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EXAMINING WARNING RESPONSE AMONG SPANISH SPEAKERS IN THE UNITED STATES TO ENHANCE MULTILINGUAL WIRELESS EMERGENCY ALERTS

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EXAMINING WARNING RESPONSE AMONG SPANISH SPEAKERS IN THE UNITED STATES TO ENHANCE MULTILINGUAL WIRELESS EMERGENCY ALERTS

A DISSERTATION APPROVED FOR THE
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DEDICATION

Immigrants in the United States are the backbone of this nation, deserving our utmost respect. This body of work is dedicated to the millions of immigrants who contribute to our society and enrich our communities.

ACKNOWLEDGMENTS

As I type this, I am on the road to my new opportunity at the University of Illinois Urbana-Champaign (*I am a certified passenger princess, so no worries about me driving!*). *Record Scratch* "Yep that's me. You probably wondering how I got into this situation…"

This dissertation would not be possible without the assistance of my Ph.D. committee. A special thank you to my co-chairs, Dr. Ioana Cionea and Dr. Justin Reedy, for all your support, flexibility, and guidance as I navigated one of the most challenging yet fulfilling chapters of my life. You both built the foundation for the scholar I have become. Dr. Gretchen Montgomery-Vestecka, you are among my strongest role models, and your scholarship always inspires me. Dr. Mark Shafer, your passion is infectious, and I swear I will always be "part geographer" in everything I do moving forward. Thank you to the Department of Communication faculty, staff, and students for always supporting me, despite coming from the meteorology world!

As a starry-eyed master's student, I always knew I wanted to combine communication and atmospheric science for the betterment of multilingual communities in the United States. This wild dream, however, would not have been possible without the support of the Cooperative Institute for Severe and High-Impact Weather Research and Operations, the NOAA National Severe Storms Laboratory, and the NWS Storm Prediction Center. This dissertation was supported by the Joint Technology Transfer Initiative Program within the NOAA/OAR Weather Program Office under Award #NA22OAR4590187. Many dear friends and colleagues made my experience one that I will never forget. Special thank you to Irene Sans, Dr. Gina Eosco, América Gaviria Pabón, Liz Leitman, Dr. Holly Obermeier, Dr. Makenzie Krocak, Dr. Joe Ripberger, Dr. Sean Ernst, Dr. Patrick Marsh, and the rest of the BIU team for creating the blueprint of the scholar that I am. There is one sole person that made this experience

unforgettable. Dr. Kodi Berry, you are my biggest champion. You are the epitome of success, and I could not have asked for a better advisor. In everything that I do in the future, I will take the lessons you have taught me in hopes that I will become even half the mentor that you were to me. I will miss you dearly, but I take solace in the fact I get to spread your legacy!

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I also dedicate this special moment to my family in Perú. By the time of writing, I will not have seen you all in over 21 years. My heart yearns for the day I reunite with you all, and I cannot wait to celebrate this accomplishment together. To my dear Jaqueline Nogueira Falcón, thank you for being the best big sister. You have been there for me and my mom in the hardest of times, and I will always be grateful for you. Carlos Lluen Falcón, you are my sidekick, my favorite Beyhive member. I am proud to be your cousin every day. You have my entire heart. To my father, Paulino Trujillo, thank you for everything. No matter the distance, you have called me weekly to make sure I was doing well. I am proud to continue the Trujillo name.

Finally, I want to devote this dissertation to my family here in the United States. To my dog, Snoopy, thank you for being my partner in crime. I should give you co-author credit for this piece of work, as you would lie next to me during every single one of my writing sessions. This dissertation would not have been possible without my life partner, Liam Llewellyn. Every day that I spend with you, I fall even more in love with you. You are my foundation and always believed in my capabilities. Nobody ever notices the "behind the scenes," but you have been instrumental in my success. I am in awe of your character and the man you are. Let this be the first of many victories for us, ¡mi amor! And last but not least, I owe everything to my mother, Eufracia Hijar Falcón. Thank you for your love, devotion, and all the sacrifices you made along the way to make a moment like this possible. You are the definition of resilience and grace. I am so honored to be your son. My decision to include both of my last names, Trujillo-Falcón, in publications was both cultural and intentional – may our family name live on. ¡Te amo, mami!

To my future self, I hope you can look back at this moment and realize all that you have overcome. Always stay humble and never lose sight of the true purpose of this work: serving underserved populations in the wake of disaster. Remember to lift as you climb and treat everyone with respect. As a professor, always recall when you were a student and strive to be considerate and caring. This world can be a cruel place; you have experienced racism and prejudice even in your own field. Never let these individuals dictate your path. Stay grounded in your truth. When you first started this career path, some said you would never make it this far as a DACA recipient. But take solace in the words of our beloved Queen B, today and always:

> "I put my heart and my soul into writing my first album *Dangerously in Love*. And after playing the songs for my record label, they told me, I didn't have ONE HIT on my album. (1) *Dangerously In Love*, (2) *Me, Myself, and I*, (3) *Baby Boy*, (4) *Naughty Girl*, and my favorite song, (5) *Crazy In Love*. And they told me I didn't have ONE HIT on my album?! I guess they were kinda right… I had ***five***."
>
> – Beyoncé Giselle Knowles-Carter

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Abstract

As one of the fastest growing groups in the United States, the Spanish-speaking population of 41.2 million represents one in ten Americans today. Spanish-speaking communities in the United States come from diverse backgrounds in Latin America, Europe, and Africa, each with unique cultural practices and hazard experiences tied to their places of origin. Such diversity, while enriching, poses considerable challenges for risk communicators trying to engage with multilingual populations in disaster contexts. Addressing the linguistic and cultural needs of these communities demands evidence-based research to establish best practices in our current emergency system.

This dissertation has two objectives aiming to enhance emergency communication systems and messages for the U.S. Spanish-speaking public. First, by integrating intercultural communication concepts, this qualitative dissertation investigates the role of cultural factors—such as disaster subcultures, dialects, and immigration status— in the understanding of warning systems by multilingual speakers in the United States. Second, by employing two risk communication frameworks, I examine how Spanish speakers in the United States respond to existing mobile, multilingual emergency warnings known as Wireless Emergency Alerts (WEAs). More specifically, I employ the warning response model (WRM) and the extended parallel process model (EPPM) to examine both the cognitive processes of warning reception and the emotional behaviors involved in decision making. To achieve these goals, I conducted 27 think-aloud and semi-structured interviews with members of the Spanish-speaking population.

Through subsequent constant comparative analysis, my results from the two objectives unravel how language disparities and cultural disconnect exacerbate vulnerabilities for non-English speaking populations. First, I found that Spanish speakers in the United States interpret

their local warning systems through multiple perspectives. Foreign-born immigrants experienced culture shock upon encountering U.S. warning systems for the first time and reported similar adaptation processes overall. U.S.-born Spanish speakers understood warning systems not only through their local geography but also through cultural experiences derived from their community and ethnic origins in Latin America. Spanish speakers living in border communities experienced differing and sometimes conflicting warning systems between the United States and Mexico. Undocumented immigrants resisted adapting to U.S. warning systems, recognizing the systemic injustices underlying these emergency systems. Second, I discovered that clear, consistent, culturally competent, and jargon-free messages empower Spanish speakers to take protective action against natural hazards like tornadoes. These effective messages were almost always the 360-character WEA messages, as they provided the necessary contextual information.

I use these insights to provide recommendations for a more inclusive multilingual emergency system in the United States. I advocate for increased coordination between governmental agencies, community leaders, and international entities, fostering a learning environment to better tailor messages for multilingual groups. Additionally, I propose the implementation of WEAs in multilingual settings to reach more underserved communities. Based on insights from my participants, I propose slight modifications to 360-character Spanish-language WEAs, which were overwhelmingly favored by my respondents. Through these recommendations, I outline a vision for a future multilingual emergency system, highlighting the key cultural and linguistic factors that need to be considered to ensure warning equity for all.

Keywords: Risk communication, bilingualism, Wireless Emergency Alerts, disaster subcultures, social science, warning response model, extended parallel process model, Hispanic, Latino

CHAPTER 1: INTRODUCTION

On May 11, 1970, residents of Lubbock, Texas faced an F5 tornado, categorized as the highest and most destructive rank on the Fujita Tornado Scale. The National Weather Service (NWS) issued warnings to residents several minutes prior to the tornado, determining that their communication and educational campaigns demonstrated "excellent quality and scope" in effectively conveying the imminent threat (U.S. Department of Commerce, 1970). The agency, however, also acknowledged that not *all* residents received adequate information throughout the event. Language barriers prevented multilingual populations, a sizable group in the area, from receiving important, lifesaving information. The Spanish-speaking population represented approximately one half of all deaths. For the first time in a federal report, the NWS acknowledged that language barriers amplified vulnerability in a disaster.

Despite the seminal finding, the United States government at the time did *not* take the lead in communicating to multilingual populations, leaving the responsibility to bilingual media partners. The lack of organization made national headlines after a violent tornado in 1987 passed through Saragosa, Texas, a town where "between 50 and 80 percent" of the population spoke Spanish (National Research Council, 1991, p. 7). Aguirre (1988) found that the NWS issued warnings only in English, leaving one radio announcer with the responsibility of translating alerts. The reliance on one individual resulted in delays and mistranslations of important terminology. Specifically, the radio announcer admitted that they did not properly translate the word "warning" into Spanish, causing mass confusion among the affected population right as the tornado approached. As a result of the tragic consequences of the disaster, the National Research Council (1991) made a nationwide call for the standardization of bilingual information across the country.

Present day, the NWS has advanced communication efforts to multilingual communities across the United States. Within the agency, two volunteer translation teams provide life-saving information in Spanish on a nationwide scale (Trujillo-Falcón et al., 2021), while some local offices occasionally translate their information into other languages, such as Samoan and Vietnamese (Smith et al., 2023). These multilingual efforts, however, have not been integrated into the broader emergency system due to their voluntary nature and lack of academic, evidence-based research (Tripati et al., 2024).

The need to pursue this integration is critical, though. Representing one in every five Americans, a total of 67 million individuals speak a language other than English at home (U.S. Census Bureau, 2021). The largest non-English-speaking population, Hispanics, are expected to triple by 2060 (Instituto Cervantes, 2022). Moreover, these communities continue to evolve as new nationalities immigrate to the United States (Montgomery et al., 2021). It is crucial to understand multilingual populations as their culture and language can affect how they perceive, interpret, and react to weather hazards, forecasts, and warnings (Trujillo-Falcón et al., 2022).

To address gaps in warning dissemination across language groups, the United States government has begun to reimagine their federal emergency communication system. Emergency officials can send a short warning message to users with mobile devices within a geo-targeted area through what are known as Wireless Emergency Alerts (WEAs). WEAs have proven to enhance individual decision making before, during, and after disasters (Bean & Grevstad, 2023; Kuligowski et al., 2023). As of 2019, the Federal Emergency Management Agency (FEMA) enhanced the capabilities of their mobile alerting system, including added support for Spanish-language emergency alerts (FEMA, 2023). With this added support, the NWS has translated all weather-hazard WEAs into Spanish. As of June 2020, they are also automated so that the

Spanish version releases alongside the English WEA (National Weather Service, n.d.a). These recent efforts in Spanish, while a significant stride to equitable risk communication practices, are not centered in evidence-based research. Previous work has suggested that well-intentioned messages can get lost in translation, and, without research insights, terminology can communicate different actions to multilingual populations (Abukhalaf & Meding, 2021; Bitterman et al., 2023; Trujillo-Falcón et al., 2022). Especially under a changing climate, in which disasters are expected to intensify and produce significant impacts to particularly underserved populations (Tripati et al., 2024), it is paramount that evidence-based, risk communication research is developed collectively with members of the community so that lifesaving information can be accessible to multiple groups (Morales et al., 2023).

Risk communication, defined as the iterative exchange of information among individuals, groups, and institutions related to the assessment, characterization, and management of risk (McComas, 2006), is an interdisciplinary field that aims to empower individuals' decision making during imminent threats. Risk communication academics have developed several useful theories and frameworks to provide insight into best practices to encourage safe behaviors. In the realm of WEAs, where character counts can limit context and characterization of imminent disasters, risk communication research has identified message content strategies that motivate people to take protective action (Mileti & Sorensen, 1990). In my dissertation, I extend this area of research to Spanish, exploring the efficacy of bilingual WEA messages with Spanish speakers in the United States. I believe that risk communication research can provide practical solutions to improved WEAs in Spanish, all while advancing theoretical frameworks in our field.

To accomplish the goal of examining the efficacy of WEA messages in Spanish, I review two risk communication frameworks, namely the warning response model (WRM) and the

extended parallel process model (EPPM). The WRM highlights five critical elements in an "effective" warning message that predict an increased likelihood of an individual taking protective action (Mileti & Sorensen, 1990). Namely, an alerting authority must include (1) the *source* of the warning message, (2) the imminent *hazard* from which people are taking protective action against, (3) *guidance* for how to respond to the warning message, (4) the specific *location* of the hazard, and (5) *timing* information that specifies when the warning begins and expires. The WRM goes further by also explaining the perceptions and behaviors that occur after an individual receives a warning message. More specifically, an individual *understands*, *believes*, and *personalizes* a warning message while *seeking additional information* and ultimately considering protective *decisions* (Mileti & Peek, 2000; Mileti & Sorensen, 1990).

Historically, the WRM has primarily concentrated on the textual content of warning messages and the outcomes they produce (Wood et al., 2018). Nonetheless, recent work is expanding this focus. By integrating concepts from the EPPM, Sutton et al. (2021) have enhanced the WRM, improving its ability to predict how people will act in response to warnings. According to the EPPM, for a message recipient to consider taking protective action, they must not only perceive and acknowledge the threat as real, but also believe that their response will effectively mitigate the risk (Witte, 1992). The latter concept, known as efficacy, can be separated into two categories: (1) *response efficacy,* or the belief that a protective action will result in safety and (2) *self-efficacy*, or the belief an individual can perform the recommended action. Sutton et al. (2021) found that, when including efficacy in addition to the WRM variables (i.e., understanding, belief, personalization, milling, and decision making), message designers were able measure the behavioral intent of individuals more accurately, offering a more comprehensive understanding of how individuals respond to warning messages.

