject online experiments manipulating four factors with adults living in hurricane-prone states (Alabama, Florida, Louisiana, Mississippi, North Carolina, and Texas) ($N = 2286$). In the next section, we review the literature that informed the studies' design.

## 2 | LITERATURE REVIEW

### 2.1 | Social norms

Social norms messages have been recommended for persuasive communication (Lim, 2022; Meyer & Kunreuther, 2017; O'Keefe, 2004), but have not been fully empirically tested in the disaster risk mitigation context. Scholars have theorized two types of social norms: descriptive and injunctive (e.g., Cialdini, 2012; Cialdini & Goldstein, 2004; Hallsworth et al., 2017). Descriptive social norms are information about how common and prevalent behaviors are among group members (i.e., what others do) (Cialdini & Goldstein, 2004). These norms serve as a cognitive shortcut for efficient decision making (Goldstein et al., 2007; Nolan et al., 2008). Injunctive social norms provide information about whether a social group commonly approves or disapproves of behaviors (e.g., what others believe should be done), which helps individuals gain and maintain social approval (Cialdini & Goldstein, 2004). Injunctive norms are either the *rewards* for aligning with others or the *punishment* for not aligning with others (Cialdini et al., 2006; Hallsworth et al., 2017).

Only a few experimental studies have tested social norms messages in disaster preparedness contexts, such as earthquakes and wildfires (e.g., Dickinson et al., 2020; Howe et al., 2018; Vinnell et al., 2019), which can inform the design of messages for risk mitigation in hurricane and flood contexts. Only one study in a flood preparedness context has tested descriptive social norms (Mol et al., 2021), although floods are one of the most common disasters in the United States. (FEMA, 2021). In the following section, we delve more into the prior research.

### 2.2 | Descriptive social norms messages with mixed empirical findings

Prior research showed that descriptive norms messages effectively motivate desired behavioral change in nondisaster contexts, such as smoking cessation and tax compliance (Cialdini et al., 2006; Goldstein et al., 2007; Hallsworth et al., 2017). However, in disaster risk mitigation contexts, studies have shown mixed findings for descriptive norms messages (Dickinson et al., 2020; Howe et al., 2018; Mol et al., 2021; Vinnell et al., 2019).

Most studies found that descriptive norms messages did not increase behavioral intentions to mitigate disaster risks (Dickinson et al., 2020; Mol et al., 2021). To illustrate, one study in the wildfire context found that messages showing neighbors with appropriate levels of vegetation around their homes made individuals less likely to engage in wildfire mitigation behaviors (Dickinson et al., 2020). Also, showing descriptive norms messages did not elicit more support for flood preparedness investment among homeowners than the control group (Mol et al., 2021).

However, one study found that descriptive norms messages were effective in the wildfire preparedness context (Howe et al., 2018). Researchers found that descriptive norms messages elicited significantly more preparedness behaviors (e.g., discussing how road closures impact evacuation plans) than the no stimuli condition. Another study in the earthquake context found that descriptive norms messages did not increase support for legislation to strengthen buildings

for earthquakes, but the messages increased the perceived feasibility of strengthening work (Vinnell et al., 2019).

One possible explanation for these mixed findings is that studies have employed different approaches to communicating descriptive norms. Some scholars used a general statement to manipulate descriptive norms. For example, Howe et al. (2018) used "many people" (p. 3). Other scholars used percentages to manipulate descriptive norms. For instance, Mol et al. (2021) used "68% of homeowners have installed at least one measure" (p. 18). One challenge of employing descriptive norms messages is that few community members typically engage in disaster risk mitigation behaviors (Brody et al., 2017; Lim, 2021; Peacock, 2003), making it challenging to accurately include percentages in messages. Unlike other contexts, such as health and environment behaviors (Cialdini et al., 2006; Goldstein et al., 2007; Hallsworth et al., 2017), employing vague language like "many" may not be the most persuasive approach (Grazzini et al., 2018; Qin et al., 2020) in a disaster context, where not many people engage in the behavior, although only one study (Howe et al., 2018) found that descriptive norm messages using "many people" (p. 3) were effective in the wildfire context.

To overcome these challenges, this study uses the raw estimated number of people living in a state (e.g., "Over 10 million Florida residents have purchased flood insurance") for descriptive norms to give the impression that many people in the state have already taken these behaviors. In another context (e.g., voting), descriptive norms messages using raw numbers (e.g., "over three and a half million New Jersey citizens voted in last year's election") effectively motivated citizens to vote, especially those who vote occasionally or infrequently (Gerber & Rogers, 2009, p. 181). Given the prior literature, our two experiments pose the following hypothesis about descriptive norms messages:

**H1**: Descriptive norms messages (presence vs. absence) will (a) change social norms perceptions, which, in turn, will (b) change intentions to engage in mitigation behaviors.

## 2.3 | Injunctive social norms messages and norms references

Prior research showed that injunctive norms messages encouraged disaster mitigation behaviors for wildfires and earthquakes (Howe et al., 2018; Vinnell et al., 2019). For example, Vinnell et al. (2019) found that injunctive norms messages ("76% of Wellingtonians said they support this legislation requiring the strengthening of earthquake-prone buildings," p. 383) increased support for the proposed legislation. As another example, Howe et al. (2018) used injunctive norms messages ("Most people think that others should pay to have at least three of the actions," p. 3) combined with descriptive norms messages, which elicited significantly more wildfire preparedness behaviors than the no stimuli condition.

One limitation of the prior research is the use of reference groups. Identifying and collaborating with credible information sources is a best practice in risk communication (Liu et al., 2021; Seeger, 2006). It is important to identify the most appropriate social norms references when developing effective social norms messages (Bicchieri & Dimant, 2019). Indeed, Ajzen (2006) instructed researchers to identify social norms references by asking people in the targeted population who would think that they should perform a specific behavior and then assessing their motivation to comply with the reference individual or group. Importantly, if people think that the target audience does not have to engage in mitigation behaviors and risk communicators use a message that is inconsistent with these beliefs, messages can backfire (Bicchieri & Dimant, 2019; Mol et al., 2021).

To support developing effective messages, scholars have identified references that may be appropriate in hurricane and flood mitigation contexts (Kranzler et al., 2020; Lim, 2021; Petrun Sayers et al., 2021). Previous research indicates that weather forecasters and local television broadcasters are the most used and influential information sources for hurricane risks (Kleier et al., 2018; Lim, 2021; Petrun Sayers et al., 2021). Additionally, coastal homeowners living in hurricane-prone states reported that insurance providers, family, and community members (e.g., neighbors and friends) are important to consider when thinking about taking hurricane protective measures (Kranzler et al., 2020). Specifically, construal level theory (CLT) explains that people understand objects and events based on the perceived psychological distance between the individual and the event (Trope et al., 2007). These feelings of psychological distance are impacted by space, time, social distance, and uncertainty/hypotheticality (Bar-Anan et al., 2006; Trope et al, 2007). As applied to the current context, neighbors can be psychologically close references geographically and socially, while individuals often believe that climate risks are distant psychologically, geographically, temporally, socially, and in terms of uncertainty (Leiserowitz, 2005; Roeser, 2012; Spence et al., 2012). To date, these references (e.g., weather forecasters, neighbors) have not been tested in injunctive norms messages despite the evidence suggesting their importance. Thus, our two experiments use weather forecasters and neighbors as injunctive norms references, and propose the following hypotheses:

**H2**: Injunctive norms messages using *weather forecasters* (presence vs. absence) will (a) increase social norms perceptions, which, in turn, will (b) increase intentions to engage in mitigation behaviors.

**H3**: Injunctive norms messages using *neighbors* (presence vs. absence) will (a) increase social norms perceptions, which, in turn, will (b) increase intentions to engage in mitigation behaviors.

## 2.4 | Social fear appeal: Social disapproval rationale

While descriptive and injunctive norms messaging shows promise in prompting mitigation behaviors, these messages might not be enough to motivate mitigation behaviors given the overall low rate of mitigation behaviors in society (Brody et al., 2017; Kranzler et al., 2020; Lim, 2021). It could also be that messages need to explain the rationale for social disapproval to enhance the perception of social norms in the disaster mitigation context.

