Bridging the gap between Academic Research and Public Perception of Natural Hazard Risk

by

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A thesis submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Master of Science

Auburn, Alabama
May 5, 2019

Keywords: Hazards, Risk, Education
Perception, Geography, Climate

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Abstract

Natural Hazards are a common but regularly misunderstood problem in our world. Researchers have training to understand the processes and risks of natural hazards to better understand how climate related hazards develop and where the heaviest impacts occur. However, the general public often lacks the knowledge or training necessary be able to fully understand natural hazard risk. This leads to a gap of information between academic research and public perceptions of climate related hazards. By measuring and quantifying risk perception, public safety information and educational initiatives can be better tailored to populations, particularly transient populations, such as that of a public university.

The primary goal of this study is to assess the perceptions and knowledge of climate related risks using a vulnerable population like that of Auburn University. In the future, researchers can use this perception of risk to inform administration and campus safety programs of vulnerable areas in climate related risk education. While transient populations may not adequately understand a place's associated risks, education and training programs can help to mitigate potential impacts. To meet this goal a survey has been disseminated to gauge the perception of climate related risks of Auburn University students.

Through analysis of the survey results, it was found that there exists a variation in the perception of risk due to various natural hazards as a consequence of experience, past natural hazard experiences, previous hazard information, region and country of origin, length of time living in Auburn, and education.

Acknowledgements

I would like to thank Dr. Christopher Burton for his role as my master's advisor. Through his mentorship, I have learned new ways to think about and analyze problems. In addition to helping me mature as an academic, he has also helped me mature as an individual. His help was insurmountably necessary for the completion of my thesis.

I would also like to thank Dr. Stephanie Rogers and Dr. Karen McNeal for serving on my thesis advisory committee. They helped me to strengthen my paper with their comments and edits. It would not be the finished product it is today, without their assistance. I would also extend thanks to the faculty of the Department of Geosciences for constant support and guidance.

Finally, I would like to thank my friends, family, and especially my loving husband, Josh. Without his help and late night sessions of Taco Bell and Guitar Hero, I would not have maintained my sanity and composure throughout this stressful time in my life.

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1.0 Introduction

Natural hazards, such as those related to a changing climate, are a common but often misunderstood problem in our world. Knowledge of the potential adverse impacts of natural hazards, their fundamental processes, and just how devastating they can be is common to researchers who study coupled natural, human, and built-environment systems. Researchers, for instance, have developed timely methodologies and powerful tools to predict losses of life, infrastructure, and livelihoods from damaging natural hazard events (Ash et al. 2014). In addition, advances in Geographic Information Science, spatial data, and spatial analysis using Geographic Information Systems (GIS) allows researchers to track and predict natural hazard occurrences like hurricanes and tornadoes from their earliest (Schumann et al 2018). However, how does the public view natural hazards and understand warnings and communication regarding them? When the public does not adequately understand risks due to natural hazards, it can lead to unnecessary adverse impacts during damaging events (Tierney et al., 2006; Ash et al. 2014). During Hurricane Katrina in 2005, for instance, a potential lack of understanding of the danger of the hurricane combined with other socioeconomic factors led to a large population in the city of New Orleans stranded without clean water, food, electricity, or medical treatment (Tierney et al., 2006). Risk education as it pertains to hurricanes might have prompted a larger part of the population to evacuate the city, leading to fewer casualties.

It is within the context of the argument posed directly above that the measurement of the perception of risk within a given population is an important approach that can be used to ascertain public opinion and education levels on natural hazards, as well as to better understand how people will prepare for and respond to natural hazard threats. By measuring and quantifying risk perception, public safety information and educational courses can be better tailored to populations, particularly when there is a population with continuously changing demographics, such as that of a public university with mixed domestic and international transient populations. To date, however, studies to better understand the perception of risk of certain populations within society are lacking (Tierney et al., 2006; Cutter et al. 2011; Schumann et al 2018). This pertains especially to populations considered vulnerable to natural hazards and disasters (Cutter et al. 2011; Schumann et al 2018). The latter includes a lack of studies pertaining to the perception of risks posed from natural hazards on a large and diverse student body (e.g. Jauernic and Van Den Broeke, 2015).

The primary goal of the work conducted for this study was to assess the perception and knowledge of natural hazard risks using a vulnerable transient population, particularly university students. Here, a case study on student risk perception was conducted using undergraduate students enrolled at Auburn University's main campus in Auburn, Alabama, USA. With improved knowledge of the perception of risk due to natural hazards, it is possible to gain a better understanding of how natural hazards may impact transient populations that may not fully and adequately understand a place's risk. Moreover, since the research was conducted using students from the Auburn University Campus, the Auburn administration and Campus Safety office can both better educate incoming students and better prepare them for potential disaster scenarios, response, and recovery efforts on campus.

1.1 Research Questions

The following broad research questions were addressed:

a) How do transient students (i.e. international or domestic students from various regions and socio-economic backgrounds) perceive risk from natural hazards which are present in the state of Alabama and the Southeastern United States?

b) How does the risk perception of students to natural hazards vary considering past natural hazard experiences, previous hazard information, region and country of origin, length of time living in Auburn, and education?

1.2 Document Structure

The research conducted for this thesis is aimed at better understanding how Auburn University students, which are often transient students, perceive the risks they face in Auburn Alabama so that further research and potential resources can be focused on educating students and communicating the risks that they face. The following chapter provides a relevant review of the literature. The third chapter presents the methods conducted to answer the research questions posed. Chapter four presents the results which includes a brief discussion of each of the results. The final chapter offers a brief summary and conclusions.

2.0 Literature Review

2.1 Definition of Risk

The culminating inquiry to the posed research questions lies in one basic concept, “natural hazard and disaster risk” Although risk is often defined in many ways throughout the various disciplines in the physical, biological, and social sciences, it is usually defined in natural hazard and risk perception research involving at least two basic components: the likelihood that a hazardous event will occur and the possibility that its impacts will cause serious influence on people that experience the event (Bostrom et al., 2008; Haimes, 2009).

To first understand areas of opportunity for research on perceived natural hazard risks, it was essential to examine the significance of previous research. Looking at past studies, it becomes evident that a greater understanding of natural hazard risk, and the perceptions of risk, is needed. Besides simply understanding what risk is, we also need to better define how people respond to risk where risk levels depend on human involvement with prior hazards, with mitigating against hazards, and with varying levels of awareness to hazards. It is within this context that risk must be viewed using both the socioeconomic status of society, perceptions, and the biophysical determinants of risk that create the vulnerability of particular places (Cutter, 1996; Liverman, 1990a; Dow 1992).

2.2 Risk Assessment from the Perception Context

One significant downfall of risk science is the impression that scientific analysis is always the most correct form of risk study, while the public perception of risk is misguided. This is often because opinions are fostered and created for the public from the media, leading to emotional reactions to events out of the control of the individual (Tierney et al., 2006). In order to more accurately calculate how people are perceiving risk there needs to be more cooperation between the analytical science and the emotional responses to a risk caused by natural hazards (Freudenburg, 1988).

While many outside of academia do not possess the technical understanding to predict or assess natural hazards with pinpoint accuracy, research has shown that prior experience with hazards can help people better understand when they are in danger of risk (Lindell et al., 2016). Lindell et al. posits that it is this prior experience that many in the general public rely on in lieu of scientific knowledge. Therefore, direct experience with natural hazards is often cited as having a positive influence on an individual's risk perception (Lindell et al., 2016; Ho et al., 2008). Additionally, individuals who have suffered personal loss (over those who have purely had direct experience) are often more likely to seek safety and warning information when they encounter future hazards (Perreault et al., 2014).

In a study conducted by Helweg-Larsen (1999), respondents that had suffered injury as a result of the 1994 Northridge Earthquake incident appeared less optimistic about future hazard experience. Their lack of previous experience or education to natural hazards created a strong response to impending natural hazard events. The respondent population, who had no previous experience with earthquakes were now afraid of injury due to one. If they had been educated in the dangers of earthquakes in advance, it is possible that this drastic change in risk perception could have been mitigated (Helweg-Larson, 1999).

It is within this context that expanding the idea of the citizen's role in disaster research is important in explaining the development of public response to natural disasters. With the emerging importance of the media, communities have begun to listen to disaster myths and misconceptions which can be propagated by media sources more than experts or even their own experiences (Fischer, 1998; Tierney et al., 2006). In the aftermath of Hurricane Katrina, the flood inundated streets of New Orleans were shown on television news to resemble war stricken Middle Eastern villages (Tierney, 2003). This guided the public opinion that Hurricane Katrina was far more devastating than it actually was. Repetition of common disaster misconceptions in media is a common factor when considering disaster opinions. (U.S. Congress 2005; Tierney, 1993).

In risk analysis, one of the main themes of discussion is how to differentiate between natural hazard risks of different levels and how the public interprets warning information. Minor risks might elicit strong reactions from some groups; whereas, truly dangerous events may not get noticed (Slovic, 1987; Kahnerman et al., 1982). To understand this issue, theoretical models have been established to relate the technical assessment of risk to sociological observations of risk perception. Such models allow researchers to better understand processes that can interact with hazards in ways that can amplify and diminish the public's perception of risk. In perhaps the most cited theoretical framework on risk, Kasperson et al. (1989) argue that the amplification of risk happens at two stages: risk transference and response (Kasperson et al., 1988). In the first stage, risk transference, researchers must identify how the information about a risk is transferred. There are two ways that direct and indirect experiences transfer risk information. Direct risk typically describes an individual that has personally experienced an event and has developed their view of risk from that experience, while indirect describes an individual that has viewed or perceived of a risk second hand and derived their opinion based on another person's experience (Kasperson et., al 1988). The second stage refers to how society responds to these risks that are amenable to bias. These biases can come from a variety of places such as political, economic, or social normative views. Simply by changing the wording of the event, news and media can influence their viewers to feel either calm or panic (Kasperson et al., 1988).

2.3 The Re-definition of Risk Perception

In 1999, a study was performed in which three communities were evaluated following Hurricane Hugo (Reddy, 1999). In the study, it was found that a strong association between development management and hazard mitigation exists. The community is first and foremost the most important line of defense. If a community is more educated, they are more likely to take evacuation procedures and relief efforts into their own hands. Less educated communities tend to be differentially affected by natural disasters and recovery efforts are primarily spearheaded by external sources. Changing the public perception of hurricanes through proper education of risks could help in mitigating the damages associated with hurricanes in the future (Reddy, 1999; Mileti, 1980; Drabeck et al., 1983).

Similarly, an additional study conducted by Craig Trumbo and colleagues in 2006 (published in 2011) on the U.S. Gulf Coast depicted the change in risk perception of those that experienced Hurricanes Katrina and Rita. It was these natural hazard experiences that helped to increase the participants overall risk perception. In this study, age and community involvement played significant roles in defining new risk perceptions. The participant's natural hazard experience was found to give them a more optimistic view on future hazardous risks (Trumbo et al., 2011). Interestingly, a complementary study was conducted again by Trumbo and colleagues in 2014 on the same group of individuals a few years later (i.e. Trumbo et al., 2014). Conversely, these results showed that there had been a drop in the perception levels as experience had decreased over time. In other words, as time passes since experiencing a natural hazard event, a person's risk perception will deteriorate. Additionally, some of the public sees the fact that they survived the previous occurrence of a hurricane as a reason for not needing to evacuate or worry about a future event (Trumbo et al., 2014).

Further education can also help throughout adulthood in influencing public risk perception of natural hazards. A study by Faupel and colleagues (1992) has shown that participation in disaster preparedness courses successfully increases an individual's perception of risk. Individuals who participated were more likely to develop and adhere to disaster preparedness plans. This new level of education can help to mitigate damages and loss of life during a multitude of natural hazards and disasters. Prior planning and preparedness have been shown as a substantial leg-up against natural hazard loss (Perry, 1979; Perry and Greene, 1982, 1983; Perry et al. 1981). However, the main problem with programs such as these are that public participation is heavily affected by demographic factors such as race, education, socioeconomic status, and age. The main participants in such programs tend to be white, middle-class, and educated individuals. The primary goal then should be to extend such programs into areas of lower socioeconomic status, particularly those which have a high risk of experiencing a natural disaster, such as the Southeastern United States coastal region (Faupel et al., 1992).

One such way which authorities in the field are changing interactions with the public regarding risk is to improve the monitoring process of tornados to allow for more precise tracking processes. The National Weather Service is the primary disseminator of public warnings of impending natural hazards. However, there is research to prove that simply receiving a National Weather Service warning will not necessarily increase proactive behaviors. As many of these warnings are simply scrolls of geographic and meteorological information, the lack of laymen's terms can impede the efficiency of an individual's actions. Adding additional educational resources could help those that live in areas of frequent natural hazard activity limit the amount of time spent deciphering warnings and increase preparedness and response (Casteel and Downing, 2013).

As the National Weather Service is the foremost authority in the U.S for weather related occurrences, any policy change that needs to happen should start with them. One such policy that is currently under research is the addition of more easily accessible weather warning systems with the use of mobile phones and internet capable units (Ash et al., 2014). There are also new programs like that of National Oceanic Atmospheric Administration's National Geophysical Data Center, that is using new internet tools and techniques that are specifically geared to reach younger more technologically savvy generations through forms of media. These new additions include a teacher's guide to natural hazards as well as online kids' sections and interactive quizzes to test user knowledge of disaster safety techniques (Dunbar, 2007).

Natural hazards are a force of nature that dramatically impact the lives of humans and society with no regard to socio-economic status. They are a driving force that can and will affect anyone and everyone within their impact zones indiscriminately. Outright preventing a hurricane or other natural disaster from happening is simply impossible, but through proper education, improvements to existing infrastructure, and early warning measures and evacuations, humans and society can be better protected against the risks associated (Zadeh, 2006).

3.0 Methods

3.1 Development of the Survey Instrument

In order to assess the risk perception and general understanding of natural hazard risk from students at Auburn University, one technique is to poll the opinions and knowledge of the student body. Here, a survey was adapted from Cutter et al. (2011) and distributed to a sample of the Auburn University student body. The Cutter et al. (2011) study was originally developed to better understand how risk perceptions within a population relate to evacuation behavior from hurricane events. The Cutter et al. (2011) survey was applied to this research because it provided a peer-reviewed survey that was administered to residents in a state (i.e. South Carolina) with a similar hazard risk profile as Alabama. As a result, the survey could be readily implemented without having to develop a new survey instrument from scratch. The modifications applied to the Cutter et al. (2011) survey were limited to simply reframing the questions to account for multiple hazards as opposed to a singular event (hurricanes). As a result, the updated survey considers rapid-onset hazards such as tornadoes, earthquakes, flash floods, and straight-line winds and as slow-onset hazards such as drought.

The target audience for the survey conducted for this research were students enrolled in undergraduate Global Geography courses taught at Auburn University, since easy access to Global Geography classes was accomplished being that the research was conducted within the Geography Department. The Global Geography 1010 course is an introductory geography course which examines spatial and locational contexts for changes in the modern world (Auburn

University, 2019). The selection of this particular course was important in that it is a course offered to all disciplines, which fulfills the social science general education requirements for undergraduate students at Auburn. It is within this context that utilizing students within the Global Geography sections at Auburn University allowed for a diverse number of respondents from different socio-economic, ethnic, regional, and educational backgrounds.