Although the established literature has provided insights into proper message protocol and how individuals cognitively process warnings, I argue that it has not adequately addressed the views of people who speak languages other than English. Multilingual populations, in general, process warnings differently than English speakers due to their varying cultures of disaster preparedness, or disaster subcultures, that originate from different parts of the world (Anderson, 1965; Engel et al., 2022; Wenger & Weller, 1973). Within Spanish-speaking communities, an individual's risk perception is shaped by the disaster subculture unique to their country of origin, as they use previous experiences to respond to future disasters (Gaviria Pabón, 2022). Recent work has also focused on examining dialects to explore how people perceive risk. Trujillo-Falcón et al. (2022) found that Spanish speakers from different countries of origin perceive the translation of warnings in varied ways due to their regional dialect, indicating that the intended message can become lost in translation. Understanding a Spanish speaker's cultural and linguistic backgrounds, then, is important when developing risk communication messages that enhance protective action (Lindell & Perry, 2004; Senkbeil et al., 2014).

When considering what constitutes an "effective" warning message, previous literature underscores why messaging may not resonate with the most underserved groups. Warning systems are shaped by hierarchical systems of authority that dictate the definition of an emergency and determine its relevance for different groups (Ellcessor, 2022). This system naturally leads to a disparity in how emergencies are recognized across White and culturally diverse populations, with criteria often tailored to the experiences of the White majority (Ellcessor, 2022). Due to systemic vulnerabilities, Spanish speakers may not trust official alerting agencies and would rather receive (and trust) information from informal sources (Fitzpatrick & Spialek, 2020; Trujillo-Falcón et al., 2024). The history of family separation and

discrimination by emergency authorities have fostered this sense of distrust among these populations, undermining the effectiveness of formal communication channels (Fussell et al., 2018). In particular, multilingual undocumented immigrants often find themselves overlooked in emergency preparedness plans, lacking access to crucial life-saving resources such as information and monetary aid during disasters; this oversight leaves them disproportionately vulnerable in times of crisis (Méndez et al., 2020, 2024). Essentially, an individual's ability to mobilize the components articulated by the WRM and EPPM is severely limited when the warning message is not in their native language and/or originates from a state institutions with a documented history of violence toward the individual's in-group (Trujillo-Falcón et al., 2024). Warning systems, then, should be tailored to consider the perspectives of multilingual and immigrant groups, as they tend to be the most greatly affected in a disaster (Trujillo-Falcón et al., 2021). More specifically, they should address *disaster subcultures, dialect, and immigration status.*

Integrating risk communication and intercultural communication concepts, I aim to foster through this dissertation a more profound understanding of the communication mechanisms underpinning warning systems and messages among multilingual communities. First, I explore the role of cultural concepts, such as *disaster subcultures*, *dialect,* and *immigration status*, in how people make sense of warning systems in the United States. Second, using the WRM, I develop research questions that explore how multilingual speakers *understand, believe, personalize, make decisions, and mill* based on information presented by Spanish-language WEA messages. I also incorporate concepts from the EPPM and examine the *response efficacy* and *self-efficacy* that WEA messages produce for multilingual speakers. As I examine these concepts,

I also integrate intercultural communication concepts to provide a comprehensive analysis of how Spanish speakers understand warnings.

The dissertation adopts an interpretive paradigm and uses qualitative research methods to answer its research questions. The interpretive paradigm is predicated on the belief that reality is a social construct emerging from human interactions. This perspective views reality as highly contextual, co-created through social exchanges, and affirmed via intersubjective agreement (Lindlof & Taylor, 2019; Tracy, 2020). Interpretivists believe knowledge is not fixed but is instead continuously shaped and reshaped through social interactions and engagement with the environment (Littlejohn et al., 2021). This approach values the sensemaking process from the participant's point of view, examining not only behaviors, but intentions, stories, and emotions (Lindlof & Taylor, 2019). The researcher's experience can significantly influence research outcomes, underscoring the role of reflexivity in this methodological paradigm (Tracy, 2020). Deriving naturally from the interpretive paradigm, qualitative research seeks to capture the rich, in-depth experiences of the studied population (Lindlof & Taylor, 2019; Tracy, 2010, 2020). It enables researchers to immerse themselves into the perspectives of insiders, often employing storytelling. By doing so, researchers can gain a nuanced understanding of participants' experiences and the contexts that shape them.

By adopting a qualitative approach, I delve beyond conventional risk communication frameworks in the dissertation, offering a richer, more culturally sensitive understanding of disaster communication processes, from the perspectives of an understudied community (i.e., multilingual speakers). Incorporating concepts from quantitative models such as the WRM and the EPPM into qualitative research within communication studies also addresses the multifaceted nature of the human experience, cultures, and behaviors. This integration is not about quantifying

qualitative insights but rather about leveraging structured frameworks from quantitative models to enrich the understanding of complex social phenomena (Creswell & Plano Clark, 2017). This approach is particularly relevant in the context of disaster communication, where quantitative frameworks such as the WRM and EPPM can provide a structured framework for how individuals interpret and respond to rapidly evolving emergencies. These frameworks have also played a pivotal role in shaping federal policies governing the dissemination of emergency warnings across the United States (Cain et al., 2024; Olson et al., 2024; Sutton et al., 2024), demonstrating the tangible impact of integrating quantitative models with qualitative research. By adopting this approach, I champion the needs of underserved populations by highlighting the shortcomings of a monolingual emergency communication system, through frameworks with which practitioners are familiar.

I conduct the qualitative research of my dissertation by incorporating think-aloud and semi-structured interviews, illuminating how cultural identity, language preferences, and community dynamics intersect with warning systems understanding and risk perception of messages. As established by the WRM, it is acknowledged that individuals follow a step-by-step cognitive process when they first encounter a warning message (Mileti & Peek, 2000; Mileti & Sorensen, 1990). Think-aloud interviews, during which participants are asked to vocalize their thoughts as they process the information presented to them, serve as a key technique for exploring these cognitive steps (Ericsson & Simon, 1984). This approach is particularly valuable for the research questions I tackle, providing insights into the thought processes individuals experience when they make sense of warning systems and messages. Semi-structured interviews employ closed- and open-ended questions, often accompanied with follow-up questions, allow for the exploration of specific themes in a conversational style (Creswell & Poth, 2018; Tracy,

2020). This flexibility facilitates a deeper understanding of participants' attitudes, beliefs, and behavior, which is suitable for contextualizing emergency warning messages. Previous research has successfully adopted this approach. For example, Bean et al. (2023) implemented think-aloud and semi-structured interviews and effectively understood how members of the United States public made sense of probabilistic WEA messages.

Through this dissertation, I contribute to a more inclusive risk communication field by incorporating intercultural concepts into existing risk communication models and developing nationwide policy recommendations for warning systems and messages. My findings will highlight the various factors that shape how Spanish speakers understand warning systems. Coming from different parts of Latin America and the United States, Spanish speakers tend to interpret warning systems through diverse cultural viewpoints (Gaviria Pabón, 2022). In respect to WEA messages, I will identify specific instances in which cultural and linguistic nuances may hinder comprehension, belief, personalization, milling, and decision-making processes. These issues can offer a new perspective in WEA research, as previous studies have primarily identified barriers to reception in English (Kuligowski et al., 2023; Olson et al., 2024). I also explore how disaster subcultures affect one’s self- and response efficacy throughout a disaster. Individuals need detailed guidance on protective actions tailored to the hazards they are accustomed to in order to feel confident and empowered to take action (Sutton et al., 2021; Trujillo-Falcón et al., 2024). All my findings will be integrated into the existing emergency system, leading to recommendations for alerting authorities responsible for disseminating Spanish-language WEA messages. Overall, my research enhances the U.S. warning system by integrating multilingualism and laying the groundwork for nationwide policies that support multilingual warning messages. The lack of evidence-based research in the non-English domain

hinders policymaking (Olson et al., 2024; Sutton et al., 2024), and this dissertation addresses this oversight.

The dissertation is organized as follows. Chapter 1 has reviewed advances and opportunities in bilingual warning systems and messages, outlining the challenge my research aims to address. Chapter 2 follows with a detailed review of scholarly literature in risk communication and intercultural communication, serving as the theoretical foundation for examining (1) warning systems in the United States and (2) Spanish-language WEA messages. This review leads to the development of research questions and also justifies the proposed approach for my dissertation study. In Chapter 3, I detail the dissertation's methodology, which combines think-aloud protocols and semi-structured interviews with Spanish-speaking participants. I describe the data analysis method, using a constant comparative analysis to iteratively examine participants' narratives (Glaser & Strauss, 1967; Lindlof & Taylor, 2019). The findings' credibility is established through validation strategies respected in qualitative research (Creswell & Poth, 2018). Chapter 4 reviews the findings from my study, incorporating narratives from Spanish-speaking participants to highlight the themes derived to answer the research questions. Finally, Chapter 5 discusses the implications of these findings and proposes theoretical contributions and practical applications for the fields of risk communication and intercultural communication, paving the way for policies on multilingual warnings in the United States.

CHAPTER 2: LITERATURE REVIEW

Warning Systems and Wireless Emergency Alerts

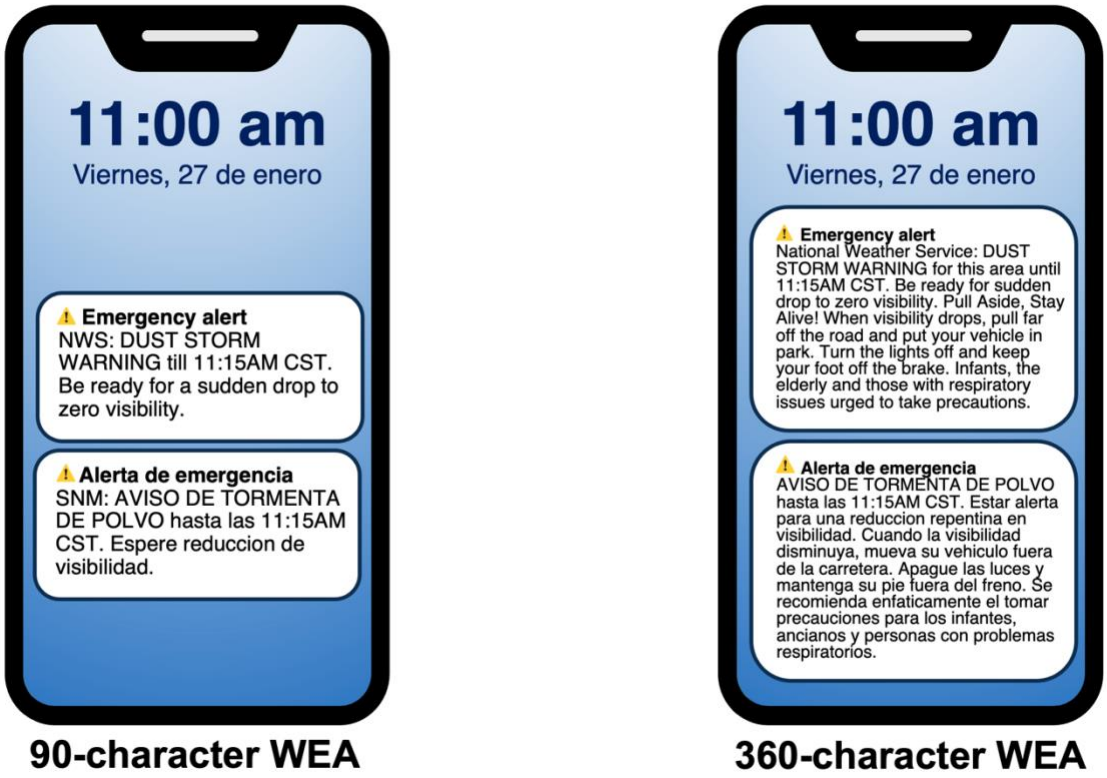
Since their inception in 1951, emergency broadcasts in the United States have transformed into a vital lifeline, providing lifesaving information during disasters (National Academies of Sciences, Engineering, and Medicine, 2018). Over the years, these broadcasts have adapted to embrace emerging technologies, extending their reach through radio, television, and mobile devices, to ensure critical alerts can reach the public swiftly and effectively (National Academies of Sciences, Engineering, and Medicine, 2018). In 2006, President George W. Bush signed Executive Order 13407, "Public Alert and Warning System," which mandated that the country have an effective and reliable system to notify the American people in the event of war, terrorist attacks, natural hazards, or other disasters (Exec. Order No. 13,407, 2006). The Executive Order resulted in Congress creating the Warning, Alert, and Response Network (WARN) Act, establishing the Integrated Public Alert and Warning System (IPAWS). IPAWS combines existing (e.g., television, radio) and new (e.g., mobile) warning systems into one modern network. The WEA program originated in 2012 and became part of the IPAWS infrastructure, opening the door for policy and procedures to be developed that enabled mobile devices to become mediators of warning information. As a result, FEMA authorized alerting officials to broadcast WEAs to mobile devices to help people stay alert in imminent emergency situations (Bean et al., 2015).

WEAs have provided critical information about natural hazards, public safety, missing child notices, and national emergencies (FEMA, 2023; National Academies of Sciences, Engineering, and Medicine, 2018). WEAs are issued by official alerting authorities at the federal, state, local, tribal, or territorial level. WEAs are broadcast one-way from cell towers to

geographically targeted areas and resemble text messages. The length of a WEA message is determined by the mobile coverage: WEAs can be up to 360 characters in length on devices using 4G LTE technology and up to 90 characters for devices on 3G or earlier networks. To enhance accessibility for those with visual or hearing disabilities, these terse messages are accompanied by a unique sound or vibration. In 2019, FEMA enhanced the capabilities of their services to support Spanish-language WEAs. The language of a WEA is determined by the phone settings (i.e., what language a user sets on their phone). All individuals in the United States receive English-language WEAs. If Spanish is selected as the primary language, then those individuals will receive both English and Spanish versions of the WEA if a translation is provided by an alerting authority (Figure 1).

