12-2021

Factors that Influence the Extent to which Cities on Florida's Atlantic Coast are Preparing for Climate Change: A multiple regression analysis and learning opportunities for policymakers

Sheila Ann Young

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by

Sheila Ann Young

Bachelor of Arts
Philosophy, minors in Music and Political Science
Hope College
1986

Master of Science
Biology: concentration Environmental Science and Policy
George Mason University
1999

Master of Arts
Military Strategic Studies
Air Force War College
2017

A dissertation submitted to the College of Engineering and Science of

Florida Institute of Technology

in partial fulfillment of the requirements

for the degree of

Doctor of Philosophy

in

STEM Education

Melbourne, Florida

December 2021

We the undersigned committee hereby approve the attached dissertation, "**Factors that Influence the Extent to which Cities on Florida's Atlantic Coast are Preparing for Climate Change: A multiple regression analysis and learning opportunities for policymakers**" by Sheila Ann Young.

_____

Samantha R. Fowler, Ph.D.
Assistant Professor
Mathematical Sciences
Major Advisor

_____

Kenyon C. Lindeman, Ph.D.
Professor
Ocean Engineering and Marine Sciences
Committee Member

_____

Kastro M. Hamed, Ph.D.
Professor
Mathematical Sciences
Committee Member

_____

Kelli Hunsucker, Ph.D.
Assistant Professor
Ocean Engineering and Marine Sciences
Committee Member

_____

Gnana Bhaskar Tenali, Ph.D.
Professor and Department Head
Mathematical Science

Abstract

Title: **Factors that Influence the Extent to which Cities on Florida's Atlantic Coast are Preparing for Climate Change: A multiple regression analysis and learning opportunities for policymakers**

Author: Sheila Ann Young

Advisor: Samantha R. Fowler, Ph.D.

This study involved a survey (Appendix A) to leaders of 158 cities inside the counties that border the Atlantic coast of Florida. The impetus behind this study was to identify how policymakers were obtaining, understanding, and sharing information about climate change in order to help inform the policymaking process about adaptation. We cannot only train students at the secondary and university levels about climate change and expect policies to change right away. Those students, for the most part, will not be in policymaking leadership positions for years or decades. What is needed now are strategies to address the climate change learning needs of current policymakers so that targeted messaging from trusted sources can reach those individuals. This study was designed to build a foundation of knowledge that would lead to improved strategies to teach policymakers about climate change science and adaptation measures to protect their cities from current and future impacts.

The survey questions focused on perceptions of the importance of climate change with regard to public health, the economy, and the environment; actual knowledge of what each community has in place in terms of plans for climate adaptation measures; and actual knowledge of information exchange between city leadership and their constituents about climate change. Online software was used through the Florida Institute of Technology's subscription to qualtrics.com to develop the electronic survey.

This research contained the following four research questions (RQs): RQ1 What perceptions do Florida's coastal community leaders hold toward the potential climate change-

related risks to their communities' health, economy, and environment? RQ2 To what extent do Florida coastal community leaders communicate with their constituents regarding climate change and the need for adaptation measures? RQ3 To what extent are Florida coastal communities implementing adaptation measures to combat impacts from climate change (i.e., combating coastal erosion, wetlands protection, severe flooding, etc)? RQ4 To what extent does the size of the city correlate with the extent to which it adopts adaptation measures to combat climate change? Standard multiple linear regression was used to analyze the data and determine if, and to what extent (magnitude), the factors mentioned in the research questions impact the extent to which cities planned for and/or adopted climate change adaptation measures.

The survey process yielded 86 fully completed responses (of the 158 surveyed) that were used in the multiple regression analysis. The result of the analysis showed that risk perception and city size explained, in part, how prepared a city was to adapt to climate change events. There was a positive correlation with both perceived risk [of climate change impact] and city size in terms of the number of measures a city adapted, and whether those adaptation measures were merely plans for adaptation or if they actually implemented measures. The research question with regard to social framing was inconclusive, with non-significant results. A larger sampling of cities might have produced significant results, but that is an area for future research.

Though the overall regression model could not be accepted given social framing was not significant, the results illustrate a variety of relationships that deserve further policy analysis and may promote policy advances. Knowing how cities obtain their information is useful in targeting climate change-related messages to those audiences. Because, as this study also showed, how prepared a city is to climate change events is partly explained by their risk perception of the possible causes and impacts of climate change.

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Acronyms and Abbreviations

CCVA	Climate Change Vulnerability Assessment
CDC	Centers for Disease Control and Prevention
DV	Dependent variable
FAC	Florida Association of Counties
FLBRACE	Florida Building Resilience Against Climate Effects
FL DEP	Florida Department of Environmental Protection
FIT	Florida Institute of Technology
Ha	Alternate hypothesis
Ho	Null hypothesis
IPCC	Intergovernmental Panel on Climate Change
IRB	Institutional Review Board
IV	Independent variable
NASA	National Atmospheric and Space Administration
NCDP	National Center for Disaster Preparedness
NOAA	National Oceanic and Atmospheric Administration
NPR	National Public Radio
NRC	National Research Council
RMSE	Root mean standard error
RQ	Research question
SME	Subject matter expert
STEM	Science, technology, engineering, and math
U.S.	United States
VIF	Variance inflation factor

Acknowledgements

I want to thank Dr. Samantha R. Fowler, committee chair, who encouraged me to pursue my areas of interest, not only in this study, but also in previous research related to climate change and education. I greatly value your time, support, insights, creativity, and sense of humor. I also want to thank my other committee members, Dr. Ken Lindemann, Dr. Kelli Hunsucker, and Dr. Kastro Hamed, for their expertise and time.

I would like to acknowledge all those who contributed to the validation of the survey instrument used in this study because without their insights and technical knowledge the study would not have been possible: Dr. Ken Lindeman from the Florida Institute of Technology, Dr. Stuart Carlton from Purdue University, Mr. Thomas Snelling and Mr. Whit Remer from the City of Tampa, Mr. Chris Ellis from the National Oceanic and Atmospheric Administration, Ms. Maya Burke from the Tampa Bay Regional Planning Council, and Dr. Colin Polsky from Florida Atlantic University.

I would like to thank the professors in the STEM Education Program at the Florida Institute of Technology as my dissertation was rooted in the tools and education theories that I learned in all their courses: Dr. Fowler, Dr. Marcinkowski, Dr. Park, and Dr. Hamed.

My friends and family also deserve special thanks for their support to me throughout this process, especially Otto, Carl, Mark, Gaby, Victor, Sally, Jean, Molly, Claudia, Marty, Amanda, and Robbie. I would also like to thank the people who helped me pursue this continued education and never faltered in their support of me: Dr. Margaret Sankey with the Air University, Mr. Thomas Ochs PE/ME with Ochs Research, Dr. Alex Dickie from the U.S. Agency for International Development, and Dr. Susan Steen from the Air Force War College. Finally, I would be remiss if I did not acknowledge the U.S. Peace Corps' Paul D. Coverdell Fellowship that allowed me to afford school in the first place.

Dedication

This is dedicated to Barb Young-McKenzie (my Mom), Bob McKenzie (my Stepdad), and Russell A. Young (my late Father) for their support and encouragement during the past decades.

Chapter 1: Introduction

Statement of Purpose

The purpose of this study was to generally identify how policymakers (i.e., city leadership) along Florida's Atlantic coastal counties think about climate change and how climate change is communicated with constituents in order to recommend strategies to improve climate change comprehension that will lead to improved adoption of adaptation measures in those institutions. To that end, a survey was employed to study various factors that influence the extent to which the cities in Florida's Atlantic coastal counties have planned for or have adopted climate change adaptation measures, the risk perception of city leadership, and communication (i.e., social framing of messages) with constituents. Human pressures from overpopulation and associated economic growth exacerbate stresses on coastal environments and threaten the ability of those cities to adapt to climate change (Wong et al., 2014). Further, the US public perception of the risks associated with climate change also influences the public policy response. The U.S. population is divided over the causes of climate change as well as the anthropogenic linkages between climate change and human activity (Bolsen et al., 2018). Researchers have found that some people simply do not understand the science behind climate change and others are influenced by the sources of information (e.g., social media, politically-appointed individuals, or the science community) that can influence to what extent people perceive climate change risk (Carlton & Jacobson, 2013; see also Kim & Kim, 2018; Ogunbode et al., 2017; Shoa & Goidel, 2016). In other cases, some cities have developed plans for climate change adaptation and those plans are in various stages of implementation (Broward, 2020; Miami-Dade, 2016; Sandoval, 2020). Some local governments have access to information for their planning, but that information is not always available in academic databases, therefore it is important to query governments directly about their plans (Lindeman et al., 2018). My hope for this study from the outset was that the results of this research would further the body of knowledge as to the

preparedness of Florida's Atlantic coastal cities toward climate change adaptation and help to enrich the policy dialogue, inform policy making, and influence future adoption of climate change adaptation measures.

Rationale

Florida has over 1,350 miles of Atlantic Ocean and Gulf of Mexico coastline. In 2010, the economic contribution from Florida's coastline exceeded $700 billion annually (Ariza et al., 2014). 0ver 75% of the state's population lives along the coast, inclusive of the Atlantic coastal communities and Gulf coastal communities. From 1960 to 2008, the population along Florida's coastline has only increased in each county, thereby increasing the vulnerability to lives, livelihoods, the environment, and property as a result of extreme events brought on by climate change (Wilson & Fischetti, 2010). Florida's coastal communities will face a large percentage of the brunt of climate change impacts from sea-level rise and coastal erosion to marine life die-off and water shortages (Carlton & Jacobson, 2013). Further, according to Heimlich et al. (2009), "Southeast Florida is recognized as one of the most vulnerable regions of the world to the impacts of global climate change" (p. 6).

Scientists predict increased hurricane intensity, accompanied by increased storm surge ranging from 25% to 47%, as well as increased sea-level rise along Florida's coastline from climate change (Balaguru et al., 2016). Ratter et al. (2012) stated that there had been a decline in American awareness and interest in climate change over the past several years and that climate change ranks near the bottom of their priorities at 28% according to a Pew Research Center 2010 poll. In order for the citizens of Florida to develop informed opinions/perceptions regarding climate change threats, they need to be able to talk about it and learn about it. For the state and environmental leaders to know what local communities are currently thinking regarding climate change threats to the state, a survey may provide that insight.

Communication can influence perception, such as is the case with social framing. If we can determine what perceptions coastal community leaders have toward climate change and the need for adaptation measures, perhaps we can provide some insights for media outlets and scientists in order to get enough adaptation information out to coastal communities so they will act on it. When faced with a crisis or threat (real or perceived), the media can and does play an important role. It can influence public perception of the crisis or threats, and play "a role at both the affected and broader scale in psychological and physical coping and recovery processes" (Norris et al., 2008, p. 476).

Communication strategies for the state of Florida have traditionally been to NOT talk about climate change, but instead, to talk around it in terms of mentioning flooding and erosion along the coasts. Downplaying the ill effects of climate change impact can also be termed as the politicization of the issue, where "politicization occurs when an actor emphasizes the inherent uncertainty of science to cast doubt on the existence of scientific consensus" Bolsen & Druckman, 2015, p. 747). In 2015, it was reported in a news outlet that then (conservative) Governor Rick Scott banned the use of the terms, "climate change," "global warming," and, "sea-level rise" from official communications (Korten, 2015). This might be contributing to the misinformation, or lack of information, on the part of Florida citizens regarding the likely impacts of climate change (Lund, 2015).

The literature is bountiful in terms of how the media and public figures can influence public opinion. For example, the idea of 'social framing' issues is used in the energy sector where the fossil fuel industry has effectively changed the views that many people hold toward the use of fossil energy by focusing on the merits of carbon capture and sequestration technologies. That industry has done an effective job of recasting the science of the damage that fossil energy sources can inflict on the environment to one of potential aid to help sequester carbon (Gunderson et al., 2020). Social framing of climate change science has negative effects

for those who do not adhere to Intergovernmental Panel on Climate Change (IPCC) guidelines for greenhouse gas reduction and adaptation to climate change. Coastal communities will face more severe hardships in the years to come without action now. It is hoped that this research will point to an endemic problem in the psyche of some Floridians, prompting action.

Research Questions

Research focused on the extent to which the cities in Florida's Atlantic coastal counties have plans in place to adopt adaptation measures or to what extent they are already implementing those plans. This refers specifically to research question 3, below. The other research questions are variables that could help explain research question 3, based on the literature. A survey was designed, reviewed, and administered to city leaders, or their designates, in 158 cities that reside in Florida's Atlantic coastal counties in order to obtain data for questions 1, 2, and 3. The data for research question 4 was available from online sources and is presented in Appendix B.

RQ1: What perceptions do Florida's coastal community leaders hold toward the potential climate change-related risks to their communities' health, economy, and environment?

Ho: coastal community leaders do not see risk with regard to climate change

Ha: coastal community leaders see risk with regard to climate change

RQ2: To what extent do Florida coastal community leaders communicate with their constituents regarding climate change and the need for adaptation measures?

Ho: coastal community leaders are not communicating with their constituents specifically about climate adaptation (a business-as-usual scenario)

Ha: coastal community leaders are communicating with their constituents specifically about climate adaptation

RQ3: To what extent are Florida coastal communities implementing adaptation measures to combat impacts from climate change (i.e., combating coastal erosion, wetlands protection, severe flooding, etc)?

Ho: coastal communities are not implementing adaptation measures (a business-as-usual scenario)

Ha: coastal communities are implementing adaptation measures

RQ4: To what extent does the size of the city correlate with the extent to which it adopts adaptation measures to combat climate change?

Ho: the size of the city does not matter

Ha: the size of the city does make a difference

Significance

This study built on previous perception studies such as those mentioned above but also asks questions of key officials in leadership (i.e., city managers, mayors, or their designates) in the cities that are located in each county that borders Florida's Atlantic Coast. The employment of a perception instrument to city officials about climate change perceptions has not been done before. The results of this study shed light on risk perception of the target cities and preparedness of those cities to meet climate challenges. The results are also a signal to climate change or resiliency organizations, scientists, and teachers to redouble efforts to explain the science and risks of climate change.

Inquiry Framework and Focus

The study herein involved a survey (Appendix A) to leaders of cities inside the counties that border the Atlantic Coast of Florida. The research was divided into two parts. Part 1 was a pilot study with cities in counties that border Florida's Gulf coast. Part 2 was the primary survey of 158 cities along the Atlantic Coast. The Atlantic Coast was the focus of the primary study because it has interesting challenges related to freshwater availability and joint watershed management, the climate change-related issues such as wave action and erosion, and the counties on that coast represent the largest population centers in the State, in Jacksonville and Miami.

The data collected from the survey addressed research questions 1-3, while the data for research question 4 was available from online sources (FAC, 2020; Florida Cities by Cubit, 2020) (see Appendix B). Assistance was obtained from several subject matter experts (SMEs) at the Florida Institute of Technology (FIT) and other reputable universities (such as Florida Atlantic University and Purdue University), as well as from the National Oceanic and Atmospheric Administration, in order to validate the survey questions. SME feedback is contained in Appendix C. Reliability was obtained following the pilot study and Cronbach's alpha analysis in SPSS, the results of which are presented both in the Methods section (Chapter 3).

The survey questions focused on risk perceptions of the importance of climate change with regard to community health, economy, and the environment; actual knowledge of what each community has in place in terms of plans for climate adaptation measures; and actual knowledge of how (or if) community leadership receive information about climate change and how (or if) they communicate to their community members. Additional questions focus on demographics such as the position of the respondent, years in that position, among other questions. FIT's subscription to qualtrics.com was used to develop the electronic survey.

Standard multiple linear regression in SPSS was used to analyze the data and determine the extent to which the factors mentioned in the research questions explained the extent to which cities have planned for and/or adopted climate change adaptation measures.

Limitations and Key Assumptions

Limitations This study was limited in a few significant ways including: 1) the Covid-19 pandemic hit cities hard in terms of available personnel to respond to additional tasks such as this survey, which in turn reduced the number of responses received; and 2) some cities in the population were very small compared to others and as a consequence, those cities often do not

provide the same level of services to their constituents as do larger cities. As a result, smaller cities did not have the impact on the dependent variable in the same way larger cities did.

Though the target audience in each city were city leaders (i.e., city managers, mayors, etc.), many cities delegated the task of responding to the survey to other staff. In some cases those staff were more attuned to the climate change adaptation measures planned or in place in their cities than the city leaders. This item is listed as a delimitation because I had no control over the survey once it was released. Further, it may have been the case that many cities would simply not have responded if it were a requirement to only receive surveys from top city leadership.

Key Assumptions: The major assumptions for this research were: 1) a significant number of respondents would send in their surveys in a timely fashion, and 2) the people instructed to answer the survey would have enough knowledge of their communities in order to respond to the survey. These assumptions appear to have been met based on the survey results.

Operational Definitions

- **"Adaptation and resilience to climate change"** refers to "the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects" (IPCC, 2014, p. 5).
- **"Adaptation measures"** refer to physical or policy actions that cities may take against climate change-related events such as, but not limited to, sea-level rise, flooding, water-borne disease, lack of freshwater, extreme heat events, runoff of fertilizers that impact marine life, beach erosion, etc. (Noble et al., 2014).

- **"Anthropogenic"** refers to resulting from or produced by human activities (IPCC Glossary, 2020).
- **"City Leadership"** refers to the lead hired employee for an incorporated city in Florida who has the responsibility to manage the affairs of that city.
- **"Climate change"** refers to "a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer" (IPCC Glossary, 2020).
- **"Coastal city"** refers to cities within counties bordering Florida's coast. Some of those cities are directly bordering saltwater bodies, while other cities are land-locked but within a county that borders the Atlantic or Gulf coast.
- "**Communicating with constituents**" refers to how a City Leadership would communicate with the members of a particular city.
- **"Green spaces"** refer to permeable areas in urban or rural settings where rain or flood water can permeate the surface.
- **"Health"** (public health) refers to the health of the human population within a given city.
- **"Heat stress"** refers to heat pressures on the natural ecosystem, compounded by the continued trend by increased climate change influences, that result from a reduction in the green environment and an increase in impermeable surfaces typically found in urban environments (Nichols et al., 2007).
- **"Intergovernmental Panel on Climate Change," or** IPCC, is an international body of the United Nations that was created to "provide policymakers with regular scientific assessments on climate change, its implications and potential future risks, as well as to put forward adaptation and mitigation options" (IPCC, 2020).

- **"Mitigation Banking" -** Mitigation banking in Florida is a common "practice in which an environmental enhancement and preservation project is conducted by a public agency or private entity ("banker")" in one location in the state in order to mitigate for wetland impacts in another part of the state (FDEP, 2020a).
- **"Outcome Expectation"** refers to an area of education scholar Albert Bandura's Social Cognitive Theory and means people are less likely to pay attention to something, or do something, if there is no anticipated payoff (Ormrod, 2012).
- "**Resilience**" refers to "the capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identify, and structure, while also maintaining the capacity for adaptation, learning, and transformation" (IPCC, 2014, p. 5).
- "**Risk Perception**" refers to judgments made by people experiencing threats posed by a particular hazard (Bhattachan et al., 2019).
- **"Rolling Easements"** refers to when communities "make no effort to restrict land use but prevent shore protection of some coastal lands either through regulation or by transferring any right to hold back the sea from owners inclined to do so to organizations that would not" (Titus, 2011, p. 4).
- **"Saltwater Intrusion"** refers to sea water movement into freshwater coastal aquifers (USGS, 2020).
- **"Self-Efficacy"** or **"Collective-Efficacy"** part of Albert Bandura's Social Cognitive theory and means that "learners are more likely to engage in certain behaviors when they believe they're capable of executing the behaviors successfully" (Ormrod, 2012, p. 127). "Collective-Efficacy" refers to Albert Bandura's Social Cognitive Theory where the same theory can be expanded to collective efficacy, whereby a group of people or

organizations would gain an increased belief they could make a difference if they did it as a team or a collective (Heald, 2017; Ormrod, 2012).

- "**Social framing**" refers to the act of presenting information in a certain manner to an audience that may be predisposed to accept that kind of message (Kim & Kim, 2017; see also Albright & Crow, 2019).
- **"Sustainability"** refers to development that meets "the needs of the present without compromising the ability of future generations to meet their own needs" (Michel, 2020).
- **"Urban parks"** are simply parks in urban settings.
- **"Vulnerability"** "occurs when resources are not sufficiently robust, redundant, or rapid to create resistance or resilience, resulting in persistent dysfunction. The more severe, enduring, and surprising the stressor, the stronger the resources must be to create resistance or resilience" (Norris et al., 2008, p. 130).
- **"Watershed"** - "is a landscape that contributes surface water to a single location, such as a point on a stream or river, or a single wetland, lake, or other water bodies….It comprises a set of physical, chemical, and biological elements connected by the flow of water." (Flotemersch et al., 2016).
- **"Wetland" -** Florida wetlands are defined as "those areas that are inundated or saturated by surface water or groundwater at a frequency and a duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils" (FDEP, 2020b).
- **"Worldviews (cultural or political)"** or beliefs, refer to how people shape their beliefs to those of the predominant social group in which they reside (Akerlof et al., 2013).

Chapter 2: Literature Review

In this chapter, factors that influence a community's ability to, and the probability of, adopting climate change adaptation measures are outlined. Though there are many varying factors that can influence a community's ability to adopt climate change adaptation measures, it was not possible to address all such factors in this study. Those factors that were of most interest were in regard to Florida's Atlantic coastal cities: the influence of population size and increased human pressures; adaptation measures that create climate-resilient communities able to adapt to climate change; perceptions of health, environmental, and economic risks as a result of climate change; and, the influence of social framing. In addition, a linkage between climate change science and education theory through the study of andragogy, behavior modeling, and social cognitive theory is provided. Finally, how this research could enhance the body of knowledge concerning factors that influence the adoption of climate change adaptation measures in Florida's Atlantic coastal communities is discussed. These findings can enhance the quality of the public policy debate on those issues.

Influence of Population Size and Human Pressures Exacerbated by Climate Change

The Intergovernmental Panel on Climate Change (IPCC) emphasized that most of the coastlines in the world are influenced by human pressures and that "population growth in many of the world's deltas, barrier islands and estuaries has led to widespread conversion of natural coastal landscapes to agriculture, aquaculture, silviculture as well as industrial and residential uses" (Nichols et al., 2007, p. 319). The IPCC report continued, "rapid urbanization has many consequences...enlargement of natural coastal inlets and dredging of waterways for navigation, port facilities, and pipelines…" that cause saltwater intrusion into surface and groundwater sources (Nichols et al., 2007, p. 319). As well, direct impacts from human influences on coastal zones also contribute to, including but not limited to: wetland drainage, fertilizer and sewage contamination of waterways that in turn negatively impact plant and marine life, the introduction

of invasive species that crowd out native species, damming or channeling waterways, alteration of freshwater and brackish water circulation systems, and ecosystem disruptions from beach nourishment and dune reconstruction (Nichols et al., 2007). As cities grow larger, the human pressures on the natural environment increase, thereby reducing the ability of the natural ecosystems to meet previous adaptation responses. These pressures on the natural ecosystem, compounded by the continued trend by increased climate change influences, will result in greater heat stresses on humans as well as plant and animal metabolisms; increased incidence of diseases; stresses on freshwater supplies; availability of land for agriculture and waterways for aquaculture, to name a few challenges (Nichols et al., 2007).

The population size, as of 2019, of the cities in Florida's Atlantic coastal counties ranges from 16 to over 800,000 (FAC, 2020; also see Florida Cities by Cubit, 2020). Often, with increased populations also comes reductions in green spaces and increases in impervious surfaces (i.e., pavement), ultimately increasing the heat stress and urban island effects in cities (Chapman et al., 2017). When researchers consider the impact on cities from climate change, one must also consider these heat stresses, in addition to flooding, freshwater reduction, changing habitat for marine life and animals, and less land for agriculture. A research question of this study is the correlation between city size and readiness of cities to climate change impacts. For that reason, city size is one of the variables of this study.

