

Intolerance of Uncertainty Predicts Storm Fears

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Abstract

Severe storms present challenges and risks to global mental health. To address these risks, underlying vulnerability factors should be considered. For example, storms often cause fear by presenting unpredictable or uncertain situations, which may be particularly distressful for individuals who experience broad intolerance of uncertainty. This is especially salient for those who experience disproportionate and uncontrollable fears and anxiety. For those high in intolerance of uncertainty, fears regarding storms could be more likely or more extreme, leading to increased distress in the event or anticipation of storms. This study investigates the possibility of uncertainty intolerance as a predictive factor for storm fears. Storm fears were assessed in severity using the Storm Fear Questionnaire (SFQ), and intolerance of uncertainty is measured using the Intolerance of Uncertainty Scale (IUS). Results of a linear regression model indicated that intolerance of uncertainty is a significant predictor of storm fears. This replicates previous literature implicating a relationship between broad intolerance of uncertainty and storm fears, and also contributes to broader literature implicating intolerance of uncertainty as a transdiagnostic factor across anxiety-related disorders. As a result of global climate change, severe weather events continue to grow more extreme and more common. As such, mental health risks related to severe weather events are increasingly important to understand. Intolerance of uncertainty has previously been identified as a risk factor in anxiety and related disorders (Eysenck, 1997) as well as weather-related trauma (Pardue, 2018). The present study serves to bridge a literature gap by linking intolerance of uncertainty to storm fear specifically.

Keywords: Intolerance of uncertainty, severe weather, severe storms, fear, storm fear, natural disaster

Introduction

Climate Change & Storms

While many of us do not think about storms on a daily basis, they are a continuous occurrence. For example, at any given moment, roughly 2,000 thunderstorms are taking place worldwide. Yearly, that number comes out to 16 million, with 10% reaching a designation of severe (NSSL, n.d.). The results of severe thunderstorms are devastating, consisting of flash flooding, fire resulting from lightning strikes, damage or injury from hail, and hazards such as fallen powerlines. While thunderstorms can be damaging on their own, they also serve as catalyst events for more severe weather. Thunderstorms, for example, do not always produce tornadoes, but a tornado will always begin as the result of a supercell thunderstorm beginning to rotate. Beginning in the 1950's tracking of tornado occurrences has shown that annually an average of 1,200 tornadoes have occurred worldwide. The same process occurs in hurricanes, with the exception of storm origin occurring over an ocean rather than land – an annual average of 86 tropical cyclones occur globally, and on average of 25 of these will develop into a hurricane. 2020 saw a record breaking 104 tropical storms, and 2021 saw a higher-than-average number of 94 tropical storms (Alves, 2022). A multitude of studies have found increases in thunderstorm, tornado, and hurricane risk in recent years, connecting these patterns back to anthropogenically-driven climatic changes (Brooks, 2013; Strader et al., 2017; GFDL, 2021). Recent decades have been the hottest on record, an attributing factor to these changes in weather patterns. This trend is only expected to continue as temperatures become increasingly extreme, causing weather patterns to become increasingly unstable over time (IPCC, 2021). Consequently, outcomes of severe weather events are tremendous in terms of damages to human life, property, and wellbeing.

Impacts of Storms on Health and Psychological Functioning

Given the frequent nature of storms, presumably everyone has some level of experience with storms in their lives. The severity of one's experiences with storms can be vastly different, with some individuals being affected more severely or frequently than others. Though storms are a natural and unavoidable occurrence, climate change elevates the severity and frequency of storm events. These alterations in weather patterns are expected to impact mental health issues, which often result from the difficult situations posed by storms to the people who experience them. Not only do structural or otherwise monetary damage result from these events, but affected individuals are more prone to develop symptoms of PTSD, anxiety, and depression (Espinel, 2019). These complications can be due to traumatic experiences that occur during a storm event, such as being trapped in a storm shelter or stuck in a flood, or events following a storm such as economic distress and loss of community.