Figure 1

A Dust Storm Warning WEA in English and Spanish Displayed on an iPhone



With this newfound capacity, WEAs can reach a specific target audience and communicate lifesaving information in a matter of seconds. Academic research has advanced strategies for developing impactful messages to local communities and have heavily influenced how WEAs are disseminated nationwide (Kuligowski et al., 2023). Over the past three decades, research on warning messages has focused on three primary areas. *Message content,* or what is in the message, includes the textual and visual information presented within a warning message (Mileti & Sorensen, 1990). In a WEA, the message content would involve the 90- or 360-character message that is presented to users. *Message style,* or how the message is presented, involves the tone, language, format, and design used to convey information (Mileti & Peek, 2000). WEA message writers, for example, can choose to produce their message free of jargon and/or be specific (or general) in their messaging. *Message structure,* which refers to how information or claims are organized within a warning message, typically includes strategizing the sequence of content (Shen & Bigsby, 2013). In a WEA message, this might involve prioritizing key points at the start or the end of the message.

Research within these three primary areas has advanced our understanding of how the public perceives and responds to warning messages. For example, shorter messages often lead to increased confusion among individuals, particularly when encountering unfamiliar hazards, as the character limit imposed on the message restricts contextualization (Bean et al., 2016). However, studies have shown that supplementing these messages with visuals or text describing protective actions can elevate the urgency of a disaster and empower the public to take appropriate measures, such as sheltering during a tornado (Sutton et al., 2021). These findings contradict earlier assumptions that solely textual information was adequate for effectively conveying the risk and severity of a hazard (Casteel & Downing, 2016), underscoring the

evolving understanding of effective risk communication strategies. Although these insights have provided significant contributions to saving life and property, there is still limited knowledge about whether these recommendations resonate with multilingual populations (Ellcessor, 2022).

Communicating Risk in Spanish: A Different Landscape

Defining "Spanish Speaker": Exploring the Interplay of Culture, Race, and Ethnicity

Understanding the concepts of culture, race, and ethnicity is essential for analyzing the diverse identities within Spanish-speaking communities in the United States. These definitions are foundational for the population I am studying in this dissertation. In the following paragraphs, I will define the term "Spanish speaker" through the lens of these concepts.

Culture can be defined as highly variable systems of meanings which are learned and shared by a people or an identifiable segment of a population (Betancourt & López, 1993; Rohner, 1984). In other words, culture comprises the subjective, human-made part of the environment, including social norms, roles, beliefs, and values (Herkovits, 1948; Triandis & Brislin, 1984). Applying the term to Spanish speakers in the United States, the concept of culture can help explain the diverse composition of the stated community. Spanish speakers in the United States can bring various, competing systems of meanings that stem from their nationality, upbringings, or immigration status to name a few (Verkuyten et al., 2019)

Race, on the other hand, is defined as a social construct used to group individuals, artificially explaining group variations (Stephan & Stephan, 2000). Traditionally, race made distinctions among physical characteristics, such as skin color, to discriminate across populations (Jones, 1991). The term race is considered outdated for many academics, as it has been proven that racial groups are more alike than they are different (Betancourt & López, 1993). Despite abundant evidence that race is a social construct, people still use the term race present day as

classification systems, sometimes even to empower their own identities (Stephan & Stephan, 2000).

Ethnicities are groups that are characterized in terms of a common nationality, culture, or language (Betancourt & López, 1993). For Spanish speakers in the United States, this means identifying with a rich tapestry of ethnic backgrounds, often tied to their countries of origin in Latin America, Spain, and Africa (U.S. Census Bureau, n.d.). Spanish speakers in the United States can identify with cultural, racial, and/or ethnic categories. However, previous research has highlighted that Spanish speakers in the United States often encounter the challenge of selecting from limited lists of racial and ethnic labels on governmental forms and everyday questionnaires, resulting in widespread confusion within the community (Terry & Fond, 2013).

When considering Spanish speakers in the United States, a researcher can categorize them into various cultural, racial, or ethnic groups and still technically be correct. For example, most researchers resort to using ethnicity through the incorporation of "Hispanic or Latino." The U.S. Census Bureau (n.d.) defines Hispanic or Latino as a person of Mexican, Puerto Rican, Cuba, Central, or South American or other Spanish culture or origin, regardless of race. While this categorizes *most* Spanish speakers, it does not encapsulate *all* of them. Spanish speakers are not *all* Hispanic or Latino; many come from Europe, Africa, and other parts of the world (Instituto Cervantes, 2022). Another limitation of this approach is the unintentional erasure of other languages. Not all Hispanic and Latino individuals have to speak Spanish to be considered "Hispanic or Latino"; they could mainly speak Portuguese or even practice an indigenous language. A lack of consistency in categorizations hinders any progress when making impactful recommendations in policy and practice (Terry & Fond, 2013). Most recently, the term of *Latinx* has been introduced to academic spaces to foster gender inclusivity. While the term resonated

with a few Spanish speakers from the United States, the word is unpronounceable in Spanish, leaving many to criticize it when using it with Spanish speakers (Noe-Bustamante et al., 2020). People have proposed using *Latine*, a gender inclusive term that is able to be pronounced in Spanish to increase equity among this population, though that topic is still hotly debated (Miranda et al., 2023).

Considering all the challenges presented, I categorize my community by the *language* they speak first, followed by *cultural, racial* and *ethnic* categories. To emphasize that not all Spanish speakers are Hispanic or Latino, I first resort to the cultural phenomena of *language* to properly label my community. Language is a knowledge system that all my participants embrace in their everyday life that helps create their "internal modes of reality" (Keesing, 1974). Next, I make important distinctions of Spanish speakers in the United States by implementing cultural, racial and ethnic categories (e.g., Mexican American, White, Chicano). By doing so, I emphasize that this group is not a monolith; rather, they represent different nationalities, social constructs, and identities.

By using this definition in risk communication, I have been able to unravel different ways Spanish speakers respond to weather and climate disasters in previous work. In one study, I identified the different ethnolinguistic identities of Spanish speakers and argued that it affects how they perceive risk terminology altogether (Trujillo-Falcón et al., 2021), a concept further explained in the next section. In another study, I focused on ethnic origin and race to explore hidden inequities among immigrant populations from different parts of Central America (Trujillo-Falcón et al., 2024). For this dissertation, I will continue to apply this nuanced approach to better understand and address the unique needs of the U.S. Spanish-speaking community in the context of emergency communication.

Disaster Inequities within Spanish-Speaking Communities

Disaster inequity refers to the unequal impact of disasters on different populations, in that vulnerable groups suffer disproportionately due to systemic social, economic, and political inequalities (Fothergill et al., 1999). These disparities manifest themselves as social vulnerabilities, or pre-existing factors that contribute to a community's ability to prevent human suffering and financial loss in the event of disaster (Cutter et al., 2000). Such vulnerabilities are pronounced within Spanish-speaking communities. Arlikatti et al. (2014) emphasized the issue of social vulnerability linked to language barriers, showing that disaster relief organizations frequently communicated important messages through channels not accessed by multilingual communities in Texas. The language disparity resulted in non-English speaking communities in Texas facing increased challenges in receiving important warnings, ultimately hindering their ability to prepare for and respond to emergencies effectively. Messias et al. (2012) revealed that socioeconomic status significantly limited Spanish speakers' access to vital lifesaving resources and information. More specifically, poverty prevented Spanish speakers from being able to afford essential emergency supplies and have access to reliable transportation, which are crucial for effective evacuation efforts. Fitzpatrick and Spialek (2020) found that social capital, or the bonds that tie citizens together, played a crucial role in coordinating and aiding disaster recovery efforts, primarily benefiting White communities following Hurricane Harvey. Conversely, Spanish-speaking communities, which historically possessed lower levels of social capital due to marginalization, found themselves excluded from emergency response planning, leaving them to fend for themselves in the aftermath of a historic disaster. These examples clearly demonstrate how social vulnerabilities serve as a precursor to disaster inequity.

Spanish-speaking communities across the United States have consistently faced disproportionate impacts from a variety of environmental threats (Trujillo-Falcón et al., 2021). For tornado hazards, language barriers have prevented Spanish-speakers from receiving critical information before, during and after a disaster (Ahlborn et al., 2012; Senkbeil et al., 2014; Trujillo-Falcón et al., 2022). Trujillo-Falcón et al. (2024) reported that Spanish-language WEA messages played a crucial role in safeguarding communities that were previously unaware of an approaching tornado, owing to the absence of information available in Spanish. In the face of wildfires, multilingual communities frequently find it challenging to respond effectively, largely due to a lack of available communication in their native languages and scarce resources for evacuation (Davies et al., 2018). These difficulties are exacerbated by their socioeconomic and immigration statuses, adding layers of complexity to take protective action and trust credible sources during the most crucial moments of disaster (Méndez et al., 2024). Similarly, these vulnerabilities are evident in the context of hurricanes, where factors such as language barriers, income levels, and immigration status obstruct the decision-making process for protective actions (Fitzpatrick & Spialek, 2020; Hilfinger Messias et al., 2012; Peguero, 2006). Through all hazards, disaster response agencies often treat multilingual communities as a monolithic group, overlooking the diverse cultural and linguistic nuances within these populations (Nepal et al., 2012). This approach exacerbates existing disparities by failing to address specific needs among the most vulnerable populations (Tripati et al., 2024). In reality, Spanish-speaking populations in the United States originate from a range of locales across Latin America, Africa, and Europe (see Table 1), with about two-thirds being immigrants themselves or the children of immigrants (Instituto Cervantes, 2022; Lipski, 2008).

Table 1

Top 5 Origin Groups for Spanish Speakers in the United States in 2022

Origin Country	# of each specific group in the U.S. population (2022)	% of Spanish speakers
Mexican	23,487,262	56.9
Puerto Rican	3,046,322	7.4
Salvadoran	1,885,421	4.6
Dominican	1,713,842	4.2
Cuban	1,682,064	4.1

Note. Data was retrieved from the U.S. Census Bureau (2021) American Community Survey 5-Year Estimates.

Although significant efforts have been made to uncover disparities contributing to social vulnerability in underserved communities, certain factors have not been properly addressed. Emphasizing that communities are not monolithic, Senkbeil et al. (2014) highlighted the need to examine culture more closely. Culture encompasses a wide range of beliefs, values, and practices that shape individuals' interactions with the world around them, including their response to emergencies (Douglas & Wildavsky, 1982). Cultural concepts have demonstrated their influence on emergency preparedness and response. For example, cultural worldviews significantly impact how individuals perceive and respond to impending hazards, affecting their risk assessment, information-seeking behavior, and decision-making processes (Morss et al., 2020).

Subcultures, or a set of symbolic ideas held by a collectivity within a larger culture (Gudykunst & Kim, 2003), can provide even deeper insights into how specific groups respond before, during, and after environmental hazards (Vaughan & Nordenstam, 1991). When repeatedly exposed to disasters or living under their constant threat, members of a subculture cultivate a specialized knowledge base for disaster response, known as *disaster subcultures* (Anderson, 1965; Wenger & Weller, 1973). For example, in Chile, earthquakes are frequent due to its geographical position, leading to a subculture in which stories of past disasters are passed down through generational stories, legends, and rituals (Engel et al., 2022). This shared history helped Chileans become more resilient in response to a historic earthquake in 2010, setting them

apart from tourists who, lacking a deeply-rooted disaster subculture, suffered higher fatalities (Engel et al., 2022). In the United States, disaster subcultures within Spanish-speaking communities are diverse, originating from individuals' homelands across Latin America, Europe, and Africa (Gaviria Pabón, 2022). Social vulnerabilities become pronounced for immigrants who are unacquainted with the types of disasters specific to the United States (Trujillo-Falcón et al., 2024). Incorporating culture in risk communication, then, can help practitioners tailor their messaging strategies to the experiences of individuals, thus empowering their response.

Extending the discussion of disaster subcultures, messages should not only align with the cultural backgrounds of communities but also resonate with their linguistic nuances (Federici, 2022). Effective communication in such contexts requires a deep understanding of how language and identity interplay within these groups. Ethnolinguistic identity theory (ELIT; Giles and Johnson 1987) explains how intergroup communication and behavior are influenced by individuals' social group memberships and their desire for positive self-perception. The theory revolves around the premise that everyone is driven to understand themselves; therefore, people will categorize themselves in social groups to help explain their belonging in the world (Tajfel & Turner, 2001). More specifically, ELIT indicates that individuals form a subjective sense of belonging or affiliation to a community through language variety and ethnic ancestry, which together shape their *ethnolinguistic identity* (Giles & Johnson, 1987). By establishing differences, individuals follow-up by reinforcing their personal image in a positive manner by uplifting their own (i.e., their in-groups) and downgrading others (i.e., their out-groups). This initiates competition among in-groups and out-groups (Turner, 1975).

According to ELIT, people use their language and ethnic ancestry to emphasize affiliation and disaffiliation with others. Language has the potential to define how certain groups

behave and interact, and thus, it can also be used as a tool of juxtaposition among out-groups (Y. Y. Kim, 2007). Through the lens of ELIT, members can attune their communication style, including accent, vocabulary, and dialect, to distance themselves from out-groups and make their in-groups more unique and thus positively received (Giles & Johnson, 1987).