Fear appeals can be applied to physical threats and to social threats (Schoenbachler & Whittler, 1996; Tanner et al., 1991). Initially, Tanner et al. (1991) extended threat and fear appeals in the protection motivation theory (PMT) (Floyd et al., 2000; Rogers, 1975) to a social context with perceived social costs of condom use for sexually transmitted diseases (STDs) stigma. Since people are sensitive to social evaluation (Dickerson et al., 2008), social disapproval messages were tested to be effective in various contexts (i.e., smoking, shoplifting) (Pechmann et al., 2003; Vermeir et al., 2017), and have been shown to be even more effective than physical threats in contexts such as drug use and tooth brushing (Evans et al., 1970; Schoenbachler & Whittler, 1996).

Providing social disapproval rationale in messages about a negative social result of (not) taking behaviors may also be effective in the disaster mitigation context, yet research has not examined this possibility. Still, in a hurricane context, Kranzler et al. (2020) indicated coastal homeowners believed that not performing hurricane preparedness behaviors may result in damaging property and decreasing the financial value of one's property, which may enhance social disapproval for mitigation behaviors. In fact, damaged and detached building components from high wind and water have damaged nearby buildings during hurricanes (Amini & Memari, 2020; FEMA, 2005). Additionally, communities experiencing hurricane damage have experienced a decrease in their property values (Bin & Polasky, 2004). Given that providing explicit negative social evaluation is critical in social norms-based fear appeals (Dickerson et al., 2008), we hypothesize that providing social consequences, disapproval, and threat can increase social norms perceptions and behavioral engagement in a natural disaster context. Given the prior research, our two experiments propose the following hypothesis:

**H4**: Social fear appeal, or social disapproval rationale, messages (presence vs. absence) will (a) increase social norms perceptions, which in turn will (b) increase intentions to engage in mitigation behaviors.

## 2.5 | Interactions among social norms messages

In order to compare the effectiveness of messages, we need to simultaneously compare messages of interest using experimental studies (O'Keefe, 2017). This also applies when multiple messages are shown together. In particular, experiments with factorial designs can be useful when research includes two or more messages, each with at least two levels (e.g., present vs. absent) (Shadish et al., 2002). Factorial designs allow researchers to "test whether a combination of treatments is more effective than one treatment" by testing "interactions among factors" (Shadish et al., 2002, p. 264).

Prior studies in the disaster context have not fully examined the interactions among message factors using a factorial design with some notable exceptions (Howe et al., 2018; Vinnell et al., 2019). For example, Vinnell et al. (2019) compared descriptive, injunctive, and combined norms messages. They found that the combined messages group significantly impacted policy support and feasibility judgment in the earthquake context, which supports our contention that these factors may work better together. Also, when Howe et al. (2018) compared descriptive, injunctive, and combined social norms conditions with a control condition in a wildfire context, they found that the descriptive and combined conditions significantly impacted participants' behaviors compared to the control condition, but there was not a significant difference among the descriptive and combined social norms messages.

Moreover, most social norms messages are used in combination in practice (e.g., GetThru.govt.nz, 2021; Ready.gov, 2021). Thus, it is ecologically valid to examine how these messages can impact behaviors in combination rather than simply comparing two or three distinct messages. Additionally, people may differently infer and interpret messages when they read different types of social norms messages in combination together, compared to when they separately read each message (Bicchieri & Dimant, 2019).

Extending the prior research, we used a factorial design in online experiments with descriptive norms, injunctive norms, and disapproval rationale messages, which provide insight into how the combinations of messages work in the disaster mitigation context. Because the prior research did not provide enough evidence to guide hypotheses for different message combinations and interactions among social norms messages using a factorial design, our two experiments answer the following research question:

**RQ1**: How, if at all, do descriptive norms, injunctive norms using weather forecasters, injunctive norms using neighbors, and disapproval rationale messages interact to (a) predict social norms perceptions, which

in turn can (b) influence intentions to engage in mitigation behaviors?

## 3 | METHOD

We conducted two online between-subject experiments ($N = 2{,}286$) with a 2 (descriptive norms: present vs. absent) × 2 (injunctive norms from weather forecasters: present vs. absent) × 2 (injunctive norms from neighbors: present vs. absent) × 2 (social fear appeal – social disapproval rationale: present vs. absent) factorial design. First, experiment 1 tested social norms messages for purchasing flood insurance ($n = 1{,}159$). Then, experiment 2 tested social norms messages for installing water barriers for water and wind risks from hurricanes ($n = 1{,}127$). These mitigation behaviors are effective and relatively easy to adopt (FEMA, 2013; Osberghaus, 2017). Additionally, people have not fully adopted these behaviors (Brody et al., 2017; Lim, 2021; Peacock, 2003), meaning there is potential to increase the adoption through effective risk communication.

### 3.1 | Procedures

Participants were recruited through Amazon's Mechanical Turk (MTurk) crowdsourcing platform for both experiments. Participants were restricted to people of 18 years or older living in hurricane-prone states in the United States who have MTurk reputations of 95% or higher and have completed at least 100 HITs (i.e., completed 100 tasks on MTurk and did not have more than 5% of their tasks rejected), following best practices in conducting social science experiments on MTurk (Cunningham et al., 2017; Peer et al., 2014).

Potential participants were provided a brief description of the two experiments and completed a brief eligibility screener (e.g., being 18 years or older, location of residence). Eligible participants were taken to the online study and completed the consent process; those who were not eligible exited the study and were thanked. Participants were randomly assigned to one of the conditions and exposed to the stimuli. Participants viewed a mock government campaign (i.e., Ready.gov) Facebook post. To ensure exposure to the message, participants listened to professional voiceover audio-recordings when reading the stimuli. Then, participants were asked to respond to measures for social norms perceptions and mitigation behavioral intentions. Participants were compensated for their time in accordance with Institutional Review Board (IRB) guidelines. Our experiments were approved by the University of Maryland IRB (approval # 1604257-2).

### 3.2 | Participants

Residents in flood and hurricane-prone U.S. states ($N = 2{,}286$) participated in the study between August and September 2020. Based on the number of federal disaster declarations (FEMA, 2021), residents from the following states were included in our sample: Alabama, Florida, Louisiana, Mississippi, North Carolina, and Texas. Overall, participants' demographic mirrored the demographics of each state's residents (U.S. Census, 2021). See the Supporting Information Appendix for more information about participants and state residents. Further details also are provided below.

#### 3.2.1 | Experiment 1: Social norms messages for purchasing flood insurance

In experiment 1 ($n = 1{,}159$), participants' mean age was 37.30 ($SD = 11.53$, $Min = 18$, $Max = 79$). In terms of sex, 547 participants identified as male (47.2%), 604 as female (52.1%), and 6 preferred not to identify their sex (0.5%). Participants averaged 21.42 min to complete experiment 1.

#### 3.2.2 | Experiment 2: Social norms messages for installing water barriers

In experiment 2 ($n = 1{,}127$), participants' mean age was 37.41 ($SD = 11.27$, $Min = 18$, $Max = 74$). In terms of sex, 543 participants identified as male (48.2%), 579 as female (51.4%), and 5 preferred not to identify their sex (0.4%). Participants averaged 29.36 min to complete experiment 2.

### 3.3 | Developing social norms messages

We developed the stimuli using materials from previous studies and government mitigation messages to increase ecological validity (see the Supporting Information Appendix). A Facebook post was selected as the message format for both experiments because Facebook is a common government communication channel for emergency management agencies (e.g., Ready.gov, 2021; Verrucci et al., 2016). To develop the studies' stimuli, we collected FEMA's Ready.gov Facebook posts for floods and hurricane risks ($N = 51$) from July 2019 to April 2020, which was the timeframe before we launched experiments 1 and 2. The stimuli were iteratively reviewed in consultation with eight communication experts (i.e., professionals with at least 5 years of industry experience), which were recruited using nonprobability sampling.