It is important when developing a survey to ensure that the survey's questions are both ethically sound and free from the surveyor's bias (Fan and Yan, 2010). It is also important that the survey participants be allowed to answer questions with anonymity to better encourage honesty in their answers (Bjorn, 2017). As a result, and as a first step, the survey was administered to students using Qualtrics (Qualtrics, 2019), which is a software program and platform that allows for the creation and distribution of internet-based surveys to anonymous participants. As an additional measure to maintain anonymity of the participants, the feature in Qualtrics that collects IP address information for students able to fill the survey out of the web was disabled. Since the information being submitted to the survey does not contain any sensitive or personal data, there was no requirement to contact Counseling Services for input although IRB approval was required.

Survey questions consisted of structured questions, offering each respondent a closed set of responses from which to choose. The advantage to this method is that data collection and analysis is simplified and quicker. Structured questions are best used when the surveyor has a thorough understanding of the appropriate responses to each question and when the surveyor is not attempting to capture new ideas or thoughts from the respondents (Cutter et al., 2011). Structured questions also assist in quantification of information. In this way answers can be assigned a quantifiable scale. This survey used a combined dichotomous and Likert response scale system (Likert, 1932). Previous studies have shown this to be an effective and quick method for data collection and analysis (Cutter et al., 2011).

An important set of questions in the survey were developed to ascertain the origin and demographics of each student. This was to delineate: 1) whether the students are domestic or international; 2) their state or country of origin; and 3) their education level (freshman, sophomore, etc.) A student's demographics help to highlight any potential bias the student may bring into the study. A student from another country who has never experienced a tornado may not fully comprehend its destructive capabilities, whereas a student who has experienced a tornado may perceive it as much more threatening (Major, 1999). Another important factor taken into consideration was the declared major and concentration of each student. This information can be used to determine if non-science majors differ in their risk perception from science majors.

In addition to basic demographics, it was important to ascertain which natural hazards students are familiar with or have experienced. This information was determined via a series of questions that asks students to select which natural hazards they have familiarity with. Familiarity with and/or exposure to prior hazard impacts is a positive influence on one's behavior during a natural hazard. Those who have previous experience are more likely to evacuate or seek shelter from dangerous hazards such as hurricanes (Dash and Gladwin, 2007; Adeola, 2008; Solis et. al., 2010). Questions addressing familiarity with natural hazards and disasters were then followed by a set of questions that allowed the students to rank which natural hazards they feel are risks to them at Auburn University. These questions were formulated to eliminate bias or possible false preconceptions of natural hazards. Finally, there were a series of questions that sought to determine how familiar each student is with basic safety protocols and procedures for a variety of natural hazards.

Upon distribution of the survey participants were given a Universal Resource Locator (URL) to a web address which directed each participant to an anonymous, non-IP tracking web page containing the survey. The target student demographic was those currently enrolled in Global Geography during the Spring of 2019. The sample size consisted of 160 students which was determined adequate via the application of an *a priori* power analysis. A power analysis is a fundamental aspect of experimental design that allows researchers to determine the sample size required to detect an effect of a given sample size with a given degree of confidence (Hunt, 2015). Following the conventions of a power analysis, a power of 0.80 and α of 0.05 was used to perform the *a priori* power analysis for an estimated large effect size of 0.5 (Hunt, 2015). The calculated sample size required to attain this power was 115. In addition to the power analysis, a margin of error was calculated for the survey using Yamane's sample size formula (Israel, 1992; Yamane 1967). With a confidence level of 95%, and assuming a 23,000 undergraduate student body, Yamane's sample size formula ($Sample\ Size = \frac{N}{1+Ne^2}$) , where N is population size and e is margin of error) yields an 8% margin of error.

3.2 Content of Survey

As highlighted in Section 3.1., the survey instrument developed for Cutter et al. (2011) was used as a guide for structuring the survey questions for this research. This was to assure the questions are grounded in the research literature. Here, 12 natural hazard types are accounted for (see Appendix A). Each question, its answers, and its purpose are outlined throughout the remainder of this subsection beginning with Questions 1-3 that were intended to acquire demographics data. As the survey was conducted with anonymous respondents, what data that was collected is general and non-identifying. This data includes student classification, degree field, and place of origin. By obtaining demographics data, potential biases are able to be highlighted. If the survey population is not representative of the student body at large, then the resulting data may be skewed towards risks which are not readily apparent in the full student population. It was important to highlight these potential biases as there is a high degree of risk personalization among varying demographics (Major, 1999).

Questions 4 and 5 were intended to determine how familiar students are with living in Auburn, Alabama. A strong sense of place is important with the context of mitigating against and responding to natural hazards and disasters. In a 2003 study by Dr. Susan Cutter and her colleagues at the University of South Carolina (Cutter et. al., 2003), the concept of social vulnerability (characteristics within social systems that create the potential for loss or harm for hazard events) was examined by surveying county socioeconomics and demographics. A result of the study showed that the longer a person has lived in a place, giving them a strong sense of place, the less vulnerable they are. These questions were also used to determine if respondents have been in Auburn at a time during which natural hazards take place (e.g. tornado season, hurricane season, winter, etc.).

Questions 6 and 7 were intended to assess past experience with natural hazards, particularly those affecting North America. Past experience with natural hazard events is an important component to determine whether an individual may have preexisting knowledge of a hazard. Cutter et. al. (2010) designed a methodology and set of indicators for measuring characteristics of community resilience (characteristics within social systems that allow communities to prepare for, response to, and recover from damaging natural hazard events). A result of that study showed that past natural hazard experience in Florida enabled communities to adopt better strategies to mitigate the impacts of hurricanes (Cutter et. al., 2010).

Questions 8-11 were intended to assess the respondent's perception of threats due to natural hazards on Auburn's campus. These questions also determine respondent's individual perception of how prepared they feel for various natural hazards. As noted in the literature review, the mitigation of risks is largely affected by the public's risk perception. If the public has a greater perception of risk due to a natural hazard, they are more likely to take community-wide and personal measures to help mitigate the damages and risk to life associated with such hazards (Reddy, 1999; Mileti, 1980; Drabeck et. al., 1983).

Questions 12-20 were intended to gauge the respondent's preparedness level for natural hazards. These questions range from concerns about risk communication to access to transportation. In addition, they provide insight to where each respondent has gained information about natural hazards. It is within this context that, risk communication is a complex subject. The sources of information regarding the communication of risk impact the perception of an individual's risk. Warning messages are important, but the content of the warning messages, including graphics and how easy the information is for the general public to comprehend is even more important. This information tends to be disseminated more often by trusted sources like the National Weather Service and local news stations (Mileti and Peek, 2000; Sorensen, 2000). Additionally, disaster preparation measures such as access to personal transportation have a great deal of effect on whether or not an individual is able to evacuate. During Hurricane Katrina, for instance, those who had access to personal transportation were able to follow evacuation orders readily. However, many people that relied on public transport were unable to evacuate effectively as personal vehicles had hindered public transport evacuation efforts (Litman, 2006).

3.3 Statistical Methods

Once the survey received responses from a sample size of 160 respondents, a statistical analysis of the data was performed. Patterns in the data were first ascertained through descriptive statistics. This process included analyzing the percentages of responses to each question. For demographics and binary response questions, this was enough to determine patterns in the data. For questions relying on Likert scales, a more thorough analysis was required. First, each qualitative response category was coded and given a quantitative value from 1-5 or 1-7 depending on the individual question's scale. These values were then averaged for each natural hazard type on each relevant question. Once mean values were obtained, restoring the quantitative data into a qualitative format and allowing an analysis of the risk perception of each natural hazard type surveyed, it was possible to visualize the results using graphical level gauges. Level gauges are a useful way to represent qualitative data in a quantitative format. They consist of a chart which through the use of a gradient color scheme and a semi-circular scale indicate the severity or prominence of resultant data (Rogerson, 2014).

In order to examine any possible relationships between the survey response data, a chi-square test of independence was performed. A chi-square test of independence was a particularly useful tool in determining how the risk perception of students to natural hazards varies considering past hazard experiences, education, country/state of origin, etc. because the chi-square statistic tests whether two variables are statistically associated.

A chi-square test of independence produces a measure of significance, χ^2, between two categorical variables in a manner in which the statistic tests whether or not the null hypothesis (in this case meaning no association between responses on paired survey questions) is valid (McHugh, 2013). To achieve a 95% confidence level, a significance level (α) of 0.05 was used.

If the corresponding probability value (*p-value*) of the χ^2 statistic was less than or equal to α, then the null hypothesis was rejected, and it was assumed that there is some amount of association between responses on paired survey questions. On the other hand, if the *p-value* of the χ^2 statistic is greater than α, then there is insufficient evidence to reject the null hypothesis, and therefore, it cannot be assumed that there must be a statistical relationship between the two responses.

Since the chi-square test of independence is a significance test, it does not relate how strongly correlated two categorical variables are. Instead, Cramer's V (ϕ_c) was used to measure the strength of the relationship between survey responses for thesis. ϕ_c ranges in values from 0 to 1, with 0 indicating no relationship and 1 indicating complete a complete association between variables (McHugh, 2013). The one caveat for chi-square tests of independence is the calculated Cramer's V tends to not show relationship strength very well. Even for strong associations, a low Cramer's V may be produced (McHugh, 2013).

4.0 Results

4.1 Survey Results

Applying basic statistics and visualization to the survey response data was the first step taken to better understand how transient students perceive risk from natural hazards present in the state of Alabama and the Southeastern United States. The first survey was disseminated on February 4th, 2019 to students in Global Geography 1010. This was accomplished by administering the survey to all 5 available class sections in Spring 2019. Since each survey question tends to build upon the other, all results are examined below in a manner in which, where warranted, the results of each survey question are accompanied by a brief discussion outlining the significance of the findings.

Question 1: Student Classification

Question 1 provides student classification data for respondents. This data in *Table 1* shows that 83.13% of respondents were first or second-year undergraduate students. Given the survey's goal of determining transient student risk perception, targeting incoming students is ideal, as new students are more likely to be familiar with current orientation information, such as safety training. Additionally, new students often come with preconceptions obtained from their country, state, city, or region of origin, influencing their views on Auburn's natural hazards. Ideally, natural hazard education programs offered by the university should target incoming students as they need to be educated about Auburn's unique risks. The surveyed population was around 80% first- and second-year students.

Table 1. Response counts and percentages for Question 1.

Student Classification	**Response Count**	**Percentage**
Freshman	91	56.88%
Sophomore	42	26.25%
Junior	25	15.63%
Senior	2	1.25%

Question 2: Which of the following best describes your degree field?

Question 2 was used to determine the range of students who may be enrolled in a STEM discipline. Adding the totals from *Table 2* for the College of Sciences and Mathematics, College of Human Sciences, School of Forestry and Wildlife, College of Engineering, and College of Architecture, Design, and Construction yields a good estimate of STEM majors. While there may be majors from other colleges or schools that yield STEM oriented degrees, these 5 were chosen as their degree listings are majority STEM related. Combined, STEM major disciplines account for 52.52% of the respondents. This provides a nearly perfect balance between STEM and non-STEM respondents. STEM majors may carry more scientific background than non-STEM majors, so by achieving a balance of STEM and non-STEM majors, there is less bias due to previously obtained scientific knowledge of hazards and disasters (Peacock et al., 2004).

Table 2. Response counts and percentages for question 2.

Major Field College or School	**Response Count**	**Percentage**
College of Agriculture	9	5.63%
College of Architecture, Design, and Construction	11	6.88%
College of Business	10	6.25%
College of Education	14	8.75%
College of Engineering	27	16.88%
School of Forestry and Wildlife	4	2.50%
College of Human Sciences	11	6.88%
College of Liberal Arts	28	17.50%
School of Nursing	15	9.38%
College of Sciences and Mathematics	31	19.38%
College of Veterinary Medicine	0	0.00%

Question 3: Which Country and/or U.S. state are you from?

Question 3 was used to determine the place of origin of respondents. Depending on where students originate, they may carry preconceptions or biases to certain natural hazard types or may have little to no knowledge of certain natural hazard types. *Table 3* shows that 90.57% of students were domestic in origin, whereas 9.43% were international students. Additionally, 79.25% of students were from the Southeastern United States (Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, and Tennessee), which arguably implies that they should be familiar with the natural hazards of Alabama.

As previously stated, one of the main goals of this study was to assess how transient populations of students from varying backgrounds perceive the risk due to natural hazards in Auburn, Alabama, while attending Auburn University. As such, obtaining demographics that support this goal and represent the university's population is imperative. The student population of Auburn University is approximately 10% international students (Auburn University, 2017). The surveyed audience was approximately 10% international students. Additionally, around 60% of Auburn University's student population is from Alabama, while the surveyed population was around this same percentage. The student body is also approximately 78% from the Southeastern United States, which also agrees with our surveyed population. As such, it can be assumed that the surveyed audience is representative demographically of Auburn's student body.

Table 3. Response results and percentages for question 3.

Country/State of Origin	**Response Count**	**Percentage**
Brazil	1	0.63%
China	2	1.26%
Colombia	1	0.63%
India	1	0.63%
Slovakia	1	0.63%
South Africa	1	0.63%
South Korea	6	3.77%
Taiwan	1	0.63%
Ukraine	1	0.63%
USA (unspecified)	8	5.03%
Alabama	92	57.86%
California	1	0.63%
Florida	4	2.52%
Georgia	18	11.32%
Illinois	3	1.89%
Kentucky	1	0.63%
Louisiana	1	0.63%
North Carolina	1	0.63%
Pennsylvania	1	0.63%
South Carolina	3	1.89%
Tennessee	8	5.03%
Texas	3	1.89%
Domestic	144	90.57%
International	15	9.43%
Southeastern US	126	79.25%

Question 4: How long have you lived in Auburn?

Question 4 was used to determine how long students have lived in Auburn. By living in Auburn for longer periods of time, a student is more likely to have experienced natural hazards which are present in Alabama. *Table 4* shows that 78.61% of students have lived in Auburn for 2 years or less. This matches closely with the 83.13% of students who are Freshman or Sophomore classification. The 3.77% of "unusable data" is due to responses which either did not include a unit of measurement (e.g. "month" or "year") or included vague responses (e.g. "Ever since I got to college”). For future surveys, this type of question should be a drop-down selection menu rather than a write in answer to avoid such participant errors.

Students who have lived in Auburn for longer will have had time to develop a sense of place. As this study was focused on entering students, around 80% of students surveyed have lived in Auburn for 2 years or less. This means that these students may not have time to develop a strong sense of place, so their surveyed answers could be representative of any preconceptions they hold when they arrive at Auburn. Students who are unfamiliar with natural hazards in the area may be more vulnerable to natural hazard threats than students who have had time to learn about Auburn’s unique risks.

Table 4. Response counts and percentages for question 4.

Time Lived in Auburn	**Response Count**	**Percentage**
<1 year	86	54.09%
1 year	15	9.43%
2 years	24	15.09%
3 years	11	6.92%
4 years	0	0.00%
5 years	3	1.89%
>5 years	14	8.81%
Unusable data	6	3.77%
Total	159	100.00%

Question 5: During which months of the year are you staying in Auburn?