Though climate change has been described as one of the greatest threats to human health in the 21st century (IPCC, 2021), psychological impacts are only recently being factored into these considerations. In 2010, the American Psychological Association Task Force on the Interface between Psychology and Global Climate Change recognized the need to bridge this gap and issued a report calling for more research into the interactions between climate change and mental health, leading to an acknowledgement of the importance of this research area (APA, 2010). Presently, there is a great deal of work being done to better understand these interactions. Some of this research existed prior to or outside of the context of worsening climate change, for example Liddell & Lyons' (1978) questionnaire analysis sought to identify etiological generalizations regarding storm phobias. Other early research similarly sought to identify the causes and characteristics of weather-related phobias, finding that they tended to result from direct or indirect experience with storms (Westefeld, 1996). It logically follows, then, that

increases in severe weather may attribute to increasing prevalence of storm fears or phobias in the general population, though there is no evidence to confirm this presently.

Storm Phobia

While fear is certainly a normal reaction to storms, weather phobias are characterized by maladaptive or excessive patterns of worry within the context of weather-related events (Westefeld, 1996). One distinguishing characteristic of phobia is that the fear experienced is disproportionate to the actual situation. Within the Diagnostic and Statistical Manual of Mental Disorders Fifth Edition (DSM-5), natural environment phobias are one of five subtypes of specific phobias (APA, 2013). Specific phobias are defined as fear or anxiety about a specific object or situation, and in the case of natural environment phobias, weather events are the object of one's phobia. "Natural environment phobia" is a broader term which includes phobias such as fear of lightning and/or thunder (astraphobia), fear of heights (acrophobia), fear of water (aquaphobia). Storm phobia refers more specifically to phobias of thunder and/or lightning (astraphobia), and fear of tornadoes and/or hurricanes (lilapsophobia.) Diagnostic prevalence of specific phobia is around 7%-9% (DSM-5), and women are more likely to experience specific phobia than men. An estimated 2% of the population will develop a storm-specific phobia, about seven million individuals across the United States and Canada (Stintson et al, 2007). However, the complicated nature of climate change and storm fears necessitate a broader definition of distress, and symptoms may be experienced by those who do not necessarily meet clinical levels.

Degree or severity of one's symptoms also can vary greatly from person to person. According to the DSM-5, individuals typically fear more than just one specific object. For example, an individual with a fear of tornadoes may also be likely to fear rain or lightning as well. On a subclinical level, an individual with storm fears would also be likely to fear more than

just one of these events. Considering that severe storms develop from minor storms, it is likely that severe storms may exacerbate the worry that is experienced in response to minor storm-related events, such as regular rain or cloudiness. Other criteria for clinical diagnosis of specific phobia include active avoidance, meaning the individual attempts to avoid the object of their phobia to the best of their ability. Thus, when an individual is unable to avoid encountering their fear, anxiety and distress may cause significant impairment. This could be especially difficult if someone is caught within a storm event very suddenly (e.g., a rapidly-evolved tornado) and experiences the presence of stress responses such as physiological arousal when encountering the object of a phobia (DSM-5). Additionally, some types of storms necessitate sheltering in place as the safest course of action, making avoidance during an actual event unsafe or impossible.

Individuals with phobias may work to structure their life such that they do not encounter the object of fear. For example, a person who has a phobia of car accidents might move to a city which has public transportation available. Similarly, an individual with a specific phobia of hurricanes might relocate to a state which is not coastal. However, storms are uncontrollable and difficult to avoid, and relocation is not always possible. Individuals often live with their symptoms due to feeling embarrassed of their phobia, and the majority of adults with storm phobias do not seek treatment (Westefeld, 1996). Typically, storm phobias take the form of obsessive monitoring of news channels and weather reports, constant vigilance such as storm preparedness, overestimation of the likelihood of a severe storm occurrence, and worry about dying or being injured during a storm (Westefeld, 1996). In addition, physiological response such as arousal is associated with the subject of one's phobia, involving response in the amygdala and other fear-related responses such as perspiration and acceleration of heart rate.

One may recognize their worries are excessive or irrational, or they may find their fears to be appropriate.

