How Publics' Active and Passive Communicative Behaviors Affect Their Tornado Responses: An Integration of STOPS and SMCC

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Abstract

During imminent threat crises publics have minutes to decide how to respond after receiving a warning. This study advances understanding of publics' crisis communicative and noncommunicative behaviors in the context of tornadoes through combining and extending two theories: the social-mediated crisis communication (SMCC) model and the situational theory of problem solving (STOPS). Findings from a survey of Southeast U.S. residents (n = 1,585) indicate that STOPS is internally consistent and accurate at measuring its intended outcomes of communicative action in problem solving. However, the STOPS measures do not have a significant relationship with the desirable outcome for imminent threat crisis communication: individuals following government's protective action guidance about tornadoes. In comparison, the expanded SMCC model predicts individuals' self-reported compliance. Finally, variables from the SMCC model and tornado-specific variables were integrated into the STOPS model to explain individuals' communicative engagement. Implications for theory and public relations practice are discussed.

Keywords: crisis, disaster, social media, publics, STOPS, SMCC

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In 2009, American adults reported that the Internet was the preferred and most reliable source for information for the first time (Zogby Interactive, 2009). That same year, government organizations began using social media for crisis communication ("HHS general guidance," n.d.). Today, crisis warnings can literally be in our pockets (Author, 2016) and with the flick of a wrist we can "like," share, and seek crisis information. In crises such as tornadoes where publics have minutes to respond once they receive a warning (NOAA, 2011), convenient access to crisis information is critically important. Yet, with the proliferation of convenient crisis information to those who have access to technology, important questions remain. For example, how do information sharing and seeking affect publics' protective action taking like sheltering in place? What non-communicative factors affect protective action taking?

To answer these questions, two theories are combined and extended: the social-mediated crisis communication (SMCC) model and the situational theory of problem solving (STOPS). According to Duhé (2015), crisis communication contributions to public relations theory began with the blog-mediated crisis communication model (Jin & Liu, 2010), which was later revised and renamed the SMCC model to reflect the burgeoning new media landscape (Liu, Jin, Briones, & Kuch, 2012). STOPS is an extension of the situational theory of publics (Grunig & Hunt, 1984, Kim & Grunig, 2011) and is the leading framework for segmenting publics based on their communicative behaviors. In combining these two theories, this study answers calls for additional theorizing about crisis communication (e.g., Author, 2014; Coombs, 2016; Manias-Muňoz , Jin, & Reber, 2019). The study also provides the first full known test of the STOPS model in a crisis context. Finally, the study integrates new constructs into the combined SMCC and STOPS model. In doing so, the study provides perhaps the most comprehensive understanding of what ultimately drives some people to take important actions like sheltering in place during a tornado. These findings can inform how governments communicate about imminent-threat crises like tornadoes.

Literature Review

Crisis communication is one of the primary research domains within public relations (Toth, 2010). In the past decade, public relations scholars have increasingly focused on crisis communication research, but there remains a need for more theory development and research that examines "real-world crises" (Manias-Muňoz et al., 2019, p. 5). We answer this call through examining the real-world crisis of tornadoes and through advancing theory on publics' crisis communicative and noncommunicative behaviors.

Tornadoes and Crisis Communication

Tornadoes are one of the most extreme and devastating severe weather events that occur in the United States (Long, Stoy, & Gerken, 2018). In the Southeast United States, tornadoes occur year round (Long et al., 2018), necessitating ongoing risk and crisis communication. It is particularly challenging to alert people about tornadoes because tornadoes strike quickly with little or no warning and can appear at almost any time (Ready.gov, n.d.). On average, there are thirteen minutes between a tornado warning and a tornado touchdown (NOAA, 2011). Thus, the Southeast United States provides the ideal context to study publics' communicative and protective behaviors related to tornadoes.

SMCC and STOPS Overview

The SMCC model explains and predicts how *various publics* (influential social media creators, social media followers, and social media inactives), *information forms* (social media, traditional media, and offline word-of-mouth communication), and *organizational sources* interact to influence how some publics seek and share crisis information, which may lead to protective behaviors such as sheltering in place (Jin, Liu, & Austin, 2014; Jin, Fraustino, & Liu, 2016; Zhu, Anagondahalli, & Zhang, 2017). STOPS posits four independent variables (problem recognition, involvement recognition, constraint recognition, and referent criterion) to explain and predict publics' communicative actions in problem solving mediated by publics' situational motivation in problem solving.

Both the SMCC model and STOPS assist public relations scholars and professionals in identifying who is most likely to communicate actively in response to problems like crises. Understanding publics' communicative problem solving or how they seek and share crisis information can help organizations better communicate with their publics during crises (Aldoory & Sha, 2006; Lee & Jin, 2019; Zhao, Zhan, & Wong, 2018). An important difference between the two models is that the SMCC model identifies communicative behaviors (e.g., information seeking and sharing) through specific information forms and sources and ultimately predicts protective behaviors such as sheltering in place, whereas STOPS aims to predict overall communicative behaviors without discerning information forms and sources.

As conceptualized in the SMCC model, information form is "whether the crisis information is transmitted via traditional media, social media, and/or offline word-of-mouth communication" (Austin et al., 2012, p. 193). Information source is "where crisis information originates from" such as an organization responding to a crisis, a journalist, or a member of the public (Austin et al., 2012, p. 193). Experts recommend communicating crisis information via a variety of sources because people typically need to receive similar information from multiple channels (and sources) before deciding how to respond (e.g., Stephens, Barrett, & Mahometta, 2013; van der Meer, 2018). SMCC model research consistently finds that crisis information form and source jointly influence publics' crisis information seeking, information sharing, crisis involvement, and protective action taking regardless of crisis type (Austin et al., 2012; Liu et al., 2015a, 2015b; Jin et al., 2016; Lee & Jin, 2019). Therefore, this study asks how publics' information seeking and sharing through a variety of forms and sources affect whether they take protective actions during disasters.

Research Question 1: How, if at all, do information seeking and sharing based on SMCC model affect protective action taking during tornadoes?

One of the components of the SMCC model that has received little empirical exploration is the classification of which publics consume and/or produce crisis information (e.g., Gurman & Ellenberger, 2015; Jin & Liu, 2010; Zhao, Zhan, & Liu, 2018). However, STOPS provides robust measures to segment publics to predict who will actively communicate about problems (Kim & Grunig, 2011). Yet, STOPS has only been partially tested in a crisis context. Kim (2016) only tested how publics' communicative actions in problem solving (CAPS) predicted how publics evaluate an organization's reputation and publics' positive behavioral intentions in crisis, not STOPS' key independent variables and situational motivation. Specifically, in an experiment testing responses to an airline crash crisis, Kim (2016) found that passive information acquisition (*attending*) is a significant predictor of how publics evaluate organization's reputation during a crisis. Information transmission (*forwarding* and *sharing*) and active information acquisition (seeking) were significant predictors of positive behavioral intentions (e.g., saying nice things about the organization in crisis to other people). Yet, Kim's (2016) work did not test several key STOPS constructs, which may help understand when publics are motivated to communicate problems during crises: problem recognition, constraint recognition, level of involvement, and referent criterion (Kim & Krishna, 2014). This study extends Kim's (2016) initial work integrating STOPS measures into the SMCC model.

Predictors of Communicative Action Taking

STOPS includes four predictors of communicative action and one mediator (Kim & Krishna, 2014). First, p*roblem recognition* occurs when people recognize a problem for which they do not have an immediately applicable solution (Grunig, 2003). People consider what to do about a problem when they have high involvement recognition and constraint recognition (Kim, Shen, & Morgan, 2011).

Second, *involvement recognition* is the extent to which people perceive they are connected to a problematic situation (Grunig, 1997), and is a predictor of situational motivation (Chen et al., 2017; Kim et al., 2012). In a crisis context, connection to a problem is a combination of how severe the threat's consequences are perceived to be and how likely one is to be affected by the threat (Glanz, Rimer, & Viswanath, 2008).