Question 5 was used to determine whether students are staying in Auburn during seasons associated with climate-related hazards. From the responses shown in *Table 5*, the results demonstrate about a 6% increase in students from the Fall to Spring semesters. This could be accounted for by 1st year students not having attended the Fall semester, starting instead in the Spring. However, this also could simply be an anomalous result as this survey was offered only in one given year, and the 6% increase in students is within the 8% margin of error for the study.

Perhaps a noteworthy result is that during the summer months, a majority of the students leave Auburn. During May (the end of the Spring semester), 36% of the students leave the state. Following this in June and July, only around 30% of the students remain in Auburn. It is then perhaps safe then to assume that those 70% that choose to leave for the summer months are unfamiliar with the weather conditions in Auburn during those times due to a lack of experience.

Table 5. Response counts for question 5.

Month	**Response Count**
January	158
February	159
March	158
April	158
May	102
June	47
July	47
August	149
September	151
October	151
November	151
December	148

In Auburn, the Tornado season occurs between the months of March and July. While tornadoes can occur outside of these months, there is a higher chance for tornadic activity during the given timeframe. Tornado occurrences peak during the months of May and June, so students on campus at this time would have a higher likelihood of experiencing such events. However, as almost 70% of the students surveyed indicated that they do not stay in Auburn over the summer months, it is less likely that these students would have prior experience with the threat of tornadoes in Auburn.

Question 6: Which of the following natural hazard events have you experienced?

Question 6 was used to determine past natural hazard experience for the students. Students with or without experience or exposure to natural hazards may have a skewed perception of risk. The data represented in *Table 6* and *Figure C1* shows that the most familiar natural hazards to the respondents are thunderstorms at 87.42% of respondents, fog at 72.33% of respondents, flash flooding at 62.26% of respondents, and tornadoes at 59.75% of respondents. The least familiar natural hazards are wildfires at only 3.77% of respondents, earthquakes at 11.95% of respondents, floods at 22.64% of respondents, and straight-line winds at 23.90% of respondents.

Table 6. Response counts for question 6.

Natural Hazard	**Response Count**	**Percentage**
Drought	50	31.45%
Earthquake	19	11.95%
Extreme Heat	70	44.03%
Flood	36	22.64%
Flash Flooding	99	62.26%
Fog	115	72.33%
Freeze	85	53.46%
Wildfire	6	3.77%
Tornado	95	59.75%
Thunderstorm	139	87.42%
Straight-line Winds	38	23.90%
Hurricane	65	40.88%

Only 60% of respondents indicated that they have experienced tornadoes at any point in their life. This would imply that the other 40% may be unaware of safety precautions to take during a tornado. However, it is not just tornadoes that need to be worried about, there are many other deadly natural hazards which routinely impact Auburn. Extreme heat, flooding, straight-line winds, and hurricanes all impact the Auburn area. Each of these natural hazards carries life threatening risk with them, but of the surveyed respondents, only 40% have experienced extreme heat, 20% have experienced flooding, 20% have experienced straight-line winds, and 40% have experienced hurricanes. A possible effect that a lack of experience has on a population is that people are less likely to prepare or be proactive if they have not experienced an event, particularly when that event is rare or damaging (Covello, 1983). As such, it is important to ensure that students are educated about the risks associated with each of these threats, to increase their likelihood to proactively consider their safety in the event a natural hazard were to impact Auburn.

Another noteworthy result is that only 11.95% of respondents claim to have experienced earthquakes. While earthquakes are uncommon in the Southeastern United States, including Alabama, small earthquakes do routinely occur (Geological Survey of Alabama, 2019). Since these earthquakes tend to be small with ground-shaking unobservable, it stands to reason that students are unaware that they would have experienced earthquakes at some point while at Auburn.

Question 7: How concerned are you with the threat of the following natural hazards in your hometown?

Question 7 further determined past experience with natural hazards. By determining the students perceived level of concern with natural hazard threats in their hometowns, it is possible to better understand the influence past experiences have on their current perception of risk in Auburn. The data for question 7 was derived using a Likert scale with a range of numerical values assigned to the responses, ranging from 5 for “Very Concerned” to 1 for “Not Concerned at all.” By obtaining the mean value of these responses, it is possible to determine whether the students as a whole are more or less concerned. For the mean values, ranges were considered: 1-2 indicates not concerned at all; 2-3 indicates not really concerned; 3 is neutral; 3-4 indicates concerned; and 4-5 indicates very concerned. Tables corresponding to questions using the Likert Scale can be found in Appendix B (i.e. *Table B1*). Here, level gauges derived from the mean values of the Likert responses are shown in *Figure 1*. These values indicate students are concerned with extreme heat, flash flooding, tornadoes, and thunderstorms in their hometowns, while they are not concerned at all with earthquakes and wildfires. These results, combined with those of question 6 indicate that students who were surveyed have little or no experience with earthquakes and wildfires. Experience with a natural hazard often influences the perception of risk due to that hazard (Covello, 1983), so these students with no experience with earthquakes and wildfires may not have had the chance to develop an adequate understanding of the risks associated with such events.

Question 8: How concerned are you with the threat of the following natural hazards on Auburn's Campus?

Question 8 begins the section of the survey focused on Auburn. This question is much like question 7 in that it seeks to ascertain perception level of natural hazard threats. An identical Likert scale (*Table B2*) is used for this question with numerical values assigned, ranging from 5 for "Very Concerned" to 1 for "Not Concerned at all." Mean values for the Likert responses were calculated with ranges as follows: 1-2 indicates not concerned at all; 2-3 indicates not really concerned; 3 is neutral; 3-4 indicates concerned; and 4-5 indicates very concerned.

Once mean values were calculated, these were used to set level gauges based on the ranges listed above (*Figure 2*). The results indicate that students are concerned with the threat of tornadoes and thunderstorms in Auburn, while they are not concerned at all with earthquakes and wildfires. These responses match up well with their hometown responses; however, flash flooding and extreme heat dropped into the "not really concerned" category.

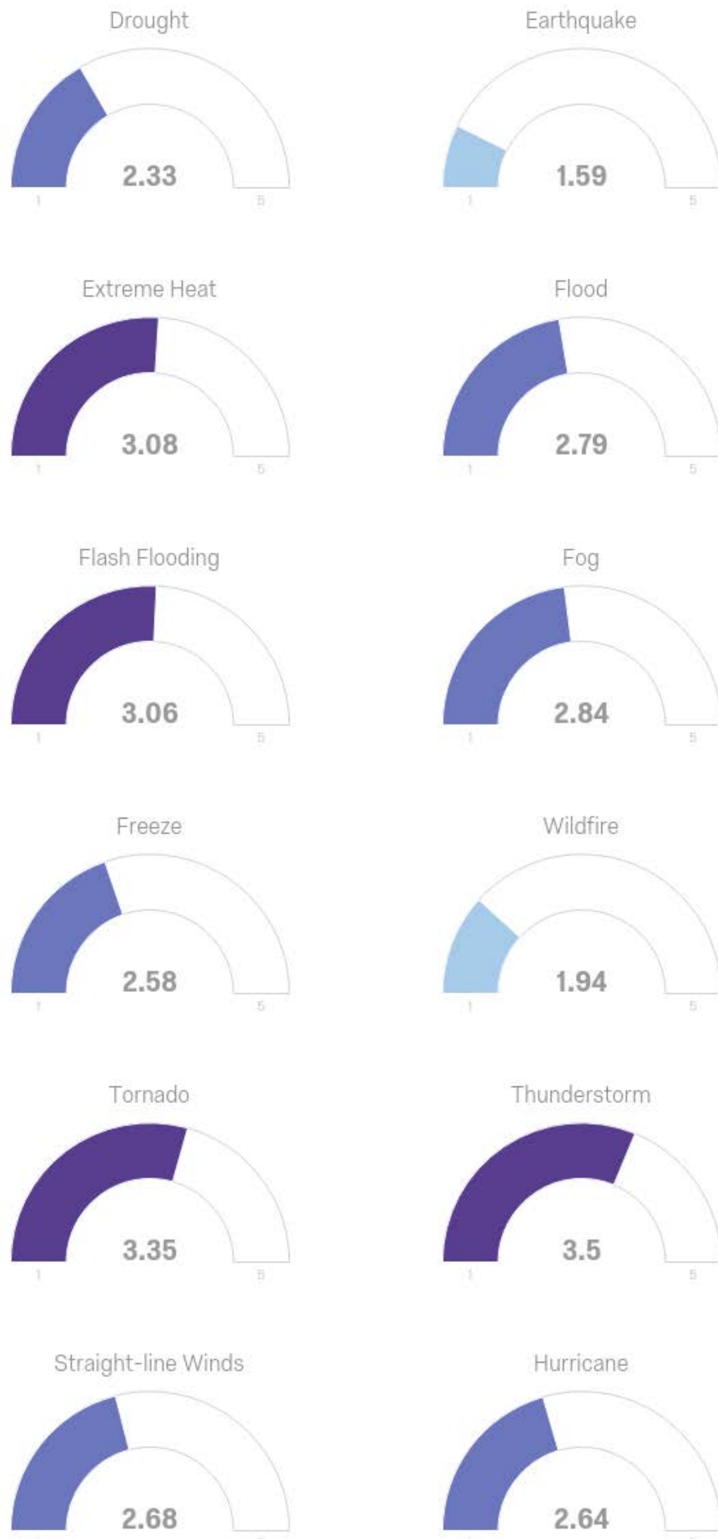

Figure 1. Gauge charts showing means of the Likert responses for each natural hazard for question 7. Gauge charts range from values of 1-5 with 1 indicating least severe (i.e. "Not Concerned at All") and 5 indicating maximum severity (i.e. "Very Concerned").

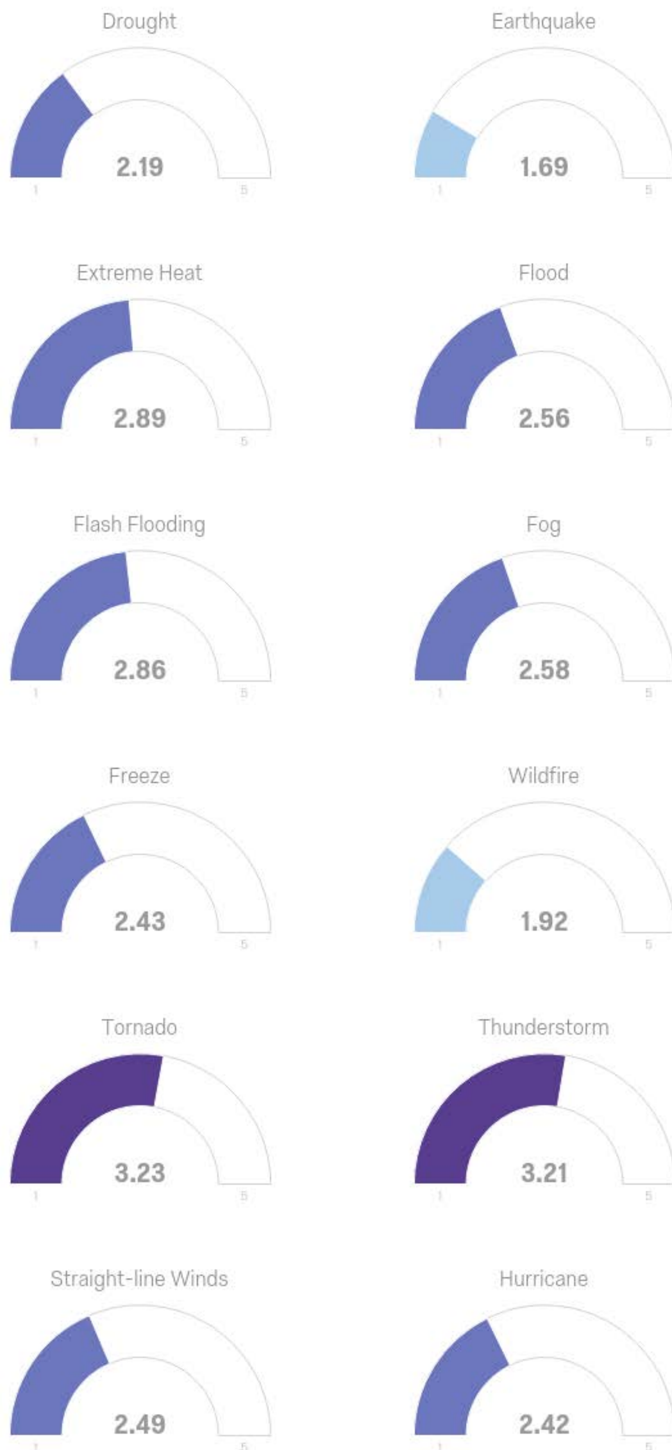

Figure 2. Gauge charts showing means of the Likert responses for each natural hazard for question 8. Gauge charts range from values of 1-5 with 1 indicating least severe (i.e. "Not Concerned at All") and 5 indicating maximum severity (i.e. "Very Concerned").

Question 9: How prepared do you feel in the event of the following natural hazards?

Question 9 was used to determine the preparation level of students for individual natural hazards. Here, a Likert scale (*Table* B3) was codified to range from 5 for "Very Prepared" to 1 for "Not Prepared at all." A similar analysis is done by calculating mean values of responses with ranges set as follows: 1-2 indicates not prepared at all; 2-3 indicates not really prepared; 3 is neutral; 3-4 indicates prepared; and 4-5 indicates very prepared.

The mean values were set up as level gauges and delineated by *Figure 3*. The level gauges indicate that students feel prepared for extreme heat, fog, freeze, thunderstorms, and tornadoes. There are no natural hazards for which students feel not prepared at all; however, all other hazards do fall in the "not really prepared" category.

Question 10: How likely are you to evacuate or seek shelter in the event of the following natural hazards?

Question 10 was used to determine the perception of when evacuation or shelter is needed during a natural hazard. A new Likert scale is used here, shown in *Table B4*, with codified values ranging from 7 for "Extremely Likely" to 1 for "Extremely Unlikely." A mean value for each hazard is again established with ranges: 1-2 indicates extremely unlikely; 2-3 indicates moderately unlikely; 3-4 indicates slightly unlikely; 4 is neutral; 4-5 indicates slightly likely; 5-6 indicates moderately likely; and 6-7 indicates extremely likely. From the calculated mean values, level gauges were set up and are demonstrated by *Figure 4*

Figure 3. Gauge charts showing means of the Likert responses for each natural hazard for question 9. Gauge charts range from values of 1-5 with 1 indicating least severe (i.e. "Not Prepared at All") and 5 indicating maximum severity (i.e. "Very Prepared").

Figure 4. Gauge charts showing means of the Likert responses for each natural hazard for question 10. Gauge charts range from values of 1-7 with 1 indicating least severe (i.e. "Extremely Unlikely") and 7 indicating maximum severity (i.e. "Extremely Likely").

The results of the level gauges indicate that students are moderately likely to evacuate or seek shelter during wildfire, hurricanes, and tornadoes; slightly likely to evacuate or seek shelter during earthquakes, floods, and flash floods; slightly unlikely to evacuate or seek shelter during extreme heat, freeze, thunderstorms, and straight-line winds; and moderately unlikely to evacuate or seek shelter during drought and fog. Risk perception and a person's willingness to evacuate, take shelter, or take other precautions during a hazard go hand in hand (Sullivan-Wiley and Short Gianotti, 2017). If a person is less likely to evacuate or seek shelter, their risk perception due to a natural hazard may be affected negatively.