Frequently, the psychological costs of storms are overshadowed by more visible damages. A cost analysis of damages incurred during Hurricane Katrina found that spending on mental health screening and treatments for mental disorders in the affected New Orleans population was around \$1,133 per capita, or around \$12.5 billion, similar to the cost of structural repairs to the city's failed levy system (Schoenbaum et al., 2009). Typically, the focus on mental health following a storm or natural disaster focuses on disorder prevalence and development. This reinforces the idea that less obvious forms of distress in response to a storm (i.e., those which do not necessarily reach a clinical level of disruption to one's daily life and functioning) are still financially costly and significant to consider in terms of storm damages. Common experiences following a severe storm are anxiety, insomnia, decreased feelings of safety, irritability, socioeconomic distress, substance abuse, and physical health effects resulting in psychological distress (Cruz et al., 2020). Most of the time, a remarkable resilience is seen in affected populations. Symptoms are frequently temporary and do not necessarily lead to development of a psychiatric disorder. Considering this, it is important to focus on addressing non-clinical symptoms in addition to clinical ones. Individuals may experience phobia-like symptoms following a storm or require non-clinical therapeutic services for assistance with short-term symptoms.

As more information emerges with regard to storm phobias over and above subclinical levels of fear, etiological information on phobias is useful in providing a framework with which to understand and acknowledge storm fears in a broader, non-clinical context. Storm fears are a rational response, as fears are in fact useful in motivating behaviors that promote self-

preservation and protection. It would be abnormal to have no fear of a potential threat, such as a severe storm. Similarly, climate anxiety is considered a mental health consequence of climate change despite fear being a rational response and motivating factor in mitigation (Clayton, 2020). The distinction between adaptive or maladaptive levels of fear is important to note. The consequences are in the individual's experience psychological distress or trauma. Despite being subclinical, symptoms such as insomnia, substance abuse, and anxiety are still present.

Intolerance of Uncertainty & Storms

Intolerance of uncertainty is a key feature in anxiety disorders and generalized anxiety (Eysenck & Derakshan, 1997). Individuals who score high in intolerance of uncertainty react strongly and negatively to uncertain situations. Individuals with an anxiety disorder have been found to score significantly higher in intolerance of uncertainty measures than those without (Birrell, 2011). Though intolerance of uncertainty is considered a trait or dispositional characteristic, situational factors such as storms also may be a cause of distress to those high in intolerance of uncertainty. Despite incredible technological advances in weather prediction models, storms still pose an inherent uncertainty for those who experience them. For instance, likelihood percentages of forecast storms do not offer an absolute guarantee as to whether a storm will materialize. This can only be known with absolute certainty when the weather event is actually occurring. Beyond likelihood of initial occurrence, exact severity of a flood or exact path of a tornado is often unpredictable even if the storm itself is anticipated. One may anticipate a storm, but experience intolerance of uncertainty in terms of whether or not one's own safety or property will be compromised during the storm. Situations such as loss of contact with loved ones and uncertainty as to their safety may also occur. Similar to storm uncertainties, climate change models can predict a range of expected effects on global weather patterns, though there

are levels of uncertainty not only as to the exact severity but also as to whether or not enough something will be done to mitigate the anticipated damages. This project considers the uncertain nature of weather events to pose the question of if intolerance of uncertainty predicts levels of storm fears.

The Present Study

The present study utilizes mass testing data to assess if intolerance of uncertainty predicts storm fears. Considering the interrelated nature of uncertainty and storms, the researcher anticipates that these variables will be related to one another. The reasoning behind this expectation lies in the inherent uncertainty of storm situations, which would likely be distressful to an individual with dispositional intolerance for uncertain situations. Presumably, a fear or phobia would be more likely to develop for these individuals following exposure to a storm (mild or severe) or would be experienced more intensely throughout the duration or anticipation of a coming storm.

Method

Participants

Undergraduate students were recruited using Oklahoma State University's online SONA recruitment system and responded to an advertisement to participate in a mass testing survey. The analytic sample size for the present study included participants who provided full responses to all measures used in present analyses (see below; $N = 365$). Demographically, the participants were 70% white, 7.4% Latino, 4.9% American Indian, 4.4% Asian, and 3% African American. 63% of participants were female, and 27.9% were male. A small percentage (<.1%) identified as transgender or preferred not to provide a response regarding their gender identity. Participants ranged in age from 19-50, with the median age being 19, and a mean age of 19.99 years of age ($SD=3.36$). A correlational design was utilized, and a linear regression analysis measured the extent to which levels of intolerance of uncertainty would predict levels of storm fears.