Third*, constraint recognition* is people's perceptions of any obstacles that may prevent them from responding to a problematic situation and is similar to the construct of self-efficacy from social cognitive theory (Bandura, 1997). When constraint recognition is high, people are unlikely to communicate about a problem (Kim et al., 2011). In crisis contexts, researchers have found that self-efficacy is the best predictor of the likelihood of following advice (Gutteling & de Vries, 2016) and positively affects individuals' decisions to prepare (Wirtz & Rohrbeck, 2017). Self-efficacy is closely related to crisis efficacy, which "reflects people's beliefs about whether they can successfully perform recommended behaviors during crisis situations that are largely out of their control" (Avery & Park, 2016, p. 4).

Fourth, *referent criterion* is prior knowledge, experience, and subjective judgement rules that people use when facing problematic situations (Grunig, 1997). In STOPS, referent criterion is measured by individuals' self-reported experiences. In crisis contexts, research has begun to test how peoples' actual knowledge (rather than self-reported) positively influences behaviors like protective action taking (Lo, Wei, & Su, 2013; Krishna, 2018; Mou & Lin, 2014). Furthermore, SMCC model research finds that prior crisis exposure increases information seeking and sharing for subsequent crises (Liu et al., 2015b).

Lastly, *situational motivation in problem solving* mediates problem recognition, constraint recognition, and involvement recognition on the communicative action in problem solving, or communicative action taking. Situational motivation in problem solving is "a state of situation-specific cognitive and epistemic readiness to make problem solving efforts."or the drive to stop and think about a problematic situation (Kim & Grunig, 2011, p. 132).

Communicative Action Taking

Studies have found three different types of communicative action taking: information seeking, information sharing, and information selection. In this section, communicative action taking will be reviewed, followed by the study's hypotheses and research questions.

Information seeking. People seek risk information until they have sufficient understanding to develop appropriate attitudes and behaviors (Gutteling & de Vries, 2017). Referred to as "milling" in the disaster sociology literature, information seeking occurs when publics need to make meaning of uncertain situations such as crises (Author, 2017; Drabek, 1969; Turner & Killian, 1957). Information seeking behavior is predicted by individual characteristics, perceived hazard characteristics, affective responses, motivation, channel beliefs, and perceived information gathering capacity (Griffin, Dunwoody, & Yang, 2012; Yang, Aloe,

& Freeley, 2014). People often need to seek multiple channels of information (Griffin, Dunwoody, & Neuwirth, 1999; Yang et al., 2014). Yet, recognizing an information need does not necessarily result in higher information seeking. People may think it is the government's responsibility to inform them about risks (Chen, Hung-Baesecke, & Kim, 2017; Kahlor, 2010).

In the SMCC model, publics seek information from media via traditional channels (e.g., newspapers and television); organizations and members of the general public via social media (e.g., Facebook and Twitter); and offline word-of-mouth communication with friends, family, neighbors, and co-workers (Liu et al., 2012; Zhao et al., 2018). According to STOPS, information seeking is called *information acquisition* and can be passive (*attending*) or active (*seeking*) (Kim & Krishna, 2014). Active problem solvers initiate searches for information whereas less active problem solvers are content to passively receive information when it comes their way (Kim & Krishna, 2014). In the first test of STOPS' information seeking constructs in a crisis context, Kim (2016) found that passive information acquisition (*attending*) was a significant predictor of publics' organizational crisis reputation, while active information acquisition (*seeking*) was a significant predictor of positive behavioral intentions, such as saying nice things about the organization during crisis. Still, research is needed to examine whether information seeking predicts other important crisis behaviors, such as publics' protective action taking.

Outside of a crisis context, research on organ donation intentions (Kim, Shen, & Morgan, 2011) and perceptions of sex crimes (Shin & Han, 2016) found that individuals' information seeking is correlated with information sharing and information selection, which are discussed further below. Furthermore, prior research confirms that these communicative actions can predict behavioral intentions such as participating in fundraising activities (McKeever, Pressgrove, McKeever, & Zheng, 2016b). In the context of the hot issue of U.S. beef imports into China, researchers found that the more communicatively active that publics are, the more they engage in information seeking and information attending (Chen et al., 2018). Finally, research finds that those who do not support hot issues like childhood vaccinations are more likely to engage in communicative actions like information seeking and sharing than those who support childhood vaccinations (McKeever, McKeever, Holton, & Li, 2016a).

Information sharing. SMCC model research finds that individuals prefer to cope with crises through offline interpersonal communication (Austin et al., 2012; Jin et al., 2016; Liu, Fraustino, & Jin, 2016; Liu et al., 2013), perhaps because they prefer to make sense of crises with people they know (Jin et al., 2016). Conversely, information sharing online may be driven by status seeking and socializing (Baek, Holton, Harp & Yaschur, 2011; Lee & Ma, 2013). According to STOPS, information sharing can be broken down into passive *information transmission* (called *sharing*) and active *information transmission* (called *forwarding*) (Kim & Grunig, 2011). Forwarding is proactive transmission of information with others whereas sharing refers to transmitting information only when asked to do so (Kim & Krishna, 2014). Kim (2016) found that information sharing (passive and active) was not a significant predictor of organizational crisis reputation, but predicted positive behavioral intentions. In the context of diet-nutrition information, Yan et al. (2018) found that information forwarding influenced deliberative risk perception and predicted individuals' health intentions. Yet, it is unknown whether information sharing predicts important crisis outcomes like publics' protective action taking.

Information selection. According to STOPS, information selection occurs passively (*permitting*) and actively (*forefending*) (Kim & Grunig, 2011). Permitting occurs when a problem solver "accepts any information that he or she receives about the problem, with little regard for the value or relevance of the information" (Kim & Krishna, 2014, p. 84). *Forefending* represents a more systematic approach to information selecting in which a problem solver "rejects or does not acknowledge certain types of information or certain information sources" (Kim & Krishna, 2014, p. 84). Kim (2016) found that no information selection (passive and active) was a significant predictor of organizational crisis reputation and positive behavioral intentions. Still, it is unknown whether information selection predicts other important crisis outcomes, such as publics' protective action taking.

So far, communicative action taking and its predictors were reviewed. Based on the previous research findings, this study proposes: **(H1)** Individuals' tornado problem recognition is positively related to their situational motivation in response to a tornado threat message; (**H2)** Individuals' tornado constraint recognition is negatively related to their situational motivation for problem solving in response to a tornado threat message; **(H3)** Individuals' tornado involvement recognition is positively related to their situational motivation in problem solving in response to a tornado threat message, (**H4**) Individuals' tornado referent criterion is positively related to their communicative action in problem solving in response to a tornado threat message, and (**H5**) Individuals' tornado situational motivation in problem solving is positively related to their communicative action in problem solving in response to a tornado threat message.

In the context of disasters, public protective action taking (e.g., sheltering in place) is the desired outcome. Only a handful of crisis communication studies have examined what influences protective action taking with inconclusive findings (e.g., Freberg, 2012, Author, 2015; Sellnow, Lane, Sellnow, & Littlefield, 2017). Therefore, this study asks:

Research Question 2: To what extent do individuals' communicative problem solving behaviors (information seeking, sharing, and selection) predict protective action taking in response to tornado threat messages?

Finally, it is unclear whether measures from the SMCC model and STOPS differ in terms of understanding how people communicate about disasters and whether together they can more fully predict how people respond to disasters. Therefore, this study asks:

Research Question 3: How do the SMCC model and STOPS compare to each other and contribute to understanding individuals' responses to tornado threat messages?

Method

The research team conducted an online survey with residents of the Southeast United States to answer the research questions and hypotheses (n = 1,585). The survey took approximately 26 minutes to complete.

Survey Deployment

The survey was developed from the literature review and ten focus groups (n = 77) with residents of the Southeastern United States. The survey was pretested by 161 participants, who were residents of the Southeast United States and who did not participate in the final survey deployment. A large private survey company (Qualtrics) fielded the survey in July and August 2016. Participants were compensated for their time in accordance with IRB guidelines for this study: points that can be redeemed for prizes or products.