Question 11: How likely do you feel your place of residence will be damaged by the following natural hazards?

Question 11 was used to address student's perception of damage due to specific natural hazards. A similar Likert scale was used here (*Table B5*), with codified values ranging from 7 for "Extremely Likely" to 1 for "Extremely Unlikely." A mean value for each hazard was established with ranges: 1-2 indicates extremely unlikely; 2-3 indicates moderately unlikely; 3-4 indicates slightly unlikely; 4 is neutral; 4-5 indicates slightly likely; 5-6 indicates moderately likely; and 6-7 indicates extremely likely.

The level gauges set from the mean values (*Figure 5*) indicate that students feel their place of residence is moderately likely to be damage by tornadoes; slightly likely to be damaged by earthquakes, floods, wildfires, and hurricanes; slightly unlikely to be damaged by flash floods, thunderstorms, and straight-line winds; and moderately unlikely to be damaged by drought, extreme heat, fog, and freeze.

During the course of looking through the survey data, there were a few standouts for perceived risk. Tornadoes are obviously extraordinarily destructive, and even those who have not experienced their threat firsthand may have seen videos showing their destructive capabilities. Tornadoes were consistently the highest on the perceived risk levels of the student population. It is easy for students to see such a destructive force and imagine what would happen if it hit them directly (Covello, 1983). However, there are other natural hazards which routinely cause heavy damage and claim lives each year that do not have such obvious destructive force associated with them. One such damaging hazard is that of straight-line winds. Straight-line winds cause much of the same destruction that tornadoes do; however, it is harder to picture them. It is easy to picture a 200 mile-per-hour whirlwind of dust and debris, but an 80 mile-per-hour invisible wind is more difficult to illustrate the destructive capabilities of. One of the most concerning results of the survey is that students in general did not perceive straight-line winds to be a highly damaging event. The general consensus is that residences were slightly unlikely to be damaged by straight-line winds. The Insurance Information Institute ranks wind and hail as the highest claims by frequency of all insurance claims from 2013 to 2017 (Insurance Information Institute, 2019). Both straight-line winds and hail are characteristic of large supercell thunderstorms, particularly those that impact the Southeastern United States. It is likely most students do not even realize what straight-line winds are. If given proper education, these students would understand that straight-line winds, particularly on a flat plain like Auburn University is located upon, are extraordinarily destructive to homes, property, and life.

Another noteworthy result is that students were not as worried about the damaging effects of floods (slightly likely) and flash floods (slightly unlikely) as anticipated. Floods and flash floods are two of the most characteristic natural hazards for property damage. Water damage is responsible for the second highest insurance claim by frequency, surpassed only by wind and hail (Insurance Information Institute, 2019).

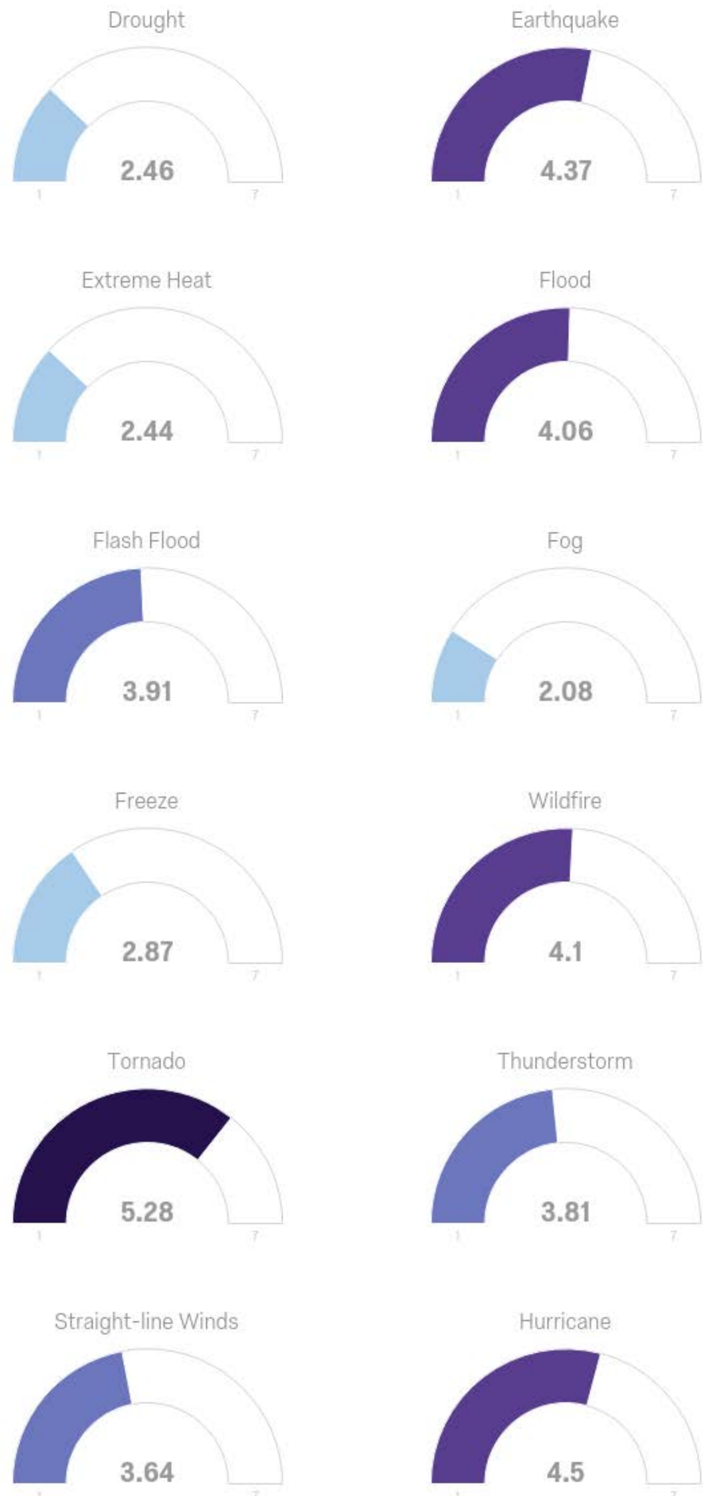

Figure 5. Gauge charts showing means of the Likert responses for each natural hazard for question 11. Gauge charts range from values of 1-7 with 1 indicating least severe (i.e. "Extremely Unlikely") and 7 indicating maximum severity (i.e. "Extremely Likely").

Question 12: Do you have a temporary place of residence to stay in the event your place of residence was damaged by a natural hazard?

Question 12 begins the preparedness portion of the survey. As represented in *Figure 6*, 106 respondents (or 67% of the surveyed population) answered that they did in fact have access to a temporary place of residence in the event their current residence was damaged or destroyed by a natural hazard. However, this leaves one-third of students who might have no place to live should their residence be damaged or destroyed.

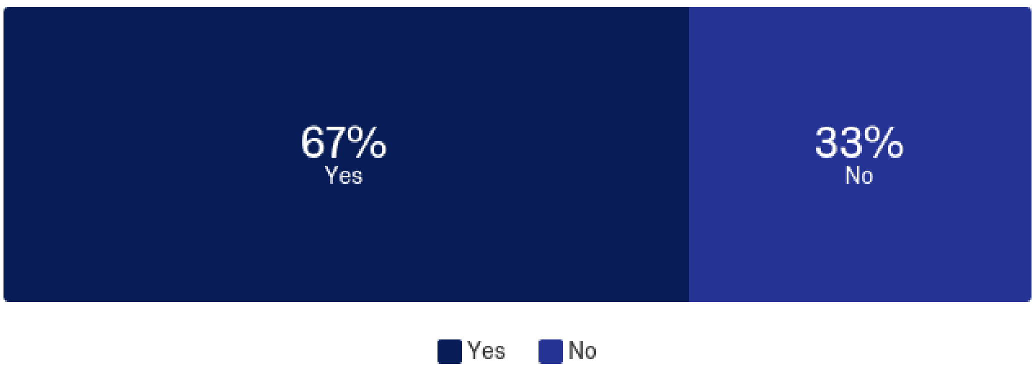

Figure 6. Shows the binary responses to question 12.

Question 13: Which of the following have provided you with useful information to help you be prepared?

Question 13 was used to find out where students get their information about natural hazards. This is not meant to assess immediate threat information but prior knowledge to be used in preparation of natural hazards. The results for this question are represented in *Table B6* and *Figure 7*. The majority of respondents cite local news (83.65%), personal experience (77.36%), and the National Weather Service (NWS) (75.47%) as their source for preparedness. Trust in authorities on matters for which the public may not have adequate knowledge, such as natural hazard risk, is important in increasing risk information to the public (Mitchell et al., 2005; Wachinger et al., 2013). However, on the other end of the spectrum, actual safety training participation is a potential cause for management concern. Disaster preparedness meetings

(3.77%), community emergency response training (7.55%), and university safety training (10.06%) all have extremely low participation rates. Additionally, primary and secondary schooling, where most new college students should be bringing in their information from, is only at 52.50%.

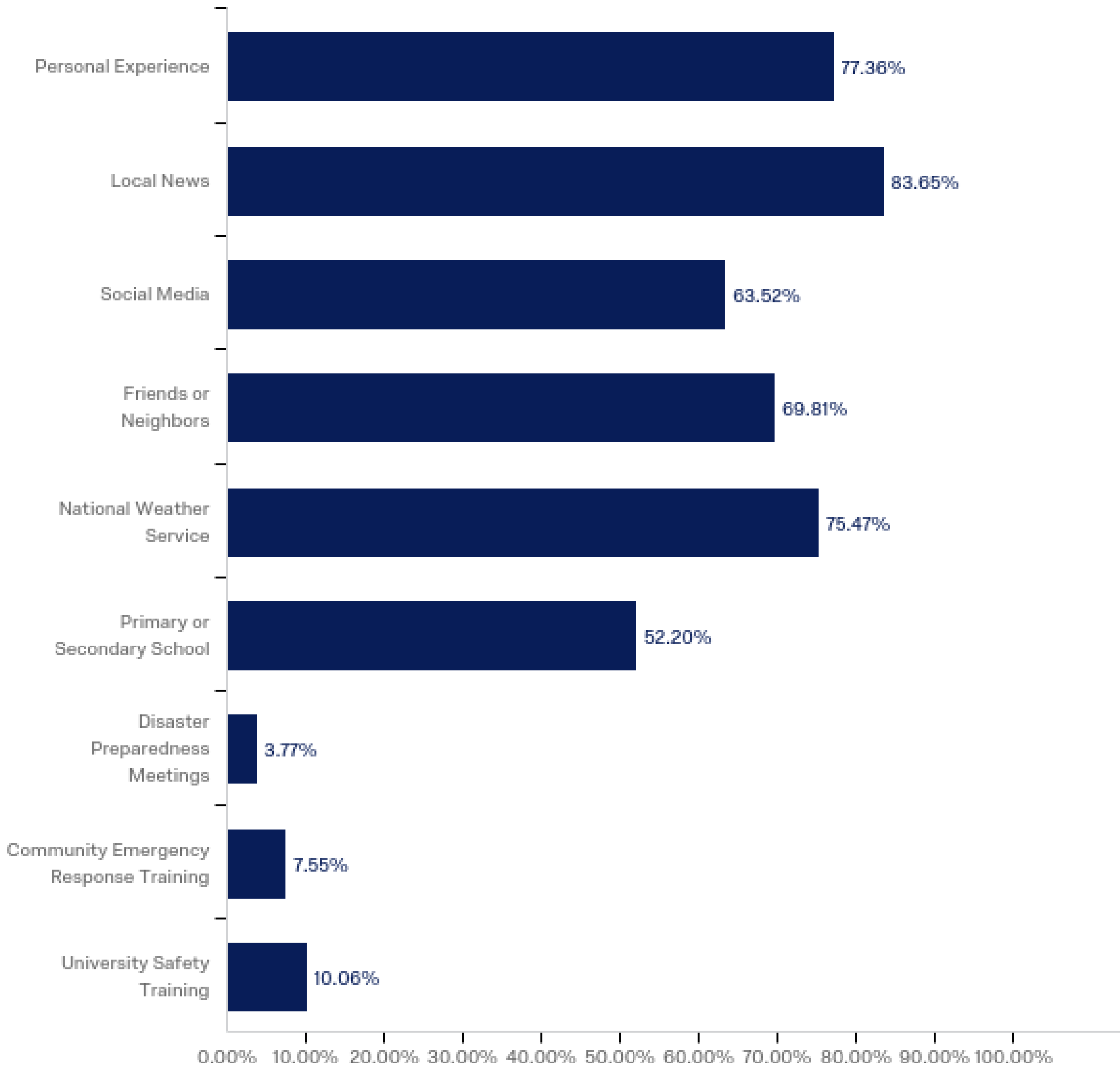

Figure 7. Bar graph showing response percentages for question 13.

Question 14: Do you feel you have a plan for the following natural hazards?

Question 14 was used to determine for which specific natural hazards students have plans. The resulting data is represented in *Table B7* and *Figure 8*. Most students feel they have a plan to deal with tornadoes (73.13%), thunderstorms (68.13%), and hurricanes (56.88%). However, all other natural hazards have fewer than 50% of students with a preparedness plan. Wildfires (11.88%), earthquakes (20.63%), straight-line winds (21.25%), and droughts (24.38%) all have very low perceptions of self-preparedness among the students.

All four of these hazards had approximately a 30% or lower past experience rate as indicated in the responses to question 6. The implication here is that students do not have or are perhaps unable to formulate a plan for a natural hazard which they have not yet experienced. The next least planned for hazard on the list is floods at 35%. As only 22% of students indicated that they had experienced a flood, this result fits in line with the above results as well.