Adaptation Measures that Create Resilient/Adaptive Communities

The IPCC is an international body of the United Nations that was created to "provide policymakers with regular scientific assessments on climate change, its implications and potential future risks, as well as to put forward adaptation and mitigation options" (IPCC, 2020). The IPCC was designed to determine where there existed a consensus in the scientific community on issues related to climate change and where further research was needed (IPCC, 2020). In addition, in later reports, it also provides recommendations to governments where

vulnerabilities to climate exist and what mitigation or adaptation measures those governments may employ to address climate change. The IPCC (2014) stated that, with high confidence, extreme coastal storm events "can cause excess mortality and morbidity, particularly along the East Coast of the USA…" (p. 1444). It also stated, "observed impacts on livelihoods, economic activities, infrastructure, and access to services in North American urban and rural settlements have been attributed to sea-level rise, changes in temperature and precipitation, and occurrences of such extreme events as heatwaves, droughts, and storms" (IPCC, 2014, p. 1444). In addition, North American ecosystems "are under increasing stress from rising temperatures, carbon dioxide concentrations, and sea-levels, and are particularly vulnerable to climate extremes" (IPCC, 2014, p. 1443). The IPCC found that adaptation measures in the U.S. tended to be reactionary and unevenly distributed around the US (IPCC, 2014).

Adaptation to climate change and resiliency are interlinked terms. Adaptation to climate change is viewed by the IPCC (2014) as "the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects" (p. 5). That is the definition of adaptation that will be used throughout this research study.

There are many definitions of resilience in the literature. The IPCC (2014) refers to it as "the capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identify, and structure, while also maintaining the capacity for adaptation, learning, and transformation" (p. 5). Davoudi & Porter (2012) refer to resilience in terms of "how much disturbance it can take and remain within critical thresholds" (p. 300). Bohensky & Leitch (2014) present the definition of a resilient community as one that has the ability to learn from extreme events and institute individual and institutional adjustments. The act of being resilient,

or adapting to change, then is presented as "a process of linking a set of adaptive capacities to a positive trajectory of functioning and adaptation after a disturbance" (Bohensky & Leitch, 2014, p. 476; Norris et al., 2008, p. 130). Likewise, vulnerability (a vulnerable community) "occurs when resources are not sufficiently robust, redundant, or rapid to create resistance or resilience, resulting in persistent dysfunction. The more severe, enduring, and surprising the stressor, the stronger the resources must be to create resistance or resilience" (Norris et al., 2008, p. 130).

In this study, several factors are discussed that would help determine whether a city is adapting to the effects of climate change including, but not limited to: protection of existing wetlands or creation of new wetland areas, beach nourishment, stormwater drainage system improvement, identification of freshwater drinking sources, protection of current freshwater sources, protection from power disruptions during intense storms such as hurricanes, wildfire prevention and management, conservation of water for agriculture use, wastewater treatment system upgrades, and creation of urban parks (Heimlich et al., 2009; see also Chapman et al., 2017). Understanding these factors, or adaptation measures, is a key variable of the study and, as such is the dependent variable.

Influence of Perceptions of Climate Change Risks

The U.S. public remains sharply divided over both the existence of global climate change and the anthropogenic causes thereof. As a result, policy changes that would assist local communities to plan for climate adaptation are occurring slowly. To overcome this, there is an immediate need for improved communication regarding the effects of climate change, to influence policy changes. An effective communication strategy would appeal to a broad audience (Bolsen et al., 2018). Bolsen et al. (2018), stated that one way to engage new audiences and lessen the opinion divide regarding climate change and potential impacts is to communicate information that is locally relatable. For example, rather than referring to just the dangers of melting glaciers on polar bears in the Arctic, one could talk about increased sea-level rise,

saltwater intrusion, and eroded coastlines in Florida. Bhattachan et al. (2019) state that investigators should look at impacts in both urbanized coastal areas and rural coastal areas. They stated that there is already a lot of literature focusing on urban areas, though some authors believe there is not enough research yet on the effects of heat stress and urbanization (Chapman et al., 2017).

There are risks (e.g., biological, economic, physical) associated with climate change, but those risks aren't as understandable to the layperson as they are to scientists because people often do not understand how those risks link to climate change. Events that are immediate and close to home are seen as more relevant and of greater concern than those risks that are longer-term and not associated with local environmental issues, according to Carlton & Jacobson (2013). Akerlof et al. (2013) state that when people can experience impacts from climate change directly, they are likely to believe the science. For example, in the Akerlof et al. (2013) study, they found that the most frequently described personal experiences of global warming were seasons, weather, lake levels, animals, and plants. Further, Akerlof et al. (2013) state that experience through social environments can also influence how people view climate change. Others state that cultural worldviews influence perceptions of environmental risk, including risks associated with climate change (Goebbert et al., 2012). Political and cultural worldviews also influence both beliefs about climate change as well as environmental changes. Cultural worldviews, or beliefs, refer to when people shape their beliefs to those of the predominant social group in which they reside (Akerlof et al., 2013).

The idea that climate change itself is not a primary risk might have some merit to it since many see it more as a driver of environment-related issues rather than the direct cause. Spence et al. (2011) stated that when people lack first-hand experience of a concept such as climate change, they would not be interested in acting on the potential threats. To those people who may be more motivated by goal-orientation theory, people who are able to relate a particular

environmental event to climate change may be more likely to do something about adaptation measures by setting specific goals to address the threats (Spence et al., 2011). Without knowledge of a clear link between climate change threats and localized environmental degradation, it is less likely for a goal-oriented individual to set those targets. Spatial distance theorists in psychology also state that people would lack concern for those things that are a further distance from their own experiences (Williams & Bargh, 2008). McCright & Dunlap (2011) analyzed 10 years of data from Gallup polls in order to look at the extent to which liberals versus conservatives believed in global warming. They further looked to see if there was a correlation between education level and climate change believability or deniability. The results of their study found that people who were more educated tended to believe climate change science, while those people with less education did not.

Risk perception about climate change is especially important because it can motivate and mobilize people into action with regard to adaptation measures needed to protect vulnerable areas. Risk perception refers to judgments made by people experiencing threats posed by a particular hazard (Bhattachan et al., 2019).

This study investigated how city leaders in Florida's coastal counties perceive risk from climate change and the associated impacts on health, the environment, the economy, in their communities. In addition to the perceived risk on the part of the city leaders, and city size, other factors such as social framing were investigated in more detail below.

Influence of Social Framing

Extreme weather events, public perceptions, and political affiliations can influence how people perceive the links between climate change and localized effects such as sea-level rise, flooding, and erosion. How messages are framed in the media can influence how people understand a phenomenon and how they in turn act on it (Kim & Kim, 2018). For example, Kim & Kim (2018) studied how the issue of marijuana was largely presented in the newspapers in the

1990s and early 2000s as a law enforcement issue rather than a medical issue, thus public opinion was focused on the criminality of it rather than the therapeutic aspect. Once the media began reporting the benefits from a medical side, the public opinion swayed toward supporting medical marijuana use. Public opinion can either motivate or inhibit action on policies to address risks from climate change as well (Albright & Crow, 2019). As a result, by analyzing public opinion, we can begin to determine how a community might respond to climate adaptation strategies. Researchers have found that, in general, the U.S. public has a weak understanding of climate change and the potential impacts we might face (Albright & Crow, 2019). Tang et al. (2010) found that local communities were most likely to move from planning to implementation on climate adaptation as long as there was a state mandate to do so. Ogunbode et al. (2017) found that communities were more likely to be influenced by political affiliation. Shoa & Goidel (2016) also found that political affiliations were the driving factors in building climate change understanding and formulating attitudes, which could lead to action. In a 2018 Gallup poll of U.S. voters, 69% of Republicans thought global warming threats were exaggerated, while only 4% of Democrats had that same belief. Those figures vary from the 2017 poll when Republican views reflected 66% and Democrats' views reflected 10% (Gallup, 2018).

How people view an issue can be influenced by messages portrayed through the media (including social media and news outlets) as well as from public figures. Gunderson et al. (2020) state that "[message or social] frames are underlying structures of beliefs, perceptions, and appreciation, mental boxes, or implicit organizing ideas that constitute necessarily simplified views and images of ambiguous situations in a complex reality" (p. 2). Continuing, Gunderson et al. (2020) add that while framing an issue allows the author to select some aspects of an issue to make them more understandable, it also provides a forum for excluding specific aspects. "The way responses to climate change are framed matters because frames influence public perceptions and are used to strengthen the case for specific policies" (Gunderson et al., 2020, p. 2).

Even the best intentions of framing can have adverse consequences, however. Bieniek-Tobasco et al. (2019) found that when they interviewed individuals who viewed environmental (i.e., climate change) documentaries, those individuals, though admitting they had a heightened awareness of environmental issues, felt more helpless after the documentary because they saw the tremendous political obstacles needed to overcome in order to address environmental challenges. One of the key issues identified in the Bieniek-Tobasco et al. (2019) study was that viewers were frustrated that, while the documentaries addressed environmental problems, they did not necessarily highlight what to do about them. That, in turn, led to more people becoming frustrated about their willingness to have any impact even if they tried to take some action about climate change. In that study, they found "a disconnect between an action and what such action could achieve hinders both motivations to take action and beliefs that taking that action would have an effect" (p. 13). The authors further highlighted Bandura's social cognitive theory of efficacy and expectations, stating that people must believe they can do something and have a certain expectation of an effective result if they act. If they only learn about what dangers are and not viable solutions, they become frustrated and fail to act (Bieniek-Tobasco et al., 2019).

There is a lot of literature that already examines voting records and climate change stances. This study does not revisit that discussion but instead focuses on how cities obtain and frame messages regarding climate change. By analyzing the opinion of city officials regarding how information about climate change is shared within their respective communities and their preferred information sources of climate change science, we can hypothesize the alternative ideas that cities might hold with regard to climate change. We may also be able to learn what cities understand about the risks associated with climate change and associated adaptation measures that could be employed. For these reasons, preferred information sources about climate change and social framing of messaging regarding climate change are variables in this study.

Formal Education and How we Learn about Climate Change

Simply teaching about science and the scientific basis for climate change is not enough to sway public opinion or public policy. In some studies, researchers found that the provision of scientific information was only negligibly correlated with people's understanding of climate change (Brulle et al., 2012). Malcolm Knowles, a leading education theorist focusing on andragogy, stated there are six key principles to describe the adult learner: 1) the learner's desire to know (i.e., the what, why, and how of something), 2) self-concept of the learner (i.e., responsibility for one's own decisions), 3) prior experience of the learner, 4) readiness to learn (i.e., the developmental stage of the learning process), 5) orientation to learning (i.e., adults are task- and problem-centered), and 6) motivation to learn (Knowles et al., 2005). Tolppanen and Aksela (2018) stated there are numerous studies that show students still are not taught enough critical thinking and problem-solving skills. They opine that understanding climate change and its related processes require skills such as these. Further, they state that many students have many misconceptions regarding climate change science, which could be overcome with these critical thinking, systems thinking, and problem-solving skills. This view, they argue, is due to the fact that historically, environmental education was never initially designed to develop critical thinkers. Instead, students are left to fend for themselves when putting the pieces, or concepts, together. For example, "reactions of greenhouse gases are taught in chemistry, thermodynamics is taught in physics, and the carbon cycle is taught in biology (and chemistry), though all of them play a key role in understanding climate change as a system" (p. 376). Tolppanen and Aksela (2018) further argue that this list of disciplines does not even begin to look at the societal issues surrounding environmental choices or possible solutions.

Health News Florida (2019) reported that while "dozens of states recognize human-caused climate change in their [education] standards," "Florida mentions human activity as an aside." Even if anthropogenic causes of climate change were taught in Florida schools, adult

learners would not have access to that information unless they had a child going through those classes where it was taught. The sources of information on climate change for the general population are typically not scientific journals, but instead, the media, or the Internet. As Eric Feldman (2015) wrote in his article in New Horizons in Adult Education & Human Resources Development, online social media platforms such as Facebook and Amazon, among others, are designed with algorithms to identify themes that mimic our (and those of our friends) recent interests (likes). If, as an adult, you are getting your news from those social platforms, they will only mimic what you already like, and typically will not show you opposing views (Feldman, 2015). Herman et al. (2017) found that the U.S. general public is ill-informed, at best, about general facts of climate change and anthropogenic sources thereof. They further found that the majority of Florida and Puerto Rico secondary science teachers could not accurately define climate change itself.

Understanding opposing views helps us to think and reason critically. Without that aspect, we are only being told what we want to hear. Balint et al. (2011) stated that the definition of a wicked problem in environmental science (such as climate change) is something that is in the eye of the beholder because it involves looking at often disparate views from scientists, policymakers at the local, state, and national levels, environmentalists, among others. Therefore, to solve an environmental wicked problem (such as climate change), a student would have to apply a wide range of skills, including cross-cutting environmental knowledge based on science, critical thinking, scientific reasoning, and systems thinking (Young, et al., 2021). But if the viewer is only seeing one side of the issue from a Facebook post that already mimics that person's views, very little critical thinking is occurring.

Daub (2010) noted that "environmental problems are often reduced to a catch-22 that portrays sustainability-oriented policies as disastrous for resource sector workers," in which "policies aimed at environmental protection and regulation have disastrous economic costs for

industry and workers" (p. 115). Bandura and Cherry (2020) believed that "most of the general public is unwilling to give up polluting lifestyles that they enjoy" in order to reduce harmful environmental behaviors. Continuing, they wrote that "media influences promote changes [in behavior] by informing, enabling, motivating, and guiding viewers to improve their lives...In the socially mediated pathway, media are used to link people to social networks and community settings…" (p. 948). To promote sound environmental behavior in a community, therefore, some cities communicate with their constituents about important environmental issues.

Ormrod (2012) noted that in Albert Bandura's theory of Social Cognition, people can learn by observing others' behaviors and the consequences that result. People can, and do, mimic the behavior and speech of others, whether they experience that through direct observation or vicariously, such as from watching someone modeling behaviors on television. In order for this to occur, Ormrod states of Bandura's theory, the individual must see the model as competent, carrying prestige and power, behavior in a stereotypical gender-appropriate manner. Applying this example to the present scenario, when the public watches people they admire speaking of climate change as if it is a passing trend rather than what most credible scientists are saying, then people begin to believe who they admire and repeat those same words. In Florida, former Governor, Rick Scott, changed the focus of discussion away from broader state policy issues on climate change and emphasized localized control of environmental hazards (Ruppert & Deady, 2017). Others understand the situation differently, however. Tristram Korten, of the Florida Center for Investigative Reporting, wrote in a 2015 article in the Miami Herald that officials from the State of Florida were explicitly told not to discuss terms such as "climate change" and "global warming" (Korten, 2015). People who admired the governor would begin to think he is right not to use those terms and they, therefore, would not use them either.

Understanding how adults learn and the linkages between model theory, andragogy, and adult dependency on the media and Internet to obtain our understanding of scientific issues, is an

important factor in understanding how people get information about climate change. This, in turn, may inform scientists and policymakers as to how to gain support from cities to be better prepared for climate change impacts by adopting adaptation measures.

Education Theory, Efficacy, and Expectations about Climate Change Preparedness

Nearly two decades ago, the National Center for Disaster Preparedness (NCDP) undertook an effort called the American Preparedness Project with the goal of understanding U.S. public perceptions regarding disaster preparedness, including climate change (DeVincenzo, 2020). Their study revealed that "65% of Americans expressed worry that climate change will influence their community's exposure to disasters. The NCDP concluded that the impact of climate change on disasters must be better integrated into communications and preparedness programs, acknowledging that a comprehensive understanding of the concerns of individuals and families is critical to emergency planning efforts" (p. 72).

The Centers for Disease Control and Prevention (CDC) issued a guide in July 2020 stating the public health impacts from climate change to the United States (CDC, 2020). There is a program in Florida, funded by the CDC, to address climate change. It is the Florida Building Resilience Against Climate Effects (FLBRACE) program, which has been in operation since 2012 (CDC, 2020). On the FLBRACE website, however, there is little mention of climate change. Instead, it refers to vulnerabilities impacting Florida due to climate variability or an increase in subtropical disturbances (FLBRACE, 2021). One link is a presentation by the Florida State Climatologist, who stated that climate (also seasonal climate or climate variability) but not climate change, related events are not bringing any new problems to the State of Florida, while in some cases, the events might be severe, they are not new (Zierden, 2020). While these statements are true to some extent, they do not fully disclose that climate change, as a result of anthropogenic activities, could wreak havoc on the state. These statements may make one believe there is not a great need to address climate change impacts in Florida. Blennow, et al.,

(2020) stated that in order to see measurable improvements in climate change adaptation, the information recipients need to both understand the severity of the issue and believe there are measures that can be taken in order to address the situation (Blennow, et al., 2020).

In education theory, Bandura's theory of self-efficacy meant that "learners are more likely to engage in certain behaviors when they believe they're capable of executing the behaviors successfully" (Ormrod, 2012, p. 127). The same theory can be expanded to collective efficacy, whereby a group of people or organizations would gain an increased belief they could make a difference if they did it as a team or a collective (Heald, 2017). Other aspects of Bandura's Social Cognitive Theory states that outcome expectations influence cognitive processes that underlie learning. These expectations in education theory stipulate that people are less likely to pay attention to something, or do something if there is no anticipated payoff (Ormrod, 2012). These theories were put to the test with climate change risk perceptions and society.

Downplaying the potential severity of climate change threats can reduce the possibility that people will react to counter those threats (Gregersen, et al., 2021). In their research, Gregersen, et al., (2021) found that "worry about climate change was an important predictor of individuals engaging in both energy curtailment and energy efficiency behaviors…" (p. 13). Their research on outcome expectancy further showed that people were more likely to implement mitigation behaviors regarding climate change when they thought those behaviors would be possible and when they thought they would be effective. That is, they were more likely to implement mitigation or adaptation measures when they had a high perceived risk about climate change events. Zigiene, et al., 2021, further studied the concept that reduced climate change activities as a collective goal but found that a lack of end-user belief in reducing climate change overall as a result of personal energy efficiency measures would be effective. Understanding

climate change risks and worrying about the outcome may be the impetus needed to promote the implementation of appropriate mitigation or adaptation measures.

Survey instrument

There has already been a lot of research on the use of surveys in the pursuit of obtaining perception data. In a 2013 study by Carlton & Jacobson conducted at the University of Florida, the researchers found that "risk perceptions were strongly influenced by attitudinal factors such as environmental attitudes and political affiliation" (p. 36). The respondents in that study were undergraduate students, most of whom were from Florida, and they all resided inland, in Gainesville. To identify the environmental risk perception factors associated with climate change, they looked at socio-demographic variables (e.g., gender, age, income, ethnicity), personal cognitive and affective variables (e.g., political attitudes, social trust, religious values, and environmental attitudes) and risk-specific variables (e.g., risk salience and risk characteristics) (Carlton & Jacobson, 2013). An important aspect of this study was the breadth of issues that the researchers addressed. They identified a key limitation as to the use of undergraduate students to test the instrument itself and recommended future research where their survey instrument was used for further research with the general public.

Marquart-Pyatt et al. (2014), when employing a public perception survey, found that "political orientation has the most important effect in shaping public perceptions about the timing and seriousness of climate change" (p. 246). They found that using reason or scientific information to objectify climate change information had only a negligible effect on public opinion, even though there is a plethora of scientific information available to the general public. The Marquart-Pyatt et al. (2014) study looked at two variables: timing and seriousness. The question of timing asked each respondent to answer which of the following statement best reflected their opinion about the effects of climate change: "they have already begun to happen, they will start happening within a few years, they will start happening within your lifetime, they

will not happen within your lifetime, but they will affect future generation, or they will never happen" (p. 250). The question about seriousness asks respondents the following: "thinking about what is said in the news, in your view is the seriousness of global warming generally exaggerated, generally correct, or is it generally underestimated?" (p. 250). In their survey, those same authors also looked at age, education level, gender, and political affiliation of the respondents.

Bulla et al. (2017) also employed a survey to investigate how North Carolina coast officials made decisions regarding climate change adaptation. Their survey included questions that looked at a respondent's willingness to take adaptive action, whether they perceived climate change as a threat to their community, and their political ideology. The study looked at five levels of threat scenarios. Not surprisingly, the study found that those individuals who perceived climate change as a threat to their community were largely more willing to take adaptive action against that threat. "However, when the perceived threat was identified as uncertain, no significant relationships were identified" between the variables (Bulla et al., 2017, p. 25). Most of the respondents for this survey were generally planners and zoning managers. Other respondents included city managers, county managers, health workers, social services employees, and emergency response personnel.

Brulle et al. (2012) looked at meta-data from 74 separate surveys over a 9-year period (from 2002 - 2010) to see what the perceived threat was to climate change. They looked at five variables: "1) extreme weather events, 2) public access to accurate scientific information, 3) media coverage, 4) elite cues, and 5) movement/countermovement advocacy" (p. 169). They found that extreme weather events and scientific information had little effect, and those variables related to political mobilization by elites and advocacy groups had the most effect. That is, the variables that had the most effect on public opinion were found to be media coverage (positively

correlated), elite partisan groups, and the polarization over environmental issues in general (Brulle et al., 2012).

A survey tool is a sound method to use when collecting data about people's perceptions and general knowledge. Electronic surveys are used widely in nearly all sectors of US society. The tool itself would be a socially acceptable means of collecting the information needed to analyze the variables discussed herein (Wright, 2005). In fact, Wright (2005) found many benefits to the use of online surveys including: the time it takes to respond to electronic surveys provides benefits to both the researcher and respondents; online surveys often allow researchers to reach a variety of audiences with a variety of questions, including sensitive ones; and, online surveys are far more cost-effective to implement. On the other hand, Wright (2005) also found that the survey tool has a key disadvantage in identifying the appropriate sample and ensuring that only those respondents within that sample complete the survey.

Summary

In this chapter, the views of researchers and leaders in the fields of climate change science, risk perception, social framing, and how people get their information about climate change in order to present the reasons to study those issues to have a better understanding of the preparedness of cities in Florida's Atlantic coastal cities to adapt to climate change were presented. While there may be other factors associated with a city's inclination to develop and implement climate change adaptation policies, such as the availability of funding to do so, these factors presented herein appeared frequently in the literature. This chapter also presented information about how the survey instrument has been used to collect perception information. Surveys are common tools to collect this kind of information presented here in this chapter.

Chapter 3: Methods

Overview

The focus of this study was to develop and administer a survey to study the factors that influence the extent to which the cities in Florida's Atlantic coastal counties have planned for, or implemented, adaptation measures to combat climate change impacts. Data collection in the survey measured risk perceptions, social framing of climate change messages, and actual adaptation planning or investments, for RQs 1-3. Appendix A is the survey instrument, after review of the subject matter experts, the pilot study, and completion of Cronbach's alpha analysis. Another optic of the study was to see if city size (i.e., population) influenced the outcome of city preparedness to climate change. Though the size of the cities in the study varied widely and the extent to which the cities are able to respond to climate change threats also varies, the threats they face to climate change-related issues are similar for many coastal communities. The data for research question 4 was already available from the Florida Association of Counties (2019) and Florida Cities by Cubit (2020) (Appendix B). A pilot study of the survey was conducted to fine-tune the validity of the survey instrument, rate of response, and to establish reliability (internal consistency) with Cronbach's alpha. For the pilot study, surveys targeted mainly Florida's Gulf Coast cities of similar economic, development, and environmental characteristics to those on Florida's Atlantic coast. For the main survey, there were 158 cities included in the survey.

Research Methodology & Design

This research was based on collecting data through a survey, for three research questions, as well as through looking at available information through public sources. Analysis of the data was through multiple linear regression in SPSS.

Research Questions All four research questions (RQs) underwent analysis through the multiple regression model in the SPSS software program. The data from the first three RQs were

addressed in a perceptions survey while the last one was available through an online public source.

RQ1: What perceptions do Florida's coastal community leaders hold toward the potential climate change-related risk for their communities?

Ho: coastal community leaders do not see risk with regard to climate change

Ha: coastal community leaders see risk with regard to climate change

RQ2: To what extent do Florida coastal community leaders communicate with their constituents regarding climate change and the need for adaptation measures?

Ho: coastal community leaders are not communicating with their constituents specifically about climate adaptation (a business-as-usual scenario)

Ha: coastal community leaders are communicating with their constituents specifically about climate adaptation

RQ3: To what extent are Florida coastal communities implementing adaptation measures to combat impacts from climate change (i.e., combating coastal erosion, wetlands protection, severe flooding, etc)?

Ho: coastal communities are not implementing adaptation measures (a business-as-usual scenario)

Ha: coastal communities are implementing adaptation measures

RQ4: To what extent does the size of the city correlate with the extent to which cities adopt climate change adaptation measures?

Ho: the size of the city does not make a difference

Ha: the size of the city does make a difference

The following list comprises the dependent and independent variables used for the statistical analysis in SPSS once the data collection phases of the pilot and main survey were

completed. Multiple regression is the best testing tool given there are many variables, all of which are continuous.