Several factors can affect what communication style individuals decide to use and maintain, especially if they feel like their in-group is under threat. Giles et al. (1977) explores communication characteristics to consider when determining the relative status of an ethnolinguistic group in society by developing the concept of ethnolinguistic vitality (ELV). The three characteristics can be assessed through objective and subjective means and are as follows: (1) demographic representation (i.e., size of group, geographical distribution, etc.), (2) institutional support (i.e., whether social institutions, such as media and governmental, support the given group), and (3) sociohistorical status (i.e., how well the group is respected). ELIT suggests that people will maintain a strong ethnolinguistic identity when their ELV is high. Since most ethnolinguistic identities cannot be easily changed (since it may be hard to learn a new language), ELIT also explains that people with low ELVs have strong ethnolinguistic identities. This, then, can explain how and why conflict can come about between in-groups and out-groups.

Spanish speakers in the United States often employ various dialects, distinct versions of a language that systematically vary while remaining mutually intelligible (Shareah et al., 2015)– to distinguish their in-groups from their out-groups (Lipski, 2008). In a risk communication context, ELIT helps explain why certain dialects are preferred over others when translating life-saving information into Spanish. Uekusa (2019) coined the term “disaster linguicism” to describe the language-based discrimination that occurs when certain dialects are prioritized in disaster situations, leaving other members of language communities particularly vulnerable. ELIT

explains this concept further by illustrating how some groups may elevate their own language variety (in-groups) while neglecting others (out-groups), exacerbating vulnerabilities and inequalities during disasters.

Disaster linguicism has been noted extensively in the weather communication space. Trujillo-Falcón et al. (2021, 2022) revealed that, in the translation process from English, risk communicators often opted for what *they* believed to be the most accurate translation based on their own Spanish dialect. This intention, however, led to inconsistencies, with different communicators using varying words to relay the same warning (e.g., “aviso,” “alerta,” “advertencia,” “vigilancia,” etc). A notable example is the translation of "warning" into both “aviso” and “alerta,” words that, despite their similarities, evoke distinct levels of risk perception among Spanish speakers, thereby affecting the clarity and urgency of warning messages (Trujillo-Falcón et al., 2022). Especially in the realm of WEAs, where terse messages do not provide ample room for contextualization (Bean et al., 2016), translations must be consistent and dialect neutral to ensure comprehension for all multilingual groups (Abukhalaf & Meding, 2021).

Effective warning systems must also delve into the complexities of individuals’ societal and legal statuses in order for it to resonate with an underserved community. Méndez et al. (2024) argue that undocumented immigrants are often excluded from comprehensive emergency planning and research, resulting in a complete oversight of their needs. This exclusion is not only an administrative oversight but a profound neglect of their unique circumstances. Undocumented immigrants, due to their non-citizen status, often face barriers that limit their access to information, resources, and support services that are critical in times of emergency (Fussell et al., 2018). This population avoids seeking help due to fear of deportation, lack of trust in authorities, or simply because emergency messages do not reach them in accessible formats or languages

(Trujillo-Falcón et al., 2024). Furthermore, their economic situations and living conditions make them more susceptible to disasters, as they are less likely to receive aid due to their documentation status (Méndez et al., 2020). In light of these considerations, warning systems must be designed to effectively reach and resonate with diverse audiences, including those often overlooked, such as undocumented immigrants (Uekusa & Matthewman, 2023). This means ensuring that warnings are not only linguistically clear but also mindful of the unique challenges faced by these communities (Méndez et al., 2020).

Considering cultural and linguistic concepts reviewed in this section, the first question of my dissertation aims to understand how Spanish speakers implement these perspectives when they respond to warning systems in the United States:

> *RQ1: In what ways do Spanish speakers in the United States understand warning systems based on cultural factors, such as their* ***disaster subculture****,* ***dialect****, and* ***immigration status****?*

Examining Warning Response Through Communication Research

Alerts and warnings deliver crucial information to at-risk populations facing imminent threats, aiming to prompt timely protective actions (Sorensen, 2000). By quickly disseminating information to at-risk populations, these communications significantly contribute to enhancing individual and community safety. The terms “alert" and "warning" are often used interchangeably, but they can have distinct meanings, especially in risk communication scholarship. Alerts serve to capture attention and help the public to recognize that there is a risk that needs attention (National Academies of Sciences, Engineering, and Medicine, 2018). An example of an alert is a tornado siren that wails before an imminent disaster. Warnings, on the other hand, typically follow alerts and *instruct* the population on what protective action should

be taken (Seeger & Sellnow, 2016). A common example of a warning includes messages conveying evacuation instructions or guidance on seeking shelter from the NWS.

In the context of WEAs in the United States, *alerts* are disseminated through mobile devices through a distinct noise or vibration on a mobile device, prompting individuals that they are at risk. The alert is often followed by a 90- or 360-character *warning* message that provides critical information about imminent threats, with the aim of prompting timely and appropriate protective actions. Once an individual receives the warning, they must make sense out of the message and consider taking protective action (Mileti & Sorensen, 1990; Witte, 1992). To examine how an individual makes meaning out of a WEA, employing risk communication frameworks can provide a more holistic explanation of the factors influencing effective message comprehension and subsequent action (and will be elaborated in the following section). For the other research questions of the dissertation, the WRM and the EPPM will serve as guidance to shed light on the complex interplay of cognitive and behavioral responses elicited by WEAs.

The Warning Response Model in Spanish-Speaking Communities

In their WRM, Mileti and Sorensen (1990) outlined five key areas of message content that increase the chances a message receiver will take protective action. These criteria have become established benchmarks for what constitutes an "effective" or "complete" warning message (Bean & Grevstad, 2023; Olson et al., 2024; Sutton et al., 2024). Here, I define the five key areas of message content from the WRM, using WEA examples for clarity.

First, effective warning messages should describe the imminent *hazard*, including the probability of risk, the potential impacts, and their severity (Wood et al., 2018). For example, in many tornado WEAs, there is a notable emphasis on the potential danger posed by flying debris, a significant and life-threatening impact of the hazard (National Weather Service, n.d.a). The

selection of wording stresses the severity of the situation and prompts the public to take the hazard seriously. Second, effective warning messages should provide clear instructions on what actions individuals should take, explain how to execute those actions effectively, and offer *guidance* on maximizing safety (Janssen et al., 2006). WEAs issued by the NWS, for example, include information about where the best places are to shelter and offer advice on what to do if one is caught outside during a hazard (National Weather Service, n.d.a). Third, effective warning messages clearly define the hazard's *location*, identify individuals at risk, specify who should take protective action, and delineate the geographic boundaries of the affected population (Wood et al., 2018). WEAs often outline counties and cities where the hazard is expected, sending geo-targeted messages to the people who should take protective action (National Weather Service, n.d.a). Fourth, effective warning messages include *timing* information, specifying when protection measures should begin, when actions should conclude, and when the message will expire or receive updates (Mileti & Peek, 2000). This is often displayed at the beginning of a WEA and tailored to the time zone of the message recipient (National Weather Service, n.d.a). Fifth, effective warning messages include the *source*, or the name of the individual or organization responsible for disseminating information. Weather WEAs always begin with "NWS" in the 90-character version or "National Weather Service" in the 360-character version to increase the credibility of the message (National Weather Service, n.d.a).

Upon receiving a warning from a formal or informal entity, individuals engage in a dynamic, evolving cognitive process that could motivate them towards taking protective measures (Mileti & Sorensen, 1990). The WRM outlines the process in which individuals begin to (1) understand, (2) believe, and (3) personalize the imminent threat, then (4) make decisions through (5) milling, which involves seeking additional information. In the following paragraphs,

each of these steps will be connected to the issue of disaster inequities faced by multilingual communities in the United States.

The WRM explains that, when an individual first hears and receives a message, they must **understand**, or comprehend, the message through their personal lens. For Spanish speakers with limited English proficiency, the challenge of message comprehension arises from the fact that the warnings are not issued in their predominant language. Language inequities have existed in our emergency communication system since its inception, tracing back to the Lubbock, Texas 1970 tornado where more than half of deaths were attributed to a lack of bilingual warnings (U.S. Department of Commerce, 1970). Despite efforts to expand resources in multiple languages, multilingual practices have yet to be operationalized across governmental agencies in the United States (Trujillo-Falcón et al., 2021). The failure of institutionalization exacerbates existing inequities, leaving non-English speakers at greater risk during emergencies (Tripati et al., 2023).

Literacy is also an important factor to consider. Originally defined as the ability of individuals to read or write, the term literacy has evolved to also consider elements such as culture, religion, and race (Santos-Hernández & Morrow, 2010). Spanish-speaking communities have lower levels of literacy than English speakers, especially when it comes to comprehending scientific content (Lee & Fradd, 1996). This lower understanding has led to disparities in how health information is received (Gorrepati & Smith, 2021) and, lately, in weather-related communications too (Trujillo-Falcón et al., 2024). Specifically, in the weather disaster context, Spanish-speaking individuals with lower literacy levels have reported feelings of helplessness prior to the onset of a tornado, citing their inability to understand written warnings as a key concern (Gaviria Pabón, 2022; Trujillo-Falcón et al., 2024).

Once understanding is achieved, individuals proceed to evaluate a warning's credibility and decide whether to **believe** the accuracy of its contents. A credible source is determined by various factors for WEAs. For example, the receiver's personal experiences impact the perceived credibility of emergency messages (G. Kim et al., 2019), and messages from recognized and authoritative sources, such as government agencies, are more likely to be trusted and acted upon (Edworthy et al., 2015). However, it is important to recognize the unique experiences of U.S. Spanish speakers may render some of these insights inapplicable to this demographic. For example, it is important to acknowledge that the source in charge of disseminating WEAs (i.e., FEMA) is housed under the Department of Homeland Security, which also houses the Immigration and Customs Enforcement (ICE). Known to disproportionately separate undocumented immigrants of Hispanic and Latinx origin, ICE is not a trusted source of information for Spanish speakers in the United States (Fussell et al., 2018). This mistrust is compounded by the practices of local authorities who, as highlighted by Ellcessor (2022), often fail to consider the linguistic needs of multilingual communities in the creation of alerts and warnings. Such oversight reinforces a dangerous narrative that non-English speakers are not "worthy disaster victims" (Méndez et al., 2020). Consequently, this perception reduces the reception of warnings among multilingual communities, as these groups increasingly question the reliability of such authorities (Trujillo-Falcón et al., 2024).

Once belief is established, an individual **personalizes** the message and evaluates whether they are susceptible to risk. Personalization may pose a challenge, particularly when an individual is unfamiliar with the local emergency system and/or lacks awareness of the looming hazard in the area in which they are located. As previously discussed in the last section, an individual's disaster subculture can prompt different levels of risk perception (Anderson, 1965;

Wenger & Weller, 1973). Gaviria Pabón (2022) illustrates these discrepancies after interviewing Guatemalan populations after the December 10–11, 2021 tornado outbreak in the Southeast United States. The author found that Guatemalans failed to personalize the risk as they predominantly encountered flood hazards in their home country. Despite some Guatemalans understanding and believing the looming tornado threat, their inability to personalize it hindered them from undertaking protective measures. In other words, a Guatemalan's past cultural experiences with severe weather resulted in a reduced perception of risk, which, in turn, contributed to greater disparities among individuals in the aftermath of the tornado hazard.

Beyond disaster subcultures, if a language lacks the term for an imminent threat, individuals may fail to recognize the risk and personalize it. Coined by Uekusa (2019), disaster linguicism refers to discrimination based on language that exacerbates the vulnerability of linguistic minorities in catastrophic events. Further extending this concept, Abukhalaf and Meding (2021) discuss the challenges faced by international linguistic minorities at institutions of higher education during disasters, emphasizing discrimination based on the language that these groups speak. They found that words used in emergency communication did not translate to other non-English languages. For example, the word "tornado" is translated to Persian as "گردباد," which is translated back to English as "whirlwind." Effective WEAs, then, must be able to be tailored to an individual's cultural and linguistic background, a perspective that holds significant value for exploration in research. Therefore, the second research question I examine in this dissertation is:

> *RQ2: How do Spanish speakers in the United States **understand**, **believe**, and **personalize** information presented by Wireless Emergency Alerts?*

Only upon completing the previous steps do individuals embark on the **decision-making** process, in which they determine the best course of action after completing the prior steps of assessing the risk at hand (Lindell & Perry, 2004). To evaluate multiple outcomes, individuals begin a **milling** process, which entails creating socially generated meaning from both formal and informal sources, to navigate their decisions (Wood et al., 2018). Formal sources are individuals or organizations that are in charge of disseminating government warnings and alerts. These include official alerting authorities, such as emergency managers and meteorologists. Informal sources are individuals or entities without formal training in disaster management but to whom people often turn to for information during emergencies. These can be community members, leaders, or trusted organizations among a specific community. For Spanish speakers, systemic barriers such as language accessibility and immigration status often make informal sources, such as bilingual pastors and educators, more approachable than official channels during disasters (Trujillo-Falcón et al., 2024).

Prior research indicates that support from informal sources does not alleviate vulnerability to disasters or facilitate recovery; instead, it is an effort by the local community to compensate for the devastating impact of exclusive social policies (Trujillo-Pagan, 2007). In the spirit of reducing disaster inequities, communities harness their internal networks, relationships, and trust to organize rapid response efforts, distribute resources, and provide mutual aid (Fitzpatrick & Spialek, 2020). Although these community-driven efforts are well-intentioned, they sometimes lead to choices that deviate from standard emergency management practices. de Onís et al. (2020), for example, observed that, following the issuance of a public health WEA exclusively in English, the local Spanish-speaking community banded together, leveraging their networks to translate and make sense of the warning. Given that most of these efforts were

informal, they resulted in inconsistent interpretations, leading to confusion regarding appropriate safety measures to be taken. This not only heightened confusion but also intensified disparities within the Spanish-speaking population. Overall, WEAs need to be examined for their ability to encourage proactive decision and information seeking, as this can exacerbate inequities in underserved groups. Therefore, I propose the following research question:

*RQ3: How do Spanish speakers in the United States engage in **decision-making** and **milling** processes based on information presented by Wireless Emergency Alerts?*

Overall, the WRM provides a foundational framework for understanding how individuals cognitively process warning messages. By identifying potential gaps in how WEAs are received, the application of the WRM can lead to improvements in message design and content (Bean et al., 2016; G. Kim et al., 2019; Sutton et al., 2018). These improvements could involve optimizing message clarity, enhancing the persuasiveness of the call to action, and ensuring accessibility for diverse populations. Thus, integrating WRM insights into WEAs can significantly enhance my dissertation by equipping me with tools to understand how non-English speaking populations process multilingual warnings.