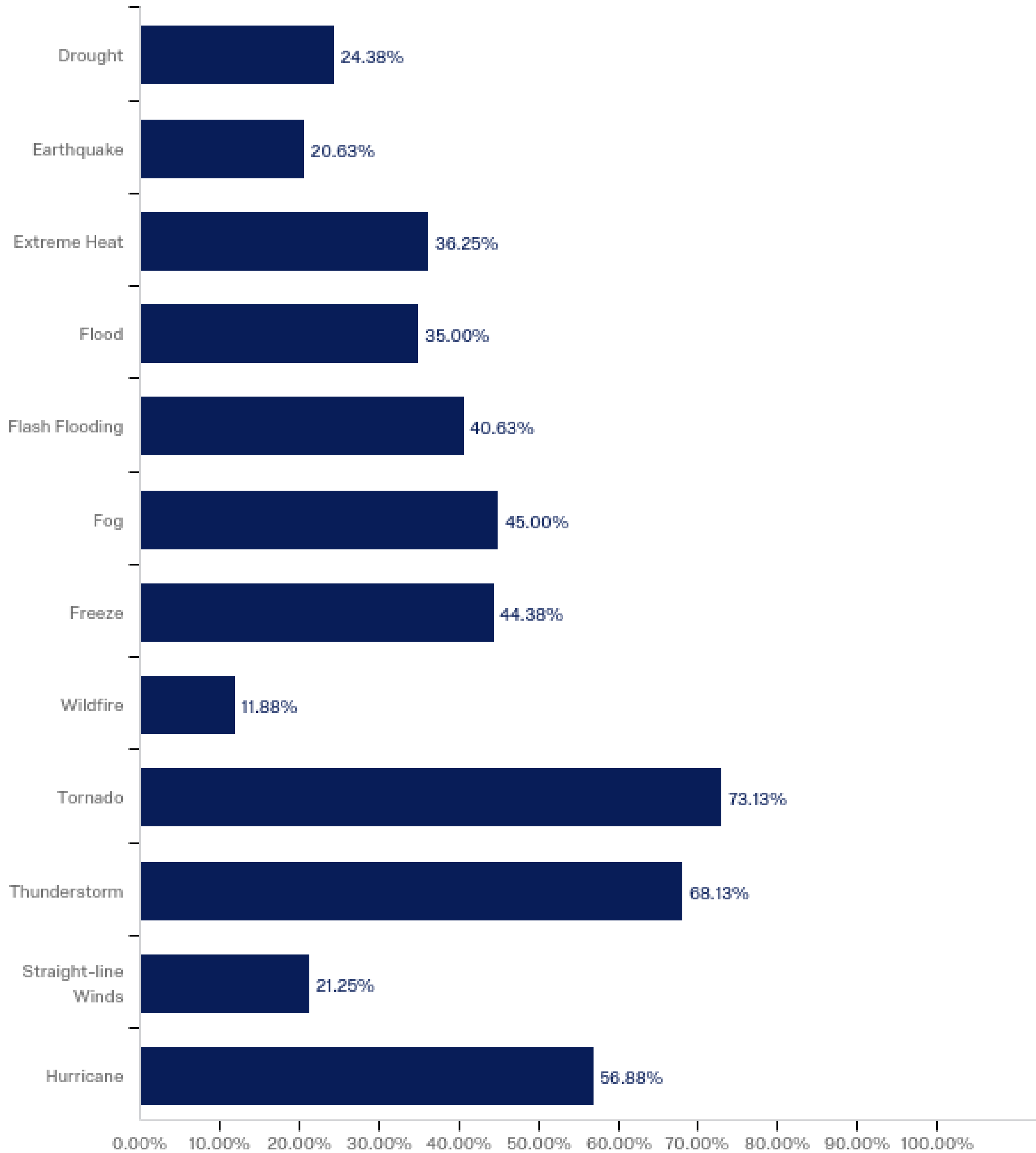

Figure 8. Bar graph showing response percentages for question 14.

Question 15: Which of the following sources would you most likely listen to for imminent natural hazard information?

Question 15 was used to determine where students get their in-the-moment natural hazard information. The response data is represented in *Table B8* and *Figure 9.* A response of 85.53% and 83.02% of respondents would listen to the local news and National Weather Service, respectively. A local news station can provide students with up to date weather forecasts, and the National Weather Service is the authority in the field. Only 54.09% of respondents said they would use the university safety alert system, and only 22.64% would listen to community emergency response organizations, both of which could provide students with up-to-date on the fly disseminations of complex weather and hazard information.

In regards to getting students to take shelter or evacuate, looking at where students get their imminent natural hazard information is important. Eighty-five percent of students indicated that they would receive imminent natural hazard information from the local news. This is often one of the most readily accessible options for the general public. One does not need to know anything about reading a map or understanding forecast data to receive warnings from the local news about an imminent threat. However, the Auburn-Opelika area does not have a local news station. The nearest news stations are based out of Montgomery, AL, Birmingham, AL, and Columbus, GA. During major storms, these news stations do provide some coverage of the Auburn-Opelika area; however, as an example, during the storms on March 3, 2019, much of this coverage was spread out, covering Macon, Tallapoosa, and Lee counties, among other surrounding areas. Until the two tornadoes touched down in Lee County, focus did not shift primarily to the area. Students watching for information on Auburn University, exclusively may have been confused by coverage of surrounding areas. A good solution to this would be to establish a university or student run news station. This could be anything from a local access TV station to a radio station.

Eighty-three percent of students indicated that they received imminent natural hazard information from the National Weather Service. The difficulty comes with how prepared the students are to interpret forecast data and long transcript-style warnings. Students with little to no knowledge of geography may have difficulty reading maps or deciphering what exactly they are looking at. Can the students identify a radar-based rotation in the atmosphere for a tornado? Most would probably not be able to do so without prior training. Even experts must look carefully at radar maps to tell where rotations are occurring. There is one major benefit of students listening to the National Weather Service. The National Weather Service has the ability to send alerts immediately to phones. Almost every student has a smartphone, so they all have the capability to receive such alerts. When the National Weather Service has deemed a situation to be even possibly life-threatening, they instruct recipients of alerts to take shelter immediately.

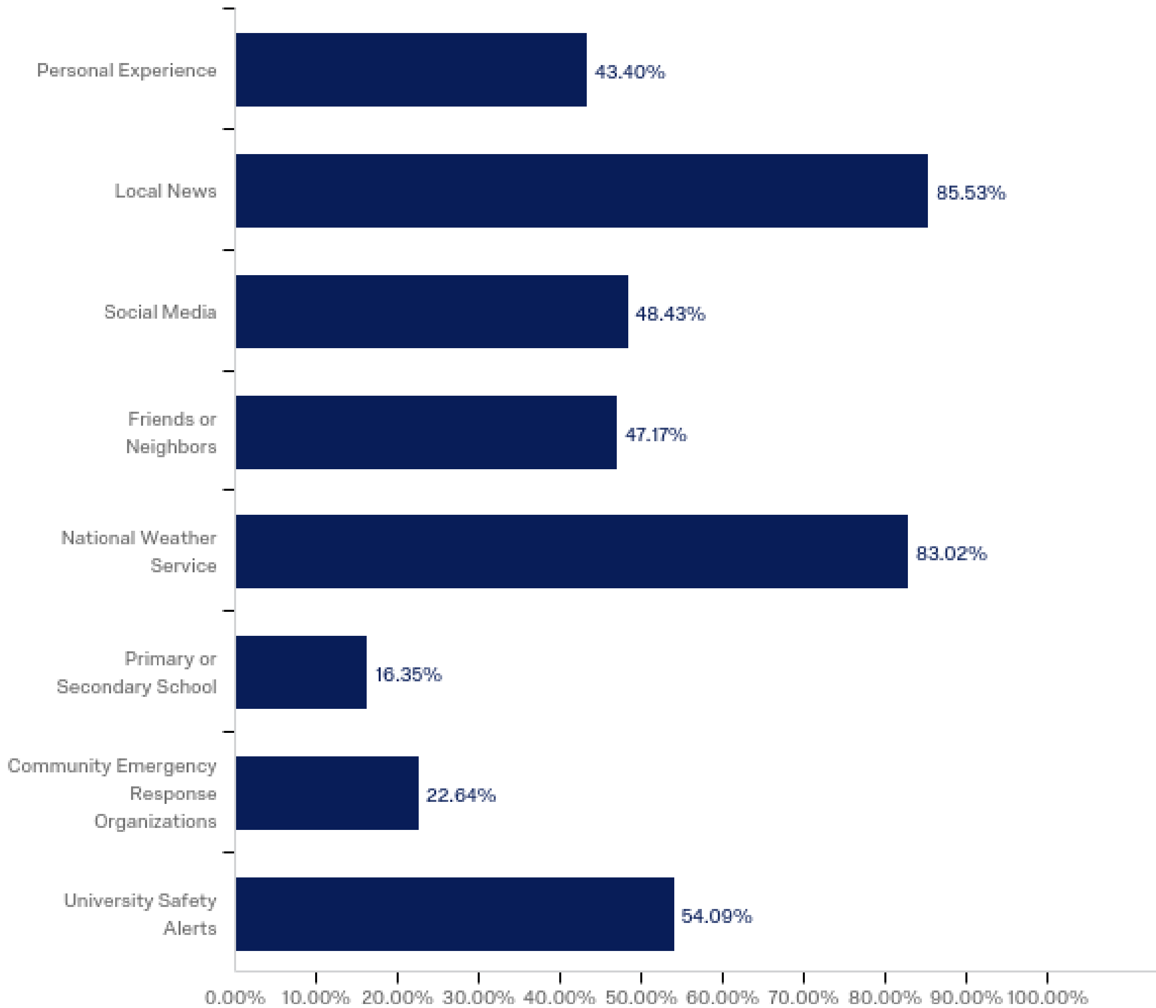

Figure 9. Bar graph showing response percentages for question 15.

The third highest source for immediate information for natural hazards for students comes from university safety alerts at 54% of respondents. This should be a reliable source of up-to-date information on events impacting Auburn's student body. During the events on March 3, 2019, Auburn University did not send out safety alerts to its students. They posted on social media, but the AU Alert system remained unused. Many students and faculty alike were unaware until after the fact that tornadoes even touched down in Lee County. It is the responsibility of Auburn University to ensure the safety of its student body, including those who live off campus and commute. Only 48% of survey respondents indicated that they lived in an on-campus dormitory. This would imply that the other 52% commutes in some form to the campus (the survey was overwhelmingly represented by first- and second-year students). Upperclassmen are more likely to live off-campus and commute. If these students did happen to live in the path of the tornadoes, they would have not received any warning from the university. While the tornadoes did not impact the university campus directly, that does not mean that they did not impact the student body. My own place of residence was under a mile from the touchdown location of the first tornado, and it experienced winds from the tornado itself. My only sources to take shelter were the National Weather Service and the Lee County Emergency Management Agency.

Question 16: Do you have access to any of the following transportation methods should you need to evacuate in the event of a natural hazards?

Question 16 was intended to determine what transportation students have access to for evacuation in the event of a natural hazard. As shown in *Table 7*, 91.82% of students have access to a car/automobile. This is useful in Alabama, as there is a lack of on demand public transportation. This leaves 8.18% of students with no access to an adequate personal vehicle for evacuation purposes.

Table 7. Response results and percentages for question 16.

Vehicle Type	**Response Count**	**Percentage**
Car/automobile	146	91.82%
Public Transportation	90	56.60%
Recreational Vehicle	11	6.92%
Motorcycle/bike	20	12.58%

Those with access to a personal vehicle will be able to evacuate more readily (Cutter et al. 2010). Over 90% of students said they have access to a car or automobile for transportation purposes. This demonstrates a positive result, as personal transportation is often the most reliable forms for emergency evacuation. However, 56% of respondents said they had access to public transportation for evacuation. Auburn does not have a city-wide public transport service, so these students are likely referring to the campus shuttle buses. While the university may decide to use these buses to evacuate students, it is unclear if this is protocol, and it would be the decision of the university whether or not to provide such options for evacuation. Either way, the university is simply not equipped to evacuate 50% of the student population, which would be around 12,000 students. Once again, proper education as to resources could easily clear up this situation. The university may in fact have access to a fleet of vehicles capable of mass evacuation, but as of the time of this writing, no such information was able to be attained.

Question 17: Do you have friends or roommates to help you evacuate or prepare for a natural hazard?

Question 17 was intended to determine if the students would have any help in preparing for or evacuating from a natural hazard. Approximately 92% (*Figure 10*) said they have a roommate or friend that can help them. There are 8% of students who must evacuate or prepare alone. As having a second person to help prepare for or evacuate from a natural hazard event is useful, this is a positive result. Students who are more likely to live together with other students have access to this helpful resource that the general population may not.

*Figure 10. Sh*ows the binary responses to question 17.

Question 18: Do you have pets to evacuate or seek shelter with in the event of a natural hazard?

Question 18 was meant to determine if students would need to evacuate or shelter their pets in the event of a natural hazard. As can be assumed due to their status as students, the majority (84%) of respondents, shown in *Figure 11*, do not need to take this extra step in preparation and evacuation. This leaves 16% of the students to consider their pets in evacuation and sheltering from natural hazards.

Figure 11. Shows the binary responses to question 18.

Question 19: Which of the following places are you most likely to seek shelter with in the event of a natural hazard?

Question 19 was used to determine where students will seek shelter in a natural hazard event. The responses are shown in *Table B9* and *Figure 12*. The highest response was on-campus storm shelters at 63.52%, while the lowest responses were public storm shelters (23.27%) and churches/community centers (31.45%).

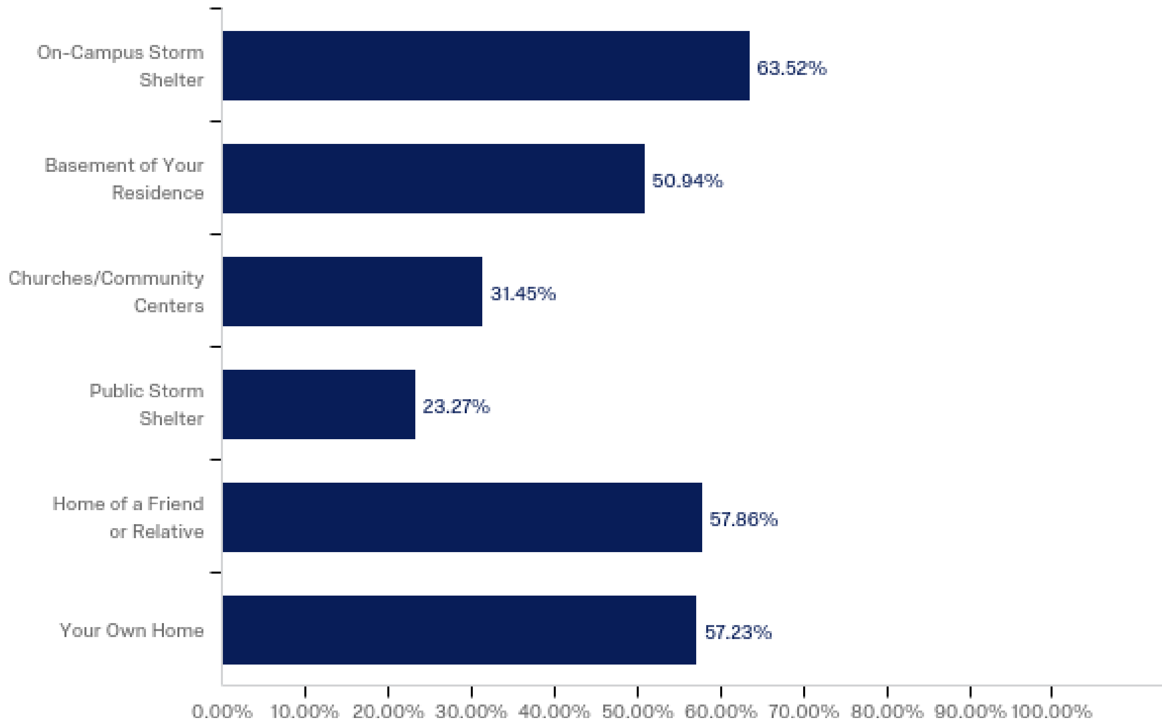

Figure 12. Bar graph showing response percentages for question 19.

One of the most important things to educate new students on is where they should shelter or evacuate to in the event of a natural hazard (Cutter et al. 2011). Sixty-two percent of students indicated that they would seek shelter in an on-campus storm shelter in the event of a natural hazard. Of those students, only 10% indicate that they received information from university safety training. This would indicate that students are instead getting their information from other sources like friends and neighbors, local news, personal experience, and social media. In other words, they learn where the shelters are, not from safety training, but from friends and word of mouth. This is not a reliable source of information, and it may account for why almost 40% of students do not indicate that they would seek shelter in an on-campus storm shelter. This number could increase if students were more knowledgeable about where storm shelters were located on-campus.