#### 3.3.1 | Descriptive norms messages

We used the raw estimated number of people for descriptive norms to give the impression that a significant number of people in a U.S. state have already taken the target behavior. We also used state residents, as prior research found that family (e.g., partners, parents), community (e.g., everyone, my community), and people who live inland could be effective descriptive norm references (Kranzler et al., 2020). We

estimated the populations who may have used flood barriers and purchased flood insurance in each target state based on previous research (e.g., Lim, 2021). To illustrate, a message Floridians received in experiment 1 was: "Over 10 million Florida residents have purchased flood insurance."

#### 3.3.2 | Injunctive norms using weather forecasters messages

Based on previous research (Kleier et al., 2018; Lim, 2021; Petrun Sayers et al., 2021), we used weather forecasters as the injunctive norms reference. To illustrate, a message in experiment 2 read: "All of your local weather forecasters agree that everyone living in hurricane-prone areas should install water barriers."

#### 3.3.3 | Injunctive norms using neighbors messages

Previous survey research (Kranzler et al., 2020) found that neighbors are important references for hurricane mitigation behaviors. Hence, we used neighbors as the injunctive norms reference. To illustrate, a message in experiment 1 reads: "Most of your neighbors think you should purchase flood insurance."

#### 3.3.4 | Social fear appeal: Social disapproval rationale messages

Kranzler et al. (2020) indicated that at-risk publics believe that not performing hurricane preparedness behaviors may result in damaging property and decreasing the financial value of one's property, which may enhance approval or disapproval for mitigation behaviors. Hence, we used this as our social disapproval rationale. A message in experiments 1 and 2 reads: "Because if you don't, your damaged home can harm others' homes and lower your community's property values."

### 3.4 | Stimuli check

We collected feedback on the message manipulations to ensure that the target population would easily understand the messages for the intended purpose. Using Amazon MTurk, 68 participants (flood insurance messages: $n = 38$, flood barrier messages: $n = 30$) from flood- and hurricane-prone states reviewed the stimuli messages. Participants were asked to describe the purpose of the messages using their own words, highlight any confusing or unclear wording, and rate the purpose of the messages on a 0 to 100 scale with options of 0 "No match at all" and 100 "A perfect match" compared to the definitions provided. All participants qualitatively reported the messages' purposes as corresponding to the intended purposes (e.g., "installation of barriers"; "purchasing flood insurance"). The match ratings for the messages' purposes ranged between 75.6 and 82.2.

### 3.5 | Measures

#### 3.5.1 | Descriptive social norms

Adapted from Bubeck et al. (2013), Lim (2022), and Vinnell et al. (2019), descriptive social norms were assessed by four items. The first item, a question, was "To what extent do your neighbors purchase flood insurance (experiment 1)/install water barriers (experiment 2) to prepare for hurricanes?" and was rated on a seven-point Likert type scale (1 = *never*, 4 = *sometimes*, 7 = *a lot*). The other three statements were rated on a 7-point Likert type scale (1 = *none of them*, 7 = *most of them*). An example item is: "Many people like me have purchased flood insurance (experiment 1)/installed water barriers (experiment 2)."

#### 3.5.2 | Injunctive social norms

Adapted from Bates et al. (2009), Lim (2022), and Vinnell et al. (2019), injunctive social norms were assessed with four questions on a 7-point Likert type scale (1 = *never*, 4 = *sometimes*, 7 = *a lot*). An example item is: "Most people who are important to me think that I should purchase flood insurance (experiment 1)/install water barriers (experiment 2)."

#### 3.5.3 | Mitigation behavioral intentions

Adapted from prior research (e.g., Lim, 2022; Terpstra & Lindell, 2013; Wilson et al., 2019), mitigation behavioral intentions were measured by asking three questions: "In the future, I intend to purchase flood insurance (experiment 1)/install water barriers (experiment 2) for future hurricanes," "Do you intend to purchase flood insurance (experiment 1)/install water barriers (experiment 2) in the near future for future hurricanes?," and "Would you intend to purchase flood insurance (experiment 1)/install water barriers (experiment 2) for future hurricanes?," on a 7-point Likert type scale (1 = *strongly disagree*, *certainly not*, *highly unlikely*, 7 = *strongly agree*, *certainly*, *highly likely*).

## 4 | ANALYSIS

To test the hypothesized model, we employed structural equation modeling (SEM) using Mplus 8.4 (Muthén & Muthén, 2017). We used confirmatory factor analysis and latent variable path analysis with the multiple-indicator-multiple-cause (MIMIC) approach (Breitsohl, 2019; Hayes & Preacher, 2014). Using the MIMIC approach with indicator coding, the unstandardized SEM coefficients show mean differences between the control and treatment group.

**TABLE 1** Measurement and structural model fit

| | | Satorra-Bentler $\chi^2$ | *df* | *p* | RMSEA | 90%CI | CFI | SRMR |
|---|---|---|---|---|---|---|---|---|
| Hu and Bentler's (1999) criteria: | | | | | < = 0.06 | | > = 0.95 | < = 0.08 |
| **Measurement model fit** | Experiment 1: Flood Insurance | 218.934 | 43 | 0 | 0.059 | [0.052, 0.067] | 0.98 | 0.02 |
| | Experiment 2: Water Barriers | 184.6 | 41 | 0 | 0.056 | [0.048, 0.064] | 0.985 | 0.018 |
| **Structural model fit** | Experiment 1: Flood Insurance | 428.658 | 178 | 0 | 0.035 | [0.031, 0.039] | 0.978 | 0.014 |
| | Experiment 2: Water Barriers | 608.309 | 178 | 0 | 0.046 | [0.042, 0.050] | 0.966 | 0.017 |

All models were fitted using the Satorra–Bentler adjustment, given that nonnormality in social science data is prevalent (Mueller & Hancock, 2019). The Satorra–Bentler adjustment accounts for the nonnormality of the data when estimating standard errors of parameter estimates and goodness of fit indices. The model fit was evaluated with Hu and Bentler's (1999) criteria: root mean squared error of approximation (RMSEA) 0.06 or lower, standardized root mean squared residual (SRMR) 0.08 or lower, and Comparative Fit Index (CFI) 0.95 or higher. These thresholds are not immutable (e.g., Marsh et al., 2004), but provide general guidance. We followed a two-phase modeling process to diagnose and validate the measurement model because we used latent variables in the model (Anderson & Gerbing, 1988). This two-phase modeling process began with the measurement phase and then moved to the structural phase.

When there were significant interactions between the experimental message factors, we examined the 95% confidence intervals of the estimated means through the "Rule of Eye 4," inference using confidence intervals, which relies on the proportion overlap between the 95% confidence intervals of the estimated means and the average margin of error, following Cumming and Finch (2005, pp. 175–176).

## 4.1 | Measurement models

In the first measurement phase, for both experiments, the model was specified so that all latent variables were allowed to covary freely to see if the measurement model achieved an acceptable fit. Additionally, the correlations among factors were examined to ensure discriminant validity. All factor correlations were below 0.80 (i.e., 64% shared variance), except for the correlations between injunctive and descriptive norms. Principal component analysis (PCA) also indicated a one-factor solution for injunctive and descriptive norms. In other words, participants perceived these concepts as identical for flood and hurricane risks. Thus, we treated them as a single factor in the models for both experiments. The overall measurement models for both experiments indicated a great fit, meaning that the items sufficiently and reliably measured the latent constructs (see Table 1). The final models' correlations among the factors were examined again. All measures were reliable. Specifically, coefficient Hs are 0.953 for social norms and 0.940 for behavioral intentions in Experiment 1 (i.e., flood insurance), and .966 for social norms and 0.940 for behavioral intentions in Experiment 2 (i.e., water barriers).

## 4.2 | Structural models

To test our hypotheses and answer our research question, structural relations were formed among the factors for both experiments. The exogenous variables were each message manipulation and their interactions. Each message manipulation was dummy-coded (absent = 0 vs. present = 1). The models included all the multiplicative interaction terms across these manipulations. The mediating variable was social norms. The endogenous variables were behavioral intentions. The overall structural model indicated a great fit (see Table 1).

# 5 | EXPERIMENT 1: SOCIAL NORMS MESSAGES FOR PURCHASING FLOOD INSURANCE

In experiment 1, social norms messages were evaluated for purchasing flood insurance. We hypothesized that the presence of the specific norms factor message will increase social norms perceptions (compared to the absence of the message), which in turn will increase intentions to purchase flood insurance.