The survey was conducted with people representative in demographics to the general Southeast U.S. population yielding a total of 1,585 responses after data cleaning. Median time to complete survey one was 26.07 minutes. From the sample, 69.8% identified as Caucasian, 22.7% identified as African-American or Black, 1.9% identified as Asian, 5.5% as Hispanic, .3%, with the rest choosing not to identify. Slightly less than half identified as male (48.8%), 50.6% identified as female, with the remainder choosing not to respond. Age ranged from 18 to 80 with 44.3 being the average (*SD* = 17.4, Median = 41). The median household income was between $30,001 and $40,000. See Table 1 for survey demographics.

[INSERT TABLE 1 HERE]

Measures

In addition to standard demographics, some tornado-specific variables were included based on the previous literature, which covered *perceived tornado likelihood* (Trainor, Nagele, Philips, & Scott, 2015; Cronbach's α =.97, and PCA indicated a one-factor solution), *tornado crisis efficacy* (Avery & Park, 2016 Cronbach's α = .90, and PCA indicated a one-factor solution), and *susceptibility* (Cronbach's α = .91). The measurement items and their factor loadings on the latent constructs are reported in the results section and in Table 4.

Additionally, the full complement of *STOPS measures* (Kim & Krishna, 2014; Ni & Kim, 2009; Cronbach's α ranged from .88 to .95) were included, and were used to construct *referent criterion, situational motivation in problem solving, and communicative action in problem solving (CAPS).*

A collection of modified measures for the disaster information seeking and sharing components of the SMCC model were included (Austin et al., 2012; Jin et al., 2016). These prior measures were further divided into subscales based on information sources and channels. Participants were asked to rate their agreement on the following statement, "If I were in an area under tornado warning, I would look for more information from/by..." Some examples in the list of information seeking channels/sources are: a local newspaper, television, local government websites, federal government websites, Facebook page updates, Twitter, blogs, talking to people I know via face-to-face, and texting people I know.

For information sharing, a statement "If I were in an area under tornado warning, I would _________" was provided with a list of information sharing behaviors. A complete list of these information seeking and information sharing items can be found in Appendix A. Principal component analysis with varimax rotation was done respectively on the information seeking and information sharing items, final items were selected based on the absolute value of the loading on the factor (greater than .70), the number of items loaded on the same factor (at least two), distinguishability among the factors (i.e., the highest loading is at least .20 greater than loadings on the other factors), and the actual wording. Eventually, the information seeking measure was divided into interpersonal (Cronbach's $\alpha = .76$), social media (Cronbach's $\alpha = .90$), mass media (Cronbach's $\alpha = .96$), and government (Cronbach's $\alpha = .89$), as shown in Appendix A. It should be noted, however, interpersonal communication and social media were not highly distinguishable, likely because interpersonal communication can be fulfilled through social media platforms as well. The information sharing measure was divided into social media (Cronbach's $\alpha = .89$) and interpersonal communication (Cronbach's $\alpha = .80$) components. See Table 2 for means, standard deviations, and correlations of these variables.

Finally, for protective action taking, we asked the participants, "Did you take action (have a physical response - like going to a safe place in your home or collecting supplies) after receiving the message?" with the choices yes (coded as 1), no (coded as 0), and "I don't recall" (coded as user missing). 146 participants reported that they do not recall. These cases were not used in the analysis involving individuals' action taking.

[INSERT TABLE 2 HERE]

Results

Measurement Model

Given that risk-specific variables and STOPS variables are used as latent variables in the model, it is necessary to validate the measurement model and follow the two-step procedures (Anderson & Gerbing, 1988). In the measurement model, risk-specific latent variables, and latent variables in STOPS were allowed to covary. The overall measurement model indicated a great fit, $\chi^2 = 5066.11$, $df = 1738$, $p < .001$, RMSEA = .036, 90% CI [.035, .037], CFI = .95, SRMR = .043, indicating that the items sufficiently and reliably measured the latent constructs. See Table 3 for the correlation matrix of the latent variables and Table 4 for the measurement items and their construct reliability *Coefficient H* (Hancock, 2001).

[INSERT TABLE 3 AND TABLE 4 HERE]

Model Conceptualization

Three models were constructed to answer the research questions and hypotheses. All models were produced in Mplus 7.0. Model fit for structural equation models was assessed with Hu and Bentler's (1999) fit criteria. These thresholds are not immutable, but are good general guides. All models, unless otherwise specified, were assessed using Satorra-Bentler normality correction. One of the most important assumptions of structural equation modeling is multivariate normality. Violating this assumption leads to higher Type I errors. Satorra-Bentler correction (Satorra & Bentler, 2010), which is available in Mplus, accounts for the non-normality of the data when estimating standard errors of parameter estimates and goodness of fit indices. All the coefficients reported were standardized coefficients.

For model building and hypotheses testing, we first tested the STOPS model as constructed by Kim et al. (2011). Then, the tornado-specific variables of *perceived tornado* *likelihood*, *tornado crisis efficacy*, and *susceptibility* (Avery & Park, 2016; Trainor et al., 2015 were introduced into the model to investigate how these variables impact communicative outcomes. Finally, we tested the communicative variables in STOPS and the SMCC model separately to provide evidence regarding the three research questions.

Situational theory of problem solving (STOPS) model. In this first model (Model 1), we tested the validity of STOPS to the issue of tornado warning. The exogenous variables in the model were problem recognition, involvement recognition, constraint recognition, and referent criterion. The endogenous variables in the model were situational motivation, six communicative outcome variables, and second-order latent variable communicative action.

The STOPS model showed a good fit, $\chi^2 = 5135.41$, $df = 1257$, $p < .001$, RMSEA = .045, 90% CI [.043, .046], CFI = .94, SRMR = .058. An examination of the path coefficients revealed that involvement recognition ($\beta = .41$, $p < .001$) and problem recognition ($\beta = .35$, $p < .001$) positively affected situational motivation, and less constraint recognition leads to increased motivation ($\beta = .29$, $p < .001$). Moreover, situational motivation ($\beta = .73$, $p < .001$) and referent criterion ($\beta = .30$, $p < .001$) had positive effects on communicative action, which is composed of information forefending ($\beta = .89$, $p < .001$), information permitting ($\beta = .76$, $p < .001$), information forwarding ($\beta = .89$, $p < .001$), information sharing ($\beta = .92$, $p < .001$), information seeking ($\beta = .91$, $p < .001$), and information attending ($\beta = .74$, $p < .001$). The overall model explained a great portion of the variances of the exogenous variables in the model (situational motivation $R^2 = .86$, communicative action $R^2 = .90$). Therefore, Hypotheses 1 to 5 were supported.

[INSERT FIGURE 1 HERE]

Risk-specific variables introduced into STOPS. Based on STOPS, risk-specific variables were added (Model 2). These variables represented individuals' perceptions specific to the risk of tornadoes, including perceived susceptibility to tornadoes, perceived tornado efficacy, and perceived tornado likelihood. These three variables were included in the model as exogenous variables that antecede individuals' problem recognition, constraint recognition, and involvement recognition. To further investigate how these risk-specific variables may impact publics' communicative behaviors, the direct path coefficients from these variables to communicative action were also estimated.