Table 1. Categorical Demographic Characteristics

| | N | % |
|-----------------------------|-----|------|
| Race/Ethnicity ¹ | | |
| White | 257 | 76.7 |
| American Indian | 27 | 8.1 |
| Latino | 18 | 5.4 |
| Asian | 16 | 4.8 |
| African American | 11 | 3.3 |
| Other | 3 | 0.9 |
| Middle Eastern | 2 | 0.6 |
| Prefer Not to Answer | 1 | 0.3 |
| Gender ² | | |
| Male | 102 | 30.3 |
| Female | 230 | 68.2 |
| Transgender | 3 | 0.9 |
| Prefer Not to Answer | 2 | 0.6 |

Note. ¹N=30 missing; ²N=28 missing.

Table 2. Continuous Demographic Characteristics

| | M | Median | SD | Range | Skewness | Kurtosis |
|------------------|-------|--------|-------|--------|----------|----------|
| Age ¹ | 19.99 | 19.00 | 3.36 | 17-50 | 4.54 | 27.99 |
| SFQ | 8.21 | 5.00 | 8.76 | 0-52 | 1.72 | 3.50 |
| IUS | 57.29 | 54.00 | 23.08 | 27-121 | 0.49 | -0.69 |

Note. ¹N=28 missing. SFQ = Storm Fear Questionnaire. IUS = Intolerance of Uncertainty Scale

Materials

The data for this study was collected by online distribution of validated survey materials. Participants must have completed both the Storm Fears Questionnaire (SFQ) and the Intolerance of Uncertainty Scale (IUS).

Storm Fear Questionnaire (SFQ; Nelson, 2013). The SFQ is a 15-item self-report questionnaire with a 5-point Likert scale response format. The scale is intended to measure behavioral, cognitive, and affective symptoms associated with storm phobia, and uses the following response format: 0 = "not at all true," 1 = "a little true," 2 = "moderately true," 3 = "very true," and 4 = "almost always true". It is important to note that while the SFQ is intended to measure symptoms of storm fears, it cannot be used as a diagnostic measure for storm phobia. However, the SFQ is a useful indicator of storm fears and symptoms of storm phobia for which further diagnostic assessment would be required. This tool is essential for measurement of storm fear and phobia as there are currently no diagnostic scales of measurement for clinical levels of concerns. Both levels of distress (clinical and subclinical) are important to consider. The scale has established good internal consistency (Cronbach's α of .95) and acceptable 2-week test-retest reliability, making it a quality psychometric evaluation of fear of storms (Nelson, 2013).

Intolerance of Uncertainty Scale (IUS; Buhr & Dugas, 2002). The intolerance of uncertainty scale is a 27-item self-report questionnaire intending to measure intolerance of uncertainty. Intolerance of uncertainty is defined as "a dispositional characteristic that results from a set of negative beliefs about uncertainty and its implications" (Dugas & Robichaud, 2007). The intolerance of uncertainty scale is a self-report measure administered as a survey. Items were rated by participants in a 5-point Likert scale ranging from 1 = "not at all characteristic of me" to 5 = "entirely characteristic of me." This version of the scale has been the

most commonly used to measure intolerance of uncertainty, and has shown great internal consistency ($\alpha = .95$).

Procedure

All survey materials were approved by the Institutional Review Board at Oklahoma State University for usage in mass testing by the Psychology Department. Participants responded to SONA advertisements for participation, and completed online questionnaires described above.

Analytic Strategy

The above survey responses were analyzed using linear regression. Participants must have completed both the SFQ and the IUS to be included in this analysis. Incomplete responses to either questionnaire were discarded and not considered in this study.

Results

Results of the simple linear regression indicated a significant effect between intolerance of uncertainty and storm fears ($F(1,363)=14.75, p < .001, R^2=.04$). More specifically, the individual predictor of intolerance of uncertainty predicted significant variation in levels of storm fears such that for every unit increase in standard deviation of intolerance of uncertainty, there was a 0.20 unit increase in levels of storm fears ($t = 3.84, p < .001$). These findings indicate a significant, non-random effect such that levels of intolerance of uncertainty predict increased levels of storm fears.