## 5.1 | Main effects (H1–H4)

The standardized path coefficients from the SEM analysis showed that the injunctive norms message using weather forecasters ($\beta = 0.185$, $p < 0.05$) and the disapproval rationale message ($\beta = 0.265$, $p < 0.05$) increased social norms perceptions. In turn, social norms strongly influenced behavioral intentions ($\beta = 0.846$, $p < 0.001$) (see Figure 1 and Table 2).

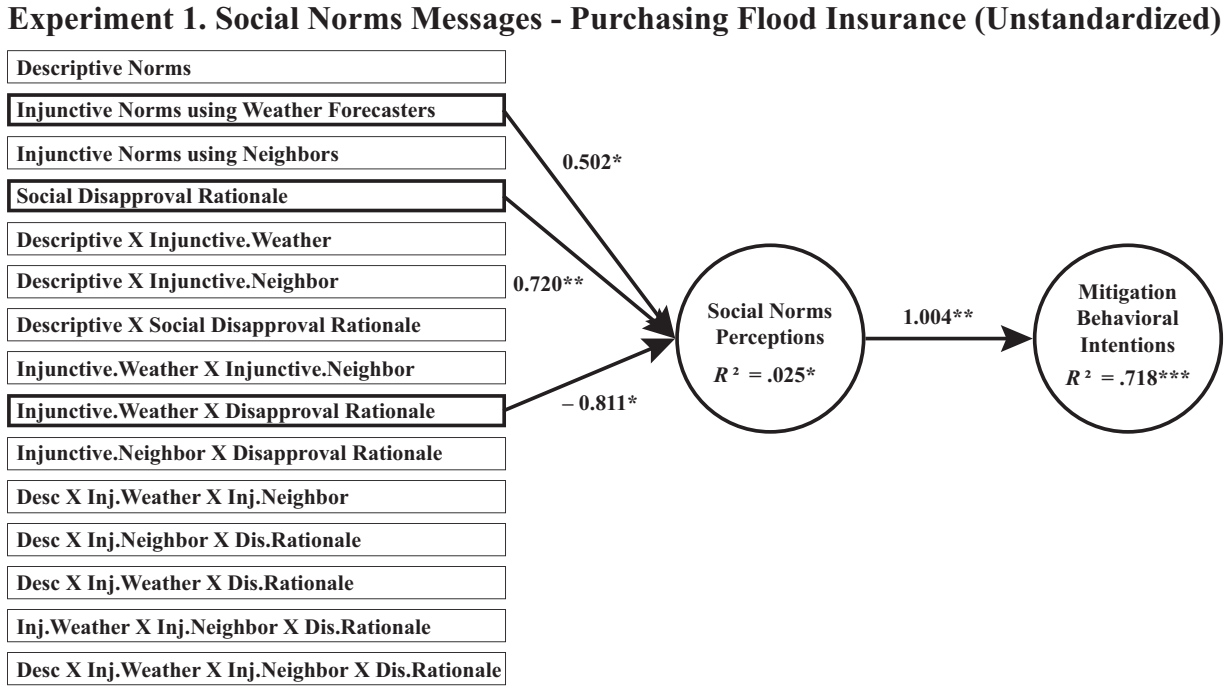


**FIGURE 1** Experiment 1. Social norms messages for purchasing flood insurance: SEM Results (Unstandardized). * significant at 0.05 level, ** significant at 0.01 level, *** significant at 0.001 level

**TABLE 2** Experiment 1: Social norms messages for purchasing flood insurance: Indirect, direct, and total effects (unstandardized)

| | Social norms perceptions | Mitigation behavioral intentions (Direct effects) | Mitigation behavioral intentions (Total effects) |
|---|---|---|---|
| Constant (No stimuli) | 4.174 | 4.317 | 4.318 |
| Descriptive Norms | 0.237 | 0.15 | 0.388 |
| Injunctive Norms (Weather Forecasters) | 0.502* | 0.242 | 0.746** |
| Injunctive Norms (Neighbors) | 0.286 | 0.139 | 0.426 |
| Social Disapproval Rationale | 0.72** | −0.114 | 0.609* |
| Descriptive × Injunctive.Weather | −0.25 | −0.315 | −0.566 |
| Descriptive × Injunctive.Neighbor | −0.044 | −0.138 | −0.182 |
| Descriptive × Disapproval Rationale | −0.482 | 0.148 | −0.336 |
| Injunctive.Weather × Injunctive.Neighbor | −0.125 | −0.307 | −0.432 |
| Injunctive.Weather × Dis.Rationale | −0.811* | −0.036 | −0.85* |
| Injunctive.Neighbor × Dis.Rationale | −0.446 | 0.021 | −0.426 |
| Desc × Inj.Weather × Inj.Neighbor | −0.46 | 0.204 | −0.257 |
| Desc × Inj.Neighbor × Dis.Rationale | 0.172 | − 0.169 | 0.004 |
| Desc × Inj.Weather × Dis.Rationale | 0.673 | −0.19 | 0.486 |
| Inj.Weather × Inj.Neighbor × Dis.Rationale | 0.054 | −0.05 | 0.005 |
| Desc × Inj.Weather × Inj.Neighbor × Dis.Rationale | 0.755 | 0.227 | 0.985 |
| Social Norms | | 1.004*** | |

*significant at 0.05 level,
**significant at 0.01 level,
***significant at 0.001 level.

**TABLE 3** Experiment 1. Social norms messages for purchasing flood insurance: Group means comparison—Social norms perceptions and mitigation behavioral intentions

| Groups | | Social norms perceptions | | Mitigation behavioral intentions | | |
|---|---|---|---|---|---|---|
| **Injunctive norms message using weather forecasters** | **Social disapproval rationale message** | ***M* (SE)** | | ***M* (SE)** | | |
| Present | Present | 4.663 (0.07) | b | 4.719 (0.09) | a | b |
| Present | Absent | 4.629 (0.08) | b | 4.833 (0.09) | a | b |
| Absent | Present | 4.692 (0.08) | b | 4.882 (0.09) | | b |
| Absent | Absent | 4.405 (0.07) | a | 4.664 (0.09) | a | |

*Note*: Means with different letters were significantly different based on proportion overlap between the 95% confidence intervals of the estimated means and the average margin of error at $p < .005$ (Cumming & Finch, 2005).

## 5.2 | Interaction effects (RQ1)

There was a two-way interaction between injunctive norms using weather forecasters and the social disapproval rationale messages in predicting social norms perceptions ($\beta = -0.259$, $p < 0.05$). Regarding the interaction, the results showed that using either the social disapproval rationale message only ($M = 4.69$), the weather forecaster injunctive norms message only ($M = 4.62$), or both ($M = 4.66$) showed significantly higher social norms perceptions than the no stimuli condition ($M = 4.40$) (see Table 3 and Figure 2). Although not hypothesized (as shown in Table 3 and Figure 3), using the disapproval rationale message only ($M = 4.83$) showed significantly higher behavioral intentions than the no stimuli condition ($M = 4.66$).

Thus, in experiment 1 (i.e., purchasing flood insurance), H2 (the injunctive norms message using weather forecasters) and H4 (the social disapproval rationale message) were supported for increasing social norms perceptions, which in turn increased intentions to purchase flood insurance. H1 (the descriptive norms message) and H3 (the injunctive norms message using neighbors) were rejected for increasing social norms perceptions, which we hypothesized would in turn increase intentions to purchase flood insurance. The overall model explained 2.5% of the variance for social norms and 71.8% of the variance for intentions to purchase insurance.

## 5.3 | Indirect effects

Although not hypothesized, the models included estimation of indirect effects (see the Supporting Information).