As a result, this tornado-specific STOPS model showed a good data-model fit, χ^2 = 6884.71, df = 1797, $p < .001$, RMSEA = .044, 90% CI [.043, .045], CFI = .93, SRMR = .060. The model and estimates of path coefficients are shown in Figure 2. Some path coefficients were worth noting. Problem recognition (R^2 = .53) was positively affected by the three risk-specific variables – perceived susceptibility (β = .27, $p < .001$), perceived crisis efficacy (β = .54, $p < .001$), and perceived tornado likelihood (β = .19, $p < .001$). Involvement recognition was also significantly affected by these three variables (R^2 = .68, β = .31, $p < .001$ for perceived susceptibility, β = .64, $p < .001$ for perceived crisis efficacy, and β = .17, $p < .001$ for perceived tornado likelihood). Constraint recognition (coded in a way the higher the value the less constraint an individual perceives, R^2 = .71) was significantly affected by perceived susceptibility (β = .24, $p < .001$) and perceived crisis efficacy (β = .79, $p < .001$), but not perceived tornado likelihood (β = .019, p = .67). Similarly, the effects of perceived susceptibility (β = .16, $p < .001$) and perceived crisis efficacy (β = .77, $p < .001$) on referent criterion were significant (R^2 = .62), but not perceived tornado likelihood (β = -.012, p = .78).

[INSERT FIGURE 2 HERE]

In addition to the significant effects of the three variables in STOPS on situational motivation, perceived crisis efficacy had a negative and significant effect (β = - .16, p = .028) and tornado likelihood had a significant and positive effect (β = .061, p < .038). The magnitude of these effects was smaller, compared to those of problem recognition (β = .39, p < .001), constraint recognition (β = .34, p < .001), and involvement recognition (β = .41, p < .001). Yet, the significant negative effect of perceived crisis efficacy indicated that the more confident a person was about avoiding harm during a tornado, the less motivated the person was towards responding to the tornado threat information. On the other hand, the significant positive effect of perceived tornado likelihood indicated that people were motivated to respond to tornado threat information when they believed that they were likely to be impacted by a tornado. Susceptibility mainly affected individuals' motivation through problem recognition, constraint recognition, and involvement recognition.

Finally, just as in the STOPS model, situational motivation (β = .47, p < .001) and referent criterion (β = .12, p < .001) had significant effects on communicative action. Furthermore, two of the risk-specific variables, perceived susceptibility (β = .11, p < .001) and perceived crisis efficacy (β = .42, p < .001), had significant effects on communicative action. These results demonstrated that STOPS was valid in the tornado context. Yet, researchers cannot ignore the risk-specific variables' role in evaluating and predicting individuals' communicative action in response to tornado threat information. These risk-specific variables serve both as important antecedent variables to problem, involvement, and constraint recognition and as direct predictors of communicative outcomes.

STOPS and SMCC on action taking. Three research questions in this study investigate to what extent individuals' communicative behaviors in STOPS compare to the communication variables in the SMCC model in terms of predicting self-reported non-communicative action taking. Two probit regression models were run in Mplus using weighted least square mean and variance adjusted (WLSMV) estimation. The coefficients from WLSMV estimation in Mplus are equivalent to probit regression coefficient, with a significant and positive coefficient indicating increased probability on the dependent variable. In the first model, six communicative outcomes variables in STOPS were used to predict action taking (a self-reported binary variable). In the second probit regression model, communication variables in the SMCC model were used as independent variables to predict the outcome variable of action taking. Variables from the SMCC model encompassed interpersonal information seeking, social media information seeking, mass media information seeking, and government information seeking. Information sharing captured social media information sharing and interpersonal information sharing.

Probit regression results show that none of the communicative outcome variables in STOPS significantly predict action taking, (unstandardized coefficient $b = 0.078$, $p = .29$ for information forefending, $b = 0.012$, $p = .86$ for information permitting, $b = 0.15$, $p = .092$ for information forwarding, $b = 0.11$, $p = .22$ for information sharing, $b = 0.015$, $p = .87$ for information seeking, and $b = 0.11$, $p = .075$ for information attending). In contrast, three of the six information seeking/sharing variables in the SMCC model predict self-reported action taking, which included interpersonal information seeking ($b = .068$, $p = .019$), social media information sharing ($b = .049$, $p = .012$), and interpersonal information sharing ($b = .11$, $p < .001$). This means that the probability of people taking action increases with people's seeking or sharing information interpersonally or sharing information through social media. Mass media information seeking, government information seeking, and social media information seeking did not have significant effects on action taking ($b = .016$, $p = .41$, $b = .011$, $p = .62$, $b = .005$, $p = .84$

respectively), meaning that people's information seeking through government, social media, or mass media did not increase the probability of people taking action. These results indicated that the SMCC model's communication engagement variable better predicted non-communicative action taking during disasters. More importantly, the results suggest that information seeking behaviors, in general, do not strongly predict action taking, except for information seeking interpersonally, and that information sharing behaviors, whether it be through interpersonal channels or social media, were significant predictors of non-communicative action taking.

Integrating STOPS and SMCC. Finally, given the significant roles of SMCC variables in predicting non-communicative action taking, we integrated the STOPS model with the SMCC model by replacing communicative actions in problem solving (CAPS) with communicative engagement. This second-order latent construct *communicative engagement* was based on the four latent variables from the SMCC model from the previous section that are found to be significantly related to non-communicative action taking, which are interpersonal information sharing (*ishrIntp*), interpersonal information seeking (*isIntp*), and social media information sharing (*ishrSoc*).

Fit indices showed a good overall data-model fit that was similar to the tornado-specific STOPS model, $\chi^2 = 2613.23$, $df = 565$, $p < .001$, RMSEA = .048, 90% CI [.046, .050], CFI = .94, SRMR = .059. We proceeded to examine specific path coefficients. In this integrated model, *problem recognition*, *involvement recognition*, and *constraint recognition* are significantly affected by all three risk-specific variables, perceived *susceptibility* to tornadoes, perceived *tornado efficacy*, and perceived *tornado likelihood*. Similar to the extended STOPS model reviewed in the last section, *referent criterion* ($R^2 = .53$) was significantly affected by perceived *susceptibility* ($\beta = .11$ $p = .005$) and *tornado efficacy* ($\beta = .72$, $p < .001$), but not perceived *tornado likelihood* (β = .066, p = .09). However, considering that referent criterion was only connected to communicative engagement in the model other than the exogenous variables, and the path coefficient was not significant (β = -.042, p = .45), referent criterion was dropped from the integrated model illustrated in Figure 3. The implications of dropping referent criterion from this integrated model are discussed in the next section.

Moreover, problem recognition, involvement recognition, and constraint recognition have significant effects on situational motivation, but risk-specific variables do not have such effects. Only situational motivation and tornado efficacy significantly affect communicative engagement, but referent criterion does not, different from the original STOPS model. All the path coefficients estimates are in Figure 3.

[INSERT FIGURE 3 HERE]

Discussion and Conclusion

As the first known test of the full STOPS model in a crisis communication context, this study found that the theory is internally consistent and accurate at measuring its intended outcomes of communicative action in problem solving. However, the STOPS measures do not significantly affect the primary desired outcome during a tornado: individuals following NOAA protective action guidance about tornadoes. In comparison, the expanded SMCC model is able to predict individuals' self-reported compliance with government guidance during tornadoes through information seeking interpersonally and information sharing through interpersonal channels and social media.

STOPS in a Crisis Context

STOPS is used to predict individuals' motivation in solving a problem or issue, and their passive and active communicative behaviors regarding the problem or issue (Kim & Grunig, 2011; Kim & Krishna, 2014). Consistent with the previous research utilizing STOPS, individuals' tornado threat recognition and involvement are positively related to their situational motivation in problem solving. Moreover, individuals' tornado situational motivation in problem solving is positively related to their communicative action in problem solving. These results indicate that individuals have the motivation to acquire information regarding tornado threats when they perceive tornado threats as a problem and see themselves affected by the problem. Furthermore, for public relations professionals, these findings highlight the importance of pre-disaster, preparedness communication so that residents in tornado-prone areas are prepared for tornado risks before they manifest into crises. Public relations professionals, in particular government communication officials, can better communicate how to mitigate and prepare for tornado risks by helping publics perceive tornado threats as a problem and see themselves possibly affected by tornado threats through effective communication intervention campaigns. Additionally, when issuing tornado watches and warnings, government organizations need to emphasize who is at risk. Current wording in alert messages such as "in this area" may not adequately alert publics that they are at risk for a tornado.