Question 20: Which of the following describes your place of residence?

Question 20 was used to determine where students live. As shown in *Table 8*, 48.43% of students live in an on-campus dormitory, 27.31% live in an apartment, 19.43% live in a home, and 3.77% live in a mobile home. Certain home types are more susceptible to damage, and those who actively own their residence would be financially responsible for any damages during a natural hazard. Those who own or rent would need to consider homeowners or renters insurance for applicable natural hazards in the area, especially for wind and water damage (Insurance Information Institute, 2019).

Table 8. Response results and percentages for question 20.

Residence	**Response Count**	**Percentage**
Home (Rental)	16	10.06%
Home (Owned)	15	9.43%
Apartment (1st to 3rd floor)	41	24.79%
Apartment (4th or higher floor)	4	2.52%
Dormitory (1st to 3rd floor)	65	40.88%
Dormitory (4th or higher floor)	12	7.55%
Mobile Home	6	3.77%

4.2 Chi-Square Test of Independence

In order to determine which results are related with one another, the chi-square test of independence (commonly known as Pearson's chi-square test) was employed. The survey questions selected and the responses to them that were paired within the chi-squared tests were chosen subjectively. However, the pairing of responses to the survey questions was conducted in a manner that facilitated a better understanding of how risk perceptions vary among the Auburn student body considering past hazard experience, previous hazard information, place of origin, length of time in Auburn. As a starting point, a chi-square test was performed to ascertain any relationship between question 8 (how concerned students are with natural hazards in Auburn) for all-natural hazards surveyed and question 13 (where students receive natural hazard information). Statistical results of this test are shown in *Table 9*. The results of the test indicate that there are associations of approximately equal strength between the concern for all-natural hazard impacts and the sources of information: personal experience, local news, social media, friends or neighbors, National Weather Service, and primary or secondary school. This indicates that each of these sources has around the same level of influence on how students view the threat of natural hazards. Interestingly, even primary or secondary school, of which only 52% of students responded as a source of natural hazard information, had a similar relationship strength with student concern. This would indicate that those students that are getting information given by K-12 classes and safety drills are retaining said information.

Table 9. Chi-square test of independence results between questions 8 and 13.

Source of Information	χ^2	***p-value***	ϕ_c
Personal Experience	300.86	$5.62*10^{-40}$	0.23
Local News	289.83	$6.41*10^{-38}$	0.21
Social Media	207.59	$4.46*10^{-23}$	0.21
Friends or Neighbors	231.52	$2.74*10^{-27}$	0.21
National Weather Service	281.96	$1.85*10^{-36}$	0.22
Primary or Secondary School	210.85	$1.21*10^{-23}$	0.23
Disaster Preparedness Meetings	54.13	0.14	---
Community Emergency Response Training	52.85	0.17	---
University Safety Training	59.84	0.06	---

The three safety training sources (Disaster Preparedness Meetings, Community Emergency Response Training, and University Safety Training) fall short of a statistically significant relationship. Given that few students cited these as sources of information on natural hazards, it makes sense that there is little association between the student perception of risk and these sources. The closest of the three is University Safety Training (with a *p-level* of 0.06) falls just out of range for significance. Participation in training exercises has been shown to increase both trust in authorities on matters of risk and the public's level of risk perception (Wachinger et al., 2013).

The next chi-square test was performed to check the relationship between question 8 and question 6 (which natural hazards have students experienced). Here, the questions were chosen as to determine if past experience with natural hazards had a significant effect on how students perceived risk due to natural hazards. As shown in *Table 10*, all natural hazard types except for earthquakes and wildfires showed a relationship between how concerned students were with the threat of each natural hazard and whether or not they had experienced the natural hazard. Earthquakes and wildfires, while rare, do occur in Alabama, but the frequency and severity of the events are so low that most students would not know even if one occurred.

Table 10. Chi-square test of independence results between questions 6 and 8.

Natural Hazard	χ^2	***p-value***	ϕ_c
Drought	158.00	$9.2*10^{-15}$	0.26
Earthquake	55.62	0.11	---
Extreme Heat	191.18	$2.97*10^{-20}$	0.24
Flood	86.20	$1.48*10^{-4}$	0.22
Flash Flooding	263.06	$5.53*10^{-33}$	0.24
Fog	243.04	$2.38*10^{-29}$	0.21
Freeze	215.94	$1.56*10^{-24}$	0.23
Wildfire	52.72	0.17	---
Tornado	250.87	$9.14*10^{-31}$	0.23
Thunderstorm	319.67	$1.64*10^{-43}$	0.22
Straight-line Winds	163.16	$1.35*10^{-15}$	0.30
Hurricane	176.67	$8.19*10^{-18}$	0.24

On the opposite end of the spectrum, straight-line winds with a ϕ_c of 0.30 shows a relatively strong relationship. This could imply that students who know of straight-line winds and have some experience with the hazard have a higher perception of risk due to straight-line winds. Only 24% of students responded that they had ever experienced straight-line winds, and previously it was shown that the majority of students do not view straight-line winds as a hazard which is likely to damage their place of residence. Thus, it can be concluded that if more students were aware of straight-line winds, the perception of risk due to them would increase, changing how damaging students would perceive the natural hazard to be. In a study by Ho et al. (2008), it was similarly concluded that experience with a natural hazard increases risk perception.

In a subsequent chi-squared test, the relationship between question 8 and question 3 (place of origin) was examined in order to determine if a student's place of origin significantly impacted their perception of natural hazard risk. As can be seen in *Table 11*, two categorical variables were looked pertaining to question 3: domestic/international and Southeastern United States. This was chosen as these are the two categories most likely to influence a change in perception of risk due to natural hazards for students in Auburn, Alabama. Both categories showed a similar strength in terms of their relationship. This may indicate that whether or not a student is from the United States, or from an international country, has some effect on how they perceive natural hazard risk. Likewise, students from the Southeastern United States also have a categorically different view of risk due to natural hazards. Both results can be explained by understanding that a person's place of origin changes which natural hazard types they would have experienced. Different media coverage of natural hazard events, as well as experience and cultural norms all play a role in risk perception (Keown, 1989). As was shown in the previous chi-square test, there is a relationship between natural hazard experience and the perception of risk due to such a hazard, so this result is consistent.

Table 11. Chi-square test of independence between questions 3 and 8.

Natural Hazard	χ^2	***p-value***	ϕ_c
Domestic/international	327.51	$5.38*10^{-45}$	0.22
Southeastern United States	310.41	$9.10*10^{-42}$	0.23

The next chi-square test of independence was to determine the relationship between question 8 and question 5 (during which months students stay in Auburn). These questions were selected to ascertain if the time of year that a student resides in Auburn affects their perception of risk due to natural hazards. The three divisions of the year seen in *Table 12* were decided upon as a result of responses received. As discussed earlier, while there was a 6% change in enrollment between the Fall and Spring semesters, there was not a significant enough change outside of the study's margin of error as to whether or not a student resided in Auburn; however, May and the summer months of June and July did see a significant change of up to 70% decrease in student residency in the summer. What the chi-square test shows is that there is a relationship between the time of the year a student resides and how concerned they are with the threat of natural hazards. As was previously mentioned, some natural hazard types like tornadoes and extreme heat have a heightened chance of occurrence during the time of the year between May and July. Since many students leave Auburn during those months, they have less likelihood of experiencing such natural hazards in Auburn.

Table 12. Chi-square test of independence between questions 5 and 8.

Time of the Year	χ^2	***p-value***	ϕ_c
Fall/Spring Semester	326.06	$1*10^{-44}$	0.21
May	244.36	$1.37*10^{-29}$	0.22
Summer	98.24	$5.11*10^{-6}$	0.21

In a subsequent paring, question 9 (how prepared students feel) responses were tested against prior hazard knowledge using the chi-square test. First compared were questions 9 and

13, chosen to determine if the information source of natural hazard knowledge significantly affected a student's perception of their own preparedness. As shown in *Table 13*, the results of this chi-square test show similar results to that of the test between questions 8 and 13. Similarly, personal experience, local news, social media, friends or neighbors, National Weather Service, and primary or secondary school as a source of natural hazard information show relationships with how prepared students feel for all surveyed natural hazard types. Unlike the association with how concerned students were with the threat of natural hazards, this relationship is weaker in strength, as evidenced by lower Cramer's V in all categories. This implies that students feel they receive more information regarding the threat of natural hazards than information regarding disaster preparedness.

Table 13. Chi-square test of independence between questions 9 and 13.

Source of Information	χ^2	***p-value***	ϕ_c
Personal Experience	217.88	$7.12*10^{-25}$	0.19
Local News	194.55	$7.90*10^{-21}$	0.17
Social Media	118.56	$9.15*10^{-9}$	0.16
Friends or Neighbors	174.18	$2.12*10^{-17}$	0.18
National Weather Service	202.90	$2.90*10^{-22}$	0.19
Primary or Secondary School	172.37	$4.22*10^{-17}$	0.21
Disaster Preparedness Meetings	42.75	0.53	---
Community Emergency Response Training	46.29	0.38	---
University Safety Training	52.27	0.18	---

Similar to the relationship between questions 8 and 13, the three disaster preparedness sources of disaster preparedness meetings, community emergency response training, and university safety training failed to reject the null hypothesis. Since all three information sources had students reporting 10% or lower participation, this makes sense logically. As there are few students citing these three as sources of information, it follows that they would not influence the overall student population's perception on natural hazard risk. The availability of information from trusted sources can affect the level of risk perception (Covello, 1983). As risk perception changes, so does an individual's level of preparedness. Providing students with more information through these disaster preparedness sources could effectively make an individual more likely to prepare for a natural hazard (Covello, 1983).

It is also worthwhile to look at how prepared students feel compared with where they get their imminent natural hazard information (questions 9 and 15, respectively). By comparing these two questions, it is possible to determine how a student's choice of imminent natural hazard information disseminator affects their perception of their own preparedness. The resulting statistics for this test are shown in *Table 14*.

First, it should be noted that all sources for immediate information on natural hazards showed a relationship with how prepared students feel in the event of a natural hazard. Personal experience, local news, social media, friends or neighbors, and National Weather Service all showed an equal strength of the relationship between the variables. However, primary or secondary school, community emergency response organizations, and university safety alerts showed stronger relationships. Community emergency response organizations, like that of Lee County, Alabama Emergency Management Agency, and university safety alerts, like that of AU Alert, provide the most timely and efficient methods of local natural hazard information. Emergency response organizations often broadcast alerts issued by the National Weather Service to weather radios or internet webpages, as well as posting on social media pages. University safety alerts get sent directly to student cellphones and email addresses. With such accessible information, it is good that students who cite these sources for immediate information feel more prepared.

Table 14. Chi-square test of independence between questions 9 and 15.

Source of Immediate Information	χ^2	***p-value***	ϕ_c
Personal Experience	101.51	$1.94*10^{-6}$	0.18
Local News	211.66	$8.76*10^{-24}$	0.18
Social Media	118.03	$1.09*10^{-8}$	0.18
Friends or Neighbors	121.95	$3.00*10^{-9}$	0.18
National Weather Service	213.27	$4.57*10^{-24}$	0.18
Primary or Secondary School	94.86	$1.36*10^{-5}$	0.28
Community Emergency Response Organizations	79.86	$7.60*10^{-4}$	0.21
University Safety Alerts	173.79	$2.46*10^{-17}$	0.21

The strongest relationship at $\phi_c = 0.28$ is primary or secondary school. This may seem an odd result as K-12 schools do not tend to broadcast disaster information to the public. However, this association does make sense if one considers that students often learn what to do in the case of natural hazards during their time in primary and secondary school (Morton et al., 2014). This includes drills for earthquakes and tornadoes, as well as providing information through elementary and high-school geography and physical science classes. Students feel that this training and knowledge helps them feel prepared for natural hazards.

The next chi-square tests were performed to account for potential differences in education. This was accomplished by examining responses from STEM vs. non-STEM majors. Here, Eliminating STEM vs non-STEM major bias is important in ensuring the survey was not skewed in either direction by more or less science knowledge. As there was approximately a 50-50 distribution of STEM to non-STEM majors, this bias would not exist in the survey results. However, a chi-square test of independence can still show if there is actually a relationship between natural hazard risk perception and scientific knowledge. The chi-square test of independence (*Table 15*) confirms that there is an association between how a student perceives the risk due to natural hazards and whether or not they are a STEM or non-STEM major (Peacock et al., 2004).

Table 15. Chi-square test of independence between questions 8 and 2.

Major	χ^2	***p-value***	ϕ_c
STEM	152.99	$5.80*10^{-14}$	0.20
Non-STEM	209.43	$2.14*10^{-23}$	0.24

When values for the Likert scales (*Tables 16* and *17*) are assigned with 5 indicating "Very Concerned" and 1 indicating "Not Concerned at all," mean values for STEM and non-STEM majors can be established. STEM majors had a mean value of 2.50 and non-STEM majors had a mean value of 2.58. This would indicate that non-STEM majors tend to be more concerned with the threat of natural hazards than STEM majors. To make sense of this result, it is important to consider that scientific knowledge may influence STEM majors into forming a risk perception in which they more accurately understand risks. This could lower how concerned they are with the threat due to natural hazards over a non-STEM major who may be uneducated as to the risks natural hazards pose, influencing them to perceive a greater risk than is necessary.

Table 16. Results for how concerned STEM majors were for each natural hazard in question 8.

Natural Hazard Type	**Very Concerned (5)**	**Concerned (4)**	**Neither Concerned or Unconcerned (3)**	**Not Really Concerned (2)**	**Not Concerned at all (1)**
Freeze	3	14	20	22	24
Hurricane	2	18	17	24	22
Drought	0	16	13	26	28
Straight-line Winds	1	16	20	26	20
Thunderstorm	4	32	25	14	8
Tornado	8	34	11	17	13
Wildfire	0	3	19	27	34
Earthquake	0	4	10	26	43
Fog	1	19	23	23	17
Flash Flooding	6	23	19	21	14
Flood	2	18	19	27	17
Extreme Heat	6	26	14	21	16
Total	33	223	210	274	256

Table 17. Results for how concerned non-STEM majors were for each natural hazard in question 8.

Natural Hazard Type	**Very Concerned (5)**	**Concerned (4)**	**Neither Concerned or Unconcerned (3)**	**Not Really Concerned (2)**	**Not Concerned at all (1)**
Freeze	0	16	20	23	17
Hurricane	0	21	12	18	25
Drought	2	11	15	19	29
Straight-line Winds	0	14	33	11	18
Thunderstorm	6	38	15	7	10
Tornado	10	33	16	10	7
Wildfire	0	8	12	24	32
Earthquake	0	3	11	20	42
Fog	1	19	22	17	17
Flash Flooding	1	30	18	13	14
Flood	1	21	18	18	18
Extreme Heat	7	23	19	14	13
Total	28	237	211	194	242

5.0 Conclusions

5.1 Overview

There is an obvious gap at Auburn University between the perception of risk of the student body and the actual risks associated with natural hazards in Auburn, AL. Much of this may simply be due to lack of appropriate natural hazard education for the student body. It is within this context that education programs can be updated or added to ensure the safety of the student body, many of which come to Auburn without prior experience or knowledge of the threats associated with the area.