Table 2. *Analysis of Variance (ANOVA) and Regression*

| | T | <i>p</i> | β | <i>F</i> | <i>df</i> | <i>p</i> | t | R^2 |
|---------------|------|----------|---------|----------|-----------|----------|-----|-------|
| Overall Model | | | | 14.75 | 1 | .000 | .04 | .04 |
| IUS | 3.84 | .000 | .20 | | | | | |

Note. Independent variable IUS (Intolerance of Uncertainty Scale).

Discussion

These results indicate a significant relationship between intolerance of uncertainty and storm fears. The implications of this finding are better understanding of a variable's relation to likelihood of storm fear. Indeed, the inability to tolerate uncertainty in situations appears to be a strong predictor. Though no causality can be drawn here, a significant relationship was found between these variables. Storm fears and phobias are underrepresented in the literature on natural disasters and intolerance of uncertainty. However, this study replicates the findings of similar research. Pardue (2018) explored various coping strategies, including intolerance of uncertainty onto emotional functioning following storms. Their results indicated lower levels of intolerance of uncertainty as protective factors against disaster-related trauma symptoms such as depression and anxiety. The results of the present study indicate high intolerance of uncertainty as a vulnerability to developing fear or phobia of storms. As storms continue to grow more extreme and more common, their emotional implications for populations require further examination. Additionally, this information is useful in understanding the impact of storms on human mental health generally. In screening individuals following a storm, intolerance of uncertainty could potentially serve as an important metric for predicting which individuals might be prone to development of phobia or fear of storms. Finally, this paper serves to contribute to the growing body of literature examining how recent climatic changes might affect human populations.

Intolerance of uncertainty is understood to be a cognitive vulnerability factor in worry and generalized anxiety disorder (Koerner & Dugas, 2008). Additionally, social anxiety and social phobia have been attributed to high intolerance of uncertainty (Boelen, 2009). However, the implications of having negative beliefs regarding uncertainty have not extensively been considered in regard to weather phobia or weather fears specifically. This article serves to

suggest that intolerance of uncertainty is a vulnerability factor in weather fear, a relationship which is previously unexplored in existing literature.

Limitations

This study was conducted as a post-hoc analysis which was pre-collected and were not collected specifically for the present research question. As a result, the study could not be modified by the researcher to include experimental manipulation of any variables. As such, no causality can be assumed between the two observed variables and the conclusions of this study are purely correlational. Additionally, the SFQ is not intended to measure phobias specifically. Thus, this study can only measure storm fears more broadly. Another limitation would be the sample used in this study. Moreover, as all of the participants were students from Oklahoma State University, they have likely lived in Oklahoma or the Midwest. This region geographically is susceptible to increased frequency of storms, specifically tornadoes, and is sometimes referred to as “Tornado Alley.” As a result, individuals in this sample may have higher exposure to storms, which may indicate that they have different types of storm-related fears and therefore may not be representative of the general population.

Future directions

As noted by the researcher, the limitations of using archival data in this study did not allow for a causal relationship to be established. Future studies could look into intolerance of anxiety prior to a storm and likelihood of developing or experiencing storm fears after the storm. This paper had no control group or temporal precedence with which to infer causality, but future studies could potentially formalize a causal relationship between the two.

Recently, research into psychological consequences of the COVID-19 pandemic has identified pre-existing health anxiety as a risk factor for heightened anxiety and subsequent

maladaptive behavior in the context of a pandemic (Sauer, 2020). Similarly, storm fears or phobias could be a risk factor for increased psychological distress in the context of climate change. Searle et al. (2010) found intolerance of anxiety to predict levels of climate anxiousness. Further investigation could be done to explore the role of storm fears in climate anxiety, as effects of intolerance of uncertainty on climate anxiety would likely be similar to storm fears. While this study was not designed to address such a claim, future research should consider the role of storm fear as a risk factor for climate anxiety.

At the time of Westefeld's 1996 analysis of weather phobias, 20% of individuals interviewed cited their phobia stemmed from viewing media coverage of storms. These interviews were conducted in 1996. Psychological impacts related to indirect experience with severe weather could be even higher today considering increased media consumption, as well as an increased frequency and severity of storm events in recent years. Future investigation could explore the indirect effects of increased exposure to severe storms on mental health outcomes.

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