The findings also suggest that communicative action in problem solving is not desirable as it does not impact individuals' taking actions (i.e., following NOAA guidance to shelter in place, move to the basement, and/or evacuate). Sociologists have long referred to a process of milling where people seek information to confirm disaster warnings before deciding whether to follow guidance provided in warnings (e.g., Drabek, 1969; Author, 2017). This may be the first study to empirically support claims that milling does not increase or might be even detrimental to action taking. Simply put, this study finds that when people are busy with communicating to solve a problem, they are less inclined to following directions from the government like sheltering in place. In other words, a primary goal of government crisis communication is to shorten the milling period so that publics more quickly move to appropriate protective action taking, especially in a tornado context where publics may have only minutes between a tornado warning and a tornado touchdown. To combat this problem, governments may need to conduct public education campaigns to emphasize the importance of immediately taking shelter in a safe place when a tornado warning is issued, and that searching for additional information regarding tornado threats can be life threatening. For example, messaging could emphasize going to a safe shelter immediately because there may only be minutes between issuing a tornado warning and a tornado touchdown. During a tornado watch, governments could share recommended resources for information seeking to help steer publics towards vetted sources that provide important information such as what a safe place to shelter is.

Future research should consider how to consolidate the STOPS measures. The current instrument (Kim & Krishna, 2014) has 112 questions, making it challenging to deploy along with other important measures. The extremely long STOPS questionnaire may explain why prior research typically tests only part of the model (e.g., Kim, 2016; McKeever et al., 2016a, 2016b).

The SMCC Model in a Tornado Context

Through integrating the SMCC and STOPS models, this study overcomes one of the key limitations of STOPS. The theory only focuses on communicative actions, but in many contexts publics need to take non-communicative actions to protect themselves, particularly in crisis contexts. In addition, much of the prior crisis research has heavily focused on publics' information seeking and sharing via media and offline interpersonal communication, which is the heart of the SMCC model (Austin et al., 2012). Findings here indicate that such communication engagement has a positive relationship with problem solving, which in turn has a positive, though smaller, relationship with individuals' tornado responses. Therefore, the SMCC model's communicative engagement construct better measures how communication can positively contribute to individuals following NOAA guidance about tornadoes, compared to the STOPS' communication action in problem solving measures.

By comparing SMCC communicative variables with those in STOPS, several theoretical and practical implications emerge. First, results highlight key differences between communicative variables in the SMCC model and STOPS. STOPS variables focus testing communicative behaviors (information seeking, sharing, and selection) regarding tornado threats in general regardless information channels and sources, while the SMCC model variables focus specific information channels and sources that publics use to seek and share information when receiving tornado warnings. When individuals are busy searching for and sharing specific information regarding tornado threats, which have already been confirmed by the government-issued tornado warnings, these communicative behaviors are redundant and keep individuals from taking necessary actions. In contrast, information seeking and sharing through specific channels and sources (interpersonal and social media) has a positive relation with individuals' taking NOAA-recommended actions in a tornado context. This points out that what information sources and channels individuals are seeking and sharing is important to consider in an urgent crisis context, when the information milling period needs to be minimized. Information seeking and sharing across redundant channels does not help in an urgent situation because it is a sign of individuals milling (delaying their protective response). Alternatively, specific information inquiry (i.e., seeking and sharing interpersonally and through social media) in a tornado context fulfills information needs and corresponds positively to taking actions. Accordingly, it is important for government public relations professionals to steer at-risk publics to the most appropriate sources for essential tornado information, specifically risk communication from the National Weather Service, and to provide directions in public education campaigns on how and what type of information should be shared properly among publics during tornadoes. Second, the sources and channels that people seek and share information are important. Communicative variables in STOPS, or communicative actions in problem solving (CAPS), are distinguished based on whether they are passive or active. Communicative variables in the SMCC model are distinguished on activeness of the communicative behaviors (seeking vs. sharing) and on where information comes from (interpersonal, mass media, social media and government) (Jin, Liu, & Austin, 2014; Jin et al., 2016; Lee & Jin, 2019; Zhu, Anagondahalli, & Zhang, 2017). This difference renders communication variables in the SMCC model more relevant to individuals' action taking during crises. Researchers and practitioners who are interested in individuals' communicative behaviors in a crisis context should focus on the forms of these communicative behaviors and the sources where these active or passive communicative behaviors take place. In other words, it is fruitful to continue examining publics' preferred sources for crisis information (e.g., government sources, media sources, friends/family) and how these sources relate to active and passive communicative behaviors (e.g., information seeking and sharing). Importantly, practitioners need to identify publics' preferred sources of crisis information based on specific crisis types so that they can motivate publics to spend less time on information milling and more time on taking appropriate protective actions.

Future research may want to replicate the new SMCC subscales tested here for information seeking and sharing, in which interpersonal, mass mediated, and socially mediated communication were divided to see to what extent communicative engagement relates to publics' crisis responses. Furthermore, future research may want to continue to expand and test the revised and integrated SMCC model proposed here (see Figure 3), which added risk-specific variables and problem solving as the outcome. Consequently, for the first time the SMCC model has been transformed from a descriptive to a predictive model.

Furthermore, the role of referent criterion becomes once again uncertain in the tornado context when STOPS is integrated with the new SMCC model communicative engagement variable. Referent criterion is prior knowledge, experience, and subjective judgement rules that people use when facing problematic situations (Grunig, 1997). Referent criterion significantly affects communicative action, which encompasses the active and passive communication behaviors proposed in the STOPS model. However, this effect becomes insignificant on communicative engagement, which is a more concrete predictor of action taking than communicative action. This result posts questions regarding the role of referent criterion on publics' communicative behaviors in relation to action taking. From a practical perspective, this finding may be good news since few Americans have extensive disaster knowledge and instead look to the government for advice on what to do during events like tornadoes. This finding thus suggests the critical importance of crafting effective crisis messaging. As Werder (2005) noted, public relations scholars have overlooked the message variable in their theory development and research. More research certainly is needed to guide how public relations professionals can write effective messages for imminent-threat disasters like tornadoes.

Future research may also explore whether referent criterion can be integrated into modelling of risk-specific variables, thereby making the construct a better fit for crisis research. For example, people's prior disaster exposure affects how they respond to crisis information (Jin et al., 2016). Another area for future research is returning to the concept of passive vs. active communicative action. It may be that the SMCC measures for information seeking and sharing could be expanded to have active and passive levels. Likewise, a new SMCC measure could be introduced to measure information receiving, which is called information selection in STOPS (Kim & Grunig, 2011).

Limitations and Conclusion

This study is limited like all research. First, the study examined only one crisis type. Second, the representative sample of adults came from a single U.S. region, and the sample demographics matched the general demographics of the region in races, gender, and socioeconomic statuses. Future research is needed for different types of crises, in different parts of the U.S. and in different countries. Future research also should examine the impact of important demographics on how people respond to crisis information. Additionally, the study examined self-reported actions, which can suffer from retrospective bias (Fischhoff, Gonzalez, Small, & Lerner, 2005). Future research could deploy the survey developed here immediately after a tornado and/or other crisis types, should funding allow for such an immediate data collection.

This study shows how complex individuals' decision-making is surrounding crises. Results show that STOPS is an internally valid model to predict individuals' passive and active communication behaviors in a crisis context. Yet, the ability of STOPS' communication variables to predict whether individuals take action to protect themselves during a crisis situation is called to question. As a result, the STOPS model in this study is improved and expanded through integrating risk-specific variables and the SMCC model's information source and channel specific communication variables. This integrated model shows a promising path to theorizing individuals' communication behaviors on not only their activeness, but also the sources or channels where these communication behaviors manifest. Such knowledge can help guide how public relations professionals communicate about imminent threats like tornadoes. In sum, this study calls for further attention on the activeness and localities of individuals' communication behaviors in public relations research.