The results of this thesis demonstrate that students are concerned with extremely damaging natural hazards such as tornadoes and hurricanes. However, it is unclear if the students have received proper information and safety training in order to deal with such events. With how destructive a natural hazard like a tornado can be, it is of utmost importance to ensure all students on campus receive adequate knowledge of shelters and preparedness training in order to minimize loss of life in such an event.

Additionally, certain threats which might not be as destructive in nature as a hurricane or a tornado, such as straight-line winds and extreme heat, can be equally dangerous to the student body. Education of such threats can seek to minimize their impact on the student body and Auburn’s campus at large.

5.2 Summary of Research Findings

Students at Auburn University appear to not have an adequate risk perception for the natural hazards which impact the university most frequently. While obvious standouts like tornadoes receive adequate risk perception from students, they are not knowledgeable in natural hazards which are less destructive, but could also have serious impacts, or that are just as destructive, just with a longer return period.

5.2.1 Research Question 1

How do transient students (i.e. international or domestic students from various regions and socio-economic backgrounds) perceive risk from natural hazards which are present in the state of Alabama and the Southeastern United States?

First and second year students, 80% of the study's demographic, may not have had time to develop a sense of place with regards to Auburn, Alabama. As such, most students carry a perception of risk primarily formed through past experience and what others have told them, whether it be through official education sources or hearing information from peers and other unofficial sources. Students at Auburn University perceive the risks due to highly damaging and common hazards like tornadoes and thunderstorms differently than the risks due to less common or less characteristic natural hazards for the Auburn, AL area (e.g. flooding, flash flooding, earthquakes, straight-line winds, or hurricanes). A possible explanation of the different perception could be that some hazards like tornadoes and thunderstorms are common in the Southeastern United States, so students may be more knowledgeable of their associated risks than other less common hazards. By improving the communication of risk to the students through education initiatives on campus, it may be possible to increase student knowledge of less common or poorly understood natural hazards, thereby changing their risk perception of such hazards.

5.2.2 Research Question 2

How does the risk perception of students to natural hazards vary considering past natural hazard experiences, previous hazard information, region and country of origin, length of time living in Auburn, and education?

One of the prominent results of this study is that place has a significant bearing on a student's risk perception. As the chi-square test of independence showed, students from the domestic United States had a different risk perception to students from international backgrounds. Furthermore, students from the Southeastern United States held yet another different risk perception to students from other origins. A person's place of origin exposes them to different education and coverage of natural hazards and exposes them to different experiences with natural hazards. A student from the Southeastern United States may have more experiences with hurricanes and tornadoes than a student from the Western United States, which in turn gives this student a better perception of risk of these hazards; whereas, the opposite may be true for natural hazards associated more with the Western United States, such as wildfires and earthquakes.

A second protuberant result is that past experience with natural hazards influences greatly their perception of risk due to natural hazards. The surveyed population was made up of 80% from the Southeastern United States, a statistic which holds true in the general population of Auburn University. There is a lack of perception of risk due to some natural hazards like wildfires and earthquakes. As these natural hazards are of lesser frequency and intensity in the Southeastern United States, it is implied that students may not have much experience with hazards of these types. Training and education initiatives can be focused on natural hazard types for which the majority of the population has little experience. This in turn would strengthen the overall risk perception of the student body.

5.3 Future Study Suggestions

Due to the time restraints of a Master's Thesis, this study was limited in scope and has sought to establish a proof-of-concept rather than a full analysis of risk perception of a transient population. Another limitation of this study is that 80% of respondents were first- and second-year students. As such, the survey participants are not representative of the entire student body as a whole. Ideally, such a survey would be given to the entire student body at Auburn University, including undergraduates and graduate students alike. Additionally, a 20-question survey does not necessarily provide nearly enough data to properly analyze the sources and preconceptions that cause the perception of risk due to natural hazards. It became apparent throughout the implementation and analysis of the survey that some of the questions led to more new questions than they provided answers. For instance, one such question which would have been useful to ask would be "Have you attended any of the voluntary natural hazard and disaster preparedness training sessions offered by Auburn University?" A study of a larger scope could include more specific questions in order to paint a broader picture of risk perception and could include students of all academic standing (e.g., undergraduates and graduates) as well as faculty and staff throughout the university, increasing the likelihood of a more diverse and representative participant base for the university as a whole.

There are several adjustments suggested for a future study. The biggest suggestion is to not include any write-in answers. While most students were able to answer these write-in answers perfectly fine, there were cases of unusable data. Since this survey includes a margin-of-error of 8%, the unusable data of 4% fell into this margin-of-error. However, a survey with a larger sample size could obtain a lower statistical variance, which would render this unusable data as a significant error. By simply eliminating the option to write-in an answer and instead giving a drop-down menu with set choices, there can be no unusable data collected in such a way.

This study was focused entirely on students in Global Geography 1010. This is primarily due to the fact that these students should have a basic knowledge of climate-related and geography-related terminology, as well as due to the ease of access to students taking courses in the same department as of the field of study. A wider ranging survey, encompassing students who may opt not to take Global Geography to satisfy their social science general education requirement would be more representative of the entire student body. It cannot be discounted that students enrolled in Global Geography have had their perception of risk shaped somewhat due to education on climate.

In a further study, it would be advantageous to cooperate with the Department of Campus Safety and Security. This department is responsible for the AU Alert system and safety training courses. By cooperating directly with this department, education efforts for natural hazard training can be focused directly on where it is needed. A suggestion would be for the faculty and graduate students within the Department of Geography to cooperate with the Department of Campus Safety and Security to undertake such a study.

5.4 Research Contributions

Natural hazard risk perception is an important metric for evaluating vulnerable populations like that of a transient student body. This study employed a methodology by which to measure the risk perception due to natural hazards of a vulnerable population. By understanding where risk perception in a population lies, safety and education initiatives can be tailor-made to the individual population. For example, at Auburn University, a campus-climate survey could be given out to incoming freshman students, allowing the Department of Campus Safety and Security to maintain up-to-date records of student risk perception. This in turn allows the communication of risk due to natural hazards to be improved upon. Rather than educating the population on every facet of natural hazards, areas where risk perception is low can be focused upon, efficiently using time and resources.

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7.0 Appendices

7.1 Appendix A: List of Survey Questions and Answers

Question 1: Student Classification

- *Freshman*
- *Sophomore*
- *Junior*
- *Senior*

Question 2: Which of the following best describes your degree field?

- *College of Agriculture*
- *College of Architecture, Design, and Construction*
- *College of Business*
- *College of Education*
- *College of Engineering*
- *School of Forestry and Wildlife Sciences*
- *College of Human Sciences*
- *College of Liberal Arts*
- *School of Nursing*
- *College of Sciences and Mathematics*
- *College of Veterinary Medicine*

Question 3: Which Country and/or U.S. state are you from?

__________ *(fill in the blank)*

Question 4: How long have you lived in Auburn?

__________ *(fill in the blank)*

Question 5: During which months of the year are you staying in Auburn? (Please check all that apply)

- *January*
- *February*
- *March*
- *April*
- *May*
- *June*
- *July*
- *August*
- *September*
- *October*
- *November*
- *December*

Question 6: Which of the following natural hazard events have you experienced? (Please check all that apply)

- *Drought*
- *Earthquake*
- *Extreme Heat*
- *Flood*
- *Flash Flooding*
- *Fog*
- *Freeze*
- *Wildfire*
- *Tornado*
- *Thunderstorm*
- *Straight-line Winds*
- *Hurricane*

Question 7: How concerned are you with the threat of the following natural hazards in your hometown?

	Very Concerned	*Concerned*	*Neither Concerned or Unconcerned*	*Not Really Concerned*	*Not Concerned at all*
Drought	o	o	o	o	o
Earthquake	o	o	o	o	o
Extreme Heat	o	o	o	o	o
Flood	o	o	o	o	o
Flash Flooding	o	o	o	o	o
Fog	o	o	o	o	o
Freeze	o	o	o	o	o
Wildfire	o	o	o	o	o
Tornado	o	o	o	o	o
Thunderstorm	o	o	o	o	o
Straight-line Winds	o	o	o	o	o
Hurricane	o	o	o	o	o

Question 8: How concerned are you with the threat of the following natural hazards on Auburn's Campus?

	Very Concerned	*Concerned*	*Neither Concerned or Unconcerned*	*Not Really Concerned*	*Not Concerned at all*
Drought	o	o	o	o	o
Earthquake	o	o	o	o	o
Extreme Heat	o	o	o	o	o
Flood	o	o	o	o	o
Flash Flooding	o	o	o	o	o
Fog	o	o	o	o	o
Freeze	o	o	o	o	o
Wildfire	o	o	o	o	o
Tornado	o	o	o	o	o
Thunderstorm	o	o	o	o	o
Straight-line Winds	o	o	o	o	o
Hurricane	o	o	o	o	o

Question 9: How prepared do you feel in the event of the following natural hazards?

	Very Prepared	*Prepared*	*Neither Prepared or Unprepared*	*Not Really Prepared*	*Not Prepared at all*
Drought	o	o	o	o	o
Earthquake	o	o	o	o	o
Extreme Heat	o	o	o	o	o
Flood	o	o	o	o	o
Flash Flooding	o	o	o	o	o
Fog	o	o	o	o	o
Freeze	o	o	o	o	o
Wildfire	o	o	o	o	o
Tornado	o	o	o	o	o
Thunderstorm	o	o	o	o	o
Straight-line Winds	o	o	o	o	o
Hurricane	o	o	o	o	o

Question 10: How likely are you to evacuate or seek shelter in the event of the following natural hazards?

	Extremely Likely	*Moderately Likely*	*Slightly Likely*	*Neither*	*Slightly Unlikely*	*Moderately Unlikely*	*Extremely Unlikely*
Drought	o	o	o	o	o	o	o
Earthquake	o	o	o	o	o	o	o
Extreme Heat	o	o	o	o	o	o	o
Flood	o	o	o	o	o	o	o
Flash Flood	o	o	o	o	o	o	o
Fog	o	o	o	o	o	o	o
Freeze	o	o	o	o	o	o	o
Wildfire	o	o	o	o	o	o	o
Tornado	o	o	o	o	o	o	o
Thunderstorm	o	o	o	o	o	o	o
Straight-line Winds	o	o	o	o	o	o	o
Hurricane	o	o	o	o	o	o	o

Question 11: How likely do you feel your place of residence will be damaged by the following natural hazards?

	Extremely Likely	*Moderately Likely*	*Slightly Likely*	*Neither*	*Slightly Unlikely*	*Moderately Unlikely*	*Extremely Unlikely*
Drought	o	o	o	o	o	o	o
Earthquake	o	o	o	o	o	o	o
Extreme Heat	o	o	o	o	o	o	o
Flood	o	o	o	o	o	o	o
Flash Flood	o	o	o	o	o	o	o
Fog	o	o	o	o	o	o	o
Freeze	o	o	o	o	o	o	o
Wildfire	o	o	o	o	o	o	o
Tornado	o	o	o	o	o	o	o
Thunderstorm	o	o	o	o	o	o	o
Straight-line Winds	o	o	o	o	o	o	o
Hurricane	o	o	o	o	o	o	o

Question 12: Do you have a temporary place of residence to stay in the event your place of residence was damaged by a natural hazard?

- *Yes*
- *No*

Question 13: Which of the following have provided you with useful information to help you be prepared? (Please check all that apply)

- *Personal Experience*
- *Local News*
- *Social Media*
- *Friends or Neighbors*
- *National Weather Service*
- *Primary or Secondary School*
- *Disaster Preparedness Meetings*
- *Community Emergency Response Training*
- *University Safety Training*

Question 14: Do you feel you have a plan for the following natural hazards? (Please check all that apply)

- *Drought*
- *Earthquake*
- *Extreme Heat*
- *Flood*
- *Flash Flooding*
- *Fog*
- *Freeze*
- *Wildfire*
- *Tornado*
- *Thunderstorm*
- *Straight-line Winds*
- *Hurricane*

Question 15: Which of the following sources would you most likely listen to for imminent natural hazard information? (Please check all that apply)

- *Personal Experience*
- *Local News*
- *Social Media*
- *Friends or Neighbors*
- *National Weather Service*
- *Primary or Secondary School*
- *Community Emergency Response Organizations*
- *University Safety Alerts*

Question 16: Do you have access to any of the following transportation methods should you need to evacuate in the event of a natural hazards? (Please check all that apply)

- *Car/automobile*
- *Public Transportation*
- *Recreational Vehicle*
- *Motorcycle/bike*

Question 17: Do you have friends or roommates to help you evacuate or prepare for a natural hazard?

- *Yes*
- *No*

Question 18: Do you have pets to evacuate or seek shelter with in the event of a natural hazard?

- *Yes*
- *No*

Question 19: Which of the following places are you most likely to seek shelter with in the event of a natural hazard? (Please check all that apply)

- *On-Campus Storm Shelter*
- *Basement of Your Residence*
- *Churches/Community Centers*
- *Public Storm Shelter*
- *Home of a Friend or Relative*
- *Your Own Home*

Question 20: Which of the following describes your place of residence?

- *Home (Rental)*
- *Home (Owned)*
- *Apartment (1st to 3rd floor)*
- *Apartment (4th or Higher Floor)*
- *Dormitory (1st to 3rd floor)*
- *Dormitory (4th or higher floor)*
- *Mobile Home*

7.2 Appendix B: Supporting Tables

Table B1. Likert scale response percentages for each natural hazard type for question 7.

Natural Hazard	**Very Concerned (5)**	**Concerned (4)**	**Neither Concerned or Unconcerned (3)**	**Not Really Concerned (2)**	**Not Concerned at all (1)**
Drought	3.14%	16.98%	20.75%	28.30%	30.82%
Earthquake	1.89%	0.63%	11.95%	25.79%	59.75%
Extreme Heat	10.06%	32.08%	23.90%	23.27%	10.69%
Flood	5.66%	22.64%	28.30%	32.08%	11.32%
Flash Flooding	6.92%	37.11%	23.27%	20.75%	11.95%
Fog	3.77%	29.56%	28.93%	22.01%	15.72%
Freeze	1.89%	21.38%	30.19%	26.42%	20.13%
Wildfire	1.26%	6.29%	18.24%	33.96%	40.25%
Thunderstorm	18.24%	38.99%	14.47%	15.72%	12.58%
Tornado	18.24%	40.88%	22.01%	10.06%	8.81%
Straight-line Winds	3.14%	18.87%	38.99%	20.75%	18.24%
Hurricane	8.81%	22.64%	18.87%	22.64%	27.04%

Table B2. Likert scale response percentages for each natural hazard type for question 8.

Natural Hazard	**Very Concerned (5)**	**Concerned (4)**	**Neither Concerned or Unconcerned (3)**	**Not Really Concerned (2)**	**Not Concerned at All (1)**
Drought	1.26%	16.98%	17.61%	28.30%	35.85%
Earthquake	0.00%	4.40%	13.21%	28.93%	53.46%
Extreme Heat	8.18%	30.82%	20.75%	22.01%	18.24%
Flood	1.89%	24.53%	23.27%	28.30%	22.01%
Flash Flooding	4.40%	33.33%	23.27%	21.38%	17.61%
Fog	1.26%	23.90%	28.30%	25.16%	21.38%
Freeze	1.89%	18.87%	25.16%	28.30%	25.79%
Wildfire	0.00%	6.92%	19.50%	32.08%	41.51%
Tornado	11.32%	42.14%	16.98%	16.98%	12.58%
Thunderstorm	6.29%	44.03%	25.16%	13.21%	11.32%
Straight-line Winds	0.63%	18.87%	33.33%	23.27%	23.90%
Hurricane	1.26%	24.53%	18.24%	26.42%	29.56%

Table B3. Likert scale response percentages for each natural hazard type for question 9.