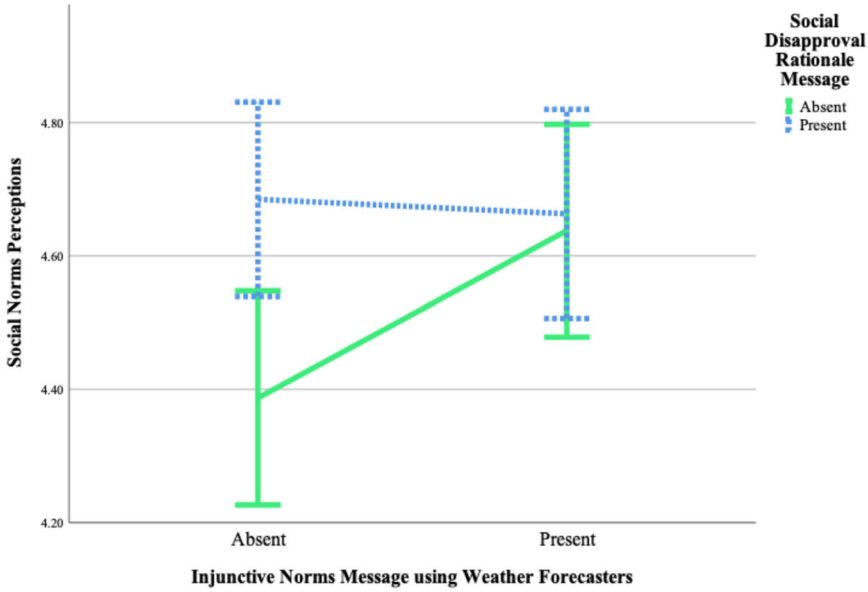


**FIGURE 2** Experiment 1: Social norms messages for purchasing flood insurance: interaction effects between the injunctive norms message using weather forecasters and the social disapproval rationale message in predicting social norms perceptions

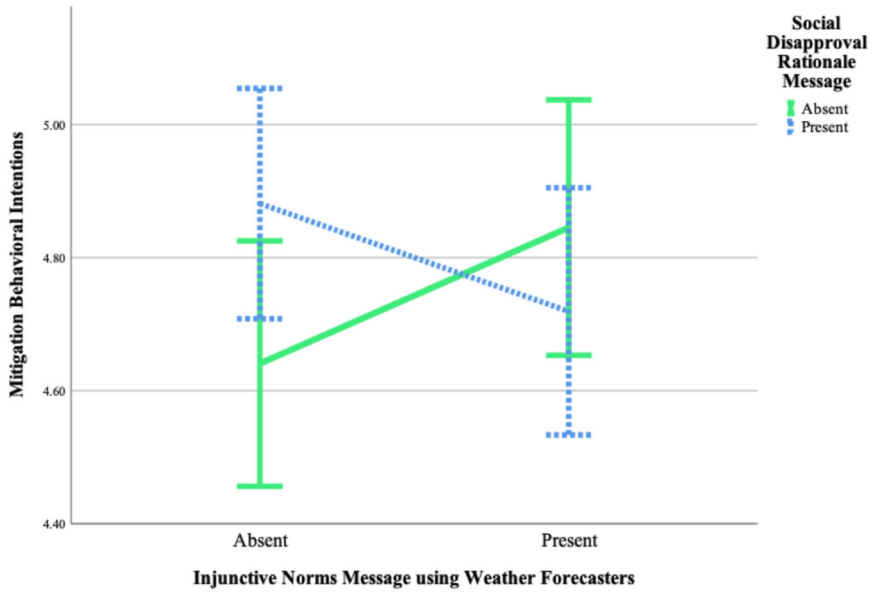


**FIGURE 3** Experiment 1: Social norms messages for purchasing flood insurance: Interaction effects between the injunctive norms message using weather forecasters and the social disapproval rationale message in predicting mitigation behavioral intentions

## 6 | EXPERIMENT 2: SOCIAL NORMS MESSAGES FOR INSTALLING WATER BARRIERS

In experiment 2, social norms messages were evaluated for installing water barriers. Like the previous experiment, our hypotheses were that the presence of the specific norms message will increase social norms perceptions (compared to the absence of a message), which in turn will increase intentions to install water barriers.

### 6.1 | Main effects (H1–H4)

The results of the standardized path coefficients from the SEM analysis showed that the injunctive norms message using weather forecasters ($\beta = 0.205$, $p < 0.05$), the injunctive norms message using neighbors ($\beta = 0.209$, $p < 0.05$), and the disapproval rationale message ($\beta = 0.210$, $p < 0.05$) increased social norms perceptions (see Figure 4 and Table 4).

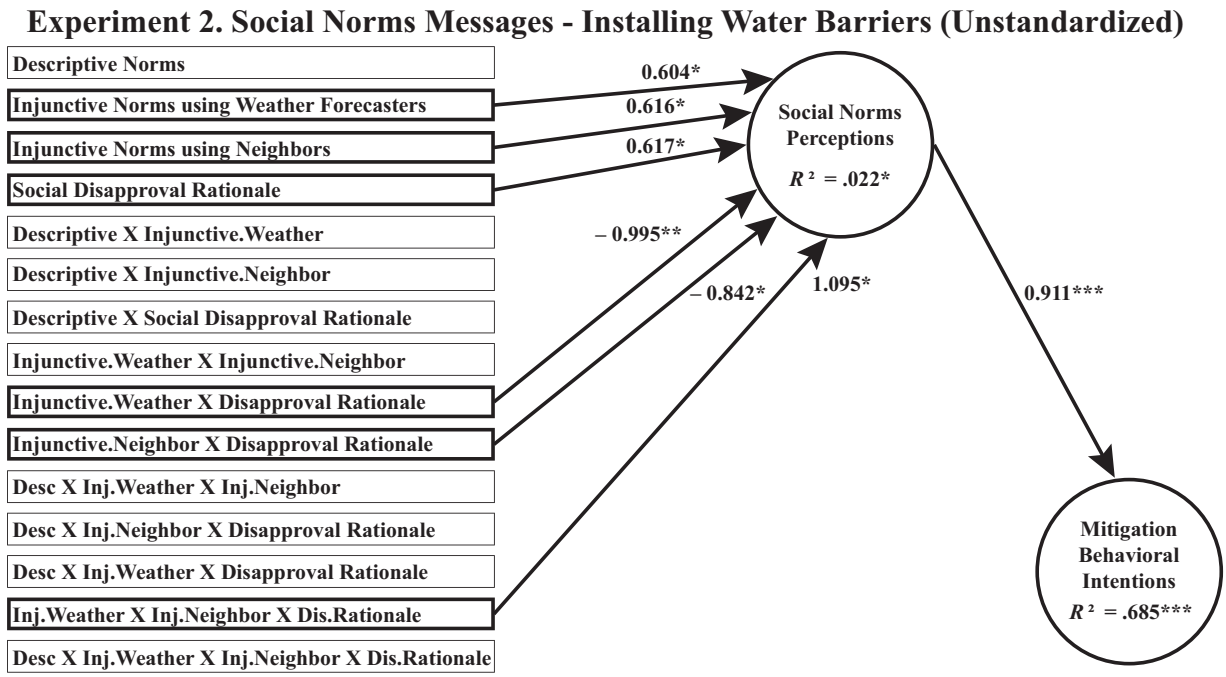


**FIGURE 4** Experiment 2: Social norms messages for installing water barriers: SEM results (unstandardized). *Significant at 0.05 level, **significant at 0.01 level, ***significant at 0.001 level

**TABLE 4** Experiment 2: Social norms messages for installing water barriers: Indirect, direct, and total effects (unstandardized)

| | Social norms perceptions | Mitigation behavioral intentions (Direct effects) | Mitigation behavioral intentions (Total effects) |
|---|---|---|---|
| Constant (No stimuli) | 3.703 | 4.166 | 4.161 |
| Descriptive Norms | 0.303 | −0.225 | 0.052 |
| Injunctive Norms (Weather Forecasters) | 0.604* | −0.15 | 0.40 |
| Injunctive Norms (Neighbors) | 0.616* | −0.242 | 0.319 |
| Social Disapproval Rationale | 0.617* | −0.263 | 0.299 |
| Descriptive × Injunctive.Weather | −0.32 | 0.119 | −0.173 |
| Descriptive × Injunctive.Neighbor | −0.187 | 0.028 | −0.143 |
| Descriptive × Disapproval Rationale | −0.397 | 0.359 | −0.003 |
| Injunctive.Weather × Injunctive.Neighbor | −0.528 | 0.108 | −0.374 |
| Injunctive.Weather × Dis.Rationale | −0.995** | 0.231 | −0.675 |
| Injunctive.Neighbor × Dis.Rationale | −0.842* | 0.353 | −0.414 |
| Desc × Inj.Weather × Inj.Neighbor | 0.376 | −0.002 | 0.34 |
| Desc × Inj.Neighbor × Dis.Rationale | 0.434 | −0.118 | 0.277 |
| Desc × Inj.Weather × Dis.Rationale | 0.579 | −0.369 | 0.158 |
| Inj.Weather × Inj.Neighbor × Dis.Rationale | 1.095* | −0.361 | 0.636 |
| Desc × Inj.Weather × Inj.Neighbor × Dis.Rationale | −0.722 | 0.037 | −0.621 |
| Social Norms | | 0.911*** | |

*significant at 0.05 level,
**significant at 0.01 level,
***significant at 0.001 level.