Dependent Variable

- Continuous raw scores for planned or implemented measures to adapt to climate change impacts (measured as a checklist on the survey)

Independent Variables

- Continuous - the extent to which cities perceive climate change risk/threats - from a Likert scale in the survey
- Continuous scores from the survey on types on how city leaders communicate with their constituents about climate change and their information sources - from a Likert scale
- Continuous - the size of city correlates with measures planned or implemented

Data Sources There were two sources of data included in this study. A survey instrument was used for obtaining data for the first three RQs. The details of the survey instrument are described below as well as in Appendix A. The data for RQ4, city size, was taken from the Florida Association of Cities (2020) and the Florida Cities by Cubit (2020).

Instrument Design The instrument for this study was a survey (Appendix A) that measured perception and actual knowledge of adaptation measures and potential impacts from climate change. The survey tool is a sound method to use when collecting data about people's perceptions and general knowledge. However, as mentioned in the limitation section in Chapter 1, though the survey was targeted toward city leaders, those individuals sometimes chose to delegate the survey response to others in their organizations. To address it, a box was included in the survey that required the respondent to check if they were responding as the city leader or designate, and to state their title.

This survey herein was based in part on a perceptions survey by Carlton & Jacobson, 2013. An important aspect of the Carlton & Jacobson (2013) study was the breadth of issues that

the researchers addressed. They identified a key limitation as to the use of undergraduate students to test the instrument itself and recommended future research where their survey instrument was used for further research with the general public. The primary author of Carlton & Jacobson (2013) study was contacted for feedback, which is included in Appendix C with the other subject matter experts. While the Carlton & Jacobson (2013) study used undergraduates as respondents, they suggest their study could be rolled out to the general population. I have made many conceptual changes to their questions and redesigned constructs from their original study. For example, while the Carlton & Jacobson (2013) survey asked its respondents about specific types of economic risks such as property damage from hurricanes, property insurance increases, property value declines, and tourism declines as separate items, the survey developed herein combines all possible economic risks together as one item. Further, the survey herein also includes additional constructs regarding social framing (i.e., how community leaders receive climate change information and how they deliver to their communities' information about climate change) and requests each respondent to fill in a checklist of which adaptation measures they have in their communities (Carlton & Jacobson, 2013). For those reasons, the survey needed to be reviewed by subject matter experts for validity and tested for reliability through a pilot study.

Instrument Validity and Reliability: Validity is an important issue in order to demonstrate that the appropriate construct of interest is being tested (Armel et al., 2011). To obtain instrument validity, assistance was sought from subject matter experts (SMEs) from the Florida Institute of Technology, the Florida Atlantic University's Center for Environmental Study, Purdue University, and a specialist from the National Oceanic and Atmospheric Administration, in the development of this instrument. The full feedback from the SMEs is included in Appendix C. To establish reliability, Cronbach's alpha was calculated in SPSS with the results from the pilot study. Those results are below.

Population Characteristics & Size

The main study population included city leaders from 158 cities in counties bordering Florida's Atlantic Coast. The pilot study population included city leaders from a cross section of cities with similar characteristics as those in the main study, but they were located in counties on Florida's Gulf Coast. The characteristics of the cities in both the main study and the pilot study are discussed below.

Main Study Characteristics The main survey was directed toward 158 cities (Appendix B) in the 12 Atlantic coastal counties of Nassau, Duval, St. Johns, Flagler, Volusia, Brevard, Indian River, Martin, St. Lucie, Palm Beach, Broward, and Miami-Dade. Cities in all counties bordering Florida's Atlantic Coast were selected for the main study for several reasons: 1) the unique (to Florida) environmental factors along the coastline due to wave action that causes erosion and saltwater infusion; 2) the policy benefit of addressing whole watersheds that comprise several counties at a time; and 3) the need to avoid oversaturation of the population with too many surveys.

Environmental factors: Florida's Atlantic Coast is known by many to have great wave action and cooler waters, compared to the Gulf Coast (Opal Unpacked, 2020). Those characteristics attract tourists to either coast depending on their interests in surfing (east coast) vs sunbathing and swimming (west coast). While both coasts face threats to sea-level rise, Yin, et al (2020) finds that the Atlantic Coast will continue to face strong, dynamic wave action and the Gulf Coast will continue to face intense storm surge, as a result of intensified climate change dynamics. Atlantic coastal cities also contain a sizable portion of the populations that are at risk of groundwater infusion from saltwater due to sea-level rise. Bloetscher et al. (2016) stated "many people believe that Palm Beach County is far less at risk from sea-level rise than other southeastern Florida counties as a result of higher elevations...however the groundwater levels

are already a challenge" (p. 6). Bloetscher et al. also noted that the same information regarding groundwater and saltwater infusion is projected for Miami-Dade and Broward counties.

Watershed management and policy issues: Watershed management and climate change adaptation, both policy issues, are linked due to the fact that climate change will likely have adverse impacts on a city's ability to manage watersheds (Furniss, 2010). Cities that share watershed management responsibilities, such as St. John's River Watershed that is located in five Atlantic coastal counties (Duval, Flagler, Volusia, Brevard, and Indian River), will face similar challenges and adaptation responses that can be captured in this study (Widney et al., 2018).

Oversaturation: Since the entire list of 158 cities on the Atlantic coast, as presented in the Florida Association of Counties website, were included in the main survey, I did not want to oversaturate that population by also using them for the pilot study. Therefore, with the exception of one city located in Brevard County, the pilot study consisted of Gulf Coast counties with similar characteristics to those on the Atlantic Coast. The characteristics of the population in the main study are listed in Table 3.1.

According to data from the Florida Association of Counties (2019) and the Florida Cities by Cubit (2020) (Appendix B), city sizes in the main study ranged from 16 to well over 800,000 people, with the average size at 37,000 people. All cities, regardless of size, had the ability to communicate with their constituents and either implement adaptation measures or benefit from other cities with the responsibility to implement climate change adaptation measures. Some larger cities have formal means of communication such as web tracking programs and smaller ones depend on face-to-face meetings. For this study, it was not the size of the city that was as important as the message of what was communicated about climate change, however to the extent that normality of the dataset can be maintained, city size was one of the independent variables that was included in the multiple regression analysis.

Table 3.1: Population Characteristics: Main Study

County (listed in geographic order from north to south)	**Population size** (ICG,2018)	**Primary Industries**	**Education level (bachelor's degree or higher)** (ICG, 2016)	**Median household income** (ICG, 2016)
Nassau	**82,692**	health care and social assistance, retail trade, utilities and manufacturing (Data USA, 2020)	**24.5%**	**$59,196**
Duval	**950,991**	Tech, manufacturing, retail (e.g., Amazon distribution center), financial centers, tourism (Hardee Solutions, 2020)	**28.1%**	**$49,196**
St. Johns	**414,300**	Tourism, manufacturing (Hardee Solutions, 2020)	**33.1%**	**$52,796**
Flagler	**107,795**	Retail, health care, and accommodation (Data USA, 2020)	**23.3%**	**$48,898**
Volusia	**531,408**	Aeronautic research; retail, health care, accommodation, finance centers (Data USA, 2020; Florida business, 2020)	**22.4%**	**$42,240**
Brevard	**582,351**	Manufacturing (aeronautics, aviation), health care, retail, tourism (Statistics Atlas, 2020)	**27.7%**	**$49,914**
Indian River	**151,448**	Health care and retail (Indian River, 2020)	**27.2%**	**$47,446**
Martin	**155,255**	Trade (e.g., Walmart), transport and utilities, manufacturing (e.g., paper) (Martin County, 2020)	**31.5%**	**$52,622**
St. Lucie	**462,076**	Health care and telecommunications (St Lucie, 2020)	**35.8%**	**$58,538**
Palm Beach	**1,437,446**	Agribusiness, aviation and aerospace engineering, financial services, distribution and logistics, clean tech, health care, marine industries (Palm Beach BDB, 2020)	**43.2%**	**$55,277**
Broward	**1,897,691**	Advanced materials & tech; aviation and aerospace; media production; and, international trade logistics (Broward County, 2020)	**31.0%**	**$52,954**
Dade	**2,788,684**	Health, retail, hospitality, defense, aviation, media production, and tech (Statistics Atlas, 2020-Miami-Dade; Hardee Solutions, 2020)	**27.3%**	**$44,224**

The group that was the target of the surveys was city government leadership. That said, once a survey made its way to a city leader, for example, it was outside the control of the researcher to ensure that only that leader completed the survey. To address this, a question was

included in the beginning of the survey to ask if the respondent was a city leader or a designate. Also incorporated into the survey is a question about the title of the person taking the survey.

Power Analysis Cohen (1992) stated that " the power of a statistical test of a null hypothesis (Ho) is the probability that the Ho will be rejected when it is false, that is, the probability of obtaining a statistically significant result" (p. 98). Cohen (1992) also stated that statistical power analysis depended on determining the alpha (significance criterion), the sample size, and the effect size because when three of those elements (e.g., power, sample size, alpha, and effect size) were fixed, the remaining element could be determined. Therefore, per Cohen (1988), a minimum of 84 responses (sample size) was required in order to conduct multiple regression with four variables, with an alpha of 0.05, a power of .80, and medium effect size (0.15).

The G*Power software (ver 3.1.9.6) is an even more powerful tool for determining power, sample sizes, alpha, or effect size (Erdfelder & Faul, 1996). G*Power required a minimum of 85 sample size with an alpha of 0.05, a power of .80, and medium effect size. Therefore, of the 158 cities surveyed, a minimum of 77 responses were needed in order to run multiple regression with three independent variables to obtain the power level desired. For the main study, G*Power's sample size minimum figure of 77, with alpha of 0.05, power of 0.80, and a medium effect size of .15 was used.

Pilot Study Results

Overview In May and June 2020, the survey was submitted to seven subject matter experts in order to obtain feedback on the validity of the survey. The details of that feedback are included in Appendix C. After addressing the reviewer's comments, in July 2020, a pilot study of the survey instrument was conducted in order to determine reliability as well as to test the survey procedure. The survey instrument can be found in Appendix A. The instrument contains 26 items in three construct categories, which represent the first three research questions. Since

the entire population of cities in coastal counties in Eastern Florida was included in the overall study, the pilot study included mainly cities in coastal counties in Western Florida for the pilot, so as not to oversaturate the main population for the primary study. Therefore, with the exception of one Brevard County city on the East Coast that was included in the pilot simply to have enough responses to evaluate instrument reliability, the majority of cities queried in the pilot were on the West Coast. The East Coast city was needed due to the unusual situation that the Covid-19 pandemic caused resulting in loss of staff and productivity in the city governments, which in turn resulted in a lower response rate than expected in the pilot.

Pilot Study Characteristics The pilot cities were selected along the Gulf Coast and although the pilot cites share some economic and development similarities with the cities in the Atlantic coastal counties, the two primary factors of wave action and watershed management make it a logical decision to address the entire East Coast in the main study. The counties in both the main and pilot studies had similar economic, environmental, and social characteristics as can be seen in Tables 3.1, 3.2, 3.3. Most of the counties in both the pilot and the main study list among their main industries healthcare or health-related services, such as the manufacturing of medical devices and pharmaceuticals. Tourism was the next most prevalent listed industry for the counties, inclusive of both the main and pilot study populations.

Process & Results The pilot survey was issued to the pilot cities on July 6, 2020 and ended on July 21, 2020. FIT's Institutional Review Board (IRB) Chair, Dr. Jignya Patel, determined that no IRB approval was necessary because the survey does not qualify as Human Subject Research given the emphasis of the survey is not on an individual's attitudes, beliefs, or emotions (personal communication email, July 4, 2020).

Table 3.2: Population Characteristics: Pilot Study

County (Gulf Coast counties listed in geographic order from north to south)	**Population** (ICG,2018)	**Primary Industries**	**Education level (bachelor's degree or higher)** (ICG, 2016)	**Median household income** (ICG, 2016)
Pinellas	**969,607**	Tourism, pharmaceuticals, med devices (hardeebusiness.com, 2020)	**29.5%**	**$47,090**
Hillsborough	**1,412,212**	Defense, tourism, retail (Statistics Atlas - Hillsborough, 2020) Health - pharmaceutical and medical device development (Hardee Solutions, 2020)	**31.4%**	**$51,681**
Manatee	**374,939**	Retail, health, accommodation (Statistics Atlas - Manatee, 2020)	**27.9%**	**$51,483**
Sarasota	**303,334**	Information tech, financial & professional services, tourism, manufacturing (metal, transport equipment) (ED Sarasota, 2020)	**19.8%**	**$44,140**
Charlotte	**174,857**	Retail, construction, utilities, healthcare (Statistical Atlas - Charlotte, 2020)	**21.6%**	**$44,865**
Lee	**716,823**	Health care, retail, hospitality, tourism (Statistical Atlas - Lee, 2020)	**26.7%**	**$50,390**
Brevard (Atlantic Coast)	**582,351**	Manufacturing (aeronautics, aviation), health care, retail, tourism (Statistics Atlas, 2020)	**27.7%**	**$49,914**

Table 3.3: Mean and Range of Characteristics of Main/Pilot Studies by County

	Population (mean)	**Education (mean)**	**Income (mean)**
Pilot study counties	647,731 (range 174,857 - 1,412,212)	26.4	$48,509
Main study counties	796,844 (range 82,692 - 2,788,684)	30.0	$51,108

The timing of the pilot survey was important. The pilot took place from July 6-21, 2020, during the Covid-19 pandemic. Though the pilot, and main survey, were designed for online submission, it was challenging reaching officials when many of them had severe staffing challenges due to sick employees and/or were attempting to work from home to avoid contaminating each other in the office. The cases of Covid-19 registered by the state in the pilot counties were some of the highest during that time frame (State of Florida, 2020).

A total of nine responses were received from the pilot counties during the two-week window for the pilot. One of those responses was not complete and therefore was discarded. In order to obtain additional responses to calculate reliability, surveys were also sent to four cities in Brevard County, a primary survey county. Of those additional responses, only one city responded in the time provided.

Reliability was calculated with the nine responses using SPSS with the 26 items in the survey. This reliability test measures the internal consistency of the constructs in the survey (Field, 2013). Cronbach's alpha was .828, achieving sound reliability of the internal consistency of the survey items (Field, 2013). Cronbach's alpha is commonly used to establish reliability when scores are obtained from multiple choice tests or surveys, such as a Likert scale (Saidi & Siew, 2019; Gall et al., 2007; Field, 2013).

There were not enough responses in the pilot study to conduct a multiple regression analysis on the full set of research questions. That was not the intent of the pilot study. One interesting fact about the pilot study responses received is that most counties viewed climate change risk to be of moderate to extreme risk, with a majority stating it was high risk to their economy, environment, and public health in their communities.

Overcoming Challenges There were several challenges identified during the pilot study including: 1) the pandemic that contributed to a low response rate; 2) technological glitches in the survey software that allowed people to skip the introductory section (not among the 26 items used in reliability); and, 3) several respondents thought the survey was generated by a robot system rather than a real person, given it was initially distributed through the Qualtrics software, and as a result, they did not respond to the initial link.

Figure 3.1: Case Processing Summary and Reliability Statistics

Case Processing Summary

		N	%
Cases	Valid	9	90.0
	Excluded[a]	1	10.0
	Total	10	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.828	.893	26

In order to improve the response rate during the primary survey, the following changes were made to the process to improve response rates:

- Survey distribution began in early 2021, which allowed time for a Covid-19 vaccines to be distributed, allowing more people to return to normal work lives;
- Letters with FIT letterhead were mailed to the cities at least a week in advance of the primary survey in order to let them know this is a real survey, and not some kind of phishing message;
- Survey was sent from the FIT email account, as opposed to sending the survey from within the Qualtrics software, so the recipients could see my picture with the survey and associated it with a real person;
- Follow-up phone calls were conducted to the recipients within a week of the survey being sent in order to urge cities to take the survey or to check their spam folders for the email); and,
- The cities were placed into four different groups in order to stagger the release of the survey so that there is time for follow-up phone calls to each before moving on to the next group of cities.

Data Analysis

Survey Scoring Scoring for each variable (research question) is detailed below. Data gathering from the first three research questions was from the survey. Data from research question four, city size, is listed in Appendix B. Scoring for all variables is as follows:

Dependent Variable: Research question 3 was the dependent variable: To what extent are surveyed Florida coastal communities implementing adaptation measures to combat impacts from climate change (i.e., combating coastal erosion, wetlands protection, severe flooding, etc)? The null hypothesis was that coastal communities are not implementing adaptation measures (a business-as-usual scenario) and the alternate hypothesis was that coastal communities are implementing adaptation measures.

To address this research question, the survey asked each respondent to check all items in the below list that applied to the climate change adaptation measures either planned or acted on in their respective communities. A "planned" measure referred to an adaptation measure that was in preparation or already in city or county ordinances. An "acted on" measure referred to an adaptation measure that was being implemented or had been implemented.

The list of climate change adaptation measures listed in the survey was as follows:

- Climate Change Vulnerability Assessment.
- Plans for strategic withdrawal (retreat)
- Rolling easement plans.
- Population density assessments and regulations.
- Building codes that include energy efficiency measures.
- Creation of urban (city) parks.
- Stormwater drainage improvements.
- Wastewater treatment system upgrades.
- Identification of new freshwater (drinking water) sources.

- Protection of current freshwater (drinking water) sources.
- Protection from power disruptions during intense storms (hurricanes).
- Wildfire prevention and management.
- Conservation of water for agriculture irrigation use.
- Protection of existing wetlands or creation of new wetland areas.
- Purchase of vulnerable properties in repetitive loss areas.
- Other, please insert response _____.

Respondents received one point for each response checked above and a zero for items not checked. The more responses, the better prepared they were for climate change events in their areas.

Independent Variable 1: Research question 1 was independent variable 1: What perceptions do Florida's coastal community leaders hold toward the potential climate change-related risk for their communities? The null hypothesis was that coastal community leaders do not see a risk with regard to climate change and the alternative hypothesis was that coastal community leaders see a risk with regard to climate change.

To address this research question, the survey asked each respondent to answer on a Likert scale a series of questions in two parts that asked:

- Risk Perceptions, part I: this referred to a judgment you make about an issue after experiencing, reading about, or hearing about a natural hazard, such as sea-level rise, drastic precipitation changes, sustained increased temperatures from year-to-year. Respondents are asked to answer each question, with the most accurate answer from the selections provided below.

Responses could have ranged from No Risk to Extreme Risk, where No Risk was issued a score of 1 and Extreme Risk was issued a score of 4.

- Risk Perceptions, part II: this referred to a judgment the respondent made about an issue after experiencing, reading about, or hearing about a natural hazard. Respondents were asked to answer each question, with the best possible answer.

Responses could have ranged from Strongly Disagree to Strongly Agree. In this question, the responses were graded depending on whether the question was negatively or positively worded. Those positively worded questions about climate change received a 4 score when they checked Strongly Agree and the Strongly Disagree responses would receive a 1 score. The converse was true of negatively worded responses, that is, a score of 4 was given to responses of Strongly Disagree and a score of 1 was given to responses of Strongly Agree. Once the raw scores are obtained, each city response to this question received an average score for that construct to be used in the multiple regression analysis table.

Independent Variable 2: Independent variable 2 addressed research question 2: To what extent do Florida coastal community leaders communicate with their constituents regarding climate change and the need for adaptation measures? The null hypothesis was that coastal community leaders are not communicating with their constituents specifically about climate adaptation (a business-as-usual scenario) and the alternate hypothesis was that coastal community leaders are communicating with their constituents specifically about climate adaptation.

There are also two parts to this question. First, the survey asked about social framing in the following manner: This section addresses how the respondent sends and receives information about climate change between the city and the citizens of that respective community. Each respondent was able to answer each question on a Likert scale from Strongly Agree to Strongly Disagree, where, for positively worded items, a Strongly Agree warranted a 4 and Strongly Disagree warranted a 1 score. The converse scores were true for negatively worded

responses, that is, responses of Strongly Agree were awarded a 1 score while responses of Strongly Disagree were awarded a 4 score.

The second part to this research question (and variable) asked the respondents to do the following: In this box, the respondent has the opportunity to RANK order the sources of information used to obtain information about climate change in order to assist in decision making in their respective city. The item the respondent listed in the #1 slot was the one the respondent depended on the most for climate change information. The item in the #10 slot had little relevance to the respondent.

- Facebook or Twitter
- Scientific (peer-reviewed) Journals and Books
- Scientific organizations such as NOAA, NASA, or the Intergovernmental Panel on Climate Change
- High School science class
- The President of the United States
- Friends, neighbors, or family
- The Florida Governor
- CNN or MSNBC News
- Staff/faculty from an in-state college or university
- In-house professional staff paid by the city
- College or University class
- NPR News
- FOX News
- Other, please insert response

Scoring of this item is listed in the below table.

Table 3.4: Scoring of Top 5 Ranked Sources on Climate Change			
A Score of:	4 means:	4 of the top 5 items include:	Scientific journals (peer-reviewed) or books
			Scientific organizations such as NOAA, NASA, or the IPCC
			Staff/Faculty from an in-state college/university
			college/university class
A Score of:	3 means:	3 of the top 5 items include:	Scientific journals (peer-reviewed) or books
			Scientific organizations such as NOAA, NASA, or the IPCC
			Staff/Faculty from an in-state college/university
A Score of:	2 means:	2 of the top 5 items include:	Scientific journals (peer-reviewed) or books
			Scientific organizations such as NOAA, NASA, or the IPCC
A Score of:	1 means:	1 of the top 5 items include:	Scientific journals (peer-reviewed) or books

Scores from parts I and II of this research question were combined for the multiple regression analysis in SPSS.

Independent Variable 3: Independent variable 3 addressed research question 4: To what extent does the size of the city correlate with the extent to which cities adopt climate change adaptation measures? The null hypothesis was that the size of the city does not matter and the alternate hypothesis was that the size of the city does make a difference. Information for this variable and research question is listed in Appendix B.

Multiple Regression Data analysis was conducted using multiple regression in SPSS. Multiple regression is a sound tool for this kind of analysis, given the interest of this study was in determining not only the significance of factors but their magnitude, in terms of the extent they impact climate change adaptation decision making. Multiple regression also works very well with both binary and continuous independent variables (Field, 2013).

In arranging the datasets in SPSS, responses from each survey were assigned case numbers to ensure no personally identifiable information appeared in the dataset. The data on the dependent variable was gathered from responses to the survey's RQ3 section, which asked about planned and actual adaptation measures in their respective community. The data on the independent variables was gathered from survey questions relating to RQs 1 and 2, as well as from the data in Appendix B.

Multiple linear regression has several assumptions that need to be met in order to complete that data analysis. The primary assumptions needed for multiple regression are: linearity, normality, homoscedasticity, independence of error observations, multicollinearity, and outliers. Once the assumptions were met, analysis of significance (p-value) and coefficients could be done in order to determine what kind of correlation the independent variables have with the dependent variable.

Linearity: this refers to the relationship between the outcome (dependent) variable and the independent variables. There must be a linear relationship between them in multiple linear regression (Field, 2013). This is achieved by reviewing the partial regression plots in the SPSS outputs section and addressing outliers, if any (Keith, 2015).

Normality: this refers to the significance of the test and is run by looking at the residuals column in the dataset and is tested by running the Shapiro-Wilk test in SPSS. If the result of the Shapiro-Wilk test was not significant ($p > .05$) it meant that "the distribution of the sample is not significantly different from the population" (Field, 2013, p. 185). A violation of normality is not an issue if the dataset is large enough, however, it does relate to the significance of the test results (Field, 2013). Normality may be addressed by reviewing outliers in the dataset (see Outliers below).

Homoscedasticity: this refers to whether the residual (error) terms are similar across all of the independent variables. This is achieved by reviewing the scatterplots to ensure there are

no obvious patterns in the data and the data are spread out consistently (Keith, 2015). Indication of patterns would have meant a violation of this assumption. A review of the dataset helps determine if there are outliers that are influencing this assumption.

Independence of errors in the observations: this refers to the residual values, or the difference between the observed values and the true values (Park, personal communication, September 2019). This is achieved by running the Durban-Watson test, which tests the correlations between the errors and is listed in the SPSS Model Summary (Field, 2013). This range is from 0-4, where normal (no clear autocorrelation) is considered between 1.5 - 2.5 (Park, personal communication, September 2019).

Multicollinearity: this refers to the assumption that the independent variables are not correlated with each other. There should be no correlation. This is achieved by reviewing the variance inflation factor (VIF) value in the Coefficients SPSS software output table for a VIF value of below 10 to ensure there is no collinearity (Grande, 2015).