The Extended Parallel Process Model

The EPPM explains how people react to fear-inducing messages, or fear appeals (Witte, 1992). Fear, a potent motivator for action, is frequently used in communication campaigns to promote positive social actions and discourage unsafe behaviors (Maloney et al., 2011). In weather disasters, official alerting authorities convey messages that strongly encourage individuals to take protective action, emphasizing that failure to do so could result in life-threatening outcomes (Eachus & Keim, 2020). In theory, the fear of potential harm should influence people to seek shelter immediately. However, the fact that many individuals ignore

these warnings suggests that messages are not entirely persuasive. The EPPM suggests that fear can be channeled to produce positive response outcomes among the public.

The EPPM posits that individuals respond to a fear message based on two factors, each comprising two elements (Maloney et al., 2011; Witte, 1992). When an individual receives an anxiety-inducing stimulus, they first *perceive the threat* and determine the degree to which they feel susceptible to harm. More specifically, an individual perceives whether the imminent hazard is dangerous (*perceived severity*) and whether it has a high likelihood of impacting them personally (*perceived susceptibility*). For example, when receiving a tornado warning, an individual would first evaluate the hazard's potential danger to their family and property. They would also assess the likelihood that the tornado could impact their home directly. Although tornado warnings are issued for entire counties, the localized nature of tornadoes means they might not pose a threat to specific individuals. Both variables are important in determining whether people take the hazard seriously and consider taking protective action.

If an individual perceives a high level of threat—that is, they believe the danger is significant and likely to impact them personally—they then evaluate their efficacy, or whether they can perform certain behaviors to avoid the threat (Maloney et al., 2011; Witte, 1992). Individuals evaluate whether the recommended behavior from a warning message is effective in reducing the overall threat (**response efficacy**) and whether they can perform the recommended action themselves (**self-efficacy**). Using the same tornado warning example, an alerted individual would review the safety instructions provided by the NWS. The warning issued by the NWS (n.d.a) advises: "Take shelter now in a basement or an interior room on the lowest floor of a sturdy building. If you are outdoors, in a mobile home, or in a vehicle, move to the closest substantial shelter and protect yourself from flying debris. Check media." After reading the

warning message, the individual would determine whether the recommended actions ensure their safety during the tornado event. They would also evaluate whether they can effectively conduct the recommended action. In this instance, do they have access to a basement or sturdy building to take cover in? If they are outside, in a mobile home, or in a vehicle, would they have the capacity to move to a nearby shelter? According to the EPPM, these important questions determine the eventual outcome of how individuals respond to the tornado in this example.

The EPPM explains that people have three responses to fear appeals determined based on their level of perceived threat and efficacy (Maloney et al., 2011; Witte, 1992). If an individual does not perceive the threat to be high, they will not experience fear. As a result, they will not seek additional information nor respond to the warning message. If, on the other hand, an individual does perceive a threat to be dangerous, they will experience fear and be motivated to reduce it by resorting to one of two cognitive mechanisms. *Fear control* occurs when people do not feel they can control what happens to them. This reaction occurs because the perceived threat of the hazard outweighs their perceived efficacy to respond. As a result, individuals resort to denial and avoidance behaviors since they do not feel empowered that the recommended safety measures can ensure their safety. *Danger control* occurs when individuals feel they can take action to mitigate the incoming hazard. Individuals are more likely to conduct danger control measures when their perceived efficacy to respond is greater than the perceived threat of the hazard. In short, *motivation to act* in response to a fear appeal message depends solely on the degree to which the message increases an individual's perceptions of the threat. However, the *type of action* taken depends on the degree of perceived efficacy to avert the threat.

Tying the three outcomes to the tornado warning example, the EPPM describes how an individual would respond during a severe weather event. If an individual does not perceive a

tornado as hazardous and/or likely to impact them directly, they would not experience fear, ignoring the warning message under the belief that it does not pertain to them. If the perceived threat induces fear, however, they would begin to take the warning message seriously, reviewing the recommended protective actions. If they do not perceive that the safety instructions can guarantee their safety, they would likely ignore the warning message. Similarly, if they are not confident in their ability to perform the listed instructions, they would also avoid the warning in hopes that it mitigates their overall fear. Conversely, feeling capable and assured by the guidance provided enhances individuals' likelihood to enact the recommended safety measures.

The EPPM provides an insightful framework that can help assess whether individuals are motivated to undertake protective actions upon receiving a WEA message. The EPPM's focus on not just perceived threat but also perceived efficacy allows for a more detailed analysis of a warning message's capacity to motivate effective decision-making during disasters. In their comprehensive review of WEAs, Bean et al. (2015) emphasized the need for further exploration of WEA's advantages, limitations, and impact. By applying concepts of the EPPM, researchers can identify the best practices for crafting WEAs that not only captivate attention but also facilitate a sense of empowerment among recipients (Sutton et al., 2021). This approach enhances the real-world impact of WEAs, ensuring safety for the United States public.

Combining the WRM and EPPM to Analyze Warning Reception

Traditionally, researchers have used the WRM to analyze the cognitive shifts that individuals take after learning about a warning (Bean et al., 2015; Olson et al., 2024). While the WRM provides a starting point for the analysis of cognitive processes, it does not consider how fear and emotions play a role in the decision to take protective action (Sutton et al., 2018). As emphasized by the EPPM, fear can dictate whether an individual will engage in protective

behaviors or become immobilized by panic (Eachus & Keim, 2020; Witte, 1992). In the realm of warning messages, which inherently evoke fear, this emotional response is critical to consider when assessing how individuals respond to WEAs (Sutton et al., 2018).

To refine our understanding and approach to emergency communication, Sutton et al. (2021) provided evidence-based research to include **self-efficacy** and **response efficacy** from the EPPM, in addition to WRM variables (i.e., understanding, belief, personalization, decision making, and milling), to assess more effectively how an individual receives, comprehends, and responds to environmental threats. This proposed approach can be beneficial for better understanding how individuals process WEA messages, as the inclusion of these two variables from the EPPM can provide insights into *why* an individual is making decisions. Therefore, I propose the following research questions:

*RQ4: In what ways do Spanish speakers in the United States believe the recommendations provided in a Wireless Emergency Alert would enhance their safety (**response efficacy**)?*

*RQ5: In what ways do Spanish speakers in the United States feel empowered (or not) in their ability to take protective action (**self-efficacy**) after reading a Wireless Emergency Alert?*

CHAPTER 3: METHOD

Participants

Participants for the dissertation study originated from the 2023 iteration of the Extended Weather and Society Survey (Reedy et al., 2022) that collected 1,598 responses of a representative sample of the U.S. Spanish-speaking adult population based on recent Census data (U.S. Census Bureau, 2021). All participants had to pass a screening question verifying their Spanish-language proficiency prior to taking the survey, which was administered through Qualtrics. Those who reported speaking Spanish "well" or "very well" were eligible to complete it. At the end of the survey, participants could provide their contact information to be selected for a follow-up interview, which would result in compensation with a $20 Amazon gift card. A total of 637 participants provided their contact information.

I employed a maximum variation sampling plan, a purposive sampling technique used in qualitative research to capture a broad spectrum of perspectives and experiences within a study population (Tracy, 2020). By deliberately seeking out individuals who differ across key characteristics, this approach ensures that the data collected represents a wide range of variations, leading to more comprehensive insights and a deeper understanding of the research topic. For this dissertation, I recruited four specific groups of participants that represent the Spanish-speaking community from various perspectives.

The first group I recruited involved Spanish speakers from various Hispanic or Latino origin countries. I followed the U.S. Census Bureau (n.d.) definition of Hispanic or Latino as “a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race” (n.p.). Research in multilingual risk communication underscores the importance of recruiting participants from diverse origin countries, as these groups are capable of

perceiving risk differently due to their dialect and disaster subculture (Gaviria Pabón, 2022; Trujillo-Falcón et al., 2021). According to U.S. Census Bureau (2021) data, the predominant Spanish-speaking populations in the United States are from Mexico, Puerto Rico, and Cuba, together accounting for nearly 70% of Spanish speakers in the country. However, to understand message reception in Spanish-speaking communities comprehensively, it is crucial to also include participants from other Hispanic or Latino countries (e.g., Perú, Venezuela, Honduras). To explore language inequities more specifically, I also actively recruited people who had limited English proficiency (LEP). According to the U.S. Census Bureau (n.d.), LEP individuals self-report speaking English less than "very well." Their increased vulnerability in disaster situations, stemming from a lack of information in languages other than English, makes LEP individuals the primary beneficiaries of multilingual WEA messages. A third group I actively recruited were Spanish speakers who were foreign born. Disaster subcultures in Latin America differ significantly from those in the United States, as they may not be accustomed to the types of hazards commonly experienced in America (Gaviria Pabón, 2022). The last group I recruited involved members of different geographies. Specifically, I recruited individuals from various NWS jurisdictions (National Weather Service, n.d.b). Previous research has noted that including these jurisdictions in weather-related studies increases the likelihood of government agencies adopting proposed changes to the risk communication system (Bitterman et al., 2023; Trujillo-Falcón et al., 2022). Table 2 illustrates the composition of my sample, comprised of 27 Spanish speakers in the United States.

Table 2

Demographics of Spanish-Speaking Sample

Demographic	**Number of recruited Participants (*n*; %)**
Gender	

Female	19; 70%
Male	8; 30%
Ethnicity	
Hispanic or Latino	27; 100%
Origin Country	
Mexican	14; 51%
Venezuela	4; 15%
Puerto Rico	2; 7%
El Salvador	2, 7%
Guatemala	1; 4%
Nicaragua	1; 4%
Argentina	1; 4%
Ecuador	1; 4%
Perú	1; 4%
English Proficiency	
LEP	16; 59%
Proficient in English	11; 41%
Nativity	
Foreign Born	19; 70%
Born in the United States	8; 30%
NWS Region	
Western Region	12; 44%
Southern Region	7; 26%
Eastern Region	6; 23%
Central Region	2; 7%

Note. The Alaska and Pacific regions were combined with the Western Region.

Procedures

Following established protocol, I obtained IRB approval for the study before reaching out to participants via email to recruit them in the study. Interviews were conducted via Zoom or telephone, depending on the preference of the participant. At the beginning of each interview, I provided participants with consent information, and I ensured that they understood what the study entailed, their rights as a research participant, agreed to be recorded, and provided information necessary for compensation.

The interviews centered around a "think-aloud" format. Think-aloud interviews prompt participants to engage with information presented to them and speak aloud any thoughts that

come to mind as they work through it. This is a useful technique to analyze the cognitive processes that individuals engage in when they interact with information (Ericsson & Simon, 1984). This particular method is effective in exploring the research questions I seek to answer in this dissertation. Warning communication frameworks have established that individuals undergo a sequential, cognitive process when they first receive a warning. More specifically, individuals must *understand, believe, personalize, and respond* to a warning all while *milling* before they even consider making *decisions* (Mileti & Sorensen, 1990). By asking my participants to think aloud their thoughts about WEA alerts in this simulated context, I was able to understand in depth their cognitive processes the moment they received a warning message. This process has also been applied successfully before in other qualitative research settings to explore how English speakers interpreted current and future warning systems in the United States (Bean et al., 2016, 2023; Sutton et al., 2018).

I initially developed the interview protocol in English to gather feedback from scholars and scientists. Afterward, I translated the questionnaire into Spanish, utilizing my degree in Spanish and experience as a bilingual meteorologist. To ensure accuracy and cultural relevance, I reviewed the translation with a panel of diverse Spanish speakers representing different dialects. This collaborative approach refined the questions to be clear and understandable across various Spanish-speaking communities.

I conducted interviews primarily in Spanish but catered to each participant's preferred language. Of the 27 interviews, 25 were conducted in Spanish, whereas two participants chose to conduct their interviews in English. Each interview began with ice breaker questions that helped the participant feel comfortable prior to the think-aloud protocol. The ice breaker questions centered around disaster subcultures and asked participants to share information about the

warning systems of their origin countries or where they were raised. More specifically, I prompted participants to describe the disasters they had experienced growing up and list the resources they relied on for lifesaving information in (1) their hometown and (2) where they currently lived in the United States. After the icebreaker, I began the think-aloud interview by listing out the instructions for the activity. To simulate the sudden reception of a message, I told the participant, "You are in [County] when you receive the following message on your mobile phone." Following the prompt, the participant randomly received either a 90-character or 360-character Spanish WEA through text. The Spanish WEA alerts came from the NWS (n.d.a) templates and are illustrated in more detail in Table 3.

Table 3

Spanish WEAs Presented During the Think-Aloud Interview, Along With the English Version

Language	90-character WEA	360-character WEA
Spanish	SNM: AVISO DE TORNADO hasta las 12:15PM CST. Refugiese ahora. Consulte medios informativos.	Servicio Nacional de Meteorologia: AVISO DE TORNADO en efecto hasta las 12:15PM CST. Busque refugio ahora en un sotano o en el interior de un cuarto en el nivel mas bajo de un edificio seguro. Si esta al aire libre, en una casa movil, o en un vehiculo, debe ir al edificio seguro mas cercano y protegerse de proyectiles. Consulte los medios informativos.
English	NWS: TORNADO WARNING in this area till 12:15PM CST. Take shelter now. Check media.	National Weather Service: TORNADO WARNING in this area until 12:15PM CST. Take shelter now in a basement or an interior room on the lowest floor of a sturdy building. If you are

	outdoors, in a mobile home, or in a vehicle, move to the closest substantial shelter and protect yourself from flying debris. Check media.