## 6.2 | Interaction effects (RQ1)

There were two, two-way interactions in predicting social norms. First, there was an interaction between the injunctive norms message using weather forecasters and the social disapproval rationale message ($\beta = -0.289$, $p < 0.01$) in predicting social norms. Second, there was an interaction between the injunctive norms message using neighbors and the social disapproval rationale message ($\beta = -0.246$, $p < 0.05$) in predicting social norms. Additionally, there was a three-way interaction among the injunctive norms message using weather forecasters, the injunctive norms message using neighbors, and the disapproval rationale messages ($\beta = 0.244$, $p < 0.05$) in predicting social norms. In turn, social norms strongly influenced mitigation intentions ($\beta = 0.832$, $p < 0.001$) (see Figure 4 and Table 4).

Regarding the three-way interaction, the results indicated that the absence of the three factors (i.e., absence of the injunctive norms message using weather forecasters, the injunctive norms message using neighbors, and the social disapproval rationale message) showed significantly lower social norms perceptions than any of the other combinations. However, having the injunctive norms messages using both weather forecasters and neighbors ($M = 4.51$), the injunctive norms message using only neighbors ($M = 4.37$), and having all three factors present ($M = 4.32$) showed significantly higher social norms perceptions than having both injunctive norms message using weather forecasters and social disapproval rationale message ($M = 4.06$) (see Table 5 and Figure 5).

Regarding the two-way interaction between the descriptive norms message and the social disapproval rationale message in predicting mitigation intentions (as shown in Table 6 and Figure 6), results indicated that having only an injunctive norms message using weather forecasters ($M = 4.50$) or only a social disapproval message ($M = 4.46$) showed significantly higher mitigation intentions than having both messages ($M = 4.25$).

Thus, in experiment 2 (installing water barriers), H2 (the injunctive norms message using weather forecasters), H3 (the injunctive norms message using neighbors), and H4 (the social disapproval rationale message) in predicting social norms were supported for increasing social norms perceptions, which in turn increased intentions to install water barriers. Additionally, H1 (the descriptive norms message) was rejected for increasing social norms perceptions. Social norms perceptions predicted behavioral intentions. The overall model explained 2.2% of the variance for social norms perceptions and 68.5% of the variance for intentions to purchase insurance.

**TABLE 5** Experiment 2: Social norms messages for installing water barriers: Group means comparison—Social norms perceptions

| Groups | | | Social norms perceptions | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Injunctive norms message using weather forecasters | Injunctive norms message using neighbors | Social disapproval rationale message | *M* (SE) | | | | | | |
| Present | Present | Present | 4.32 (0.12) | | | c | d | e | f |
| Present | Present | Absent | 4.51 (0.13) | | | c | | e | f |
| Present | Absent | Present | 4.06 (0.13) | | b | | | | |
| Present | Absent | Absent | 4.30 (0.13) | | b | | | | f |
| Absent | Present | Present | 4.17 (0.13) | | b | | d | | |
| Absent | Present | Absent | 4.37 (0.13) | | | c | d | | f |
| Absent | Absent | Present | 4.28 (0.12) | | b | | | e | |
| Absent | Absent | Absent | 3.80 (0.12) | a | | | | | |

*Note*: For social norms, there was a significant three-way interaction among the injunctive norms message using weather forecaster, the injunctive norms message using neighbors, and the social disapproval rationale message. Means with different letters were significantly different based on proportion overlap between the 95% confidence intervals of the estimated means and the average margin of error at $p < .05$ (Cumming & Finch, 2005).

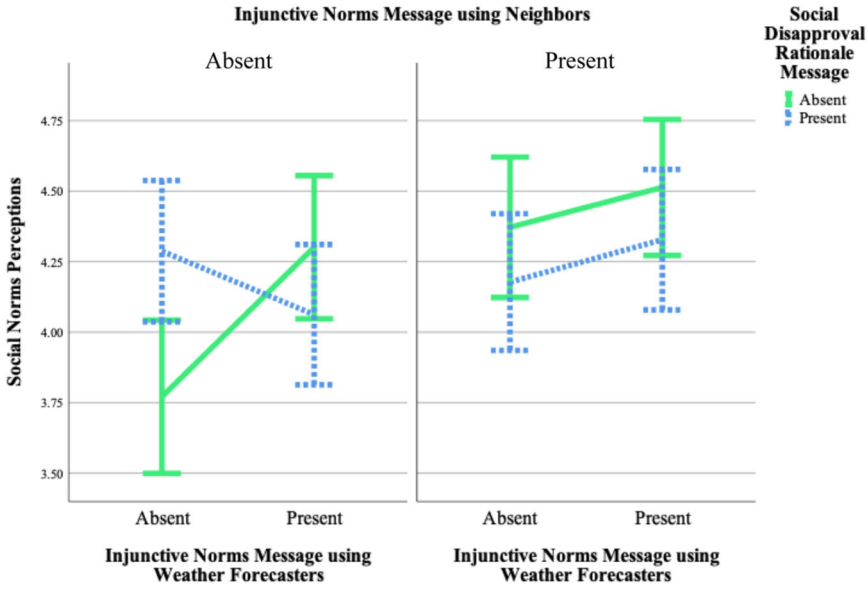


**FIGURE 5** Experiment 2: Social norms messages for installing water barriers: Interaction effects between the injunctive norms message using weather forecasters, the injunctive norms message using neighbors, and the social disapproval rationale message in predicting social norms perceptions

## 6.3 | Indirect effects

Although not hypothesized, the models included estimation of indirect effects. See the online supplement.

## 7 | DISCUSSION

Prior research has not fully examined how a variety of social norms can be integrated into messages to motivate community members' disaster mitigation behaviors in an ecologically valid way (Dickinson et al., 2020; Howe et al., 2018; Mol et al., 2021; Vinnell et al., 2019). To close gaps in the prior research, our two experiments developed and tested, through a factorial design, combinations of descriptive norms messages based on raw estimated numbers of residents who have adopted mitigation behaviors, injunctive norms messages using weather forecasters and neighbors, and social fear appeal, or social disapproval rationale, messages.

Our experiments provide new evidence on which social norms messages work for relatively easily adoptable flood and hurricane mitigation behaviors. Specifically, in experiment 1 (i.e., purchasing flood insurance), the injunctive norms message using weather forecasters and the social disapproval rationale message significantly increased social norms perceptions, which in turn influenced behavioral intentions. In experiment 2 (i.e., installing water barriers), the injunctive norms message using weather forecasters, the injunctive norms message using neighbors, and the social disapproval rationale messages significantly increased social norms perceptions, which in turn influenced mitigation intentions. Additionally, we found significant interaction effects among messages in predicting social norms perceptions. We further

**TABLE 6** Experiment 2: Social norms messages for installing water barriers: Group means comparison—Mitigation behavioral intentions

| Groups | | Mitigation behavioral intentions | | | |
|---|---|---|---|---|---|
| **Injunctive norms message using weather forecasters** | **Social disapproval rationale message** | ***M* (SE)** | | | |
| Present | Present | 4.25 (0.09) | a | | |
| Present | Absent | 4.50 (0.09) | | | c |
| Absent | Present | 4.46 (0.09) | | b | c |
| Absent | Absent | 4.31 (0.09) | a | b | |

*Note*: For mitigation behavioral intentions, there was a significant two-way interaction between the injunctive norms message using a weather forecaster and the social disapproval rationale message. Means with different letters were significantly different based on proportion overlap between 95% confidence intervals of the estimated means and the average margin of error at $p < .05$ (Cumming & Finch, 2005).