Outliers: refer to points that do not reside within a random pattern along the residuals line in the residuals plot, instead they represent extremely high or low values. These points can have an impact on the regression line; therefore they must be addressed. If these points are found along the regression line, there are a number of diagnostic analyses that can be employed to determine which points are problematic (Keith, 2015). Visual observation of the scatter and residual plots provides an indication of outliers (Park, personal communication, September 2019). Calculating Cook's D (Cook's Distance) on the residuals dataset also provides an indication of outliers or influential factors. Values in excess of the Cook's D value should be reviewed for possible elimination from the dataset (Park, personal communication, September 2019).

Data imputation. In some cases, survey respondents choose not to respond to a question. The reason for this lack of response was not always known. An absence of a data point in the

dataset can influence the statistical test, causing problems in the analysis. One statistical method commonly used to address the lack of data points is called data imputation (The Analysis Factor, 2020). The Qualtrics survey software allows the designer to force respondents to answer most questions before moving on to the next question. By employing a data imputation method, missing data issues could be avoided. The survey in the Qualtrics software was set up to ensure respondents answered as many questions as possible before moving on to another question. When a data issue of this sort arises, imputation will be employed. Andridge and Roderick (2019) stated data imputation is, in essence, the act of making inferences about the population and that "it is important to note at the outset that usually sample surveys are conducted with the goal of making inferences about population quantities such as means, correlations, and regression coefficients, and the values of individual cases in the data set are not the main interest. Thus, the objective of imputation is not to get the best possible predictions of the missing values, but to replace them by plausible values…" (p. 40).

In the final multiple regression analysis, after addressing all assumptions and outliers, the standardized coefficients in the SPSS coefficients output table as well as the significance level in the ANOVA table in order to determine the relative correlation of the independent variables with the dependent variable in the predictor equation are reviewed.

Summary

In this chapter, the research questions that was used in this study, the results of the pilot study, the characteristics of the population that was surveyed, the methodology for addressing those research questions, the scoring used on the surveys, and the data analysis process that was implemented to analyze the multiple regression output were presented.

Chapter 4: Results

Overview

This study looked at whether, and to what extent, three key independent variables influenced the climate change preparedness of cities located in counties along Florida's Atlantic Coast. Those independent variables were 1) what perceptions do Florida's coastal community leaders hold toward the potential climate change-related risk for their communities; 2) to what extent do Florida coastal community leaders communicate with their constituents regarding climate change and the need for adaptation measures; and 3) to what extent does city size influence the extent to which cities have adopted climate change measures. Data for the first two independent variables and the dependent variable were gathered through a survey that underwent reliability and validity measures in a pilot study. Data for the third independent variable was obtained from the Florida Association of Counties (FAC) website in 2020 and the Florida Cities by Cubit websites (FAC, 2020; Florida Cities, 2020). The results of the relationships between risk perception and city size with climate change preparedness were positively correlated and significant. The relationship between social framing and climate change preparedness was inconclusive.

Survey Process Data gathering took place from January through May 2021. The population of 158 cities was divided into four groups to allow for ease with follow-up contacts directly with each city. Initially, each city received a letter in the mail describing the forthcoming survey. After about a week, to allow for postal delivery, each city's top leader (e.g., Mayor, City Manager, Town Manager, etc.) was sent a direct email referencing the letter and asking them to complete the online survey. If there was not a response from a particular city after another week, an additional email was sent again referencing the letter and previous email. This process continued from between 4 to 6 times per city, if needed, in order to obtain a response.

Issues with Survey Completion. There were a few issues that arose that resulted in either a city not responding fully or requesting an alternate format for the survey. These specific instances are listed here:

- Approximately 30 surveys were not included in the final 86 because they were not completed.
- Three cities stated they would not complete the survey because they did not think their response would be kept confidential. Those surveys were also not included.
- One city requested the survey by mail because their city policies did not allow them to click on a link in order to take the survey. That city was mailed a hard copy of the survey to complete. That survey was included in the overall 86.
- One city requested the survey be emailed to them embedded into an email because their city policies also precluded them from clicking on any links over the internet. That city was emailed the embedded survey and completed it. It was also included in the 86.
- Five cities from four different counties found a loophole in the survey that allowed them to advance to the next section without completing the section in question. That is a problem with the Qualtrics software itself. The question not answered was the second part of RQ2, addressing social framing and the ranking of climate change information sources. In this case, data imputation was used to obtain a score for that particular question, and the survey was included in the final analysis. An average of county results for part two of RQ2 was added to part one in order to obtain a score for the five cities in question.

Data Imputation: The data imputation method used to handle part two of RQ2 was the average score, or mean imputation because it is one of the most commonly used data imputation methods (Nakagawa & Freckleton, 2011). The data that was averaged was from the same county

in which the cities were located so that the response would be plausible from cities in the county in which they reside.

Research Questions Four research questions (RQs) were reviewed in this study using a linear multiple regression model in the SPSS software program. The data from the first three RQs were obtained in a perceptions survey while the data for RQ four, which corresponds to independent variable 3, was obtained from the FAC and Florida Cities websites in 2020 (FAC, 2020; Florida Cities, 2020). RQ 3 was the dependent variable in this study. Below are the research questions with related null hypotheses (Ho) and the alternate hypotheses (Ha).

RQ1: What perceptions do Florida's coastal community leaders hold toward the potential climate change-related risk for their communities?

Ho: coastal community leaders do not see risk with regard to climate change

Ha: coastal community leaders see risk with regard to climate change

RQ2: To what extent do Florida coastal community leaders communicate with their constituents regarding climate change and the need for adaptation measures?

Ho: coastal community leaders are not communicating with their constituents specifically about climate adaptation (a business-as-usual scenario).

Ha: coastal community leaders are communicating with their constituents specifically about climate adaptation.

RQ3: To what extent are Florida coastal communities implementing adaptation measures to combat impacts from climate change (i.e., combating coastal erosion, wetlands protection, severe flooding, etc.)?

Ho: coastal communities are not implementing adaptation measures (a business-as-usual scenario).

Ha: coastal communities are implementing adaptation measures.

RQ4: To what extent does the size of the city correlate with the extent to which cities adopt climate change adaptation measures?

Ho: the size of the city does not make a difference.

Ha: the size of the city does make a difference.

Cities Surveyed The cities in both the pilot and main survey had similar characteristics, as listed in Tables 3.1 and 3.2 in Chapter 3. There were technically 160 cities included in the 12 Atlantic Counties listed on the FAC and Florida Cities websites in 2020 (FAC, 2020; Florida Cities, 2020), but not all 160 were queried in the survey. The two cities not included in the main study were Hastings (St. Johns County) and Marineland (Flagler County). While the FAC website listed the town of Hastings, St. Johns County, as an incorporated city in 2020, the former city's website stated that it dissolved as a city and is now under the jurisdiction of St. Johns County, and therefore was not part of the survey (St. Johns Government, 2021). The city of Marineland borders both Flagler and St. Johns County and was listed twice on the FAC website. For this study, Marineland in Flagler was dropped, and Marineland in St Johns received the survey. As a result, there were a total of 158 cities that received the survey, with 86 fully completing the survey. Approximately 30 additional cities began but did not complete the survey, and therefore, those surveys were discounted. The 86 full survey responses were from cities in all counties along the Atlantic Coast, with the exception of Nassau County, where there were no responses after multiple attempts.

The population of the 86 respondent cities, one of the three independent variables, ranged from 220 to 414,751 people, with a mean of 36,176 (Table 4.1).

Table 4.1: Descriptive Statistics of Respondent Cities by Population Size

	N Statistic	Range	Min Statistic	Max Statistic	Mean
City Pop	86	414,531	220	414,751	36,176.5

Survey Respondents City leaders (i.e., mayors, city managers, town managers) were asked to take the survey; however, they were also offered the opportunity to delegate that survey response to other people working for their respective city. The survey collected data related to whether a respondent was the city leader or delegate and how long the respondent was working in that particular position. Of the 86 respondents, 47 self-identified as city leaders, while 39 self-identified as having a different position from top city leadership. Further, 50 of the respondents stated they had been in their respective positions for fewer than 5 years, 20 stated they had been in their positions from between 5 and 10 years, and 16 stated they had been in their positions for longer than 10 years.

Scoring There were 15 questions for respondents to answer for research question 1 (risk perception). Those scores ranged from 1 to 4 per question. All values for that question in a given survey were added together then divided by 15. The maximum possible score for RQ1 was a 4. City responses for this question averaged 2.91 overall, with a range from 1.4 to 3.93.

Research question 2 had two parts. The first part had nine questions with scores ranging from a possible 1 to 4 per question. All values for that question in a given survey were added together then divided by 9. Part 2 of RQ2 had a possible 4 points granted and was based on how the respondents ranked possible information sources for climate change information they used. Respondents were afforded the possibility of receiving one additional point in part 2, RQ2, if they had a write-in response that warranted an additional point. For example, one city was granted one additional point for their information source coming from the scientific community, such as a regional resiliency organization. The scores for both parts were then added together. The maximum possible score for RQ2 was 9, including the possible extra point for an acceptable write-in response. City responses for this question averaged 5.63 overall, with a range from 2.44 to 7.89.

The dependent variable (research question 3), preparedness, had a possible score of 30. The respondents were given 1 point for each checked item that related to planning, 2 points for each checked item that related to items that were considered reactionary to climate change events, and 3 points for those actions that were considered anticipatory (Table 4.2). The average score for this research question was 11.41, with a range of 0 (zero) to 23. Several cities also were awarded additional points (inclusive in the range value) for responses that were not part of the list in the survey but were deemed appropriate. For example, one city was awarded 2 additional points for implementing a storm risk study that included flood-proofing of critical buildings in that community. Another city was awarded one extra point for a build code plan that included building in flood plains.

Table 4.2 shows the possible adaptation preparedness measures for the dependent variable and research question 3, that each city could select from based on the literature review, along with the allocation of points (Heimlich et al. (2015); IPCC (2001); SME Reviewer comments (2020)).

As can be seen in Table 4.2, planning documents (e.g., codes, regulations, plans) were awarded 1 point, implementing reactive measures (e.g., stormwater and wastewater treatment improvements, conservation of water for agriculture use, wildfire prevention and management, among others) were awarded 2 points because they are mainly reactionary in nature, while creation of urban parks, purchase of vulnerable properties in repetitive loss areas, and protection or creation of wetlands were awarded 3 points because they were mainly anticipatory (of a large climate change event) in nature.

The independent variable (research question 4) regarding city size simply listed the population. As seen in Table 4.1, this variable had a mean of 36,177 persons, with a range of 220 to 414,531.

Table 4.2: Point Allocation for Adaptation Measures		
Item	**Plan, Reactive, Anticipatory**	**Pts**
Protection of existing wetlands or creation of new wetland areas	A, R	3
Creation of urban (city) parks	A, R	3
Stormwater drainage improvements	R	2
Wastewater treatment system upgrades	R	2
Identification of new freshwater (drinking water) sources	P	1
Protection of current freshwater (drinking water) sources	R	2
Protection from power disruptions during intense storms (hurricanes)	R	2
Wildfire prevention and management	R	2
Conservation of water for agriculture irrigation use	R	2
Climate Change Vulnerability Assessment	P	1
Building codes that include energy efficiency measures	P	1
Population density assessments and regulations	P	1
Purchase of vulnerable properties in repetitive loss areas	A, R	3
Rolling easement plans	A, R	1
Plans for strategic withdrawal (retreat)	P	1
Other (to be inserted)	TBD	TBD
(IPCC, 2001; Mimura et al. (2014))		

Multiple Linear Regression Analysis

The minimum number of samples needed to maintain power (.80) with a medium effect for multiple linear regression with three independent variables is 77 (G*Power, 2020). The descriptive statistics table (Table 4.3) shows the dependent variable (Preparedness) with a mean of 11.41 (rounded) out of a possible 27-30 (up to 3 additional points up to 30 could be awarded for write-in responses). Confidence intervals were 95%, alpha of .05, and there was a medium

effect based on the F statistic. Independent variable (IV) 1 (Risk Perception) had a mean score of 2.91 out of 4. IV2 (Social Framing) had a mean score of 5.57 out of 8-9 (one additional point could have been awarded for an appropriate fill-in response). IV3 (City Population) had a mean score of 36,177 (rounded).

Table 4.3: Descriptive Statistics of Model

		Mean	Std. Deviation	Max points	N
Preparedness		11.41	5.25	27-30*	86
Risk Perception		2.91	0.53	4.00	86
Social Framing		5.62	1.03	8-9*	86
City Population		36,177	56,566	----	86

*Additional points in preparedness and social framing could have been awarded to cities with appropriate write-in responses.

The model summary table (Table 4.4) shows an R^2 of .170, with a significance of 002. This translates to a 17% change in the dependent variable (climate change preparedness) as a result of the influence from the independent variables combined. F^2 is the measure of effect size in multiple linear regression. F^2 (R^2 / 1- R^2) is .21. Effect sizes between .15 and .34 are considered medium effects (Keith, 2015).

Table 4.4: Model Summary

Model	R	R Square	F Change	Sig. F Change	Durbin-Watson
1	.412a	.170	5.590	.002	1.904

a. Predictors: (Constant), City Pop, Social Framing, Risk Perception
b. Preparedness Variable: Preparedness

The results of ANOVA table (Table 4.5) show an F value of 5.590, with a significance of <.05 (at .002) with climate change preparedness as the dependent variable and risk perception, social framing, and city size (population) as the independent variables. From this table, it is possible to calculate the root mean standard error (RMSE), that is, how far the observed values fall from the residuals line. The RMSE (the square root of the following equation: SS residuals / N-K-1, where N =86, k = 3) is 4.87, which is quite high and an indicator that the entire model fit is not great. Values of less than .05 are best fit for residuals models (Keith, 2015). One of the reasons for this is likely explained by looking at the coefficients table.

Table 4.5: ANOVA[a]

	Sum of Squares (SS)	df	Mean Square	F	Sig.
Regression	397.801	3	132.600	5.590	.002[b]
Residual	1944.955	82	23.719		
Total	2342.756	85			

a. Dependent variable: Preparedness
b. Predictors (independent variables): Risk perception, social framing, city size

The coefficients table (Table 4.6) shows the extent to which each independent variable influences the dependent variable (climate change preparedness). The risk perception standardized beta is .233, which is a medium effect, ($t = 2.045$, $p < .05$). This means that for every 1 standard deviation increase in risk perception while controlling for the other variables, there will be a .233 increase in climate change preparedness. The social framing standardized beta is -.019, which is a very small effect, ($t = -.118$, $p > .05$). This means that for every 1 standardized deviation increase in social framing while controlling for other variables, there will be a decrease in climate change preparedness. This value, however, is not significant. The city

size standardized beta is .283, which is a large effect size, ($t = 2.683$, $p > .05$). This means that for every 1 standard deviation increase in city size, there will be a .283 increase in climate change preparedness. The constant t value of 1.207 is medium however, it is not significant with a p-value greater than .05. Generally, t values of 2 or greater with a p-value of less than .05 are considered significant (Park, Personal Communication, 2019).

Table 4.6: Coefficients

		Standardized Beta	t	Sig.
(Constant)			1.207	.231
Risk Perception (IV1)		.233	2.045	.044
Social Framing (IV2)		-.019	-.118	.863
City Size (IV3)		.283	2.683	.009

Notes:
- confidence intervals at 95%.
- Dependent variable: preparedness

The overall model for this study using the standardized coefficient beta would be:

Preparedness = .233 (risk) - .019 (social framing) + .283 (city size) + constant

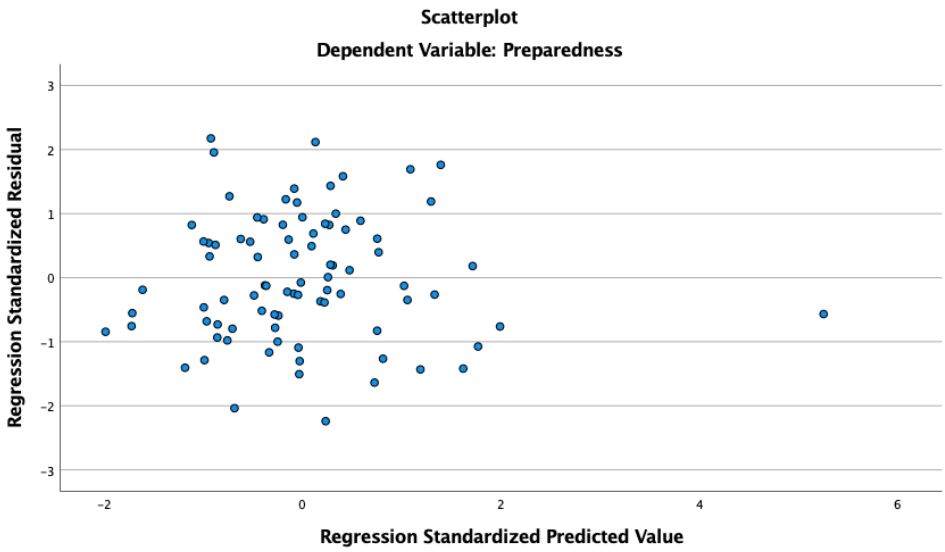
However, given that social framing was not significant, this model cannot be recommended to explain climate change preparedness.

Assumptions All assumptions were met. The key assumptions for multiple linear regression are linearity, independence of errors, homoscedasticity, and normality of the residuals, with linearity being the most important assumption that should be met in multiple linear regression (Keith, 2015).

Linearity: this refers to the relationship between the outcome (dependent) variable and the independent variables. There must be a linear relationship between them in multiple linear

regression (Field, 2013). Looking at the scatterplot of residuals, as can be seen by Figure 4.1, the data points are randomly scattered, which is an indication of linearity as well as homoscedasticity. Scatterplots that would have shown obvious patterns in the data points would have been violations of these two assumptions (Field, 2013).

Figure 4.1: Scatterplot: Dependent Variable on Preparedness



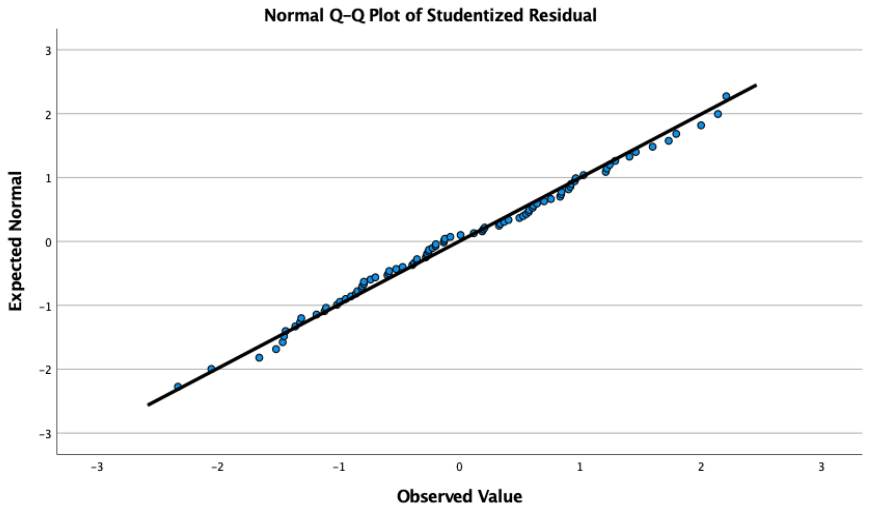
Independence of errors: this refers to the residual values, or the difference between the observed values and the true values (Park, personal communication, September 2019). This is achieved by running the Durban-Watson test, which tests the correlations between the errors and is listed in the SPSS Model Summary (Field, 2013). This range is from 0-4, where normal (no clear autocorrelation) is considered between 1.5 - 2.5 (Park, personal communication, September 2019). The result of the Durbin-Watson test was 1.904, well within the normal range.

Homoscedasticity: this refers to whether the residual (error) terms are similar across all of the independent variables. This is achieved by reviewing the scatterplots to ensure there are no obvious patterns in the data and the data are spread out consistently (Keith, 2015). Indication

of patterns would mean a violation of this assumption. A review of the dataset helps determine if there are outliers that are influencing this assumption. The scatterplot above (Figure 4.1) shows there is generally random patterning around the 0 residuals line, with one exception, Miami. This city was left in the dataset, however, because it is an important component of any strategy to help Florida to prepare for climate change.

Normality: this refers to the significance of the test and is run by looking at the residuals column in the dataset and is tested by running the Shapiro-Wilk test in SPSS. If the result of the Shapiro-Wilk test is not significant ($p > .05$) it means that "the distribution of the sample is not significantly different from the population" (Field, 2013, p. 185). A violation of normality is not an issue if the dataset is large enough; however it does relate to the significance of the test results (Field, 2013). The result of the Shapiro-Wilk test showed the normality statistic of .989 and to be significant with a p-value of > .05 at .664. The Q-Q plot (Figure 4.2) also supports the normality claim, with the data points clustering fairly closely to the residual line.

Figure 4.2: Normal Q-Q Plot of Studentized Residual



Another assumption, though not as important as the first four mentioned, is that of multicollinearity. As mentioned in the previous chapter, multicollinearity refers to the assumption that the independent variables are not correlated with each other. There should be no correlation. This is achieved by reviewing the VIF value in the Coefficients SPSS output table for a VIF value of below 10 to

ensure there is no collinearity (Grande, 2015). The VIF values for risk perception was 1.281, social framing was 1.172, and city size was 1.101; all values are well below the 10 threshold.

Outliers: Outliers refer to points that do not reside within a random pattern along the residuals line in the residuals plot; instead, they represent extremely high or low values. These points can have an impact on the regression line; therefore they must be addressed. Visual observation of the scatter and residual plots provide an indication of outliers (Park, personal communication, September 2019). As mentioned previously, Miami is clearly an outlier with regard to city size; however, it was left in the regression calculus because of its importance in any climate change preparedness strategy in the state.

Independent Variable Interaction: Moderation

The combined effect of two variables on another is called moderation in multiple regression and is also known as interaction (Field, 2013). It is the moderator variable that can influence the relationship between the predictor and outcome variable (Hayes, 2018). Field (2013) produced a figure adapted to the variables in this study (Figure 4.3) to show how an interaction, or moderation variable, impacts a dependent variable.

This analysis is conducted in SPSS with a software extension to SPSS called Process, by Andrew Hayes (Hayes, 2018). The result of the Process analysis for moderation is shown in Table 4.7. An interaction (Int_1) is occurring between the IV city size (here, Pop) and the IV risk perception, ($t = -2.1975$, $p = < .05$, at .0308). Thus, city size is moderating the effect that risk perception has on climate change preparedness, and given that the interaction coefficient is negative, as city size increases, the risk perception effect decreases (SPSS, 2021).

Figure 4.3: Effect of Moderator Variables

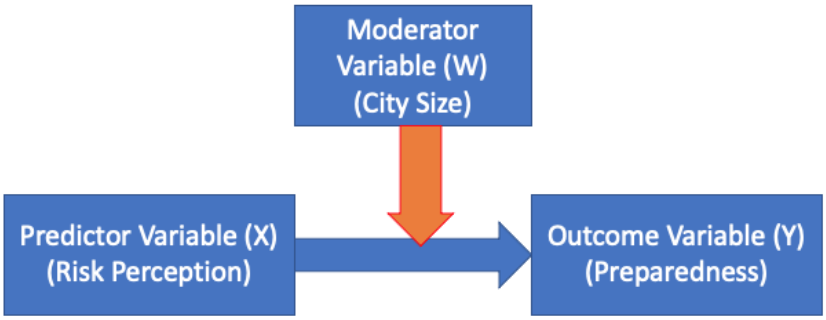


Table 4.7: Process Analysis: Interaction of City Size on Risk

```
OUTCOME VARIABLE:
 DV_Prep

Model Summary
          R       R-sq        MSE      F(HC0)        df1        df2          p
      .4481      .2008    23.1146      6.5819     4.0000    81.0000      .0001

Model
              coeff    se(HC0)          t          p       LLCI       ULCI
constant     1.1825     3.6774      .3216      .7486    -6.1344     8.4994
V1_Risk      3.0252     1.0191     2.9684      .0039      .9974     5.0529
V3_Pop        .0002      .0001     2.4116      .0181      .0000      .0004
Int_1        -.0001      .0000    -2.1975      .0308     -.0001      .0000
V2_Ave        .0079      .5336      .0147      .9883    -1.0538     1.0695

Product terms key:
 Int_1    :        V1_Risk  x        V3_Pop
```

Given the interaction effect was significant, the next step was to review the conditional effects of that interaction (Table 4.8). According to Crowson (2019), the conditional effects are tests of simple slopes, which test the relationship between risk (X) and preparedness (Y) at three levels of the moderator (W; city size). Since the variable on city size (Pop) was not normally distributed, the analysis was presented as percentiles, rather than standard deviations, under the V3_Pop heading in Table 4.8. At the 16th percentile on the centered Pop variable (top data line) the effect was positive and significant (b = 2.8827, se = 1.0069, p = .0053). At the 50th

percentile on the centered moderator variable the effect was also positive and significant (b = 2.2424, se = 1.0033, p = .0282). At the 88th percentile of the centered Pop size variable, the effect was negative but not significant (b = -1.0715, se = 1.9190, p = .5781) (Crowson, 2019).