Note. WEA templates are provided by NWS (n. d.b) and are disseminated nationwide present day. Participants only received the English or Spanish WEA message during the think-aloud interview, depending on their stated language preference. If participants spoke both English and Spanish, I first presented the Spanish version, then later showed the English version during the interview to evaluate the quality of the translations.

As participants talked aloud their thoughts, revelations, or confusion, I did not guide them nor gave them any suggestions. After they completed the think-aloud activity, I followed up with semi-structured questions that focused on different message characteristics established by the WRM, such as their overall understanding, belief, and personalization of Spanish WEAs (Mileti & Sorensen, 1990). Additionally, I also included semi-structured questions that explored the self-efficacy and response efficacy of the respondent, as established by the EPPM (Witte, 1992). If participants received a 90-character WEA, I followed up and inquired whether the 360-character version provided more clarity (or not). If participants indicated proficiency in English, I asked them to evaluate the English version of the WEA by the NWS (n.d.a) and provide feedback on any nuances that might have been lost in translation (see Table 3). I ended the interview with questions about phone settings and WEA preferences. The proposed interview protocol, which resulted in interviews that lasted anywhere from 20 to 50 minutes (M = 35 minutes and 50 seconds; SD = 9 minutes and 18 seconds), can be found in Appendix A (Spanish) and Appendix B (English).

After the completion of interviews, I transcribed the audio recordings. To protect participant privacy, identifiable information was removed from the transcripts, and audio files were deleted once transcription was complete. Within U.S. bilingual communities, confidentiality is important, as the most vulnerable groups comprise immigrants who may not be

comfortable disclosing personal information (Senkbeil et al., 2014). The interviews produced 478 single-spaced pages of transcriptions.

Constant-Comparative Analysis

I employed the constant-comparative method as the foundational framework for analyzing the qualitative data derived from interviews. Developed by Glaser and Strauss (1967), this method facilitates the systematic categorization and analysis of data to generate new theoretical insights. The method's iterative nature, involving continuous interaction between data collection and analysis, ensures that the emerging themes are firmly rooted in the data through extensive coding and conceptualization (Lindlof & Taylor, 2019). Prior to any analysis, I engaged in data reduction by *filtering* out irrelevant information to focus solely on data pertinent to the research questions, *group* data that address similar topics, and *organizing* codes by assigning them to topics based on coherent meaning (Lindlof & Taylor, 2019). This preliminary coding was crucial in minimizing cognitive overload during the open coding phase, the first step of the constant-comparative analysis.

Open coding, or the initial, unrestricting coding of data, allows researchers to examine transcripts meticulously and open an inquiry (Strauss, 1987). I began open coding by implementing Owen's (1984) guidelines for discerning patterns in the data. I identified instances of *repetition* (i.e., terms, words, or phrases that recur in responses), *recurrence* (i.e., different words that convey similar meanings), and *forcefulness* (i.e., where the participant expresses strong emotions). Lindlof and Taylor (2019) suggest iteratively coding line-by-line with a continuous comparison of participants' responses and previous codes. This comparison focuses on the substantive *meaning* of the responses rather than their grammatical structure. The overarching goal is to thoroughly account for all data, eventually forming comprehensive,

equivalent categories. Through these strategies, I immersed myself in data analysis to understand how participants perceived risk and considered decisions when first receiving a WEA message. Once I fully immersed myself in the data, I started unraveling *in vivo* codes, or terms used by social actors to characterize their scene, identities, and actions (Lindlof & Taylor, 2019). The contextualization of certain terminologies used in Spanish to describe imminent hazards and risk provided valuable insights into the eventual identification and labeling of themes in my analysis.

Following open coding, my study progressed to the *focused* coding phase, where initial codes are synthesized, and labels are condensed into categories and subcategories. This phase involves refining recurring and/or similar codes to ensure they comprehensively represent the data (Bryant & Charmaz, 2007). To fulfill this step, I developed a codebook to organize codes into preliminary, defined categories and began initial *theoretical memo writing* to enhance the understanding and thematic interpretation of these categories (Lindlof & Taylor, 2019). By directly engaging with transcripts, I was able to delve into sensemaking process with the collected data and to decipher the narrative they convey (Tracy, 2020).

In the final step of the constant-comparative analysis, categories are further defined and reconfigured, as deeper insights are gathered through *axial coding*. In axial coding, distinct categories are integrated into a broader thematic category (Lindlof & Taylor, 2019). Axial coding acts as a bridge, linking previously isolated categories into a unified thematic category. In other words, the network of categories and their interrelationships are integrated to form a cohesive theoretical framework (Glaser & Strauss, 1967). Through this process, the analysis is developed based on a rigorous and iterative process, ensuring that it is deeply grounded in the data and reflective of the complexities inherent in the cognitive processing of WEA messages.

Validation Strategies

To ensure that the findings are authentic representations of participants' statements and lived experiences, I employed validation strategies established by Cresswell and Poth (2018) and Tracy (2020). According to Cresswell and Poth (2018), validation in qualitative research is the "attempt to assess the 'accuracy' of the findings, as best described by the researcher, the participants, and the readers (or reviewers)" (p. 259). Researchers are encouraged to apply *at least two* of the nine validation strategies to ensure the veracity of their findings. In my dissertation, I used four strategies.

First, I clarified researcher bias by engaging in reflexivity, acknowledging my personal biases, values, and experiences that I brought to this qualitative research (Creswell & Poth, 2018). This reflective disclosure provides the reader with a clear understanding of my perspective and standpoint as I conducted this research. As a Latino immigrant from Perú, I brought a unique perspective to the research study. I can understand how language barriers can reduce message effectiveness and how cultural differences can affect risk perceptions. I am also able to understand the inequities experienced by undocumented immigrants in disaster contexts. These aspects gave me the opportunity to be more relatable to my participants and engage in deeper conversation with them. However, as a meteorologist, I am also extremely familiar with scientific jargon and so I could introduce biases in respect to how warning messages are translated and interpreted. Moreover, as a researcher deeply engaged with this subject, I occupied a position of power relative to my participants, reflecting my extensive study in this field. Being transparent about these practices made my qualitative research more powerful and credible.

Second, I strengthened the validity of my findings by employing crystallization (Tracy, 2020), a postmodern alternative to triangulation (Creswell & Poth, 2018). This approach involved incorporating multiple voices and theoretical frameworks to enhance the qualitative

quality and depth of the research. To provide a holistic perspective on how Spanish speakers made sense of warning systems and WEAs, I included diverse perspectives in my dissertation. Through a maximum variation sampling plan, I actively recruited participants of various ethnic backgrounds, language abilities, ancestry, and geographical locations within the United States. This approach allowed me to explore the diversity among Spanish-speaking groups in different climates and cultures, challenging the notion that these groups are monolithic and homogeneous. Additionally, as reviewed in the previous section, I applied two frameworks, the WRM and EPPM, to thoroughly analyze warning responses. Combining these frameworks allowed me to examine messages for both their content and engagement with the message receiver, ensuring that messages not only captured attention but also motivated action.

Third, I used member checking, a process of soliciting participants' views on the author's interpretations of the data (Creswell & Poth, 2018). I reached out to all participants via email after completing my analysis and provided them with a summary of my initial findings. I invited them to share their initial reactions and feedback, and 7 participants responded. This provided them with an opportunity to either question or validate the findings from their perspective. For participants that spoke both English and Spanish, I also asked whether the quotes were translated in a representative manner that reflected their experiences. Overall, participants agreed that the analysis accurately reflected their experiences and expressed gratitude for having their voices uplifted in this study. They suggested some minor tweaks in the translated quotes, which were implemented to ensure their perspectives were captured fully and accurately. For transparency, I included all quotes in their English and Spanish translation in Appendix C.

Fourth, I provided a thick description and wrote in detail about the participants I interviewed (Creswell & Poth, 2018). This process helped contextualize their perspectives,

especially since they were from different backgrounds and cultures. The icebreaker questions in my interview protocol allowed me to get to know more about participants' disaster subcultures and the type of emergency system(s) with which they were the most familiar (Appendix A and B). Before delving into the discussion of each finding in Chapter 4, I introduced each paragraph with relevant background information on the participant. For example, if I interviewed a Peruvian, foreign-born participant who was LEP, I provided these details and reviewed information sources they regularly used in their native country to stay safe during environmental disasters. This contextualization, especially noting that the Peruvian government does not consistently experience severe weather or utilize WEA, set the stage for examining disparities among different Spanish-speaking groups. Using these validation strategies, I gathered authentic qualitative accounts of how multilingual speakers respond to emergency messages.

CHAPTER 4: FINDINGS

Understanding the unique challenges faced by Spanish speakers in interpreting U.S. warning systems is crucial for effective communication and public safety. To address these challenges, my study investigated the cultural factors that shape how Spanish speakers comprehended and responded to warning systems in the United States (RQ1). Additionally, I examined how Spanish speakers understood, believed, personalized, made decisions, milled for information, and assessed their efficacy when receiving a WEA message using the extended WRM (RQs 2-5). This chapter includes the findings of the constant comparative analysis undertaken, revealing themes for each research question, as described in more detail below.

Understanding Warning Systems Through Cultural Contexts (RQ1)

RQ1 asked, "*In what ways do Spanish speakers in the United States understand warning systems based on cultural factors, such as their disaster subculture, dialect, and immigration status?*". Findings revealed that Spanish speakers' understanding of warning systems was shaped by their cultural experiences and backgrounds stemming from (1) their country of origin, (2) their time in the United States, (3) living in a borderland community, and (4) their undocumented status. The themes identified for this research question are summarized in Table 4 and are elaborated in the following paragraphs through the stories of Jackie (Venezuelan immigrant), Mariela (Argentinian immigrant), Jorge (Salvadoran American), Juliana (Mexican American), and Teresa (Mexican immigrant). Their stories highlight how Spanish speakers from various parts of Latin America and the United States interpret warning systems, which illustrates the nuanced ways cultural factors impact their understanding. Despite living in similar geographical areas and climates in the United States, their diverse cultural backgrounds and documentation status explain why they tended to respond differently to similar disasters.

Table 4

Warning Systems and Culture (Answers to RQ1)

Theme	Description
Culture shock prompt foreign-born Spanish speakers to undergo similar adaptation processes	Immigrants from Latin America to the United States often felt overwhelmed by unfamiliar cultures, dialects, and extreme weather hazard warning systems they have never encountered before. Therefore, they adapted to the U.S. warning system through similar, dynamic processes.
Cultural factors from local and ethnic backgrounds shape how U.S.-born Spanish speakers understand warning systems	Individuals who had lived in the United States all their life understood warning systems through various cultural viewpoints, including their ethnic origin and current geographical location.
Cultural differences and conflicting warning systems complicate how border communities understand warning systems	In borderlands, both immigrants and U.S.-born individuals were accustomed to integrating two distinct disaster subcultures despite living just miles apart.
Undocumented immigrants distrust and question the objectivity of warning systems	Regardless of their time in the United States, undocumented immigrants were hesitant to trust warning systems due to historical exploitation and distrust of government agencies.

Culture Shock Prompts Foreign-Born Spanish Speakers to Undergo Similar Adaptation Processes

The first theme identified among all foreign-born Spanish speakers was related to the culture shock they experienced when adapting to warning systems. The dialect and disaster subculture often differed significantly from what individuals were accustomed to in Latin America, initially leaving them overwhelmed as they navigated an entirely new warning system for which they were unprepared. To adapt, these immigrants relied on social networks and trusted media sources within their communities to learn how to respond to weather and climate extremes in their new residential areas. Despite coming from various parts of Latin America,

foreign-born Spanish speakers adapted to new warning systems in similar ways. They faced ongoing stressors exacerbated by the new climate, but through continuous adaptation, they gradually reduced their culture shock over time.

For instance, Jackie, a 29-year-old immigrant who has LEP, moved to Florida seven years ago from Venezuela after living there for 22 years. Growing up in a region marked by inactive weather, Jackie did not experience significant meteorological hazards, and, as a result, did not learn how to prepare for extreme weather phenomena she would later face in the United States, a common theme among all participants:

> Well, where I lived [in Venezuela] nothing ever happened. The heat was terrible. In Venezuela, the only event that received worldwide attention was the tragedy in Vargas, which was a landslide in a mountain caused by heavy rain. That happened far away from where I lived specifically but it was a tragedy and many people died there.

In other words, Jackie's Venezuelan disaster culture did not emphasize weather changes. Media outlets provided limited weather information, leading her to overlook weather conditions when making decisions in her daily life, a pattern that resonated with nearly all participants:

> [In Venezuela], people only learn about severe weather after it has already become extreme, not before. At least with Vargas, all the general population learned about it when it was already a catastrophe, when there were already deaths [reported], when it was already horrible… right around the same time the rest of the world found out too.

Jackie experienced culture shock when she first moved to Florida. Suddenly, everyone around her prioritized weather in their daily lives. Unaware that resources such as 7-day forecasts existed, Jackie felt lost upon her arrival in Florida. Adding to these challenges, Jackie also has LEP and felt anxious about learning new weather phenomena in a language she did not understand. Fortunately, the bilingual weather enterprise and local community have ramped up their efforts to provide information in multiple languages in the Florida region (Trujillo-Falcón et

al., 2021). Jackie expressed her gratitude for these resources, as they helped her adapt to her new home and climate:

> Here in Florida, there is a very famous hurricane season. I am very happy with the fact that they send you brochures and all the precautions you have to take during that time of the year. They are very efficient in that aspect. It helped me a lot when I first moved here as I got used to the new climate.