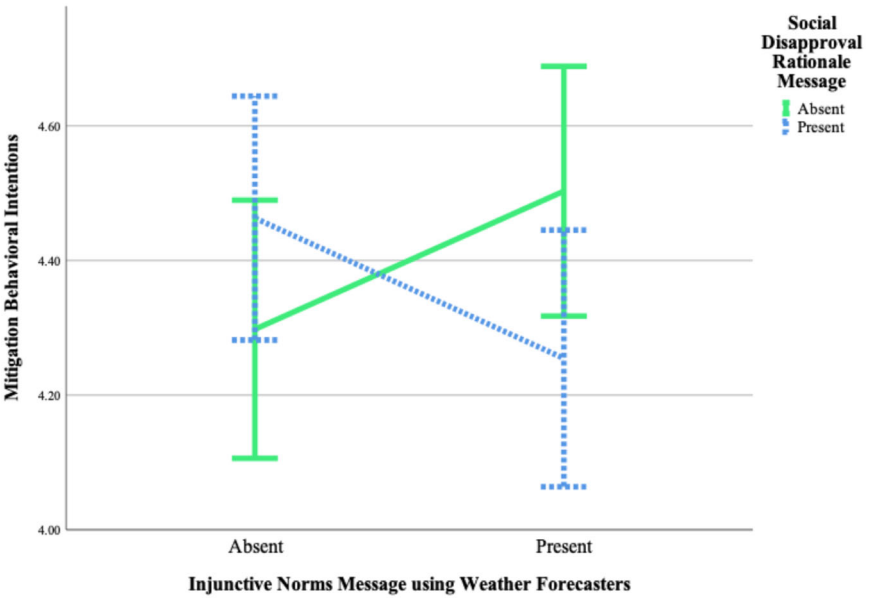


**FIGURE 6** Experiment 2: Social norms messages for installing water barriers: Interaction effects between the injunctive norms message using weather forecasters and the social disapproval rationale message in predicting mitigation behavioral intentions

discuss these findings below (See Table 7 for a summary of findings).

## 7.1 | Descriptive social norms messages

H1 posited that descriptive norms messages change social norms perceptions, which in turn change mitigation intentions. Descriptive norms messages in our experiments did not significantly increase or decrease social norms perceptions or mitigation intentions. This finding is somewhat surprising because a large body of scholarship finds that descriptive norms messages effectively motivate desired behavioral change in nondisaster contexts, such as smoking cessation and tax compliance (Bicchieri & Dimant, 2019; Goldstein et al., 2007; Hallsworth et al., 2017). Our experiments add to the growing evidence that descriptive norms messages are not effective in the disaster context (Dickinson et al., 2020; Mol et al., 2021; Vinnell et al., 2019) compared to the minimal evidence that finds these messages to be effective in the disaster context (Howe et al., 2018).

One contribution of our experiments to the descriptive norms literature is the use of ecologically valid messages. The descriptive norms messages used in prior disaster research, such as "many people" (Howe et al., 2018, p. 3) and "99% of people in your community" (e.g., Nolan et al., 2008, p. 918) may lack ecological validity, as they may not represent actual behavioral data in disaster mitigation. Instead, our experiments tailored descriptive norms messages using a large raw number of residents (e.g., "over 8 million") engaging in the target behavior based on prior data examining these behaviors (Brody et al., 2017; Lim, 2021; Peacock, 2003). These messages may give the impression that most community members (i.e., homeowners) have taken the behavior, in line with research finding that homeowners are the appropriate descriptive social norm reference for hurricane risks (Kranzler et al., 2020). Unfortunately, the tested descriptive norms messages in our two experiments were unsuccessful at motivating the desired mitigation behaviors. More research is needed to develop, test, and compare ecologically valid forms and references of descriptive norms messages to definitively conclude that these messages should not be

**TABLE 7** Summary of Findings

| Social norms message features | Messages tested | Results | |
|---|---|---|---|
| | | **Experiment 1: Flood insurance** | **Experiment 2: Water barriers** |
| **Descriptive norms message** | ⚠ Over 10 million Florida residents have purchased flood insurance | Not Supported | Not Supported |
| **Injunctive norms message using weather forecasters** | ⚠ All of your local weather forecasters agree that everyone living in hurricane-prone areas should purchase flood insurance | Supported | Supported |
| **Injunctive norms message using neighbors** | ⚠ Most of your neighbors think you should purchase flood insurance | Not Supported | Supported |
| **Social fear appeal – social disapproval rationale message** | ⚠ Because if you don't, your damaged home can harm others' homes and lower your community's property values | Supported | Supported |

used in practice, as others have suggested (Rogers et al., 2018).

There might be various explanations regarding why the descriptive norms messages tested in our experiments did not encourage hurricane and flood risk mitigation behaviors. One possibility is that individuals' hurricane and flood mitigation behaviors do not affect their neighbors' risk levels. In comparison, for wildfires, individuals' mitigation behaviors can affect their neighbors' risk levels and vice versa (Dickinson et al., 2020). Another possibility is that descriptive norms may not be the most effective social norms messages for disaster mitigation behaviors, especially if there is no strong social pressure. When there is no strong social approval or disapproval, showing that many other people engage in the behavior may not be effective, unlike other behaviors with potential social stigma, such as smoking (e.g., Cialdini et al., 2006; Goldstein et al., 2007; Hallsworth et al., 2017). Additionally, individuals may not understand the numeric information in descriptive norm messages, which future studies can test with various decision aids (e.g., using independent event rates, visuals) (Dobson et al., 2018; Lee et al., 2022; Trevena et al., 2021).

## 7.2 | Injunctive social norms messages using weather forecasters

H2 posed that injunctive norms messages using weather forecasters will increase social norms perceptions aligning with the message, which in turn increase behavioral intentions. We found that an injunctive norms message using a weather forecaster is effective in motivating community members to purchase flood insurance and install water barriers.

Although prior research emphasized the importance of identifying the social norms references for the target audience (Ajzen, 2006; Bicchieri & Dimant, 2019), previous studies mostly used the community or most people as the injunctive norm references in a disaster context (e.g., Howe et al., 2018; Vinnell et al., 2019). Our experiments are unique in that they develop and test weather forecasters—the preferred information sources based on prior research (Kleier et al., 2018; Lim, 2021; Petrun Sayers et al., 2021)—as an injunctive norms message feature. Given the importance of trust in effective risk communication (Liu & Mehta, 2020; Siegrist, 2021), it is imperative for injunctive norms messages to employ trusted sources for risk information.

To encourage hurricane and flood risk reduction behaviors, governments and other organizations can use trusted messengers (e.g., weather forecasters). For example, emergency management agencies could partner with weather forecasters and communicate that weather forecasters believe community members should take flood and hurricane mitigation measures. Additionally, government organizations can invite weather forecasters when facilitating workshops, webinars, community events, or public service announcements (PSAs) to share injunctive norms messages when communicating disaster risks. Scholars are just beginning to theorize effective message strategies for motivating community disaster preparedness during quiet weather (Liu et al., 2022). Our findings add to this nascent research.

## 7.3 | Injunctive social norms messages using neighbors

H3 posed that messages with injunctive norms using neighbors will increase social norms perceptions, which in turn increase mitigation behavioral intentions. In our experiments, an injunctive norms message using neighbors increased social norms perceptions, which in turn increased behavioral intentions to install water barriers (experiment 2). However, an injunctive norms message was not effective for motivating the purchase of flood insurance (experiment 1).

The findings provide empirical evidence and extend prior survey research on communities (e.g., neighbors) as injunctive norms references for hurricane risk mitigation behaviors (Kranzler et al., 2020). Previous researchers found that community members, neighbors, and most people as the

injunctive norms references most effective for motivating behavior change in the wildfire and earthquake contexts (e.g., Howe et al., 2018; Nox & Myles, 2017; Vinnell et al., 2019). Our experiments reveal that injunctive norms messages using neighbors effectively motivate community members to install water barriers, but not to purchase flood insurance.