Table 4.8: Process Analysis: Effects

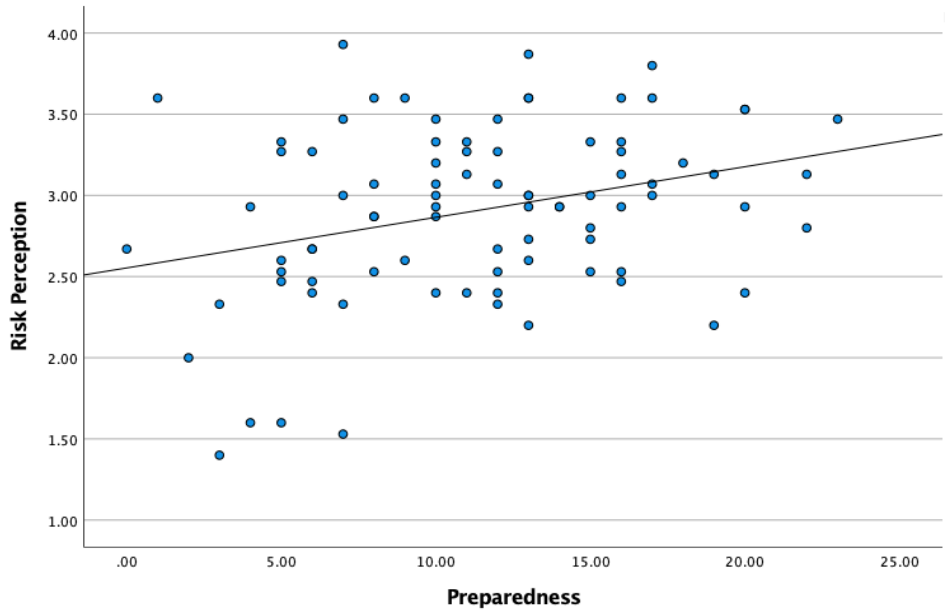
```
    Focal predict: V1_Risk  (X)
          Mod var: V3_Pop   (W)

Conditional effects of the focal predictor at values of the moderator(s):

     V3_Pop     Effect    se(HC0)          t          p       LLCI       ULCI
  2630.0400     2.8827     1.0069     2.8628      .0053     .8792     4.8862
 14451.0000     2.2424     1.0033     2.2350      .0282     .2461     4.2388
 75633.6000    -1.0715     1.9190     -.5583      .5781    -4.8896     2.7467
```

Addressing the Research Questions

Based on the multiple regression analysis, the research questions can now be addressed. To aid in synthesizing and presenting the data, several of the tables below depict the information divided into three groups (i.e., groups 1, 2, and 3). Group 1 had 28 cities with scores from 0 to 8 (i.e., the lowest scores); Group 2 had 30 cities with scores from 9 to13 (i.e., the medium scores); and Group 3 had 28 cities with scores from 14 to 23 (the highest scores).

Research Question 1: What perceptions do Florida's coastal community leaders hold toward the potential climate change-related risk for their communities? It can be stated that Florida's Atlantic Coastal cities see risk with regard to climate change. In other words, risk perception explains a city's preparedness level. The higher the risk perceived, the higher the preparedness level in general (Figure 4.4).

Figure 4.4: Risk Perception Growth with Preparedness Level



Additional information gleaned from the survey responses regarding risk perception is presented below and in Appendix G. Table 4.9 shows the respondents' grouped answers to the question of whether risk posts a significant impact to public health, the economy, and the environment in their respective communities.

Table 4.9: Climate Change Risk and Impact

"*What is the risk of climate change exerting a significant impact on Public Health, the Economy, or the Environment in your community?"*

Preparedness Groups	**Public Health (max = 4)**	**The Economy (max = 4)**	**The Environment (max = 4)**
Group 1	2.21	2.11	2.50
Group 2	2.5	2.73	2.80
Group 3	2.46	2.71	2.79

Table 4.10 shows the respondents' grouped answers to perceived threats from sea-level rise and localized flooding.

Table 4.10 - City Perceptions of Threats from Sea-level Rise vs. Localized Flooding		
	"Sea-level rise poses an economic threat to my city."	*"Localized flooding poses an economic threat to my city."*
Preparedness Groups	**Average Scores (max = 4)**	**Average Scores (max = 4)**
Group 1	2.79	2.93
Group 2	3.33	**3.57**
Group 3	**3.43**	3.46

Table 4.11 shows the respondents' grouped answers to the question of whether issues of the economy, the environment, and public health can be addressed at the same time.

Table 4.11: Cities' Risk Perceptions Regarding Balance	
"Our city does not have to make a choice between the Economy, the Environment, and Public Health. All three can be addressed at the same time."	
Preparedness Groups	**Average Scores (max = 4*)**
Group 1	2.82
Group 2	3.17
Group 3	2.96
*a score of 4 would mean all the city agreed that all three factors (the Economy, the Environment, and Public Health) could be addressed simultaneously	

Research Question 2: To what extent do Florida coastal community leaders communicate with their constituents regarding climate change and the need for adaptation measures? Based on the non-significant results in the multiple regression analysis for this coefficient variable, the null hypothesis cannot be rejected. Below are respondents' grouped answers to several of the questions in the survey.

Although this variable was not found to be statistically significant, there remains interesting information to learn from the survey responses. For example, Table 4.12 shows the number one climate change information source from the surveyed cities. The number one source of information for all three groups (i.e., Group 1, Group 2, and Group 3) was scientific organizations such as the National Oceanic Atmospheric Administration (NOAA), the Intergovernmental Panel on Climate Change (IPCC), and the National Aeronautics and Space Administration (NASA). The second-highest score was for in-house staff, and the third-highest score for climate change science information was peer-reviewed journals and books. There were cities (9) that received their number one source of information from Facebook or Twitter.

Table 4.12: Cities' First Choice for Climate Change Science Information

Which information sources on climate change science were listed as their #1 resource?	**Climate Change Preparedness Group 1**	**Climate Change Preparedness Group 2**	**Climate Change Preparedness Group 3**	**Totals**
Scientific organizations such as NOAA, IPCC, NASA	8	13	15	36
In-house staff	4	8	2	14
Peer-reviewed journals and books	4	3	3	10
Facebook/Twitter	4	3	2	9
NPR news	2		1	3
University staff/faculty	--	1	1	2
FOX news	1	--	--	1
University class	1	--	--	1
The President	1	--	--	1
Other (these were fill-in responses that included responses provided under each category)	3 (regional inter-city group, FL Sea Grant, Regional Planning Council)	2 (SE Florida Regional Climate Change Compact, consultants)	4 (FL DEP, Eastern Fl Regional Planning Council, and a city council)	9 (some cities listed several fill-in answers)

Table 4.13 shows the respondents' grouped answers to the question of whether those cities send messages to their constituents specifically about climate change-related information.

Table 4.13: Cities Sending Climate Change Messages to Constituents	
"Our city does not send messages (e.g., bulletins, newspapers, Facebook posts) out to its constituents that are specifically climate change-related."	
Preparedness Groups	**Average Scores (max = 4)**
Group 1	2.29
Group 2	2.80
Group 3	2.93

Table 4.14 shows the respondents' grouped answers to the question regarding the extent to which their city might show more support for climate change if a prominent or influential person or group would show more support for the subject. In the survey, these were presented as four separate questions.

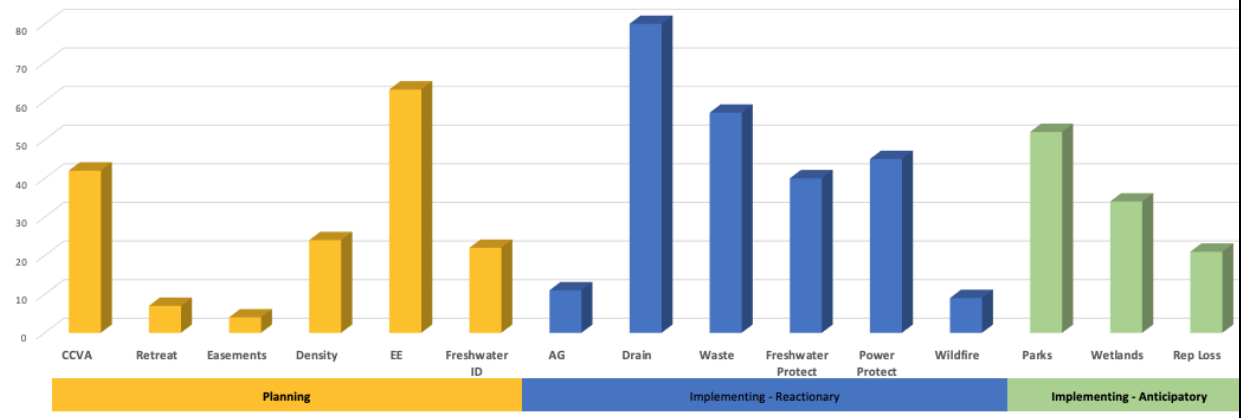
Table 4.14 - City Support from Various Individuals or Public Entities				
"Our city would show more support for climate change adaptation measures if our [President, Governor, County Board, City Council] showed their support for climate change."				
Groups	**The President (max = 4)**	**The Governor (max = 4)**	**County Board (max = 4)**	**City Council (max = 4)**
Group 1	2.36	2.64	2.5	**2.71**
Group 2	2.53	2.6	**2.67**	**2.67**
Group 3	2.43	2.79	2.64	**2.82**

Research Question 3: To what extent are Florida coastal communities implementing adaptation measures to combat impacts from climate change? Based on the results of the

statistical analysis, it can be concluded that coastal counties are implementing adaptation measures, which can be explained in part due to their risk perception and city size. Figure 4.5 shows a tally of all cities' responses to the question on the survey regarding climate change preparedness.

Figure 4.6 (Tally of City Responses of Climate Change Preparedness by Group) shows how cities in three different groups responded to the adaptation measure question on the survey. The details of Figure 4.6 are also presented in Appendix F.

Figure 4.5: Tally of All Cities' Responses to Climate Change Preparedness



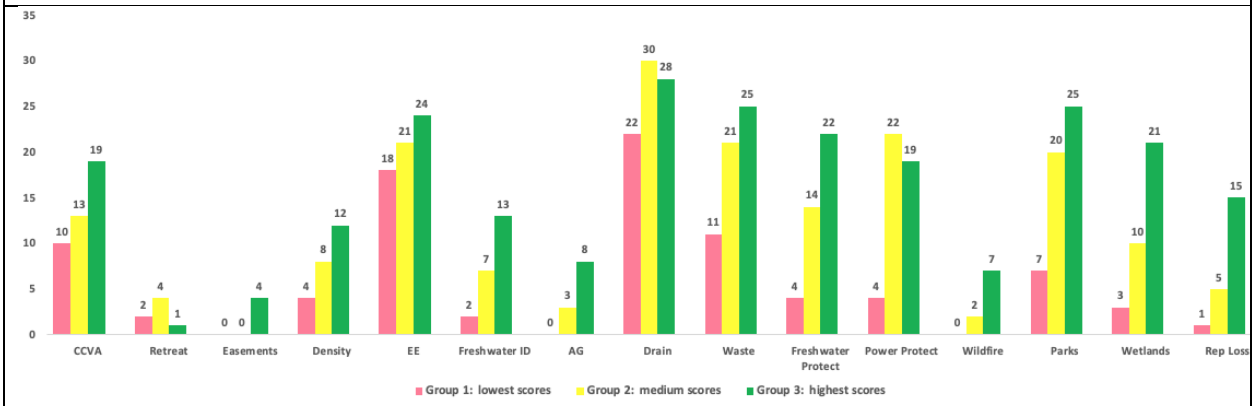
Notes

PLANNING: CCVA = climate change vulnerability assessment; Retreat = plans for strategic withdrawal; Easements = rolling easement plans; Density = population density assessments and regulations; EE = building codes with energy efficiency measures; Freshwater ID = identification of new freshwater (drinking water) sources.

REACTIONARY: AG = conservation of water for agriculture irrigation use; Drain = stormwater drainage improvements; Waste = wastewater treatment system upgrades; Freshwater Protect = protection of current freshwater (drinking water) sources; Power Protect = protection from power disruptions during intense storms (hurricanes); Wildfire = wildfire prevention and management.

ANTICIPATORY: Parks = creation of urban (city) parks; Wetlands = protection of existing wetlands or creation of new wetland areas; Rep Loss = purchase of vulnerable properties in repetitive loss areas.

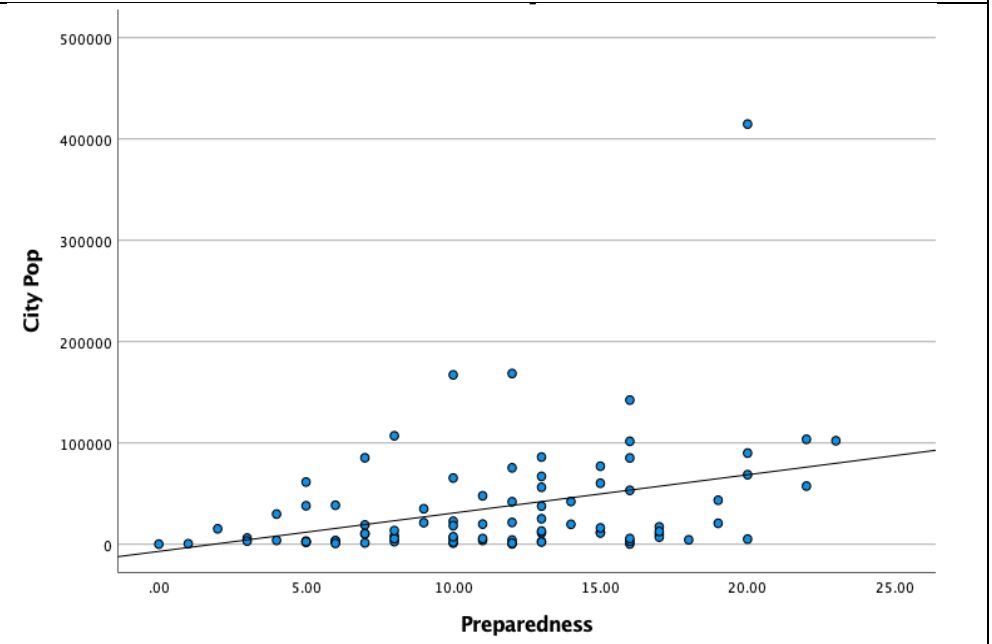
Figure 4.6: Tally of City Responses to Climate Change Preparedness by Group



Notes
Group 1 – respondents with survey preparedness scores of 0-8.
Group 2 – respondents with survey preparedness scores of 9-13.
Group 3 – respondents with survey preparedness scores of 14-23.

Research Question 4: To what extent does the size of the city correlate with the extent to which cities adopt climate change adaptation measures? Based on the results of the statistical analysis, a city's preparedness for climate change can be explained in part by city size (Figure 4.7).

Figure 4.7: City Size and Climate Change Preparedness



Summary

In this chapter, an analysis of data using a linear multiple regression model was presented. There were mixed results in terms of addressing the research questions. Further research would be required to look deeper into the research question regarding social framing. Social framing was not an influential factor in this study, however, given that city size had a moderating effect on risk perception, these variables should be studied in further detail in future research.

The overall regression model was not acceptable due to the coefficient variable on social framing, as it was not significant. Further, the RMSE was quite high at 4.87. A greater number of survey responses may provide different results in future research.

Chapter 5: Discussion

Overview

The rationale to study this topic was based on the fact that human pressures from overpopulation and associated economic growth exacerbate stresses on coastal environments and threaten the ability of those cities to adapt to climate change (Wong et al., 2014). The U.S. lacks any clear strategy to assist cities with climate change adaptation measures; therefore, it is up to the states and/or each city to address its issues individually (Kalesnikaite, 2019). Further, the U.S. public perception of the risks associated with climate change also influences the public policy response (Bolsen et al., 2018). Researchers have found that some people simply do not understand the science behind climate change, and others are influenced by the sources of information (e.g., social media, politically appointed individuals, or the science community) that can influence to what extent people perceive climate change risk (Carlton & Jacobson, 2013; see also Kim & Kim, 2018; Ogunbode et al., 2017; Shoa & Goidel, 2016). In other cases, some cities have developed plans for climate change adaptation, and those plans are in various stages of implementation (Broward, 2020; Miami-Dade, 2016; Sandoval, 2020). Some local governments have access to information for their planning, but that information is not always available in academic databases; therefore, it is important to query governments directly about their plans (Lindeman et al., 2018).

After completing a pilot study to establish the reliability and validity of the survey instrument in July 2020, the survey was conducted of 158 cities in 12 Atlantic coastal counties in Florida from January to May 2021. Of the original 158 cities that received the survey, 86 fully completed and used in this study. Those completed surveys were from cities in 11 of the 12 counties along the Atlantic Coast. The results of this study show that two of the three factors studied do explain the question of which factors, among those studied, influenced the extent to which cities in Florida's Atlantic coastal counties are prepared for climate change (with varying

degrees) or have adopted climate change adaptation measures. The two factors or independent variables that explained city climate change preparedness were risk perception and city size. Multiple linear regression provides possible explanations, not necessarily cause-and-effect relationships (Keith, 2015). Keith (2015) continued to state that explanations, however, may lead to predictions. The factor that showed inconclusive results, due to a lack of significance in the multiple regression output, was social framing. This chapter includes a discussion of the results of the multiple regression analysis from Chapter 4 of this study as well as a discussion of trends found in the survey, which were not part of the multiple regression analysis, but which can inform the knowledge base on climate change and city preparedness. Finally, implications for learning institutions and awareness building, as well as future research options, are at the end of this chapter.

Preparedness: Adoption of Climate Change Adaptation Measures

The extent to which a city is prepared for all of the climate change-related events depends on a lot of factors, including but not limited to where the city is located in relation to the ocean, whether it contains a large city with many impermeable surfaces, the size of the population, among other factors. Heimlich et al. (2009) state that Southeast Florida, comprising four counties (Palm Beach, Broward, Dade, and Monroe), the first three of which are within the parameters of this study, "was reported to be one of the ten most vulnerable coastal metropolitan areas in the world, ranking 4th in terms of exposed population and 1st in terms of the value of exposed assets by the Organization for Economic Cooperation and Development" (p. 1). Each city in this study area, including many in Southeast Florida, would need to evaluate the types of measures appropriate for itself and not every adaptation measure is appropriate for every city.

This study selected a range of adaptation measures in order to capture the possible range of items that cities within the survey area would need in order to protect themselves against the adverse effects of climate change-related events. It is not meant to be a comprehensive list of

each and every item needed in each city in the study area. What this study provides is a general idea of preparedness, with some statistically significant explanations of why some cities are more prepared than others to address events related to climate change.

As Table F.1 (Appendix F) shows, Group 1 cities had fewer planning documents (36) as well as fewer implementing actions (52) related to climate change preparedness. Many of these cities also had lower risk perception scores and had smaller city sizes compared to the other cities surveyed. Cities in Group 2 (Table F.2) had a total of 53 planning items and 127 implementation items, and many of these cities ranked moderately in terms of risk perception and city size overall. Finally, cities in Group 3 (Table F.3) had 71 planning and 165 implementation items, and many of these cities also ranked highest in terms of risk perception scores and city size. The item that was identified most by all cities, in all groups, was stormwater drainage improvement in the implementation phase. This was followed by energy efficiency building codes in the planning phase. In terms of geographic representation, cities from all respondent counties from Dade to Duval comprised the lower preparedness group. There were fewer counties represented in preparedness group 3 but an even mix from those counties located in the southern and northern sections of the survey area.

The reasons that some cities are more prepared than others are varied and discussed further in the following sections. Depending on who completed the survey on behalf of each city, the items checked may differ. For example, some respondents were on the job for a very short period and completed preparedness items may have preceded them in that city. The dependent variable, climate change preparedness, items were selected from a variety of sources in order to attempt to capture the breadth of city characteristics (i.e., rural vs. urban, small vs. large, inland vs. coastal) that could be found along Florida's Atlantic Coast. The multiple regression analysis results in Chapter 4 showed that risk perception and city size were positively correlated with increased climate change preparedness, while social framing of climate change

messages was negatively correlated and non-significant. What is interesting to consider is that not all cities that ranked highest in climate change preparedness also were the highest among risk perception. Some cities' climate change preparedness Group 3, for example, ranked in the lowest risk perception group.

The Influence of Risk Perception on City Preparedness for Climate Change

Though there are risks associated with climate change, not everyone views those risks in the same way (Carlton & Jacobson, 2013). Nichols et al., 2007 stated that as cities grow larger, the human pressures on the natural environment increase, thereby reducing the ability of the natural ecosystems to meet previous adaptation responses. These pressures on the natural ecosystem, compounded by the continued trend by increased climate change influences, will result in greater heat stresses on humans as well as plant and animal metabolisms; increased incidence of diseases; stresses on freshwater supplies; availability of land for agriculture and waterways for aquaculture, to name a few challenges (Nichols, et al., 2007).

This study asked city leaders (e.g., mayors, city/town managers) or their designates to opine about their perceived environmental-, economic-, and human health-related risks associated with climate change (Table 4.9). The statistical analysis results indicated that a city leaders' (or designates') views on risk explains, in part, the extent to which a city had adopted climate change adaptation measures. There were also a few risk outlier cities (Figure 4.4), where a couple of cities listed higher risk, yet they ranked lower in terms of preparedness. Years on the job could help explain risk perception. Figure G.1 (Appendix G) shows a slight decline in risk perception as years on the job increases. This could be a factor of a newer set of eyes looking at city preparedness, that is, the newer staff might see things that longer-term staff do not. It should be noted that risk perception is not the only factor that explains why a city may have adopted climate change adaptation measures. Those cities in question could be at the early stages of planning, or they simply might not have the resources to complete adaptation initiatives on their

own. A majority (50 out of 86) of the survey respondents had been in their respective positions for a relatively short while (i.e., fewer than five years), while others (16) had been in their positions for over 10 years. The adaptation measures planned or implemented in the respondents' cities could have been in place prior to the respondent taking their current position. The decline in risk perception with years on the job could also be an indication of the need for training in the area of climate change for staff who have been in their positions longer. Researchers have found that some people simply do not understand the science behind climate change and others are influenced by the sources of information (e.g., social media, politically-appointed individuals, or the science community) that can influence to what extent people perceive climate change risk (Carlton & Jacobson, 2013; see also Kim & Kim, 2018; Ogunbode et al., 2017; Shoa & Goidel, 2016). Further, not everyone has access to peer-reviewed scientific literature. Sources of information about climate change for the general population are typically not scientific journals, but instead, the media and/or the Internet (Feldman, 2015). Others have found that political affiliation drives one's perception of risk associated with climate change (Akerlof et al., 2013). This study did not ascertain the reasons behind risk perception, however.

As seen in the previous Chapter, there is also a negative interaction between city size and risk perception (Table 4.4). As city size increases, the risk perception in terms of climate change risks decreases. That was only the case with the smaller and medium-sized cities, however. There was no interaction detected with the larger cities. There could be several reasons for the interaction. Some cities could have access to more resources in order to afford upgrades to systems, and therefore their perception of risks may be reduced as a result (Kalesnikaite, 2019). There were three general questions in the survey that asked the respondents to rate risk with regard to public health, the economy, and the environment. Those results are in Table 4.9. In all groups, the respondent cities stated that climate change posed a larger threat to their cities' environment than to public health or their economies, with the economy as second -and public

health as the third-highest ranking. This response could be a factor of people understanding climate change to be primarily an environmental issue and they simply have not studied climate change in relation to health or the economy.