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Table 1. Survey Demographics (Total)[1]

		Survey		Southeastern U.S. Average[2]
		Frequency	Percent	
Race	Caucasian	1098	69.8%	73.16%
	Black	357	22.7%	21.70%
	Hispanic	107	6.8%	7.58%
	Native American	0	0%	0.64%
	Asian	30	1.9%	2.43%
	Not to identify	0	0%	
Gender	Male	767	48.8%	48.87%
	Female	795	50.6%	51.12%
	Not to identify	10	0.6%	
Household Income	less than 20,000	309	19.7%	
	20,001-30,000	296	18.8%	
	30,001-40,000	318	20.2%	
	40,001-50,000	103	6.6%	
	50,001-60,000	83	5.3%	
	60,001-70,000	89	5.7%	
	70,001-80,000	102	6.5%	
	80,001-90,000	77	4.9%	
	90,001+	193	12.3%	
State	Alabama	79	5.0%	
	Arkansas	33	2.1%	
	Florida	526	33.5%	
	Georgia	190	12.1%	
	Kentucky	91	5.8%	
	Louisiana	54	3.4%	
	Mississippi	30	1.9%	
	N.Carolina	184	11.7%	
	S.Carolina	78	5.0%	
	Tennessee	100	6.4%	
	Virginia	186	11.8%	
	W.Virginia	21	1.33%	
	Total	1572		

[1] The numbers reported in the tables deviate slightly from the total number of survey participants because participants could select multiple races and genders. The team used unique survey identification numbers to calculate the totals in these tables.
[2] United States Census Bureau QuickFacts (2017). We obtained numbers from each state of the U.S. Census Bureau QuickFacts and averaged the numbers.

Table 2. Means, Standard Deviations, and Correlations of SMCC Variables

	SeekMass	SeekGov	SeekSocial	SeekIntp	ShareSocial	ShareIntp
Seek Mass Media	3.53(2.33)					
Seek Gov	.586	4.42(1.99)				
Seek Social	.629	.601	3.93(2.17)			
Seek Intp	.554	.556	.690	4.56(1.76)		
Share Social	.470	.420	.625	.493	3.82(2.25)	
Share Intp	.235	.328	.363	.561	.449	5.26(1.66)

Note. All the correlations are significant at the .001 level. The diagonal of the table shows means and standard deviations of the variables. The variables are (from top down) mass media information seeking, government information seeking, social media information seeking, interpersonal information seeking, social media information sharing, and interpersonal information sharing.

Table 3. Correlation Matrix of Latent Variables

	SSP	CE	TL	PR	CR	IR	RC	SM	IFF	IPT	IFW	ISH	ISEEK
Susceptibility													
Crisis efficacy	0.08												
tornado likelihood	0.59	0.25											
Problem R.	0.38	0.37	0.52										
Constraint R.	0.26	0.47	0.42	0.65									
Involve R.	0.41	0.39	0.56	0.69	0.72								
Referent C.	0.18	0.56	0.33	0.50	0.67	0.62							
Situational M.	0.42	0.38	0.54	0.80	0.71	0.76	0.51						
IFF	0.30	0.51	0.46	0.64	0.76	0.76	0.74	0.72					
IPT	0.37	0.41	0.47	0.72	0.67	0.69	0.57	0.80	0.68				
IFW	0.30	0.43	0.44	0.60	0.76	0.74	0.65	0.68	0.77	0.59			
ISH	0.30	0.46	0.47	0.64	0.78	0.76	0.66	0.72	0.81	0.62	0.86		
ISEEK	0.28	0.42	0.45	0.60	0.76	0.73	0.64	0.70	0.80	0.61	0.88	0.86	
IATT	0.38	0.43	0.50	0.71	0.64	0.68	0.56	0.79	0.67	0.79	0.57	0.62	0.58

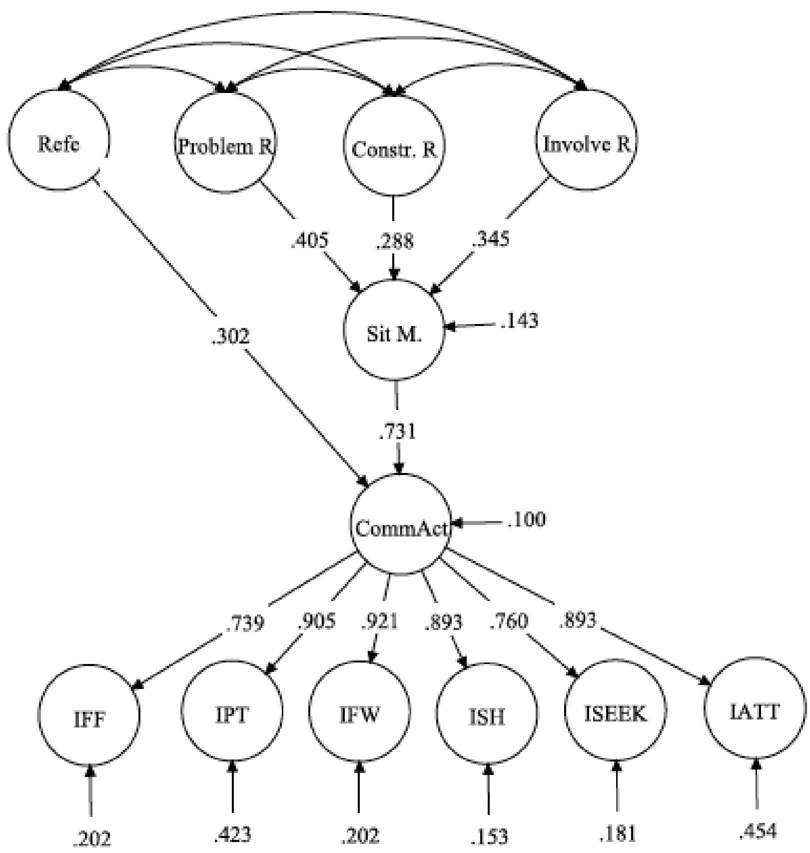

Figure 1. Original STOPS model tested by the current dataset (χ^2 = 5135.41, *df* = 1257, *p* < .001, RMSEA = .045, 90% CI [.043, .046], CFI = .94, SRMR = .058). IFF = Information Forefending. IPT = Information Permitting. IFW = Information Forwarding. ISH = Information Sharing. ISEEK = Information Seeking. IATT = Information Attending. All path coefficients shown are significant.