Having recently celebrated her 7-year anniversary in Florida, Jackie expressed that she now feels integrated into the hurricane preparedness culture. Her journey was not straightforward: she faced several challenges along the way but eventually adapted to the new warning system in Florida. She now primarily relies on a mobile weather application to stay informed about incoming weather and to ensure her family's safety. This transition highlights how culture shock arose from the differences between Venezuela's semi-arid disaster subculture and Florida's tropical climate. In a short period, Jackie had to learn to navigate a disaster subculture that required constant weather vigilance. Her adaptation process was not linear; she learned new things with each hazard she encountered to eventually become prepared.

Mariela, a 48-year-old immigrant who has LEP, is also a local Floridian, but her origins trace to a different country in South America. Raised in the capital city Buenos Aires, Mariela lived in Argentina for 25 years before moving to the United States, where she has spent the last 23 years in Florida. Unlike Jackie, she experienced extreme weather growing up and even became familiar with local, meteorological phenomena of her area (which are described in the Argentinian dialect of Spanish). These events, however, were still largely different than the ones she would eventually encounter in Florida:

> I used to experience heavy rain and floods in the city [of Buenos Aires], which is on the edge of a river. This is all due to what they call the “sudestada,” or when the wind runs to the side of the river and the water rises. But there are no hurricanes, tornadoes, snow, there is nothing [like that in Argentina]. In other words, we usually experience rain, wind, and sometimes hail.

Due to repeated severe weather events, Argentina has invested resources to disseminate information about extreme weather (Lohigorry et al., 2018).[1] Mariela admitted that she was aware of these communications; however, she felt her country's disaster subculture had not been well connected to the weather enterprise. She reflected on recent events that had occurred in her home country, as most of her family still lived in Buenos Aires:

> You find out about [extreme weather] right when it happens... I watch a lot of news from Argentina because of my family. And I saw that the person who does the weather said in the headlines, "warning, level orange... there is warning, level orange" for the probability of heavy rain with winds. But people do not pay much attention to the warning, they say "well, rain, wind, and that's nothing." Then it turns out that it was super strong and there were consequences.

Like Jackie, Mariela also struggled to adjust to Florida's disaster subculture when she first moved. She suddenly had to manage hazards she had never been taught to handle, leading to her unfamiliarity of the overall warning system. Her LEP compounded these challenges. She admitted that her first hurricane seasons were particularly difficult as she relied on others for lifesaving information. However, after a few years, she eventually adapted to the new disaster subculture, thanks in part to bilingual resources and the support of her community.

> In Argentina nobody ever experiences a hurricane. I had to live through hurricanes [when I moved to Florida], and I was scared to death because of the [extreme] winds. Compared to Argentina, the meteorological culture [in Florida] is much more serious and obviously better organized... I did notice the difference when I moved here for the first time. At the beginning, it took me by surprise… now it seems normal to me. But well, it's like a cultural thing, isn't it?

After 23 years in Florida, Mariela has become well-acquainted with the state's tropical climate and its hazards. She takes pride in using the lessons she learned to help new immigrant communities navigate the challenges of adapting to a new disaster subculture. As her husband is

[1] It is important to acknowledge that the Servicio Meteorológico Nacional Argentina, the country's weather agency, has been in operations for more than 150 years. However, they do not have the same level of radar technology, resources and funding than the U.S. NWS, hindering their efforts to reach broader audiences (Nesbitt et al., 2021).

a pilot, she asked him to educate her on weather terminology and forecasting technology. As a result, she is now considered a weather expert in her local community, using several mobile weather apps and analyzing radar signatures like a "seasoned pilot."

Despite coming from Argentina, a country that frequently experiences severe weather, Mariela still faced culture shock when moving to Florida. Argentina's active warning system kept people aware of weather changes, but the combination of an ambivalent disaster subculture and significantly different weather hazards in the United States initially overwhelmed her. Mariela's adaptation mirrored Jackie's: both felt culture shock and relied on community resources to adjust to the new warning systems. All the foreign-born participants I interviewed experienced similar acculturation processes as they managed a stress-adaptation dialectic. As explained by Kim (1988), immigrants adapt to a new culture in a non-linear fashion, experiencing stress and growth incrementally. Moving to areas with completely different weather than they were used to, their disaster subculture did not equip them with the proper tools to adapt to a new warning system. As a result, participants used similar strategies to become accustomed to the new warning system, relying on social networks and media sources to provide information in their dominant language. This finding is important, demonstrating similar adaptation processes despite coming from diverse climates in Latin America.

Cultural Factors from Local and Ethnic Backgrounds Shape How U.S.-Born Spanish Speakers Understand Warning Systems

The second theme that emerged from the interviews revealed the influence of multiple cultural factors on the way U.S.-born Spanish speakers understood warning systems. Despite never having lived in Latin America, the culture and traditions passed down from previous generations were very important to U.S.-born Spanish speakers. Most participants recalled

historic disasters from their countries of origin, as recounted by their parents and grandparents. Some even began to make sense of disasters in the United States through the lens of these stories, which inspired them to become local experts and help their families navigate unfamiliar hazards. Combined with their own lived experiences in the United States, these narratives helped them navigate and comprehend their local warning systems. When participants moved within the United States, they often described the transition not just in terms of climate but also by comparing various cultural differences of the two geographical locations. Proximity to their ethnic community was crucial for many participants, as it was where they practiced and lived their culture, collectively making sense of warning systems. Without this connection, adapting to a new warning system, even within the United States, was challenging. Overall, this finding notes that individuals' local culture, rooted in their ethnic community, also played a role in how they responded to warning systems.

For example, Jorge, a 31-year-old Salvadoran American, grew up in Los Angeles, California. Although his parents were born in El Salvador (and he rarely visits the Central American country), he embraces his Salvadoran culture daily and identifies more as Salvadoran than American, a common trend among all U.S.-born participants. In Los Angeles, he did not experience extreme weather events, such as tornadoes or hurricanes, but vividly remembered how he became accustomed to responding to earthquakes:

> Ever since I was a kid, the schools here in Los Angeles have always prepared us for earthquakes. For example, when the bell rang, which was a test, we had to go under the table or stand like this where the door is or go outside the building.

Although Jorge had not experienced many meteorological disasters, he was proficient in weather preparedness. He frequently watched the local Spanish-language Univision station in Los Angeles and enjoyed English-language content from The Weather Channel. This repeated

exposure to environmental information familiarized him with local Californian folklore related to earthquakes, such as "The Big One," which predicts a significant earthquake along the San Andreas fault. This knowledge inspired him to become his family's emergency preparedness expert, maintaining several emergency kits for any potential disaster. He has observed cultural differences within his family, particularly among relatives who were not raised in Los Angeles. Understanding their backgrounds, Jorge did not judge them but rather tried to help them whenever he could:

> I have had family members tell me “What are you preparing for?!” Well, you never know. But they are also the first to say, “Oh, you have something I can borrow from [your preparedness kit]?" Well, of course, here you go!

When asked about unfamiliar weather phenomena, such as tornadoes, Jorge admitted that he would not be prepared for them and expressed some concern. However, with his English proficiency, he was confident that he could quickly develop a plan and keep his family safe.

Juliana, a 47-year-old Mexican American, moved to California two years ago after spending 45 years in El Paso, Texas. She made the decision to pack her bags and move across the country for a new job opportunity. However, she still experienced homesickness and missed her hometown’s food and culture. Juliana’s move to California brought not only personal and sentimental changes but also a significant shift in climate:

> In El Paso, there were sandstorms and hail from time to time. It was very large hail about the size of a golf ball. I also once experienced a tornado. But here in California, it sometimes gets kind of sandy but not as much as [El Paso] ... earthquakes are the most intense thing here in California.

Repeated exposure to severe weather in Texas prompted her to become more engaged in her environment and surroundings. In El Paso, the local community trusted and followed Aldo Acosta, a bilingual broadcast meteorologist who has been providing lifesaving information to Spanish-speaking communities since 1991. With over three decades of experience, Aldo fostered

a culture of preparedness, frequently encouraging his viewers to stay informed about the weather each week, according to Juliana. However, Juliana's experience in California has been notably different. She mentioned the absence of a trusted meteorologist in the area, likely due to the infrequency of extreme weather events. As a result, a disaster subculture of awareness was not properly established. Additionally, living in a rural part of California, away from major cities, further disconnected her from reliable weather sources. This new environment is one of the many aspects she misses about her native El Paso:

> In El Paso, I watched Univision and meteorologist Aldo Acosta every day. He is the one who kept us informed of the weather. In California, I tend to use the mobile apps more. [Where I live,] the TV needs internet connection and so like nothing is live, so they say. I live very far away from Los Angeles… so I have seen meteorologists on TV, but I do not have one like Aldo Acosta.

Jorge and Juliana's stories represent the perspectives of participants born in the United States. Jorge combined his Salvadoran culture with his experiences in California, which motivated him to consider the vulnerability of his family members to hazards in the United States. All participants, regardless of whether they had visited their countries of ethnic origin, reflected on their family's experiences to understand warning systems in the United States, revealing an intriguing nexus. Juliana's move from El Paso to a rural town in California represented not just a change in climate but also a shift in culture. She relied extensively on her local community to collectively make sense of warning systems and disasters. Most participants who moved to new areas in the United States expressed similar concerns: Although the culture was different, the local community was crucial in helping them navigate the complexities of their new environment. This result highlights that disaster subcultures can be shaped by various factors, leading to unique experiences for Spanish speakers.

Cultural Differences and Conflicting Warning Systems Complicate How Border Communities Understand Warning Systems

The third theme emerged from the culturally diverse border region between the United States and Mexico. This region encompasses parts of four U.S. states (California, Arizona, New Mexico, and Texas) and six Mexican states (Baja California, Sonora, Chihuahua, Coahuila, Nuevo León, and Tamaulipas; Wilder et al., 2013). A few participants reported living on either side of these borderland communities, and their perspectives are crucial to highlight because they processed two warning systems simultaneously. Their stories revealed that messaging strategies between the United States and Mexico varied significantly, sometimes conveying different levels of urgency to communities receiving information from both sides. Consequently, people in borderland areas grew up navigating and making sense of two often culturally distinct warning systems, highlighting the complexity of responding to disasters in these regions.

For instance, Teresa is a 51-year-old Mexican Immigrant with a fascinating story. Born in a borderland region, she lived the first 18 years of her life in Tijuana, Baja California, Mexico. Tijuana, a vibrant city located just south of the United States border, is a cultural melting pot where Mexican and American cultures intersect frequently. Growing up in Tijuana, Teresa experienced a blend of traditions, languages, and lifestyles influenced by its proximity to the United States. This unique cultural intersection was evident in the daily life of Tijuana's residents, who often travel to the United States for work and come back to Mexico to their families, according to Teresa. Given that they had access to both American and Mexican television channels, Teresa noticed stark differences in how the two countries communicated extreme weather hazards, despite being only minutes apart. She realized that even though the same weather events affected both sides of the border, the warnings varied greatly due to

differences in infrastructure and each country's ability to keep their residents safe. This experience highlighted for Teresa the importance of understanding and adapting to diverse weather communication strategies, a skill that proved invaluable when she moved to the United States at the age of 18:

> In Mexico, we tuned into the television [for weather information]. At that time, printed newspapers were much more common. There was a section of the week's forecast that they printed. But we also had access to American news because the signal came through. So, one heard [weather information] in much more detail and there was a different approach between the two countries. The effect was very interesting. [Because of their infrastructure], they were saying [in the United States], "This [weather event] is going to happen. Stay tuned," while [in Mexico] they were saying "run for your life," [laughs].

Teresa's experience in the borderlands reflects those of other participants living in similar regions. The two agencies responsible for communicating extreme weather phenomena in the United States and Mexico are the NWS and Servicio Meteorológico Nacional (SMN), respectively. Notably, their methods of disseminating extreme weather information differ significantly due to local infrastructure and needs from the community, according to Teresa. In the United States, all users in a geotargeted threat area receive a WEA message on their mobile devices (National Weather Service, n.d.a). In Mexico, the SMN disseminates information through newsletters or special notices via telephone, email, or online platforms, which mainly reach more urbanized areas (Sardiñas et al., 2022). Currently, Mexico lacks an integrated alert system to disseminate warning information systematically, which creates information gaps for many Mexicans (Sardiñas et al., 2022). Participants from border communities highlighted that these cultural and warning system differences affected how they perceived risk and understood warning systems as a whole. Addressing these issues is critical for a safer future.

Undocumented Immigrants Distrust and Question the Objectivity of Warning Systems

The fourth and final theme captures the experiences of undocumented immigrants in the United States and their understanding of a warning system that has traditionally not served them. All participants had proper immigration documentation at the time of the interview, but some had previously been undocumented immigrants, and several currently had undocumented family members. They reflected on the longstanding disconnect between undocumented communities and warning systems, citing multiple reasons for their distrust and challenges in accessing these resources. This divide led to a heightened skepticism towards any official warning systems, even after becoming documented. Language barriers compounded the issue for LEP participants, as traditional warning messages are typically in English, which heightened their mistrust.

Continuing her story, Teresa now lives on the other side of the borderland, in San Diego, California, where she has spent the past 33 years. Living in San Diego, Teresa finds herself amidst a large community of undocumented immigrants, many of whom face significant challenges and inequities. She has witnessed firsthand the struggles of these communities, from limited access to essential services to constant fear of deportation. Teresa emphasized the importance of including these particularly marginalized groups in emergency preparedness efforts. She shared rumors that the NWS recently collaborated with the U.S. Border Patrol to provide weather information for their operations. This allegation has been confirmed; for the past few years, NWS Weather Forecast Offices have provided direct support to U.S. Border Patrol sector offices and stations, including those in the San Diego-Tijuana border community, to assist with their operations (Moreland et al., 2019). Teresa opposed this collaboration due to the U.S. Border Patrol's notorious history of separating families in the borderlands. She emphasized that the NWS should be a service for *all,* not an exclusionary one:

> [The National Weather Service] should remain neutral because they are providing a service and they do not want [the immigrant community] to say later that they are a part of the government interested [in deporting them], not so much in informing them.