Understanding the risk of climate change may improve our behavior and thereby improve our preparedness. Further, when that risk is perceived to be a proximal threat, the risk is perceived to be greater than if it is a distant threat (Fletcher et al., 2021). Fletcher et al. (2021) continued stating that determining risk requires the ability to imagine risk and appropriate mitigation measures, which in turn require the ability to imagine possible consequences from climate change in our local areas. They found that one's environmental beliefs (i.e., whether humans have a right to modify the environment to suit their own needs) were the best predictor of a respondent's level of concern about climate change. Understanding the outcome or consequences of a mitigation or adaptation measure, or taking no action at all, is also a fundamental element of Bandura's Outcome Expectation theory whereby people need to know of the anticipated payoff of an action before they would be willing to take action (Ormrod, 2012).

The results of this study demonstrated that risk perception positively correlates with climate change preparedness in a majority of the cities surveyed. The question moving forward is - what drives risk perception? Carlton & Jacobson (2013) wrote that events that are immediate and close to home are seen as more relevant and of greater concern than those risks that are longer-term and not associated with local environmental issues. Table 4.10 shows how this is reflected in the results of this study as well in that how people view sea-level rise vs. localized flooding can be viewed both spatially and temporally. For example, sea-level rise happens in the ocean as opposed to one's own street and it takes longer to show an impact on a community than localized flooding. The average score for each group of cities rose when a localized natural disaster question was asked but fell when the question was asked in a more remote fashion. The survey did not ask the respondents to distinguish between spatial or temporal perceptions.

Akerlof et al. (2013) state that when people can experience impacts from climate change directly, they are likely to believe the science, and that experience through social environments can influence how people view climate change. Goebbert et al. (2012) found that cultural worldviews influence perceptions of environmental risk, including risks associated with climate change. Understanding what drives risk perception will be a critical next step to understanding how to encourage more cities to adopt climate change adaptation measures.

One area that was omitted from this survey was the question of political affiliation. This was by design. Though many studies have observed correlations between political affiliation and climate change beliefs, that factor might better explain perceived risk as opposed to the adoption of climate change adaptation measures, the dependent variable in this study (McCright & Dunlap, 2011). Other authors found that individuals of the same political party had differing views of the risk surrounding climate change (You & Ju, 2019). Therefore, understanding how people get their information about climate change seemed to be a more direct line of reasoning, than one's voting habits in the efforts to learn about answering the question of factors that lead to climate change preparedness.

Risk perception and city climate change preparedness are positively correlated, and risk perception was shown to help explain preparedness in the multiple regression model. City size has an effect on risk perception as well. What is missing is how people obtain and assimilate risk perception information related to climate change. As some researchers believe, without understanding the risks of climate change, people may not worry about the possible outcome, and therefore, they may not understand the need to mitigate, nor understand the potential payoffs in adopting adaptation measures, against the ill-effects that climate change. Another area that needs to be investigated in a future study is the list of issues that drive risk perception about climate change in Florida. Additional data covering risk perception in the survey can be found in Appendix G.

The Influence of Social Framing on Climate Change Preparedness

This study looked at two aspects of social framing: the extent to which cities would show support for climate change adaptation measures provided there was also support from other sources (i.e., their constituents, city councils, the Governor, the President) and how city officials obtain their information regarding the science of climate change. These two aspects of the survey were combined for one social framing score. The result of the statistical analysis was inconclusive, with a non-significant result for the social framing variable, as seen in Table 4.6 Coefficients Table in Chapter 4. Something to consider for future research would be to investigate in further detail that variable and look at some of the reasons behind the negative Beta (-.019), which would have indicated a negative relationship between social framing and climate change preparedness had that variable been significant ($p < .05$). Keith (2015) stated that the meaning of non-significant results in multiple regression simply aids a researcher in determining whether "the relation between two variables is large enough so that we can assume it did not happen by chance" (p. 539). While we see differences in the data for social framing among the three groups of cities, those differences are not large enough to definitively state that they are not simply a consequence of chance. In other words, if the results were significant, we could confidently say that it would be very unusual to get different results by chance (Keith, 2015).

This survey looked at how city leaders communicate with their constituents about climate change, what might improve support in their communities for adopting climate change measures, and where city leaders obtain their information about the science behind climate change. This variable was designed to take a closer look at whether the framing of climate change messages could help explain how prepared a city was toward climate change. How people view an issue can be influenced by messages portrayed through the media (including social media and news outlets) as well as from public figures. Gunderson et al. (2020) state that "[message or social]

frames are underlying structures of beliefs, perceptions, and appreciation, mental boxes, or implicit organizing ideas that constitute necessarily simplified views and images of ambiguous situations in a complex reality" (p. 2). Table 4.13 shows the results of the survey listed by respondent group and shows that respondents in Group 1 tended to communicate less with their constituents specifically about climate change than those in Group 3. Further analysis of the data (Table H.1) shows that city leaders tended to communicate with their constituents about issues closely related to, or cause by, climate change but never mentioned those words in the communication, with Groups 1 and 3 showing slightly higher scores than those in Group 2. Continuing, Gunderson et al. (2020) added that while framing an issue allows the author to select some aspects of an issue to make them more understandable, it also provides a forum for excluding specific aspects. "The way responses to climate change are framed matters because frames influence public perceptions and are used to strengthen the case for specific policies" (Gunderson et al., 2020, p. 2). Another area for future research would be to look more closely at how climate change messages are communicated with constituents.

The rationale behind the first section of the social framing variable in this study was to investigate the extent to which influences from the constituents within a given community, the city council, the Governor, the President, or a County Board, would cause cities to show more support for climate change adaptation. In response to those questions, the city groups had a mixed set of responses, as can be seen in Table 4.14. In Groups 1 and 3, it was the influence of the city council that would make a difference in terms of a city's support for climate change adaptation measures. Cities in Group 2 listed the county board and city council at the same level. The closer the public entity was to the city, the higher the score, in general. The Governor ranked higher than the county boards for Groups 1 and 3, perhaps because state funding is tied to following state rules on environmental compliance (State of Florida, 2021a; State of Florida, 2021b). Ormrod (2012) wrote that in Albert Bandura's Social Cognitive Theory, people need to

respect the persons they are mimicking in order to model their behavior, or in this case, views on climate change. Taking a closer look at why individuals at the city council level are seen as more influential as opposed to the Governor or President could be addressed further in future research.

The second part of research question 2 in this study looked at where the respondents obtained their information about climate change science. Respondents were asked to rank order their sources of scientific information about climate change. Table 4.12 shows that the number one source of information for all three groups (i.e., Groups 1, 2, and 3) was scientific organizations such as the National Oceanic Atmospheric Administration (NOAA), the Intergovernmental Panel on Climate Change (IPCC), and the National Aeronautics and Space Administration (NASA). The second-highest score was for in-house staff, and the third-highest score for climate change science information was peer-reviewed journals and books. An area that was not addressed was the level of expertise on the part of the in-house staff. That is an area that would have to be addressed in future research. There were cities (9) that received their number one source of information on climate change from Facebook or Twitter. That was more the case with Groups 1 and 2 than it was for Group 3. It is unclear as to which information cities are obtaining from Facebook or Twitter, and further research into that is needed. This survey asked that cities only rank source materials.

As Eric Feldman (2015) wrote in his article in New Horizons in Adult Education & Human Resources Development, online social media platforms such as Facebook and Amazon, among others, are designed with algorithms to identify themes that mimic our (and those of our friends) recent interests (likes). If, as an adult, you are getting your news from those social platforms, they will only mimic what you already like and typically will not show you opposing views (Feldman, 2015). The importance of this issue with regard to climate change messaging cannot be overstated. People could mimic what they read on Facebook and Twitter and, as seen

in Table 4.12 and nine cities stated those were their number one sources of information about climate change science. Herman et al. (2017) found that the U.S. general public is ill-informed, at best, about general facts of climate change and anthropogenic sources thereof. They further found that the majority of Florida and Puerto Rico secondary science teachers could not accurately define climate change itself. Facebook announced in March 2021 that it was launching a new program to track and tag misinformation about climate change as a result of the proliferation of the subject on its platform (DW news, 2021). Bandura found that people learn by observing others' behavior and can mimic others' messages (Ormrod, 2012). The challenge, however, remains that although a social media platform such as Facebook will flag misinformation about climate change, which is in some cases the primary source of climate change science, it will not help people to critically think through the hordes of misinformation and myths (DW news, 2021). Not all climate change posts on Facebook or Twitter contain misinformation, however. NOAA, NASA, and the IPCC all have Facebook and Twitter feeds with scientific information about climate change. Further research is needed to understand exactly what information cities are obtaining from those media platforms.

Also of note is in the Other section of Table 4.12 where cities wrote in their primary sources of information come from other organizations, many regional collaborations among cities. Heald (2017) pointed to Bandura's theory of collective efficacy in climate change when considering whether people would be willing to act on climate change reduction issues. Heald noted that Bandura pointed to the need for "social initiatives that build people's sense of collective efficacy to influence the conditions that shape their lives and those of future Generations" (p. 6). Group collaboration may be an area for future research as well as a recommendation to cities in order to increase their knowledge about climate change adaptation strategies.

Though the variable on social framing related to climate change messaging and communication was found not to be statistically significant, this research did provide clues as to where people go to get information about climate change and who they listen to about climate challenges and adaptation measures. The challenge that scientists and scientific organizations face is how to educate or re-educate adults on the science, and associated risks, of climate change once they have completed their general education? Most adults do not return to the formal education setting once they graduate.

Given the plethora of misinformation about climate change that is pervasive throughout social media and given most people do not have access to peer-reviewed journals, it is very challenging to provide accurate, up-to-date information about climate change science and adaptation measures. National Public Radio (NPR) recently reported, in fact, about a study that showed it was older Americans over the age of 65 who were most likely to share misinformation from Facebook (NPR, 2021 June). That same NPR report stated that it is that same age group that was most represented in the 2018 U.S. general election (NPR, 2021 June). Grinberg, et al. (2019) also reported on the proliferation of misinformation on Twitter during the 2016 election and that sharing of misinformation, in general, was positively correlated with increases in age. It is all the more important for science institutions and regional planning councils to understand how adult learners are obtaining their information about climate change and who they tend to trust or listen to about that science so that they can improve the quality and quantity of messages to reach those city audiences.

In addition to improving targeted messages about climate change to informal education audiences, since climate change is generally not taught in the schools or universities as a comprehensive subject, but instead, it is taught in several different classes, those learning institutions would benefit from improved curricula that encourage comprehensive and critical

thinking about climate change, to better prepare them for the world challenges ahead of them (Tolppanen & Aksela, 2018).

Though the independent variable on social framing resulted in a non-significant statistic result in the multiple regression analysis, much can still be learned from the survey responses, namely, where city leaders go to get their information about climate change and who they believe their constituents would listen to most when it comes to making decisions about climate change preparedness investments. An area that could be addressed in future research is understanding these issues in more detail. Additional average score results to the survey questions about research question 2 can be found in Appendix H.

City Size and Climate Change Preparedness

The IPCC (2014) stated that, with high confidence, extreme coastal storm events "can cause excess mortality and morbidity, particularly along the East Coast of the USA…" (p. 1444). It also stated, "observed impacts on livelihoods, economic activities, infrastructure, and access to services in North American urban and rural settlements have been attributed to sea-level rise, changes in temperature and precipitation, and occurrences of such extreme events as heatwaves, droughts, and storms" (IPCC, 2014, p. 1444). In addition, North American ecosystems "are under increasing stress from rising temperatures, carbon dioxide concentrations, and sea-levels, and are particularly vulnerable to climate extremes" (IPCC, 2014, p. 1443). The IPCC found that adaptation measures in the U.S. tended to be reactionary and unevenly distributed around the U.S. (IPCC, 2014). Larger cities have more resources to address climate change, but they also have more people and property to be concerned with. The results of the multiple regression analysis showed that city size explains, in part, the extent to which cities are prepared for climate change. The larger the city, the more prepared. The results of this study also showed that city size influences risk perception. That is, city size was found to be moderating the effect that risk

perception had on climate change preparedness, and as city size increased, the risk perception effect decreased.

The cities with the largest populations who responded to this survey reside in Southeast Florida, where they are also extremely vulnerable to climate change-related events. As cities grow larger, the human pressures on the natural environment increase, thereby reducing the ability of the natural ecosystems to meet previous adaptation responses. These pressures on the natural ecosystem, compounded by the continued trend by increased climate change influences, will result in greater heat stresses on humans as well as plant and animal metabolisms; increased incidence of diseases; stresses on freshwater supplies; availability of land for agriculture and waterways for aquaculture, to name a few challenges (Nichols et al., 2007). Often, with increased populations also comes reductions in green spaces and increases in impervious surfaces (i.e., pavement), ultimately increasing the heat stress in cities (Chapman et al., 2017). Florida cities of all sizes face the daunting task of finding a balance between preparing for climate change events and meeting the overall economic, health, and environmental needs within their communities. Table 4.11 shows that cities in Group 2 (with medium preparedness scores) had higher scores on the ability to achieve a balance between the economy, health, and the environment, than did cities in Groups 1 and 3. There could be several reasons for this. As this study showed that preparedness for climate change increases with city size, it could be that the largest cities tend to understand the risk but they also tend to have more financial resources to address climate change than do smaller cities.

The population of the respondent cities ranged from 220 to over 414,000 people. Of 28 cities in the lower preparedness group (Group 1), a majority of those (19) were also in the lower 50th percentile in terms of population. The reasons for a lower level of preparedness among the smaller cities could be varied (e.g., lack of political support for climate-friendly policies, lack of financial resources, lack of understanding of risk, etc.). The question of why a city was not

prepared as another was not part of this investigation. Of the 28 cities in preparedness group 3, a majority of those (18) were in the higher 50th percentile in terms of population. Of the 43 cities in the higher 50th percentile in terms of population, 30 of those are located in either Palm Beach, Broward, or Miami-Dade counties. Those counties have a longer track record of studying climate change impacts and acting on their vulnerabilities in their areas than do counties northward through participation with the Southeast Florida Climate Change Compact, which was initiated in January 2010 (SFCCC, 2021). Further, Southeast Florida counties also have devised many bold policies to address climate change, such as Miami-Dade's new sea rise strategy to build back further from the sea and better (SFCCC, 2021).

As cities learn about climate change vulnerabilities, their risk perception also increases, which in turn leads to the implementation of policies that help protect them from climate change events. The urgency for Southeast Florida to adapt climate change measures is especially critical given its geography and proximity to the coast. Rose (2020) stated, "Thanks to its low elevation, Southeast Florida faces a myriad of concerns as water rises around it. By 2045, over a fifth of the region is projected to be underwater at high tide, based on the current rate of global warming" (p. 377).

The following section addresses several recommendations for learning and science institutions and awareness-building opportunities in general to help improve the understanding of climate change science and adaptation as a result of the research herein.

Implications for Learning Institutions and Awareness-building Opportunities

Targeting policymakers about climate change through formal education pathways is not enough to inform those same policymakers about climate change. Those individuals, in general, are not in secondary or university classrooms. It behooves scientists and educators, therefore, to seek other means to inform those policymakers about the science behind climate change and adaptation measures (National Research Council, 2010). The National Research Council (NRC)

(2010) stated that climate change-related decisions "involve many other factors besides climate science, including economics, social values, competing priorities, and the risk and inherent messiness involved in virtually all complex decisions" (p. 252). Given that policymakers are generally not attending formal education any longer and that the breadth of issues surrounding climate change is not taught in the schools in a comprehensive manner, there need to be other means to inform policymakers about all aspects of climate change science – threats, risks, mitigation, adaptation, and payoffs of addressing climate change.

This study highlighted the potential policy opportunities that could positively influence cities along Florida's Atlantic Coast to become better prepared for climate change. These opportunities range from policies for regional and national scientific institutions and local cities to policies for schools, universities to increase awareness of climate change adaptation measures. As mentioned in Chapter 2, simply teaching about science and the scientific basis for climate change is not enough to sway public opinion or public policy. In some studies, researchers found that the provision of scientific information was only negligibly correlated with people's understanding of climate change (Brulle et al., 2012). Health News Florida (2019) reported that while "dozens of states recognize human-caused climate change in their [education] standards," "Florida mentions human activity as an aside." Building awareness of the science behind climate change and assisting individuals with weeding out opinions from scientific facts are especially important in Florida, where climate change denialist theories remain. Below are some areas where cities and institutions could improve awareness of the science of climate change and associated adaptation measures they could take in order to protect more Floridians from the impacts of climate change-related events.

Regional Planning Institutions This study pointed out that many cities look to regional planning councils to help them plan for climate change events. Several regional groups were mentioned by name, such as: the Southeast Florida Regional Climate Change Compact; the

Eastern Florida Regional Planning Council; Florida Sea Grant; and the Florida Department of Environmental Protection. Following Bandura's collective efficacy theory, working in groups to address climate change could be another way to help Florida cities believe they can make a difference in curbing the impact of the effects of climate in their communities (Heald, 2017; Bandura, 2012). These organizations might be able to play a bigger role in building awareness by speaking to city councils and at public fora in the cities about climate change-related risks in their areas and strategies to move from planning to implementation. The collaboration among cities should also include a discussion and evidence of successful climate change adaptation measures in order to convince cities of the benefits of those measures.

Cities Speaking with their Constituents Cities themselves could improve climate change preparedness by raising awareness of the risks and associated adaptation measures they could take by holding more discussions within their cities about climate change events and potential local impacts. They could have specific city boards that focus on climate change risks and adaptation measures. In-house staff received the second-highest number of votes from cities for their climate change science information, after scientific organizations such as NOAA, NASA, and the IPCC. Cities utilize these in-house resources more to improve awareness building. In addition, cities should join regional efforts to learn more about climate change and to share information on strategies. Discussions with city leaders and constituents should explicitly include a discussion of the potential benefits, or payoffs, of implementing climate change adaptation measures (Bandura, 2012; Ormrod, 2012).

Continuing Education for In-House staff Climate change has not been taught well in many science classes, given the breadth of subject matter that it covers. It is not only a science issue; climate change covers public health and economic issues as well (Herman et al., 2017; Young et al., 2021). People who learned about climate change up until today never received a comprehensive curriculum that addressed all the varied aspects of climate change. Given the

extent to which in-house staff are depended on for guidance to the city on climate-related issues, it would be important for this staff to have city-supported continuing education opportunities to stay on top of the latest information.

Increased Information Awareness by Science Organizations Science organizations such as NASA, NOAA, the IPCC, among others, could help to improve awareness of the science behind climate change and adaptation measures by promoting more public awareness campaigns that target social media platforms and by including in those messages the environmental, economic, and public health implications of doing nothing about climate change as well as the payoffs of implementing policies now. These organizations were seen as the number one source of information about climate change science. Cities depend on them to have the best information to help them prepare.

Schools and Universities These institutions could improve the teaching of climate change by utilizing critical thinking and building sound evidence and source materials. Schools and universities need to teach students how to filter out opinion versus scientific fact. This study showed that some cities depend on Facebook and Twitter for their primary sources of information. Therefore, it would help students to understand the science of climate change by helping them to weed out the opinions from scientific facts in those platforms. Tolppanen and Aksela (2018) stated there are numerous studies that show students still are not taught enough critical thinking and problem-solving skills. They opine that understanding climate change and its related processes require skills such as these. Further, they state that many students have many misconceptions regarding climate change science, which could be overcome with these critical thinking, systems thinking, and problem-solving skills. This view, they argue, is due to the fact that historically, environmental education was never initially designed to develop critical thinkers. Instead, students are left to fend for themselves when putting the pieces, or concepts, together. For example, "reactions of greenhouse gases are taught in chemistry, thermodynamics

is taught in physics, and the carbon cycle is taught in biology (and chemistry), though all of them play a key role in understanding climate change as a system" (p. 376). Tolppanen and Aksela (2018) further argue that this list of disciplines does not even begin to look at the societal issues surrounding environmental choices or possible solutions. Teaching institutions should not wait for Facebook or Twitter to do this teaching for them. To that end, Florida schools should take some time during in-service training to update teachers on the current science around climate change, not only to educate them on the environmental factors but also to provide them with instruction information on public health and economic implications related to climate change. Helping teachers and instructors understand what the potential payoffs are of adopting climate change adaptation measures would eventually help students to understand the outcome expectations of implementing those measures (Ormrod, 2012).

Future Research Opportunities

Future research that investigates social framing with either a larger survey audience or more in-depth qualitative interviews may provide greater insights into how cities obtain information about climate change adaptation. While the independent variable of social framing resulted in inconclusive results in this study, a larger survey size may produce more conclusive results. Similarly, a qualitative study may get to the heart of the issues of what drives risk and what cities and their constituents are thinking in terms of the need for adaptation measures for their communities. Perhaps more importantly, future research can look more closely at the question of why people hold certain risk perceptions about climate change and whether they believe anything can be done to reduce the impacts. These issues get to the heart of Bandura's social cognitive theory of collective efficacy and outcome expectations (Crosman, et al., 2019).

Another interesting area of study would be a deeper dive into what factors are influencing perceived risks of climate change, looking at not only the environment but also the public health and economic risks. We know from this study the extent to which risk helped explain climate

change adaptation and that city size was a moderating factor on risk, but we do not know what other factors might influence a city's risk perception. A quantitative or qualitative study would help shed light on this issue.

This study also highlighted that city size plays a role in terms of explaining the extent to which cities are prepared for climate change. Future research could investigate equity issues surrounding resources and decision-making regarding climate mitigation and adaptation based on city size. To what extent are smaller cities disadvantaged in terms of their ability to protect themselves is an interesting area to investigate.

The value of adaptation measures to cities is another area that could be researched. Cities need to see the payoffs of implementing measures from social, economic, and environmental standpoints.

Future research could be conducted on understanding the breadth of adaptation measures already in place in cities and devise a framework to assist cities with their own adaptation strategies. Though this study did not take an in-depth look at how adaptation was integrated, or mainstreamed, into city policies, understanding a framework for how this could be accomplished with Florida cities could be helpful to some cities. Rauken et al. (2015) stated that "mainstreaming of climate change adaptation has been promoted…as advantageous to have decision-makers considering adaptation needs in their own sectors. Expected benefits from mainstreaming are increased coherence among policies, reduced chances of duplications and policies that contradict each other (p. 409).

Finally, a very important area for study would include a deep look at how climate change is taught in schools - both at the secondary and university levels - with the goal of understanding how the curricula in those institutions can be enhanced to improve the cross-cutting nature of the science of climate change. Using wicked problem-solving exercises to help students think

through the issues around climate change will also arm them with critical thinking skills to better fend off misinformation from social media and other sources (Young et al., 2020).

Limitations

The study was designed to be conducted through a remote survey using the Qualtrics software. The pilot study took place during the height of the Covid-19 pandemic in June and July 2020, and several lessons were gleaned from the experience with the pilot study. For example, the Qualtrics software could automatically send a link to the respondents, making it easier for the investigator to send out the survey. However, many respondents did not trust the link they received from the automated system. Many changes to the process were changed, as a result, during the main study, which took place from January to May 2021. For example, a typed letter was sent through the mail to all city leaders in the survey pool a week ahead of sending the electronic link. The link was then sent to each city leader as a personal email rather than from the Qualtrics software system. Still, even with these changes, some city policies precluded their employees from clicking on links. In the few situations an embedded survey sending an email or mailing the survey through the Postal Service rectified the situation. Though statistical significance was reached on two of the three independent variables, there were still nearly 30 surveys that were only partially answered for unknown reasons. More responses may have provided additional insights into the social framing variable responses. Further, the lack of follow-up that a trained interviewer could provide during a qualitative interview is not possible with electronic software (Wright, 2005 Apr; Howard, 2019 Aug).

Surveys from an unknown or trusted source are also problematic in terms of improving response rates (Adetia, et al., 2020). Several cities questioned the nature of the company, Florida Tech, for example. Other cities questioned whether the survey responses could keep their responses confidential. Those cities received their responses at about the same time as the insurrection happened in the U.S. Capitol building, January 6, 2021. Though correlation does

not equal causation, no other cities at any point in the data collection phase questioned the confidentiality of the responses. Several cities that received surveys at this time raised the issue of confidentiality and anonymity of the respondent and therefore declined to take the survey. It is not known how many other cities declined to respond to the survey for the same reason.