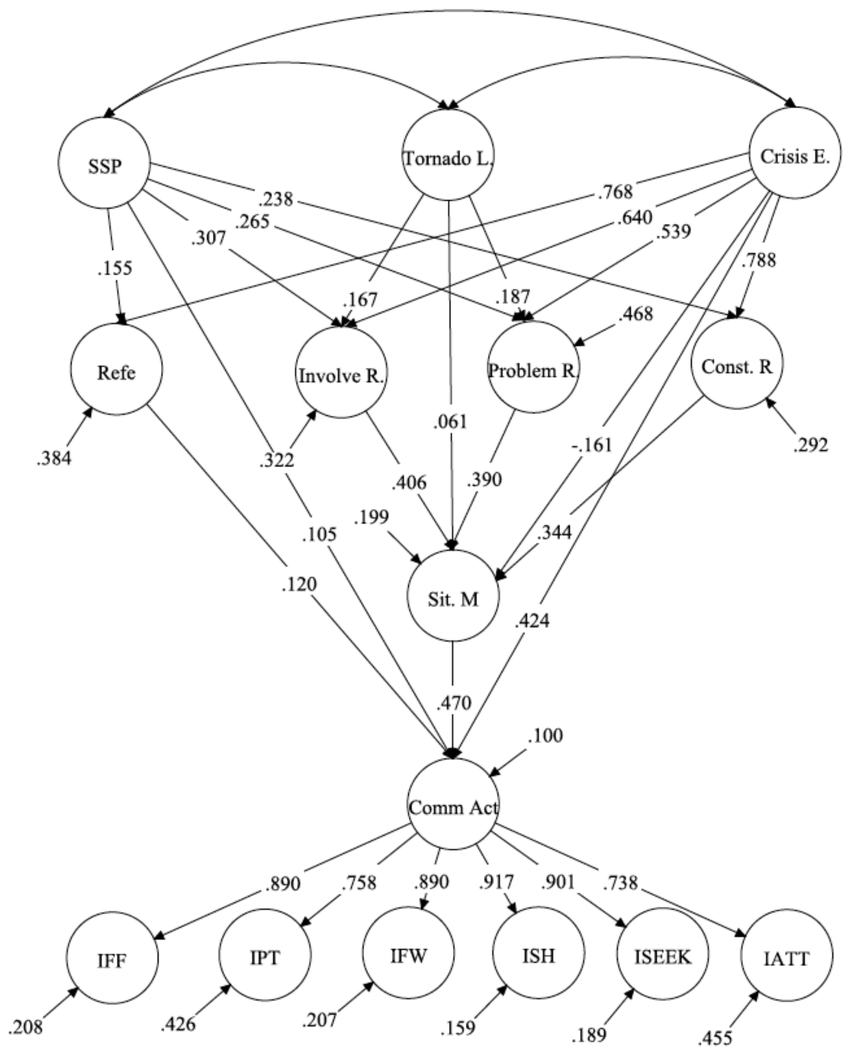

Figure 2. STOPS with risk-specific variables (χ^2 = 6884.71, *df* = 1797, *p* < .001, RMSEA = .044, 90% CI [.043, .045], CFI = .93, SRMR = .060). All path estimates shown are significant. SSP = susceptibility; Tornado L. = perceived tornado likelihood; Crisis E. = perceived crisis efficacy; Refe = referent criterion; Involve R. = involvement recognition; Problem R. = problem recognition; Const. R = constraint recognition; Sit. M = situational motivation. Comm Act = communicative action.

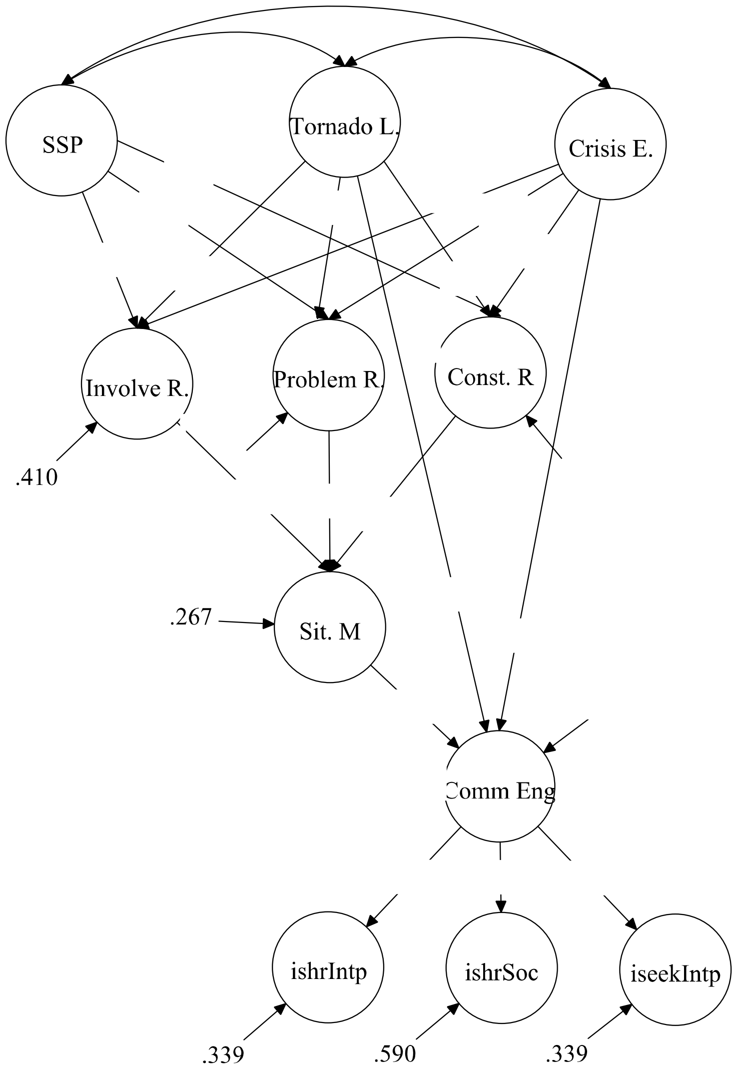

Figure 3. Integrated STOPS and SMCC model (χ^2 = 2613.23, *df* = 565, *p* < .001, RMSEA = .048, 90% CI [.046, .050], CFI = .94, SRMR = .059). All path estimates shown are significant. Comm Eng = Communicative Engagement; ishrIntp = interpersonal information sharing; ishrSoc = social media information sharing; iseekIntp = interpersonal information seeking. The residual variance for problem recognition was .500 (equivalent to R^2 = .500, omitted from the diagram given the space constraint).

Supplementary Material to Publish Online: Table 4

Table 4. Measurement Items, Factor Loadings, and Construct Reliability

Latent Variable	Measurement Items	Loadings	SE	*Coeff. H*
susceptibility	How susceptible are you to getting injured in a tornado? (0-10)	0.847	0.013	0.874
	How susceptible is your residence to getting damaged in a tornado? (0-10)	0.859	0.011	
	How at risk is your community of getting hit by a tornado? (0-10)	0.783	0.014	
crisis efficacy	I have access to adequate shelter in my home.	0.685	0.017	0.817
	I feel confident I know the signs indicating when a tornado is coming.	0.701	0.018	
	I have adequate supplies stored in my home in case of a tornado emergency.	0.748	0.016	
	My family knows what to do in case of a tornado.	0.757	0.017	
tornado likelihood	How often do you think about potential tornadoes occurring near where you live and/or work? (0-10)	0.91	0.009	0.960
	How concerned are you about potential tornadoes near where you live and/or work? (0-10)	0.908	0.008	
	How often do you think about the threat of tornadoes occurring near where you live and/or work? (0-10)	0.951	0.005	
	How often do you think about preparing for the possibility of a tornado occurring near where you live and/or work? (0-10)	0.915	0.006	
problem recognition	I am concerned about this issue regarding tornado warnings a lot.	0.842	0.010	0.891
	Something needs to be done to improve the issue of tornado warnings.	0.814	0.013	
	The government should take action to make changes to how people respond to tornado warnings.	0.806	0.014	
	With regards to tornado warnings, I see a huge gap between what it should be and what it is now.	0.808	0.013	
constraint recognition	I can make a difference in the way tornado warnings problems are solved.	0.923	0.006	0.945
	I feel I can improve the problematic situation of tornado warnings.	0.921	0.008	
	I feel that my ideas or opinions matter to those who are addressing tornado warnings issues in the government.	0.875	0.009	
	I can make a difference and improvement regarding tornado warnings.	0.848	0.009	
involvement recognition	Problems about tornado warnings affect my life.	0.864	0.008	0.947
	I am closely connected with issues facing tornado warnings.	0.895	0.006	
	I think the issues of tornado warnings could affect me personally.	0.846	0.010	
	I feel a strong relationship between the issues of tornado warnings and myself, or those close to me.	0.909	0.007	
	I am connected with the issues surrounding tornado warnings and their consequences.	0.883	0.007	
referent criterion	I know how to deal with the problem of tornado warnings.	0.875	0.008	0.948
	I have a clear idea and direction to deal with problems of tornado warnings.	0.922	0.006	
	I have good ideas about how to deal with problems of tornado warnings.	0.916	0.006	
	I could easily come up with a plan to deal with tornado warnings.	0.893	0.007	
situational motivation	I am curious about the problems associated with tornado warnings.	0.868	0.009	0.885
	I frequently think about tornado warnings problems.	0.796	0.009	
	I would like to better understand the problems with tornado warnings.	0.863	0.009	