Natural Hazard	**Very Prepared (5)**	**Prepared (4)**	**Neither Prepared or Unprepared (3)**	**Not Really Prepared (2)**	**Not Prepared at All (1)**
Drought	6.92%	29.56%	26.42%	20.75%	16.35%
Earthquake	3.14%	12.58%	21.38%	32.08%	30.82%
Extreme Heat	9.43%	41.51%	22.01%	17.61%	9.43%
Flood	3.14%	28.93%	22.64%	30.82%	14.47%
Flash Flooding	4.40%	33.33%	22.64%	27.04%	12.58%
Fog	12.58%	40.88%	27.04%	11.32%	8.18%
Freeze	6.92%	42.77%	23.91%	15.09%	11.32%
Wildfire	3.14%	12.58%	22.64%	30.82%	30.82%
Tornado	10.06%	39.62%	21.38%	18.87%	10.06%
Thunderstorm	12.66%	37.34%	24.05%	17.09%	8.86%
Straight-line Winds	5.03%	21.38%	38.99%	20.75%	13.84%
Hurricane	7.55%	29.56%	30.19%	18.24%	14.47%

Table B4. Likert scale response percentages for each natural hazard type for question 10.

Natural Hazard	**Extremely Likely (7)**	**Moderately Likely (6)**	**Slightly Likely (5)**	**Neither (4)**	**Slightly Unlikely (3)**	**Moderately Unlikely (2)**	**Extremely Unlikely (1)**
Drought	2.52%	5.03%	12.58%	16.35%	8.81%	18.87%	35.85%
Earthquake	27.67%	18.24%	22.01%	8.18%	8.81%	6.92%	8.18%
Extreme Heat	5.03%	8.81%	18.87%	15.09%	11.95%	18.24%	22.01%
Flood	21.38%	23.90%	21.38%	9.43%	10.06%	7.55%	6.29%
Flash Flood	11.32%	21.38%	23.27%	16.35%	6.29%	13.21%	8.18%
Fog	2.52%	2.52%	8.18%	16.98%	6.29%	15.09%	47.80%
Freeze	9.43%	9.43%	10.69%	16.98%	7.55%	18.24%	27.67%
Wildfire	38.36%	23.27%	13.21%	8.18%	5.03%	5.66%	6.29%
Tornado	54.09%	18.24%	11.95%	3.77%	5.66%	4.40%	1.89%
Thunderstorm	11.95%	13.84%	18.24%	14.47%	12.58%	13.21%	15.72%
Straight-line Winds	7.55%	10.69%	15.09%	24.53%	10.06%	15.72%	16.35%
Hurricane	40.25%	22.01%	16.35%	6.29%	5.03%	6.92%	3.14%

Table B5. Likert scale response percentages for each natural hazard type for question 11.

Natural Hazard	**Extremely Likely (7)**	**Moderately Likely (6)**	**Slightly Likely (5)**	**Neither (4)**	**Slightly Unlikely (3)**	**Moderately Unlikely (2)**	**Extremely Unlikely (1)**
Drought	1.26%	1.89%	11.95%	13.84%	12.58%	14.47%	44.03%
Earthquake	15.09%	24.53%	21.38%	8.18%	2.52%	8.81%	19.50%
Extreme Heat	0.63%	3.77%	10.06%	13.21%	10.69%	20.13%	41.51%
Flood	6.92%	17.61%	27.67%	8.81%	11.32%	16.98%	10.69%
Flash Flood	6.29%	17.61%	22.64%	10.69%	11.95%	18.24%	12.58%
Fog	0.00%	3.77%	5.66%	14.47%	5.66%	11.95%	58.49%
Freeze	1.26%	7.55%	14.47%	11.95%	13.84%	20.75%	30.19%
Wildfire	18.24%	10.69%	21.38%	9.43%	11.95%	9.43%	18.87%
Tornado	27.04%	27.67%	23.27%	6.92%	3.77%	6.29%	5.03%
Thunderstorm	5.66%	10.06%	25.79%	17.61%	13.84%	13.21%	13.84%
Straight-line Winds	1.89%	11.95%	21.38%	25.79%	7.55%	14.47%	16.98%
Hurricane	15.09%	20.13%	25.79%	11.32%	5.66%	10.69%	11.32%

Table B6. Response counts for question 13.

Preparedness Training Source	**Response Count**
Personal Experience	123
Local News	133
Social Media	101
Friends or Neighbors	111
National Weather Service	120
Primary or Secondary School	83
Disaster Preparedness Meeting	6
Community Emergency Response Training	12
University Safety Training	16

Table B7. Response counts for question 14.

Natural Hazard	**Response Count**
Drought	39
Earthquake	33
Extreme Heat	58
Flood	56
Flash Flooding	65
Fog	72
Freeze	71
Wildfire	19
Tornado	117
Thunderstorm	103
Straight-line Winds	34
Hurricane	91

Table B8. Response counts for question 15.

Information Source	**Response Count**
Personal Experience	69
Local News	136
Social Media	77
Friends or Neighbors	75
National Weather Service	132
Primary or Secondary School	26
Community Emergency Response Organizations	36
University Safety Alerts	86

Table B9. Response counts for question 19.

Shelter Location	**Response Count**
On-Campus Storm Shelter	101
Basement of Your Residence	81
Churches/Community Centers	50
Public Storm Shelter	37
Home of a Friend or Relative	92
Your Own Home	91

7.3 Appendix C: Supporting Figures

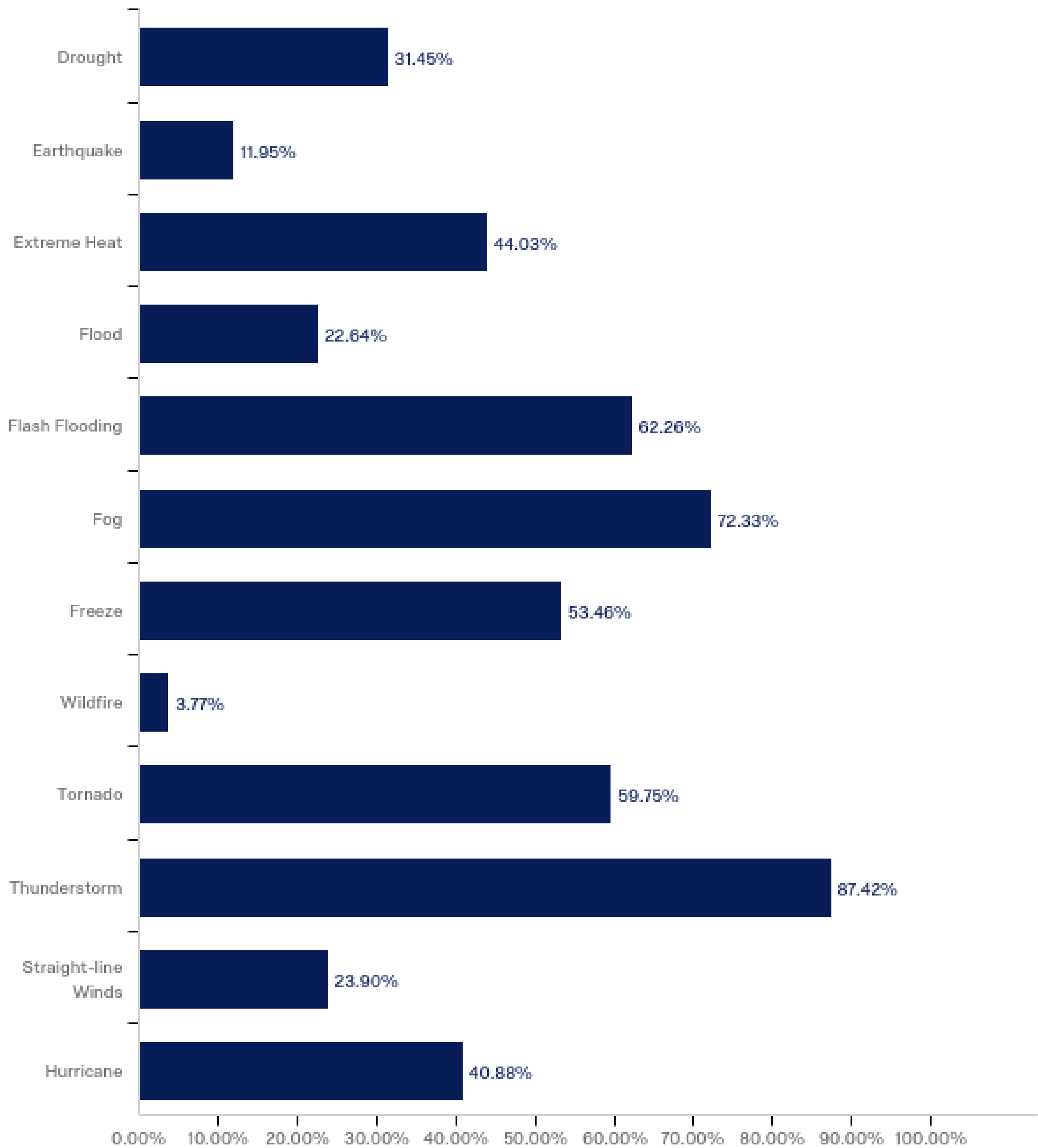

Figure C1. Bar graph showing the percentage of responses for each natural hazard type for question 6.

7.4 Appendix D: Miscellaneous Chi-square Tests of Independence

The results for this chi-square test are shown in *Table D1* and are in line with results from the relationship between questions 8 and 13 and questions 9 and 13. This time, however, the associative strength was higher. Personal experience, local news, social media, friends or neighbors, National Weather Service, and primary or secondary school all indicate strong associations with whether or not students are likely to evacuate or seek shelter in the event of a natural hazard. This implies that while students also use these information sources for planning and forming a perception of risk due to the surveyed natural hazards, they use these sources more for what they need to do to protect themselves in the case of a natural hazard impact.

Table D1. Chi-square test of independence between questions 10 and 13.

Source of Information	χ^2	***p-value***	ϕ_c
Personal Experience	593.46	$7.51*10^{-86}$	0.26
Local News	590.99	$2.26*10^{-85}$	0.25
Social Media	436.17	$5.90*10^{-56}$	0.25
Friends or Neighbors	546.58	$8.25*10^{-77}$	0.26
National Weather Service	531.12	$7.54*10^{-74}$	0.25
Primary or Secondary School	455.76	$1.34*10^{-59}$	0.28
Disaster Preparedness Meetings	68.97	0.38	---
Community Emergency Response Training	76.50	0.18	---
University Safety Training	77.15	0.16	---

Once again, disaster preparedness meetings, community emergency response training, and university safety training all fail to provide enough evidence to establish a relationship. Low participation is likely to blame. Students cannot act on information they do not receive.

Transportation access can also play an important role in whether or not a student has the ability to evacuate, so questions 10 and 16 were tested against one another. As was assumed and is shown in the statistical results in *Table D2*, the availability of vehicles for evacuation purposes has a strong association with whether or not a student will evacuate in a natural hazard event.

Car/automobile, public transportation, and motorcycle/bike all indicated strong relationships. Recreational vehicle access did not indicate a relationship. This is likely due to recreational vehicles not being the first choice for transportation for students. Only 7%, within the 8% margin of error for this study, indicated that they had access to a recreational vehicle, so it stands to reason that students do not look to recreational vehicles as their evacuation transport.

Table D2. Chi-square test of independence between questions 10 and 16.

Transportation Type	χ^2	***p-value***	ϕ_c
Car/automobile	606.19	$2.55*10^{-88}$	0.24
Public Transportation	465.18	$2.30*10^{-61}$	0.27
Recreational Vehicle	61.06	0.65	---
Motorcycle/bike	154.80	$4.28*10^{-9}$	0.33

One noteworthy result is that students who indicated access to a motorcycle or bike have a strong association with using that as their evacuation vehicle, with a Cramer's V of 0.33. This implies that there may be students whose only personal transportation is a motorcycle or bike, so they would default to using their singular method of transportation in an evacuation scenario.

Students may feel it is easier to evacuate or seek shelter in the event of a natural hazard with the help from a friend or roommate. As such, questions 10 and 17 were tested against one another. The results of this chi-square test of independence (*Table D3*) align with prior assumptions in this study. Students who have a friend or roommate to aide in evacuation or sheltering for a natural hazard are more likely to take shelter or evacuate in the event of a natural hazard. Students who do not have a friend or roommate to assist them may experience more difficulty in evacuating or taking shelter. It helps for a student to have someone assist them when they need it most.

Table D3. Chi-square test of independence between questions 10 and 17.

Friend or Roommate	χ^2	***p-value***	ϕ_c
Yes	633.20	$1.40*10^{-93}$	0.25
No	75.69	0.19	---

Likewise, pets can have an impact on whether or not a student will choose to evacuate during a natural hazard. To test this, questions 10 and 18 were compared. The results of this test are shown below in *Table D4*. The expected result was that owning a pet would associate with readiness to evacuate. There are extra precautions that must be taken when evacuating an animal which may not understand what is going on or how to keep itself safe. This result was reflected in the test. However, the opposite result was also reflected. Students who do not own a pet area related with those who feel ready to take shelter or evacuate. This may imply that students feel not owning a pet gives them greater ability to evacuate, as evidenced by a stronger Cramer's V. In other words, both pet owners and non-owners both have their decision to evacuate or take shelter influenced by whether or not they own a pet.

Table D4. Chi-square test of independence between questions 10 and 18.

Pet	χ^2	***p-value***	ϕ_c
Yes	89.97	0.03	0.22
No	631.70	$2.74*10^{-93}$	0.26

It is assumed that how damaging a person feels a natural hazard is (question 11) depends greatly on how knowledgeable they are in regards to that natural hazard (question 13). To see if student responses to the survey also indicate this, a chi-square test of independence was performed. Like the previous tests which compared question 13 with another, this test, statistical results of which are shown in *Table D5*, yields a relationship between the information sources of personal experience, local news, social media, friends or neighbors, National Weather Service, and primary or secondary school and how damaging a student perceives a natural hazard to be. A result that differs, however, is that university safety training is also associated with the perception of damage due to natural hazards, quite strongly even with a Cramer's V of 0.28. This implies that the students who are getting university safety training are taking away from said training which hazards are most damaging. However, participation in university safety training of 10% is still very low.

Table D5. Chi-square test of independence between questions 11 and 13.

Source of Information	χ^2	***p-value***	ϕ_c
Personal Experience	537.42	$4.71*10^{-75}$	0.25
Local News	488.83	$8.18*10^{-66}$	0.23
Social Media	394.15	$3.13*10^{-48}$	0.23
Friends or Neighbors	446.35	$7.58*10^{-58}$	0.24
National Weather Service	518.83	$1.67*10^{-71}$	0.25
Primary or Secondary School	393.93	$3.43*10^{-48}$	0.26
Disaster Preparedness Meetings	44.99	0.98	---
Community Emergency Response Training	58.78	0.72	---
University Safety Training	91.49	0.02	0.28