Summary

This chapter included a discussion of the statistically significant multiple regression analysis results of the independent variables of risk perception and city size, which both showed that they helped explain the extent to which cities in counties along Florida's Atlantic coast were prepared for climate change events as well as current city thinking of climate risks in general. The survey results for the independent variable on social framing, though not statistically significant, provided other insights into the thinking of city officials about climate change and helped frame several policy recommendations. Finally, that information provided a guide for education and policy recommendations and opportunities for future education research.

This study identified several areas of what city leaders think about climate change. It also asked questions about how they obtain their information about climate change science and whether additional support from other leaders (i.e., the President, Governor, County Board, City Council) would help the constituents in the city support climate change mitigation efforts. This study, however, did not ask why people held certain risk perceptions or why additional support from particular external audiences would help to improve climate change adaptation measures adopted in a particular community. To get to the heart of outcome expectations, additional questions would need to focus on why the respondents believe certain adaptation measures are better than others for their community, as well as their perceived benefits of implementing specific adaptation measures. To better understand collective efficacy and support for climate change adaptation measures, additional questions would need to focus on why certain regional

organizations are more important than others in creating an environment where cities took more actions toward climate change mitigation in their areas (Bandura, 2012; Crosman, et al., 2019). The study herein provides foundational information for future research that could address those questions.

At issue, for further consideration, is also the question of how to educate policymakers, who are no longer students, about climate change science and adaptation measures? Understanding their perceived risks and where they obtain information to make decisions helps to understand some of their thinking processes, but it does not help them to take misinformation about climate change they may find on social media platforms and critically analyze it for falsehoods. Addressing city councils directly, as well as seeking additional public service announcements about climate change science and adaptation measures from trusted sources such as NASA, NOAA, the IPCC, or regional planning organizations, may be the best means of educating adults who no longer wish to seek formal education and therefore would have limited access to scientific resources.

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Appendix A

Main Survey

Research Question 1

The first question is divided into two parts, both addressing risk perception, and addresses research question 1 of the study. The first part will address the construct of perceived risk the respondent has regarding the views of their constituents.

Research Question 2

The next part of the survey will address the construct of actual messages sent from your city to the members of your community regarding climate change and adaptation, and is designed to address research question 2, social framing.

Research Question 3

The below chart will be used to determine what each city has in terms of plans or implemented adaptation measures.

Florida Tech Survey: Florida Cities Adoption of Climate Change Measures.

This is an official survey as a dissertation requirement with permission from the Florida Institute of Technology's Institutional Review Board. The overall responses and analysis from these surveys may be shared with other city managers in the State of Florida, to advance policy dialogue regarding climate change adaptation in the State. No individual survey responses will be released to the public.

By clicking on the box below, you acknowledge you have read and agree with the above statement and agree to take the survey.

○ I have read the above statement and agree to take the survey.

2 Please indicate that you are a City Leader (e.g., City Mayor, City Manager, City Clerk, etc, or designee) and write your title in the blank provided.

○ Yes

○ No, Please enter your title here _____

3 How many years have you served in that position (of city leadership)?

○ 0-2 years (1)

○ 3-5 years (2)

○ 5-7 years (3)

○ 7-10 years (4)

○ more than 10 years (5)

4 Please enter the name of the city and county (City, County) you represent.

_____

RQ1a). *Risk Perceptions, part II: this refers to a judgment you make about an issue after experiencing, reading about, or hearing about a natural hazard, such as sea-level rise, drastic precipitation changes, sustained increased temperatures from year-to-year. Please answer each question, with the most accurate answer from the selections provided below. AFTER ANSWERING THE THREE QUESTIONS BELOW, PLEASE CONTINUE THE SURVEY TO THE NEXT SECTION.*

	No Risk (1)	Moderate Risk (2)	High Risk (3)	Extreme Risk (4)

What is the risk of climate change exerting a significant impact on PUBLIC HEALTH in your community? (1)	○	○	○	○
What is the risk of climate change exerting a significant impact on ECONOMIC development in your community? (2)	○	○	○	○
What is the risk of climate change exerting a significant impact on the ENVIRONMENT in your community? (3)	○	○	○	○

RQ1b). Risk Perceptions, part II: this refers to a judgment you make about an issue after experiencing, reading about, or hearing about a natural hazard. Please answer each question, with the best possible answer from the selections provided below.

	strongly disagree (1)	slightly disagree (2)	moderately agree (3)	strongly agree (4)
"Sea-level rise poses an economic threat to my city." (1)	○	○	○	○
"Localized flooding poses an economic threat to my city." (2)	○	○	○	○
"Melting glaciers pose an environmental threat to my city." (3)	○	○	○	○

"Increased water-borne diseases as a result of flooding pose a public health threat to my city." (4)	○	○	○	○
"Increased saltwater intrusion into freshwater sources poses a PUBLIC HEALTH threat to my city." (5)	○	○	○	○
"Increased saltwater intrusion into freshwater sources poses an ECONOMIC threat to my city." (6)	○	○	○	○
"Increased saltwater intrusion into freshwater sources poses an ENVIRONMENTAL threat to my city." (7)	○	○	○	○
"Threats to marine life pose a threat to my city's economy." (8)	○	○	○	○
"Maintaining green spaces, parks, and wetlands is not related to climate change adaptation." (9)	○	○	○	○

"Wetland mitigation banking (i.e., maintaining a wetland in a different part of the State of Florida while building over wetlands in my part of the State) is an acceptable environmental tradeoff and will not cause localized problems during times of flooding." (10)	○	○	○	○
"Cities with a lot of impermeable (e.g., cement) surfaces tend to be hotter during the summer than cities with more parkland and other impermeable (e.g., grassy) surfaces." (11)	○	○	○	○
"Our city does not have to make a choice between the ECONOMY, the ENVIRONMENT, and PUBLIC HEALTH. All three can be addressed at the same time." (12)	○	○	○	○

RQ2a). Social Framing. This section addresses how you (in your city leadership position) send and receive information about climate change between the city and the citizens of that respective community.

	strongly disagree (1)	disagree (2)	agree (3)	strongly agree (4)

"Our city does not send messages (e.g., bulletins, newsletters, Facebook posts) out to its constituents that are specifically climate change related." (1)	○	○	○	○
"Our city sends messages to our constituents that are related to the influences of climate change such as on flooding, stormwater drainage, coastal erosion, but we do not specifically mention climate change." (2)	○	○	○	○
"Our city openly speaks about climate change threats and risks in public meetings as well as other information outlets (e.g., community meetings, Facebook discussions, etc)." (3)	○	○	○	○

"Our city would show more support for climate change adaptation measures if we had better information about the impacts in our city, in particular." (4)	○	○	○	○
"Our city would show more support for climate change adaptation measures if our President showed their support for climate change." (5)	○	○	○	○
"Our city would show more support for climate change adaptation measures if our Governor showed their support for climate change." (6)	○	○	○	○
"Our city would show more support for climate change adaptation measures if our County Board showed their support for climate change." (7)	○	○	○	○

"Our city would show more support for climate change adaptation measures if our City Council showed their support for climate change." (8)	○	○	○	○
"Citizens of our city never raise the issue of climate change adaptation to city officials or to local elected officials." (9)	○	○	○	○

RQ2b). In this box, you have the opportunity to RANK order the sources of information you use to obtain information about climate change in order to assist in decision making in your city. Simply move the items into your preferred rank order. The item you list in the #1 slot is the one you depend on most for your climate change information. The item in the #10 slot has little relevance to you.

_____ Facebook or Twitter
_____ Scientific (peer-reviewed) Journals and Books
_____ NPR News
_____ Scientific organizations such as NOAA, NASA, or the Intergovernmental Panel on Climate Change
_____ FOX News
_____ High School science class
_____ The President of the United States
_____ Friends, neighbors, or family
_____ The Florida Governor
_____ MSNBC or CNN news
_____ Staff/faculty from a college or university
_____ In-house professional staff paid by the city.
_____ College or University class
_____ Other, please insert response

RQ3). Please check ALL items below that apply to the climate change adaptation measures EITHER <u>planned</u> or <u>acted on</u> in your community. A "planned" measure refers to an adaptation measure that is in preparation or already in city or county ordinances. An "acted on" measure refers to an adaptation measure that is being implemented or has been implemented.

- ☐ Climate Change Vulnerability Assessment (CCVA).
- ☐ Plans for strategic withdrawal (retreat)
- ☐ Rolling easement plans.
- ☐ Population density assessments and regulations.
- ☐ Building codes that include energy efficiency measures.
- ☐ Creation of urban (city) parks.
- ☐ Stormwater drainage improvements.
- ☐ Wastewater treatment system upgrades.
- ☐ Identification of new freshwater (drinking water) sources.
- ☐ Protection of current freshwater (drinking water) sources.
- ☐ Protection from power disruptions during intense storms (hurricanes).
- ☐ Wildfire prevention and management.

- ☐ Conservation of water for agriculture irrigation use.
- ☐ Protection of existing wetlands or creation of new wetland areas.
- ☐ Purchase of vulnerable properties in repetitive loss areas.
- ☐ Other, please insert response

_____

Thank you for taking part in this educational survey. Your responses will help to inform Florida's officials, educators, researchers, and scientists regarding planning and implementation of climate adaptation measures.

Please indicate below if you would be interested in the full results of this survey. No individual survey will be released, only the analysis of the overall results.

- ○ Yes, please
- ○ No, thank you

Appendix B - Florida's Atlantic Coastal Cities

** county seat. *split in 2 counties	**County**	**City** (FAC, 2020)	**Year Incorporated** (FAC, 2020)	**Population** (Florida Cities by Cubit, 2020)
	Brevard	Cape Canaveral	1963	9,926
	Brevard	Cocoa	1895	17,259
	Brevard	Cocoa Beach	1925	11,240
	Brevard	Grant-Valkaria	2006	3,873
	Brevard	Indialantic	1952	2,782
	Brevard	Indian Harbour Beach	1955	8,456
	Brevard	Malabar	1962	2,738
	Brevard	Melbourne	1888	77,101
	Brevard	Melbourne Beach	1923	3,098
	Brevard	Melbourne Village	1957	664
	Brevard	Palm Bay	1960	103,681
	Brevard	Palm Shores	1959	890
	Brevard	Rockledge	1887	25,265
	Brevard	Satellite Beach	1957	10,315
**	Brevard	Titusville	1887	43,529
	Brevard	West Melbourne	1959	19,118
	Broward	Coconut Creek	1967	53,313
	Broward	Cooper City	1959	30,450
	Broward	Coral Springs	1963	122,681
	Broward	Dania Beach	1904	29,873
	Broward	Davie	1961	92,848
	Broward	Deerfield Beach	1925	75,506
**	Broward	Fort Lauderdale	1911	168,615
	Broward	Hallandale	1927	37,732
	Broward	Hillsboro Beach	1939	1,890
	Broward	Hollywood	1925	142,374
	Broward	Lauderdale Lakes	1961	33,168
	Broward	Lauderdale-by-the-Sea	1947	6,105
	Broward	Lauderhill	1959	67,037

	Broward	Lazy Lake	1953	25
	Broward	Lighthouse Point	1956	10,419
	Broward	Margate	1961	123,478
	Broward	North Lauderdale	1963	42,269
	Broward	Oakland Park	1929	42,020
	Broward	Parkland	1963	24,872
	Broward	Pembroke Park	1957	6,103
	Broward	Pembroke Pines	1961	155,239
	Broward	Plantation	1953	85,049
	Broward	Pompano Beach	1947	102,239
	Broward	Sea Ranch Lakes	1959	670
	Broward	Sunrise	1961	86,154
	Broward	Tamarac	1963	61,102
	Broward	Weston	1996	65,448
	Broward	Wilton Manors	1947	11,878
	Indian River	Fellsmere	1911	5,201
	Indian River	Indian River Shores	1953	3,936
	Indian River	Orchid	1965	417
	Indian River	Sebastian	1924	22,188
**	Indian River	Vero Beach	1919	15,326
	Flagler	Beverly Beach	1955	334
**	Flagler	Bunnell	1913	2,685
	Flagler	Flagler Beach	1925	4,482
*	Flagler	Marineland	1940	16
	Flagler	Palm Coast	1999	76,450
	Volusia	Daytona Beach	1876	61,859
	Volusia	Daytona Beach Shores	1960	4,255
	Volusia	DeBary	1993	19,338
**	Volusia	DeLand	1882	27,700
	Volusia	Deltona	1995	85,281
	Volusia	Edgewater	1924	20,776
	Volusia	Holly Hill	1901	11,665
	Volusia	Lake Helen	1888	2,619

	Volusia	New Smyrna Beach	1887	22,792
	Volusia	Oak Hill	1927	1,788
	Volusia	Orange City	1882	11,226
	Volusia	Ormond Beach	1880	38,612
	Volusia	Pierson	1929	1,691
	Volusia	Ponce Inlet	1963	3,046
	Volusia	Port Orange	1913	56,386
	Volusia	South Daytona	1951	12,294
	Duval	Atlantic Beach	1926	12,718
	Duval	Baldwin	1876	1,419
	Duval	Jacksonville Beach	1907	21,615
**	Duval	Jacksonville	1832	826,865
	Duval	Neptune Beach	1931	7,112
	St. Johns	Hastings	1909	593
*	St. Johns	Marineland	1940	16
	St. Johns	St. Augustine Beach	1959	6,258
**	St. Johns	St. Augustine	1822	13,092
	Nassau	Callahan	1911	1,138
**	Nassau	Fernandina Beach	1825	11,541
	Nassau	Hilliard	1847	3,069
	Palm Beach	Atlantis	1959	2,017
	Palm Beach	Belle Glade	1945	17,722
	Palm Beach	Boca Raton	1925	85,413
	Palm Beach	Boynton Beach	1920	68,741
	Palm Beach	Briny Breezes	1963	604
	Palm Beach	Cloud Lake	1948	133
	Palm Beach	Delray Beach	1911	61,495
	Palm Beach	Glen Ridge	1947	220
	Palm Beach	Golf	1957	252
	Palm Beach	Greenacres	1926	38,079
	Palm Beach	Gulf Stream	1925	928
	Palm Beach	Haverhill	1959	1,885
	Palm Beach	Highland Beach	1949	3,629

	Palm Beach	Hypoluxo	1955	2,631
	Palm Beach	Juno Beach	1953	3,233
	Palm Beach	Jupiter	1925	56,337
	Palm Beach	Jupiter Inlet Colony	1959	398
	Palm Beach	Lake Clarke Shores	1957	3,359
	Palm Beach	Lake Park	1921	8,272
	Palm Beach	Lake Worth	1913	35,110
	Palm Beach	Lantana	1921	10,536
	Palm Beach	Loxahatchee Groves	2006	3,173
	Palm Beach	Manalapan	1931	410
	Palm Beach	Mangonia Park	1947	1,783
	Palm Beach	North Palm Beach	1956	12,177
	Palm Beach	Ocean Ridge	1931	1,807
	Palm Beach	Pahokee	1922	5,858
	Palm Beach	Palm Beach	1911	8,358
	Palm Beach	Palm Beach Shores	1951	1,150
	Palm Beach	Palm Beach Gardens	1959	49,108
	Palm Beach	Palm Springs	1957	19,769
	Palm Beach	Riviera Beach	1923	32,723
	Palm Beach	Royal Palm Beach	1959	34,421
	Palm Beach	South Bay	1941	4,711
	Palm Beach	South Palm Beach	1955	1,212
	Palm Beach	Tequesta	1957	5,652
	Palm Beach	Wellington	1995	57,514
**	Palm Beach	West Palm Beach	1894	101,668
**	St. Lucie	Fort Pierce	1901	41,646
	St. Lucie	Port St. Lucie	1961	167,252
	St. Lucie	St. Lucie Village	1961	585
	Miami-Dade	Aventura	1995	37,239
	Miami-Dade	Bal Harbor	1946	2,976
	Miami-Dade	Bay Harbor Islands	1947	5,755
	Miami-Dade	Biscayne Park	1933	3,099
	Miami-Dade	Coral Gables	1925	47,885

	Miami-Dade	Doral	2003	47,534
	Miami-Dade	El Portal	1937	2,361
	Miami-Dade	Florida City	1914	11,850
	Miami-Dade	Golden Beach	1929	924
	Miami-Dade	Hialeah	1925	227,395
	Miami-Dade	Hialeah Gardens	1948	21,957
	Miami-Dade	Homestead	1913	63,290
	Miami-Dade	Indian Creek	1939	92
	Miami-Dade	Key Biscayne	1991	12,402
	Miami-Dade	Medley	1949	858
	Miami-Dade	Miami Beach	1915	90,057
	Miami-Dade	Miami Gardens	2003	107,147
	Miami-Dade	Miami Lakes	2000	29,448
	Miami-Dade	Miami Shores Village	1932	10,659
	Miami-Dade	Miami Springs	1926	14,037
**	Miami-Dade	Miami	1896	414,751
	Miami-Dade	North Bay Village	1945	7,524
	Miami-Dade	North Miami	1926	60,313
	Miami-Dade	North Miami Beach	1926	42,113
	Miami-Dade	Opa-locka	1926	15,610
	Miami-Dade	Palmetto Bay	2002	23,643
	Miami-Dade	Pine Crest	1996	18,447
	Miami-Dade	South Miami	1926	13,576
	Miami-Dade	Sunny Isles Beach	1997	21,395
	Miami-Dade	Surfside	1935	5,776
	Miami-Dade	Sweetwater	1941	19,963
	Miami-Dade	Virginia Gardens	1947	2,394
	Miami-Dade	West Miami	1947	6,024
	Martin	Jupiter Island	1925	929
	Martin	Ocean Breeze Park	1960	381
	Martin	Sewall's Point	1957	2,226
	Martin	Stuart**	1914	16,237

Appendix C

Subject Matter Expert Reviews

I wrote to the following people:

1. **Dr. Stuart Carlton**, Assistant Director, IL-IN Sea Grant College Program, College of Agriculture, Purdue University, carltons@purdue.edu
2. **Thomas Snelling**, Director of the Planning and Development Department (and Green Officer), City of Tampa, 306 E. Jackson Street, 3rd Floor North, Tampa, FL 33602, (813) 274-3100, ext. 47575, thomas.snelling@tampagov.net
    a. Phone call from Mr. Snelling - 6/18 - likes the link between environmental and health issues especially. He also likes the inclusion of questions about where people get their information (social framing). He thinks I included all of the relevant information and that targeting the city managers is the appropriate audience for the surveys. Since he is retiring in a week, he passed this on to his successor, Mr. **Whit Remer** (Whit.Remer@tampagov.net), to see if he has additional comments. Additional comments of issues to consider are from Whit Remer below.
3. Heidi Stiller, South Regional Director, NOAA Office for Coastal Management, St. Pete. A major federal climate adaptation expert for the Gulf Coast, Heidi.Stiller@noaa.gov
    b. She wasn't able to provide comments because of time, but passed the request to her colleague at another NOAA office to provide feedback:
        i. **Chris Ellis,** Ph.D., Social Scientist, NOAA Office for Coastal Management, 2234 S. Hobson Avenue, Charleston, SC 29405-2413 843-740-1195, chris.ellis@noaa.gov
5. **Maya Burke,** Tampa Bay Regional Planning Council, Maya Burke, Science Policy Coordinator, Maya Burke has spent more than 10 years working in water resource project

management, regulatory compliance, land acquisition, and environmental land use planning for the Southwest Florida Water Management District and Tampa Bay Regional Planning Council. mburke@tbep.org

6. **Colin Polsky,** PhD, Director, Center for Environmental Studies, Florida Atlantic University, 3200 College Ave, DW-312, Davie, FL 33314, +1-954-236-1334, cpolsky@fau.edu,
7. **Dr. Kenyon Lindeman,** Professor, Florida Institute of Technology, Melbourne FL. lindeman@fit.edu.

SME Feedback:

Chris Ellis, Ph.D., Social Scientist, NOAA Office for Coastal Management, 2234 S. Hobson Avenue, Charleston, SC 29405-2413. 843-740-1195, chris.ellis@noaa.gov

"Wow, your survey was fascinating to read through. Thanks for the opportunity to review. Very well done! You did a really thorough job of defining terms and clarifying phrases, which is so critical to such surveys. I only added a few, rather minor suggestions. I think your resulting data will offer incredible insight into how elected officials think and process climate-related matters in your part of the country. Likely, many suspicions/hypotheses will be confirmed, but I'll bet there will be many surprises, as well! It was a pleasure to review, and I think you're in super shape."

1. Q2 RQ1b). Risk Perceptions, part II: this refers to a judgement you make about an issue after experiencing, reading about, or hearing about a natural hazard. Please answer each question, with the best possible answer from the selections provided below.

"Any threat to marine life poses a threat to our economy."

Ellis: This is a bit of a sweeping statement, which may be the intent, but there's no wiggle room for clarification. Not sure if that may be useful in this question, as well as the question directly above.

2. Q4 RQ2b). In this box, you have the opportunity to RANK order the sources of information you use to obtain information about climate change. Simply move the items into your preferred rank order. The item you list in the #1 slot is the one you depend on most for your climate change information. The item in the #10 slot has little relevance to you.

   Ellis: Depending on the social circle you're engaging, NPR can be viewed as a more centrist news outlet, versus a right-leaning FOX News. Wondering if a more stereotypical left-leaning organization like CNN should be added to the list? Would be interesting to see how responses are distributed across these three.

Dr. Kenyon Lindeman, Professor, Florida Institute of Technology, Melbourne FL. **lindeman@fit.edu**.

a. Initial comments (May 15, 2020):

   ii. Should city managers be the only target audience for the surveys?

   iii. Verbiage change in introduction from "with the expectation that these will advance policy dialogue," to "to advance policy dialogue…"

   iv. Introduction: change City Manager (or equivalent) to City Manager (or delegate)

   v. RQ1a: change "best possible answer" to "most accurate answer"

   vi. RQ2a:

      1. *Add new question: does the community have a Climate Change Vulnerability Assessment, CCVA? This is a typical first, serious step, many communities have done these, many haven't*
      2. *Change "the President, Governor, County Board, Mayor, etc" to "the President, Governor, County Board, Mayor, City Council"*

   vii. RQ2b: Internet sources - need to clarify if talking about climate change

organizations or climate change websites. If websites, there are a lot of skeptic sites that need to be teased out from what is presented through organizations.

viii. *RQ3:*

1. *separate "beach nourishment" and "construction of seawalls"*
2. *Change "stormwater drainage improvements" to "stormwater improvements"*
3. *Add "building code revisions"*
4. *Add "density regulation revisions"*

Thomas Snelling, Director of the Planning and Development Department (and Green Officer), City of Tampa:

Phone call from Mr. Snelling - 6/18 - likes the link between environmental and health issues especially. He also likes the inclusion of questions about where people get their information (social framing). He thinks I included all of the relevant information and that targeting the city managers is the appropriate audience for the surveys. Since he is retiring in a week, he passed this on to his successor, Mr. **Whit Remer**, to see if he has additional comments. Additional comments of issues to consider are from Whit Remer below.

Whit (Remer),

I just got off the phone with Ms. Young and provided my comments to her verbally. I thought the survey achieved its goals over all. I told her that we recently hired you and that I thought you could provide some insights and input based on her request below. I lost track of her email and it has unfortunately "sat" in my queue too long. Is it possible for you to do a quick review and respond in the next few days. My tardiness has caused her to be in a bit of a rush.

From Whit: Thanks for allowing me an opportunity to review. I might suggest incorporating questions related to:

- *social/environmental justice/equity*
- *influence by peer cities*
- *influence by outside organizations*

Maya Burke, Tampa Bay Regional Planning Council, Maya Burke, Science Policy Coordinator:

Introduction: Governance forms vary from city to city- some have a strong mayor and a city administrator, while others have a weak mayor and city manager. Consider who you want to address in this survey and use appropriately flexible language to capture that target role.

RQ1a. Because climate change refers to a broad suite of natural hazards, you may want to specifically refer to the climate hazards of greatest importance to your study (e.g. sea level rise, precipitation changes, increased temperature).

RQ1b.

- *The generic reference to "virus" may produce bias because of unrelated concerns associated with the current COVID-19 pandemic.*
- *Urban heat island effects are exacerbated by global climate change. Caution on conflating the two phenomena without being clear about their relationship.*
- *This question is structured as a logical fallacy/false dichotomy. It implies that there is an either/or choice when this is not true (and is raised in the subsequent question).*

RQ2a. The use of the term "community" in this question is confusing. Do you mean the public/citizens/constituents of the local government? Or do you mean the public servants/government staff? This should be clarified.