One possible explanation for these findings is that installing water barriers is a structural risk mitigation measure that could help reduce both individuals' and their neighbors' risks, whereas purchasing flood insurance is a recovery measure that only helps an individual household. In other words, an injunctive norms reference (i.e., neighbors) may be more persuasive when the target mitigation behavior impacts both individuals and their neighbors. Another possible explanation is that individuals can see and observe their neighbors' water barriers, yet they cannot see their neighbors' flood insurance purchase. Still, prior research showed mixed findings on the impacts of injunctive norms for observable behaviors compared to non-observable behaviors (Howe et al., 2018; Vinnell et al., 2019). If at-risk publics can observe their neighbors' mitigation behaviors, messages about these behaviors may seem more plausible, credible, or convincing, which future research can examine. A third possibility is that installing water barriers is a one-time mitigation action, whereas purchasing flood insurance, ideally, is an ongoing mitigation behavior. It may be that one-time mitigation measures are more palpable to some individuals, which future research can examine.

If future research supports our conclusions, organizations should consider the visibility, timing (i.e., risk reduction during vs. after disasters), and the characteristics and coverage (personal homes and possibly neighborhood vs. individual household) of mitigation behaviors when choosing injunctive norms references. Organizations may also need to conduct primary research (e.g., surveys, interviews, or informal focus groups at community meetings) if they do not know the appropriate injunctive norms reference for their communities. Such research could ask community members who would think that they should perform a specific behavior.

## 7.4 | Social fear appeal: Social disapproval rationale messages

H4 posed that social fear appeal, or social disapproval rationale messages will increase social norms, which in turn will increase mitigation intentions. We found that social disapproval rationale messages increased social norms perceptions, which in turn increased mitigation intentions to purchase flood insurance (experiment 1) and install water barriers (experiment 2). Our experiments uniquely develop and test social disapproval rationale as a social norms message feature in the disaster risk mitigation context, in which strong social approval or disapproval for the target behaviors does not exist (Brody et al., 2017; Kranzler et al., 2020; Lim, 2021). Research showed that, because people are sensitive to social evaluation (Dickerson et al., 2008), it is effective to use social norms-based fear appeals and provide social disapproval rationale messages, such as a result of (not) taking behaviors in non-disaster contexts (e.g., shoplifting, smoking) (Pechmann et al., 2003; Schoenbachler & Whittler, 1996; Vermeir et al., 2017). In our experiments, we found a way to increase social norms perception in the disaster context. Specifically, to effectively tap into social norms, or perceived social expectations, for disaster risk mitigation it is important to communicate social disapproval messages describing why community members should perform mitigation measures and the social consequences of not doing so (e.g., their damaged home can harm others' homes and lower their community's property values).

One caveat is that such social fear appeal, or social disapproval rationale, messages provide arguments for why individuals should perform mitigation behaviors by showing social consequences of not performing the behaviors, rather than simply stating that many people have (or have not) performed the behavior (i.e., descriptive norms) or many people think that they should (or should not) perform the behavior (i.e., injunctive norms). In other words, the foundation of descriptive and injunctive norms messages is facts about community members' actual behaviors, whereas social disapproval rationale messages are based on persuasive arguments. Organizations should be cautious to not impose their own perspectives of possible consequences and impacts, which might be different from what community members think. For example, in our experiments, we used previous research findings drawn from community members' perceptions (Kranzler et al., 2020) to address this concern. Future studies can also examine the process of social norms-based fear appeals and social disapproval messages in detail (e.g., Lim et al., 2019; So et al., 2016; Tannenbaum et al., 2015).

## 7.5 | Interactions between experimental factors

RQ1 inquired about the nature of the potential interactions among social norms messages in our experiments. We found significant interaction effects between the injunctive norms message using weather forecasters and the social disapproval rationale message in predicting social norms perceptions in experiment 1 (i.e., purchasing flood insurance). Additionally, there were significant interaction effects among the injunctive norms message using weather forecasters, the injunctive norms message using neighbors, and the social disapproval rationale message in predicting social norms perceptions in experiment 2 (i.e., installing water barriers).

For both experiments 1 and 2, exposure to one of these social norms messages yields significantly higher social norms perceptions than no message exposure. However, for mitigation intentions, exposure to one of the social norms messages does not mean higher mitigation intentions. Specifically, for purchasing flood insurance (experiment 1), the social disapproval rationale message only shows significantly higher behavioral intentions than the no message condition. Conversely, for installing water barriers (experi-

ment 2), only the injunctive norms message using weather forecasters or only the social disapproval message shows significantly higher behavioral intentions than exposure to the messages containing both injunctive norms using forecasters and the social disapproval rationale.

These findings are counterintuitive because having both weather forecaster injunctive norms messages (i.e., experts believe that community members should adopt a behavior) and disapproval rationale messages (i.e., the reasons why community members should engage in a behavior) could augment the impacts of the message features. One possibility is that there might be a match or mismatch (i.e., congruency) between messages with an injunctive norms reference and the social disapproval rationale message feature, which may impact individuals' message processing and/or message credibility perceptions (Ajzen, 2011; Bicchieri & Dimant, 2019). In other words, individuals may find it unrealistic that weather forecasters say damaging others' homes and lowering community property values as reasons for adopting mitigation behaviors, even though weather forecasters are people's preferred sources of disaster information (Kleier et al., 2018; Lim, 2021; Petrun Sayers et al., 2021).

Another possible explanation for the lower effectiveness of the combined message features than a single message feature is that a short, single message feature might increase behavioral intentions more than two, relatively long message features. While previous research suggested that longer messages are much more effective generally at motivating target behaviors (Shen et al., 2015), other research indicated that individuals have to be motivated to adopt the behavior for longer messages to be effective (Pierro et al., 2005). Organizations may choose the most appropriate messages between injunctive norms and disapproval rationale in each situation by considering the availability of highly visible and credible weather forecasters, the plausibility and feasibility of the social disapproval rationales, and its match (i.e., congruency) with norm references, and whether a community already has social approval or disapproval of the target behaviors.

## 8 | LIMITATIONS

Like all studies, our experiments have limitations. First, the results cannot be generalized to other disaster types, countries, and cultures, which future studies can explore. Second, to test combined social norms message features or interaction effects, participants were exposed to longer messages, which makes it unclear whether interaction results are from combined social norms message features versus message lengths. Third, like most online data collection using convenience sampling, such as professional panels and student participants, MTurk samples may share common potential concerns, such as cheaters, speeders, professional survey-takers, or self-selection bias (Kees et al., 2017). Our experiments attempted to address these concerns by using screening questions, MTurk reputation eligibility, and attention check items.

Fourth, our experiments did not limit participants based on homeownership, home types, and age of their home, which future research can examine. Our experiments also did not examine whether participants are living in hurricane-prone areas within their state, yet this might be difficult to ascertain and not accurate because "[FEMA's] flood maps may not even accurately communicate current flood risk, let alone provide a guide to the future" (Pralle, 2019). Also, other more effective messages targeting social norms may exist than the messages tested in our experiments. Different messages might have different effects, and additional research is warranted given that this is one of the first social norms message studies in the disaster context. Lastly, our studies modeled previous studies and government communication materials on Facebook for wording, visuals, and emojis. Future studies can examine the impacts of different visuals and emojis (e.g., Dobson et al., 2018; Lee et al., 2022), communication channels (e.g., Buntain & Lim, 2018; Liu et al., 2020; Olson et al., 2019), and during the pandemic (e.g., Botzen et al., 2022).

## 9 | CONCLUSION

With climate change, more community members will experience disasters, such as hurricanes and floods (IPCC, 2022; Marsooli et al., 2019; NOAA, 2022). To help prepare communities for these enhanced risks, organizations need to effectively communicate disaster risk mitigation behaviors (Balog-Way et al., 2020; FEMA, 2019). Our experiments contribute to the limited body of scholarship on disaster risk mitigation measures and communication, and offer validated messages that organizations can employ (see the Supporting Information Appendix for a summary of effective messages). When organizations partner with community members to effectively identify and use evidence-based communication, we will better mitigate disaster risks.

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## SUPPORTING INFORMATION

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

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