information forefending	I have a selection of trusted sources that I check for updates on problems with tornado warnings.	0.773	0.012	0.918
	Others respect my perspective about the problems with tornado warnings because it is simple and clear.	0.838	0.010	
	I have invested enough time and energy so that I understand the problems with tornado warnings.	0.878	0.008	
	I know where to go when I need updated information regarding problems with tornado warnings.	0.787	0.011	
	I easily judge the value of information pertaining to tornado warnings.	0.755	0.014	
	I feel like resisting some persuasive efforts about the problems with tornado warnings.	0.718	0.014	
information permitting	I welcome any information about problems with tornado warnings.	0.818	0.011	0.918
	I am interested in all views on problems with tornado warnings.	0.870	0.008	
	To make better decisions regarding problems with tornado warnings, I listen to views and information opposite to my own as long as they are related to the issue.	0.830	0.010	
	For the problems with tornado warnings, I welcome any information regardless of where it comes from.	0.821	0.012	
	I listen even to the opposite views when it comes to problems with tornado warnings.	0.800	0.013	
information forwarding	It is one of my top priorities to share my knowledge and perspective about tornado warnings.	0.900	0.007	0.978
	I look for chances to share my knowledge and thoughts about issues with tornado warnings.	0.908	0.006	
	I actively seek out opportunities to participate in public opinion polls about the problems with tornado warnings.	0.937	0.004	
	I love to start conversations about issues with tornado warnings with others.	0.933	0.005	
	I volunteer to inform others about the problems with tornado warnings.	0.938	0.004	
	I often play a leadership role in initiating conversation about problems with tornado warnings.	0.933	0.005	
	I frequently express my opinions confidently about what should be done to deal with the problems associated with tornado warnings.	0.934	0.005	
information sharing	I participate in casual conversations about problems with tornado warnings.	0.798	0.011	0.948
	I am sure that I will be quite active in passing on information related to tornado warnings in the near future.	0.771	0.011	
	I am a person to whom my friends and others come to learn more about issues with tornado warnings.	0.921	0.005	
	In the past, I researched the problems with tornado warnings seriously.	0.897	0.007	
	At times I am asked to give advice regarding tornado warnings.	0.917	0.005	
information seeking	I compare new information I receive to previous research I've conducted about tornado warnings.	0.889	0.007	0.970
	From time to time, I contact people about problems with tornado warnings to learn what kind of solutions there are.	0.923	0.006	
	I regularly visit websites relevant to addressing problems with tornado warnings.	0.949	0.004	
	I regularly check to see if there is any new information about the issues with tornado warnings on the internet.	0.936	0.005	
	I search online resources or regular bookstores to find useful information about tornado warnings.	0.931	0.005	
information attending	If I hear someone talking about the problems with tornado warnings, I am likely to listen.	0.848	0.009	0.917
	If I saw something on the news about problems with tornado warnings in surfing the Internet, I would click and read it.	0.842	0.011	

I attend to news when they cover problems with tornado warnings.	0.871	0.009
I pay attention to problems with tornado warnings when a news report appears on TV news.	0.860	0.010

Note. Coefficient H, a construct reliability measure, is calculated based on Hancock (2001).

Supplementary Material to Publish Online: Appendix A

SMCC Information Seeking and Information Sharing Measures

Information Seeking (on a 7-point Likert scale, from 1 strongly disagree to 7 strongly agree)
If I were in an area under tornado warning, I would look for more information from/by ________

- A local newspaper
- A national newspaper
- Television
- Local government websites
- Federal government websites
- Online videos (e.g., YouTube videos)
- Facebook page updates
- Twitter
- blogs
- Talking to people I know via face-to-face and/or phone conversations
- Emailing people I know
- Texting people I know
- Viewing pictures related to the disaster on a site dedicated to photo sharing (e.g., Flickr, Pinterest)

Information Sharing (on a 7-point Likert scale, from 1 strongly disagree to 7 strongly agree
If I were in an area under tornado warning, I would _________

- Like a Facebook post I read about the warning
- Retweet a tweet I read about the warning
- Email the website where I read about the warning
- Tell people I know (e.g., family, friends and co-workers, etc.) via face-to-face conversations about the warning
- Tell people I know (e.g., family, friends and co-workers, etc.) by emailing them about the warning
- Call people I know (e.g., family, friends and co-workers, etc.) via telephone to talk about the warning
- Text people I know (e.g., family, friends and co-workers, etc.) about the warning
- Like a government Facebook post about the warning
- Share a government Facebook post about the warning on my Facebook page
- Comment on a government Facebook page about the warning
- Post information on my friends? Facebook pages or groups about the warning
- Retweet a Twitter post about the warning
- Tweet about the warning
- Write a blog post on my own blog about the warning
- Post a comment on someone else's blog about the warning
- Make a comment on someone else's online video about the warning
- Upload a picture related to the warning on a site dedicated to photo sharing (e.g., Flickr, Pinterest)
- Follow relevant weather sources on Facebook

Principal Component Analysis of Information Seeking Items

Items	I	II	III	IV
A local newspaper	0.189	**0.914**	0.234	0.048
A national newspaper	0.206	**0.912**	0.242	0.023
Television	0.082	-0.037	0.080	0.913
Local government websites	0.223	0.248	**0.866**	0.140
Federal government websites	0.244	0.366	**0.823**	0.036
Online videos (e.g., YouTube videos)	0.431	0.590	0.451	-0.15
Facebook page updates	**0.707**	0.258	0.369	-0.101
Twitter	**0.654**	0.391	0.364	-0.197
Blogs	0.575	0.539	0.354	-0.206
Talking to people I know via face-to-face and/or phone conversations	**0.734**	0.179	0.033	0.334
Emailing people I know	0.534	0.547	0.356	-0.086
Texting people I know	**0.809**	0.093	0.136	0.164
Viewing pictures related to the disaster on a site dedicated to photo sharing (e.g., Flickr, Pinterest)	0.597	0.490	0.342	-0.108

Note. Results are based on a principal component analysis with varimax rotation. Selected items are in bold. Television is not selected because no other item loads on the same factor.

Principal Component Analysis with Information Sharing Items

Items	I	II	III	IV
Like a Facebook post I read about the warning	0.486	0.590	0.133	0.377
Retweet a tweet I read about the warning	**0.803**	0.312	0.230	0.154
Email the website where I read about the warning	0.533	0.427	0.134	0.555
Tell people I know (e.g., family, friends and co-workers, etc.) via face-to-face conversations about the warning	0.171	0.026	**0.776**	0.335
Tell people I know (e.g., family, friends and co-workers, etc.) by emailing them about the warning	0.246	0.306	0.388	0.704
Call people I know (e.g., family, friends and co-workers, etc.) via telephone to talk about the warning	0.103	0.103	**0.856**	0.097
Text people I know (e.g., family, friends and co-workers, etc.) about the warning	0.169	0.389	**0.747**	-0.051
Like a government Facebook post about the warning	0.470	0.727	0.129	0.334
Share a government Facebook post about the warning on my Facebook page	0.444	0.768	0.243	0.137
Comment on a government Facebook page about the warning	0.497	0.689	0.143	0.367
Post information on my friends? Facebook pages or groups about the warning	0.472	0.715	0.24	0.234
"Retweet" a Twitter post about the warning	**0.840**	0.384	0.216	0.089
Tweet about the warning	**0.857**	0.354	0.217	0.097
Write a blog post on my own blog about the warning	**0.796**	0.369	0.102	0.281
Post a comment on someone else's blog about the warning	0.709	0.458	0.109	0.363
Make a comment on someone else's online video about the warning	0.653	0.510	0.100	0.382
Upload a picture related to the warning on a site dedicated to photo sharing (e.g., Flickr, Pinterest)	0.654	0.458	0.156	0.354
Follow relevant weather sources on Facebook	0.436	0.724	0.255	0.098

Note. Results are based on a principal component analysis with varimax rotation. Selected items are in bold. Items that cross load on more than one factors are deleted.