- *Consider rephrasing to address the comment above: "Constituents never raise the issue of climate change adaptation to city officials or to local elected officials" or preferably "Staff would should more support for climate change adaptation measures if members of our community raised the issue of climate change adaptation to city officials or to local elected officials."*

RQ2b. Options should be considered carefully and listed neutrally:

Facebook or Twitter (Other Social Media? -- is this about following influential scientists, official government sources, or friends/family-- because it only asks about the channel it mixes in the potential sources you are parsing in later options)

Scientific (Peer-reviewed) Journals and Books

~~*Whatever*~~ *Elected officials* ~~*tell me*~~

NPR News (Is it the liberal lean or what?)

Scientific Internet sources such as NOAA, NASA, or the Intergovernmental Panel on Climate Change (Is it about the internet, science, or reputable/official government sources?)

FOX News (Is it the conservative lean or what?)

~~*I learned about it in*~~ *School*

I am skeptical about what anyone just tells me, so I always verify the information through scientific sources. (Not sure what this gets at)

Friends, neighbors, and family

~~*If climate change were "a thing" I would have learned about it in school.*~~

Other, please insert response

RQ3.

- *"Stormwater" should be one word.*
- *"Population density code measures" is not clear. I think you are referring to land use regulations, such as zoning for future land use maps which regulate the number of living units per acre or the allowable floor area ratio (FAR).*
- *Consider adding the purchase of vulnerable properties in repetitive loss areas and/or the implementation of rolling easements (https://www.epa.gov/sites/production/files/documents/rollingeasementsprimer.pdf*

Dr. Stuart Carlton, Assistant Director, IL-IN Sea Grant College Program, College of Agriculture, Purdue University, carltons@purdue.edu

1. City managers seem to be the appropriate audience for this type of survey.
2. Separate "sea level rise" from "localized flooding" - "Sea level rise and localized flooding pose an economic threat to my community."
3. It will be interesting to see during the pilot phase if the negatively worded questions confuse people.
4. Question RQ2b) *(In this box, you have the opportunity to RANK order the sources of information you use to obtain information about climate change*) mixes sources of information from general ideas to the Internet or books. Take another look to make those sources more consistent.

Colin Polsky, PhD, Director, Center for Environmental Studies, Florida Atlantic University, 3200 College Ave, DW-312, Davie, FL 33314, +1-954-236-1334, cpolsky@fau.edu,

Q2 & Q11: are you first exposing the respondents to a description of climate change that should, or might, modify their perception? The way the question is framed, it seems like you are, but I didn't see what that prompt/stimulus would be.

Q11: if the degree of risk reported by the respondents is important to your analysis, then you might want another question or two that helps you calibrate what each respondent means by "moderate," "high," etc.

On our website, you can see our full survey questions, and the associated responses. In the press releases we only report on a small subset of the questions. I think some of the other questions we haven't yet mentioned in the press releases might be of interest to you.

I think early in the survey you reference communities as being possibly a different target population than decision makers. But I think the rest of the questions focus only on decision makers. Are you also gauging public opinion among citizens? That group should probably be thought of as separate, deserving its own battery of questions. Also, I've found that decision makers, for analytical purposes, should probably be divided into two groups: elected, and staff.

Finally, have you read the work about what influences climate change public opinion by Dan Kahan? In our upcoming work this fall, I have two masters students who will be incorporating Kahan's ideas about "cultural identity" into their Theses. I think adding a question or two to that effect could be helpful for you, depending on exactly what kind of correlations you are looking to test. Let me know if you'd like my students to send you what those questions look like.

Appendix D
List of Cities in the Pilot Study

Lee County

- Fort Myer, 2. Fort Myer Beach

Charlotte County

- Punta Gorda

Pinellas County

- St Pete Beach

Sarasota County

- Sarasota
- Venice

Manatee County

- Palmetto

Hillsborough County

- Tampa

Brevard County

- Satellite Beach

Appendix E

Communication to the Cities

Sample Letter sent to the Cities

Subject: Florida Tech Survey

Date

Dear City Leader,

I am leading a study through Florida Tech on the extent to which cities in Florida's Atlantic Coastal Counties are prepared to address a host of environmental conditions (e.g., flooding, storm surge, drought, increased temperatures, etc) related to climate change. The information in the study will help to build the body of knowledge on climate change adaptation measures in our eastern coast cities, and serve as a policy aid to help cities develop measures appropriate for them. Your city is part of this study.

To that end, in the coming days you will receive an electronic survey link to the Qualtrics survey software from my Florida Tech email account in order to take the survey. That email address is: sheila2018@my.fit.edu. It is perfectly acceptable to delegate this task to someone else on your staff.

Your participation in this survey is *greatly* appreciated. At the end of the survey you will have the option to agree to receive a copy of the final report once it is completed. I hope you will take the 5 minutes needed to complete the survey and help in the development of this study.

Very Respectfully,

Sheila A. Young, PhD Candidate
STEM Education
Florida Institute of Technology
(https://www.fit.edu/)
Melbourne, FL
sheila2018@my.fit.edu

Sample Email sent to the cities:

Dear Mayor XXX,

In February, I mailed to you a letter explaining that a survey link would be forthcoming. This study will look at the extent to which cities in Florida's Atlantic Coastal Counties are prepared to address a host of environmental conditions (e.g., flooding, storm surge, drought, increased temperatures, etc) related to climate change. The information in the study will help to build the body of knowledge on climate change adaptation measures in our eastern coast cities, and serve as a policy aid to help cities develop measures appropriate for them. YYY City is part of this study.

Here is that link for the survey:
https://fit.co1.qualtrics.com/jfe/form/SV_6PzssPkdDpRK2fX

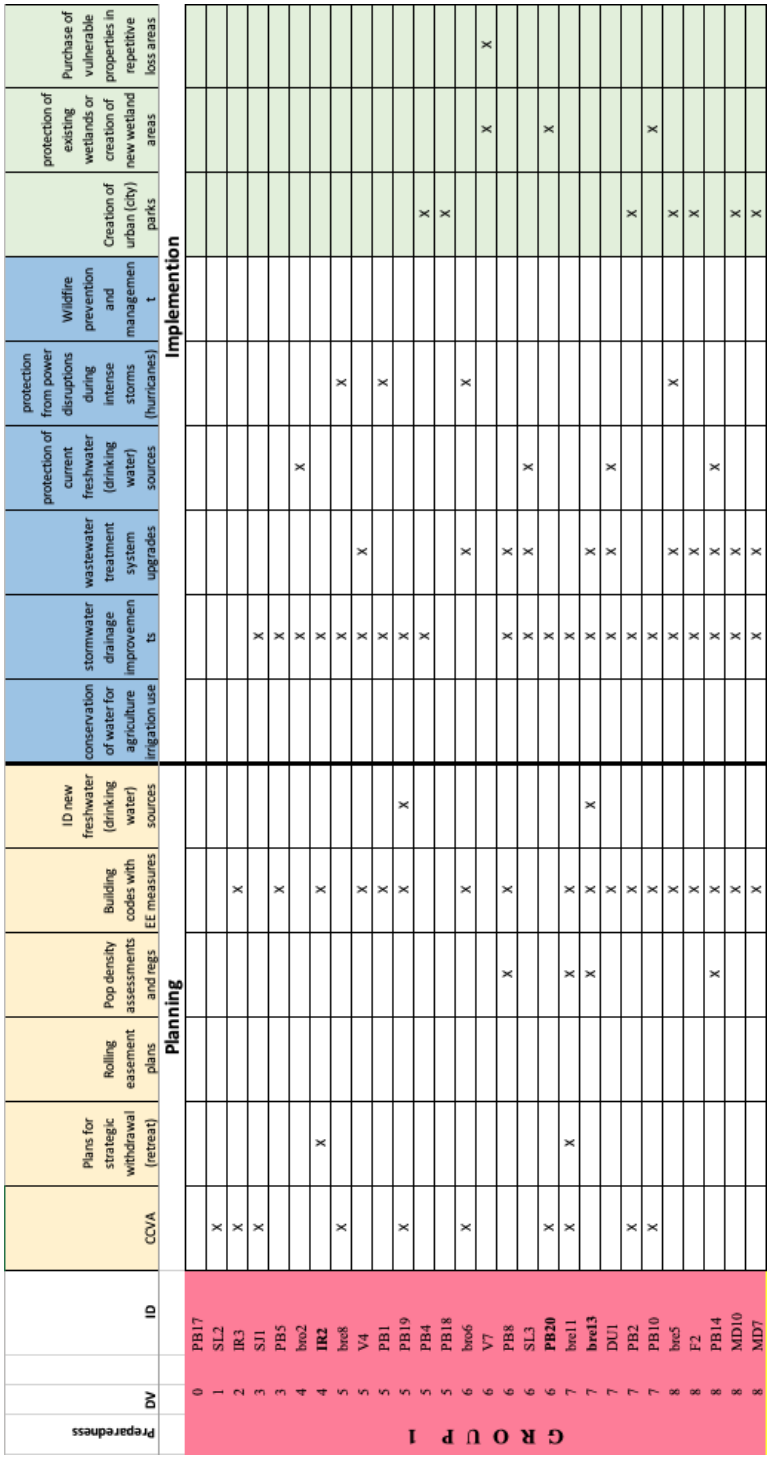
Your participation in this survey is greatly appreciated. At the end of the survey you will have the option to agree to receive a copy of the final report once it is completed. I hope you will take the 5 minutes needed to complete the survey and help in the development of this study.

Very Respectfully,
Sheila
--
Sheila A. Young
FIT PhD Candidate, STEM Education
Paul Coverdell Peace Corps Fellow (Mauritania '87-'89)
Phi Kappa Phi Honor Society

Appendix F

Preparedness Groupings of Cities

Table F.1: Group 1 Preparedness Responses



Preparedness	DV		ID	CCVA	Planning: Plans for strategic withdrawal (retreat)	Planning: Rolling easement plans	Planning: Pop density assessments and regs	Planning: Building codes with EE measures	Implemention: ID new freshwater (drinking water) sources	Implemention: conservation of water for agriculture irrigation use	Implemention: stormwater drainage improvements	Implemention: wastewater treatment system upgrades	Implemention: protection of current freshwater (drinking water) sources	Implemention: protection from power disruptions during intense storms (hurricanes)	Implemention: Wildfire prevention and management	Implemention: Creation of urban (city) parks	Implemention: protection of existing wetlands or creation of new wetland areas	Implemention: Purchase of vulnerable properties in repetitive loss areas
GROUP 1	0		PB17															
	1		SL2	X														
	2		IR3	X				X										
	3		SJ1	X							X							
	3		PB5					X			X							
	4		bro2								X		X					
	4		**IR2**		X			X			X							
	5		bre8	X							X			X				
	5		V4					X			X	X						
	5		PB1					X			X			X				
	5		PB19	X				X	X		X							
	5		PB4								X					X		
	5		PB18									X		X		X		
	6		bro6	X				X				X						
	6		V7														X	X
	6		PB8				X	X			X	X	X					
	6		SL3								X	X	X					
	6		**PB20**	X							X						X	
	7		bre11	X	X		X	X			X							
	7		**bre13**		X		X	X	X		X	X	X					
	7		DU1					X			X	X	X					
	7		PB2	X				X			X					X		
	7		PB10	X				X			X						X	
	8		bre5					X			X	X		X		X		
	8		F2					X			X	X				X		
	8		PB14				X	X			X	X	X					
	8		MD10					X			X	X				X		
	8		MD7					X			X	X				X		

Table F.2: Group 2 Preparedness Responses

Preparedness	DV	ID	CCVA	Plans for strategic withdrawal (retreat)	Rolling easement plans	Pop density assessments and regs	Building codes with EE measures	ID new freshwater (drinking water) sources	conservation of water for agriculture irrigation use	stormwater drainage improvements	wastewater treatment system upgrades	protection of current freshwater (drinking water) sources	protection from power disruptions during intense storms (hurricanes)	Wildfire prevention and management	Creation of urban (city) parks	protection of existing wetlands or creation of new wetland areas	Purchase of vulnerable properties in repetitive loss areas
GROUP 2	9	PB9	X			X	X			X	X		X				
	9	**MD13**				X	X			X			X		X		
	10	bro8					X			X	X	X			X		
	10	bro10								X			X		X	X	
	10	V5	X				X			X					X	X	
	10	PB13	X				X			X	X	X	X				
	10	SL1	X				X	X		X	X				X		
	10	M1	X				X			X	X		X	X			
	10	MD5	X							X	X	X					X
	10	MD6	X				X	X		X			X		X		
	11	bre4				X				X			X		X	X	
	11	MD1	X				X			X	X		X		X		
	11	MD2	X				X			X		X	X		X		
	11	MD9		X			X			X	X		X		X		
	12	bro3					X			X	X	X	X		X		
	12	bro4				X	X	X		X	X		X		X		
	12	bro12	X				X			X	X				X	X	
	12	V1								X	X		X		X	X	
	12	DU2								X	X	X				X	X
	12	PB7				X	X	X		X	X	X	X				
	12	PB11		X					X	X		X	X			X	
	13	bre3				X	X			X	X	X	X		X		
	13	bre6				X				X	X			X		X	X
	13	bre10							X	X	X	X	X			X	
	13	bro5	X				X	X		X	X				X		X
	13	bro9		X		X	X	X		X		X	X		X		
	13	bro13	X					X		X	X	X	X		X		
	13	**SJ2**	X				X			X	X	X	X				X
	13	PB6					X			X		X	X		X	X	
	13	MD3		X			X		X	X	X		X		X		

Table F.3: Group 3 Preparedness Responses

Preparedness	DV	ID	CCVA	Plans for strategic withdrawal (retreat)	Rolling easement plans	Pop density assessments and regs	Building codes with EE measures	ID new freshwater (drinking water) sources	conservation of water for agriculture irrigation use	stormwater drainage improvements	wastewater treatment system upgrades	protection of current freshwater (drinking water) sources	protection from power disruptions during intense storms (hurricanes)	Wildfire prevention and management	Creation of urban (city) parks	protection of existing wetlands or creation of new wetland areas	Purchase of vulnerable properties in repetitive loss areas
GROUP 3	14	**bro15**				X	X			X	X	X	X		X		
	14	PB12					X	X		X	X	X			X		X
	15	bre7	X							X	X	X		X		X	X
	15	bro11	X			X	X			X		X	X		X	X	
	15	V6				X		X		X	X				X	X	X
	15	M2	X				X	X		X	X		X		X	X	
	15	**MD12**	X		X		X			X	X		X		X		X
	16	bro1	X				X			X	X	X	X		X	X	
	16	bro7	X				X			X	X	X	X		X	X	
	16	F1		X		X	X		X	X			X			X	X
	16	V2				X		X	X	X	X	X			X	X	
	16	**V8**	X				X			X				X	X	X	X
	16	PB16	X				X			X	X	X		X	X	X	
	16	MD8					X	X	X	X	X	X				X	X
	17	bre1	X			X				X	X		X		X	X	X
	17	bre2	X				X	X		X	X	X			X		
	17	**DU4**	X				X			X	X	X			X	X	X
	17	DU3	X			X	X	X	X	X	X	X	X		X		
	18	**F3**			X		X		X	X	X	X	X		X	X	
	19	bre12	X			X	X	X		X	X	X	X	X	X	X	
	19	V3				X	X	X	X	X	X	X	X		X	X	
	20	IR1					X		X	X	X	X	X		X	X	X
	20	PB3	X				X	X		X	X	X	X		X	X	X
	20	MD4	X		X	X	X		X	X	X	X	X		X	X	
	20	MD11	X		X	X	X			X	X	X	X		X		X
	22	bre9	X				X	X		X	X	X	X	X	X		X
	22	PB15	X				X	X		X	X	X	X	X	X	X	X
	23	bro14	X			X	X	X		X	X	X	X	X	X	X	X

Appendix G

Research Question 1: Other Risk Perception Responses

Figure G.1 shows how many years on the job the respondents had, while also indicating their overall risk perception of climate change. The risk perception score is an average for that section of the survey.

Figure G.1: Risk Perception and Years on the Job

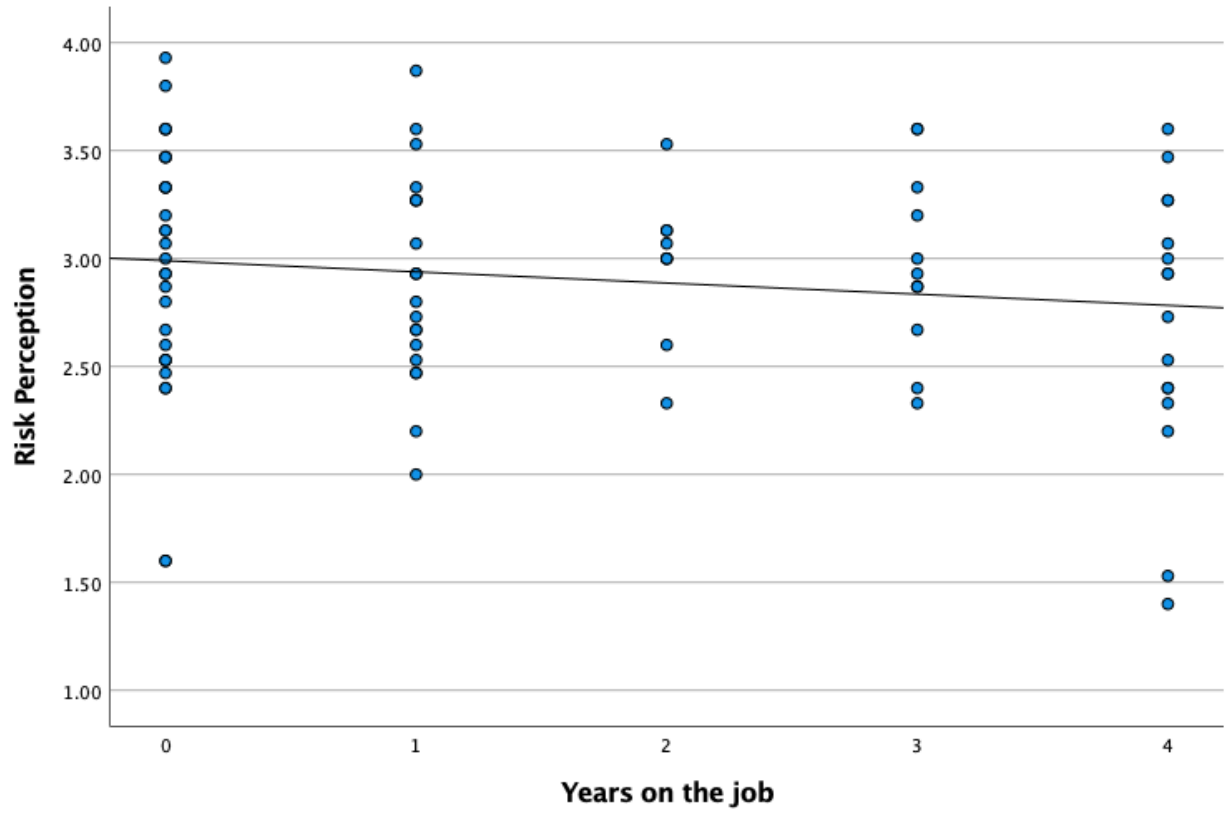


Table G.1 contain the respondents' grouped answers to the question of whether or not melting glaciers pose an environmental threat to their respective cities.

Table G.1: Cities' Risk Perceptions of Melting Glaciers	
"Melting glaciers pose an environmental threat to my city."	
Preparedness Groups	**Average Scores (max = 4)**
Group 1	2.36
Group 2	2.73
Group 3	2.79

Table G.2 contains the respondents' grouped answers regarding whether increased water-borne diseases as a result of flooding pose public health threat to their communities.

Table G.2: Cities' Risk Perceptions of Increased Water-borne Disease	
"Increased water-borne diseases as a result of flooding pose a public health threat to my city."	
Preparedness Groups	**Average Scores (max = 4)**
Group 1	2.61
Group 2	2.77
Group 3	2.79

Table G.3 contains the respondents' grouped answers regarding of whether increased saltwater intrusion into freshwater sources poses a public health threat to their communities.

Table G.3: Cities' Risk Perceptions of Increased Salt-water Intrusion on Public Health	
"Increased saltwater intrusion into freshwater sources poses a Public Health threat to my city"	
Preparedness Groups	**Average Scores (max = 4)**
Group 1	2.64
Group 2	2.97
Group 3	3.00

Table G.4 contains the respondents' grouped answers regarding whether increased saltwater intrusion into freshwater sources poses an economic threat to their communities.

Table G.4: Cities' Risk Perceptions of Increased Salt-water Intrusion on the Economy	
"Increased saltwater intrusion into freshwater sources poses an Economic threat to my city"	
Preparedness Groups	**Average Scores (max = 4)**
Group 1	2.61
Group 2	2.87
Group 3	2.93

Table G.5 shows the respondents' grouped answers to the question of whether increased saltwater intrusion into freshwater sources poses an environmental threat to their communities.

Table G.5: Cities' Risk Perceptions of Increased Salt-water Intrusion on the Environment	
"Increased saltwater intrusion into freshwater sources poses an Environmental threat to my city"	
Preparedness Groups	**Average Scores (max = 4)**
Group 1	2.68
Group 2	3.00
Group 3	3.04

Table G.6 contains the respondents' grouped answers to the question of whether threats to marine life poses a threat to the economy in their respective cities.

Table G.6: Cities' Risk Perceptions of Threats to Marine Life	
"Threats to marine life pose a threat to my city's economy"	
Preparedness Groups	**Average Scores (max = 4)**
Group 1	2.43
Group 2	2.77
Group 3	2.86

Table G.7 contains the respondents' grouped answers as to whether or not maintaining green spaces, parks, and wetlands is related to climate change adaptation.

Table G.7: Cities' Risk Perceptions related to Parks, Green Spaces, and Wetlands	
*"Maintaining green spaces, parks, and wetlands is **not** related to climate change adaptation."*	
Preparedness Groups	**Average Scores (max = 4)**
Group 1	3.04
Group 2	3.17
Group 3	3.71

Table G.8 contains the respondents' grouped answers regarding the state's wetland mitigation banking system.

Table G.8: Cities' Risk Perceptions related to Wetland Mitigation Banking	
*"Wetland mitigation banking (i.e., maintaining a wetland in a different part of the State of Florida while building over wetlands in my part of the State) is an acceptable environmental tradeoff and will **not** cause localized problems during times of flooding."*	
Preparedness Groups	**Average Scores (max = 4)**
Group 1	3.04
Group 2	3.20
Group 3	3.21

Table G.9 contains the respondents' grouped answers to the question of the impacts of impermeable surfaces.

Table G.9: Cities' Risk Perceptions related to Impermeable Surfaces	
"Cities with a lot of impermeable (e.g., cement) surfaces tend to be hotter during the summer than cities with more parkland and other impermeable (e.g., grassy) surfaces."	
Preparedness Groups	**Average Scores (max = 4)**
Group 1	3.43
Group 2	3.47
Group 3	3.64

Appendix H

Research Question 2: Other Social Framing Responses by Group

Table H.1 shows the respondent groups answered the question about environmental or natural disaster-related events without specifically speaking about climate change.

Table H.1: Cities Sending Messages to Constituents but Not about Climate Change	
"Our city sends messages to our constituents that are related to the influences of climate change such as flooding, stormwater drainage, coastal erosion, but we do not specifically mention climate change."	
Preparedness Groups	**Average Scores (max = 4)**
Group 1	2.68
Group 2	2.57
Group 3	2.68

Table H.2 shows how the respondent groups answered the question about whether the city speaks openly about climate change.

Table H.2: Cities Openly Speaking about Climate Change	
"Our city openly speaks about climate change threats and risks in public meetings as well as other information outlets (e.g., community meetings, Facebook discussions, etc)."	
Preparedness Groups	**Average Scores (max = 4)**
Group 1	2.36
Group 2	2.97
Group 3	2.89

Table H.3 shows how the respondent groups answered the question about whether their city would show more support about climate change if only they had better information about the impacts to their cities.

Table H.3: Cities Needing Better Information about Climate Change	
"Our city would show more support for climate change adaptation measures if we had better information about the impacts in our city, in particular."	
Preparedness Groups	**Average Scores (max = 4)**
Group 1	2.68
Group 2	2.90
Group 3	2.89

Table H.4 shows the grouped responses about whether citizens raise the issue of climate change to the city.

Table H.4: Constituents Speaking about Climate Change	
"Citizens of our city never raise the issue of climate change adaptation to city officials or to local elected officials."	
Preparedness Groups	**Average Scores (max = 4)**
Group 1	2.57
Group 2	3.23
Group 3	3.07