Warning systems have traditional connections to governmental agencies linked with separating the families of undocumented immigrants (Fussell et al., 2018; Méndez et al., 2024). Participants not only recognized these vulnerabilities but also expressed a deep-seated mistrust towards official alerting authorities, contributing to their skepticism of warning systems even after they became citizens. This divide highlights how adaptation processes may differ for these groups. Rather than gradually adapting to warning systems, undocumented immigrants may never fully embrace them, as their refusal often signifies a strong allegiance to their local community.

Overall, these results underscore the necessity of recognizing Spanish-speaking communities in the United States as diverse and not monolithic. Despite a shared language, cultural factors such as ethnic origin and documentation status lead to varied interpretations of warning systems. Most foreign-born individuals adapted to these systems in similar ways, with the exception of undocumented immigrants, who resisted adaptation due to perceived systemic injustices. U.S.-born individuals consider not only geography but also their local and ethnic cultures when making sense of local warning systems. Meanwhile, borderland communities navigate competing warning systems from both sides of the border. These insights highlight the importance of tailoring emergency communication strategies to address the distinct needs and experiences within Spanish-speaking communities.

Warning Response for Wireless Emergency Alerts in Spanish (RQ2 and RQ3)

The next two research questions (RQ2 and RQ3) examined how Spanish speakers understood, believed, personalized, made decisions, and engaged in milling after receiving a WEA message for a tornado hazard. These research questions are based on the original WRM

(Mileti & Peek, 2000; Mileti & Sorensen, 1990). Their findings are discussed in this section in detail.

The themes that emerged in response to these research questions revealed insights into how Spanish speakers perceived warning messages and started to consider initial decisions based on such messages. RQ2 asked, *"How do Spanish speakers in the U.S. understand, believe, and personalize information presented by WEAs?*". The overuse of unfamiliar acronyms, inconsistent communication of time zones, confusion caused by dialect preferences, and incorrect phone settings set to English all hindered Spanish speakers' *understanding* of WEA messages. In terms of *belief,* Spanish speakers trusted WEA messages if the message properly identified the source and did not use an acronym to introduce them to the user. *Personalization* varied depending on the participant's disaster subculture. To communicate an unfamiliar hazard, participants recommended using capitalization, color, images, and minimizing warning jargon to reduce confusion.

RQ3 asked, "*How do Spanish speakers in the United States engage in decision-making and milling processes based on information presented by WEAs?*". Depending on the format of the WEA (i.e., 90 or 360 character), Spanish speakers considered different *decision-making* strategies. The 360-character WEA messages seemed to resonate more with participants, as more context helped them navigate unfamiliar scenarios. *Milling* processes varied among foreign-born and U.S.-born participants. However, all participants decreased their milling time considerably with 360-character WEA messages. To enhance information seeking, participants suggested the implementation of links and landing pages that could guide them to more resources. These themes are explained in more detail in Table 5.

Table 5

Warning Response Among Spanish Speakers (Answers to RQ2 and RQ3)

WRM Variable and RQ	Theme	Description
Understand (RQ2)	Trouble identifying the source of WEA messages	Spanish speakers often struggled to identify the source of WEA messages (i.e., the NWS), which affected their trust and response. This issue arose because some Latin American countries lacked meteorological government agencies. Also, less frequent extreme weather meant people rarely interacted with such entities. The confusion mainly occurred in the 90-character WEA, as many did not recognize the acronym 'SNM.'
Understand (RQ2)	Confusion over time zones and their applicability	Foreign-born individuals, especially those from countries with a single time zone, struggled with defining acronyms. The confusion grew because there was no consistent way to communicate time zones in Spanish.
Understand (RQ2)	Misinterpretation of key terms due to dialectical differences	Terms such as 'flying debris' lacked a direct translation in Spanish. The translated term 'projectiles' was misinterpreted as 'bombs,' causing confusion about the nature of the threat.
Understand (RQ2)	Issues with comprehending WEA messages due to phone settings	Some Spanish speakers unintentionally disabled bilingual WEA messages by setting their phones to English, either to continue learning the language or due to dissatisfaction with poor translations from English.
Belief (RQ2)	High trust and credibility for WEA messages	Spanish speakers generally trusted the information provided by WEA messages. WEAs tended to resonate with foreign-born populations, who are documented.
Belief (RQ2)	WEAs perceived as spam when acronyms are used to describe the source	Since most participants did not understand what "SNM" meant, they often resorted to ignoring the message altogether, thinking it was spam rather than a warning.
Personalization (RQ2)	Spanish speakers used their disaster subcultures to personalize tornado hazards	The disaster subculture of Spanish speakers shaped how they responded to tornado hazard information and how seriously they took the hazard.
Personalization (RQ2)	Strategic capitalization increased sense of urgency	Strategically capitalizing words that emphasized urgency or protective actions heightened awareness among Spanish speakers

Personalization (RQ2)	Warning jargon inhibited proper personalization	"Tornado warning" did not have a direct translation into Spanish. Individuals found "alerta" to be a viable alternative. However, plain-language statements were more favored among participants.
Decision-Making (RQ3)	90-character WEAs fell short for effective decision making	Short messages failed to prompt the necessary urgency or lead most Spanish speakers to take tornado warnings seriously. Only those with prior experience with tornadoes felt that these messages were adequate for making informed decisions.
Decision-Making (RQ3)	Enhanced urgency and message processing through 360-character WEAs	360-character WEAs not only enhanced urgency, but also led *all* Spanish speakers to begin processing the warning message at hand.
Milling (RQ3)	Foreign-born Spanish speakers relied on knowledgeable community members and media sources	Spanish speakers born outside of the United States created socially generated meaning out of warnings through their social networks and trusted media sources, such as television, radio, and mobile applications.
Milling (RQ3)	U.S.-born Spanish speakers proudly embrace the role of community messengers	Spanish speakers born in the United States recognized that some of their family members may not have established trusted sources of information, so they take it up as their own responsibility to be a critical messenger during severe weather events.

To highlight the inequities and variations in responses to WEA messages, I incorporated participant perspectives from different countries of origin, nativity statuses, and levels of language proficiency. RQ2 answer employed quotes from Adriana (Mexican Immigrant with LEP), Javier (Nicaraguan Immigrant with LEP), Lucia (Mexican Immigrant), Gabriela (Venezuelan Immigrant with LEP), Erendira (Venezuelan Immigrant with LEP), Mauricio (Mexican Immigrant with LEP), Andrés (Salvadoran American), Jackie (Venezuelan Immigrant with LEP), Diego (Guatemalan Immigrant with LEP), Valentina (Mexican Immigrant with LEP), Juliana (Mexican American), and Miguel (Mexican Immigrant with LEP). RQ3 features stories from Gabriela (Venezuelan Immigrant with LEP), Erendira (Venezuelan Immigrant with LEP),

Noelia (Mexican Immigrant), and Teresa (Mexican Immigrant). By incorporating these diverse viewpoints, I was able to analyze how cultural and linguistic factors influenced varying levels of understanding, belief, personalization, decision-making, and milling of WEAs.

Understanding, Belief, and Personalization of WEAs (RQ2)

Understanding. I first found that Spanish-speaking participants struggled to understand WEA messages right from the first word. Both 90- and 360-character WEA messages begin by identifying the source. In both versions, the National Weather Service is translated to Servicio Nacional Meteorológico (SNM). However, to save character space, the 90-character version uses the SNM acronym. Spanish-speaking participants reported being unfamiliar with the SNM acronym in the 90-character WEA. Although some Spanish-speaking countries have national weather agencies known as SNM, many parts of Latin America do not have such established organizations, let alone a recognizable acronym.

Lacking this context, Adriana, a 34-year-old Mexican immigrant with LEP, admitted she would Google the meaning of SNM before making any decisions when she first encountered the 90-character WEA message. Although Mexico has a weather agency with the acronym SNM, she did not recognize it, as she primarily relied on the radio for weather information during her 16 years in Mexico. In the United States, where she had lived in Oregon for the past 18 years, she primarily relied on websites and local news for her weather updates. She did not recall ever seeing the acronyms NWS or SNM in the coverage she watched. The search result of SNM she found online made her laugh and left her even more confused: “I have no idea what SNM means. I would go to Google and see what it means… [Visits Google] … I see [SNM] stands for Neuroleptic Malignant Syndrome… that is not it, [laughs].”

Javier, a 46-year-old Nicaraguan immigrant with LEP, recently moved to the United States after living in the Central American country for 44 years. Nicaragua has a national weather agency, but it does not use the acronym SNM. Instead, it is known as the Instituto Nicaragüense de Estudios Territoriales, or INETER for short. When Javier encountered the SNM acronym, his first guess further puzzled him as he tried to make sense of the warning: "I do not know [what SNM means]. I am sure it means synonyms."

Lucia, a 35-year-old Mexican immigrant, faced similar issues when trying to understand the 90-character WEA message. Growing up in the desert climate of Mexicali, Mexico, where heat waves were the primary weather hazard, she had little interaction with the SNM during her 18 years there. After moving to the United States and joining the Navy, she became familiar with the NWS, but not its acronym in either English or Spanish. When she tried to guess what SNM stood for in the 90-character WEA message, she arrived at a surprising yet reasonable deduction: "SMN sounds like something else to me, like BDSM, really."

Message receivers in both the 90- and 360-character WEAs faced yet another understanding barrier after reading the time zone information. It is important to acknowledge that time zones in Spanish-language WEA messages use English abbreviations: "EST" for Eastern Standard Time, "CST" for Central Standard Time, and "PST" for Pacific Standard Time. Although these abbreviations may be widely recognized in the United States, time zones are often communicated differently in Spanish. For instance, Univision, a major Spanish-language network in the United States, uses the following format for national programming: "P/C/PAC" to indicate Eastern, Central, and Pacific time zones. The conflicting acronyms across languages led to significant confusion, causing many recipients, especially those who had recently arrived in the country, to ignore the time zone information altogether.

Gabriela, a 34-year-old with LEP, lived in Venezuela for 33 years before recently immigrating to New York. She admitted that she was completely unfamiliar with time zones, as her native Venezuela only has one time zone for the entire country. When she encountered the abbreviation "EST" in a message, she tried interpreting it in Spanish as "estado situación del tiempo," which translates to "state of the weather." She said, " EST? I really have no idea what it means. State of the weather?"

Erendira, a 28-year-old Venezuelan immigrant who arrived in Illinois six months ago, admitted to having the same difficulties understanding time zone information. She focused solely on the time and ignored the time zone altogether. She noted, "Tornado warning until 9:45.... CST? I do not understand "CST" … I kept reading [the warning] and ignored it." Similarly, Javier, a 46-year-old immigrant from Nicaragua with LEP, also recently moved to the United States, and has lived in California for the last two years. He acknowledges that in his brief time in the country, he has seen different variations of time zone acronyms, but does not know what they mean. Acknowledging that the acronym comes from the English language, he gave his best shot at guessing what it meant: "I only know that PM means the afternoon. [As for PST], I've seen several acronyms like that, but I don't know what it is… [maybe] Priority Storm Time?".

Dialects also caused confusion among Spanish-speaking communities in their understanding of WEA messages. In the 360-character WEA message, safety recommendations are provided for the public to follow. One such recommendation advises people who are outside to find secure shelter immediately to protect themselves from flying debris. The word "debris" does not have a direct translation in Spanish and is often translated to "proyectiles." However, the meaning of "proyectiles" can vary across Latin America. Participants familiar with extreme weather events could associate "proyectiles" with scattered pieces of material thrown into the air

by a tornado. However, for Spanish speakers from countries with a history of war, "proyectiles" often conjures horrific images of warfare, leading to confusion and increased anxiety when processing WEA messages.

Mauricio, a 42-year-old Mexican immigrant with LEP, spent the first 18 years of his life in Mexico City. He recalled living through severe thunderstorms, where strong winds frequently caused damage in his hometown. Having spent 24 years in the United States, Mauricio has become more familiar with tornadoes through television coverage. Due to his experiences with strong wind phenomena in both countries, he was able to associate the Spanish word "proyectiles" with the English concept of flying debris. However, he also recognized that his community might interpret the same word differently due to dialect variations:

> I understood the word "proyectile" as if it were to say that the tornado dismantled a house and everything it damaged flew away. There are many people in other countries who understand it as bullets. That is what they are most used to.

Andrés, a 26-year-old Salvadoran American, has heard vivid accounts of the war and conflict in his home country from his family. El Salvador experienced a brutal civil war from 1980 to 1992, which left deep scars on its people (Green & Ball, 2019). More recently, the country has faced ongoing violence and strife due to gang conflicts and political instability (Martínez, 2017). These experiences have profoundly shaped Andrés's perception of the word "proyectiles," leading him to associate it with missiles or bombs rather than flying debris. Despite being born in the United States, these cultural and historical contexts have shaped his interpretation of the word. He stated, "The word "proyectiles" is like a bomb, like a shooting. I would see the word "proyectiles" and think there is a gunfight, and they are using armed weapons. I would think someone is committing a criminal act." Thus, this instance reveals how deeply personal and communal histories can affect the understanding of language and emergency warnings.

Although my analysis primarily focused on how Spanish speakers understood WEA messages, it is important to acknowledge that some participants might not have even received these alerts in a real-life scenario. As mentioned in Chapter 2, Spanish-language WEAs are only accessible if a user's phone language is set to Spanish (either as the primary or secondary language). Many LEP participants reported being unaware of this requirement, and thus did not know they needed to set their phone to Spanish. In fact, many willingly set their phone language to English to help them learn the language through repeated exposure. Had they known that setting their phone to Spanish was necessary to receive lifesaving alerts in a language they could understand, they would have done so immediately. Jackie, a 29-year-old Venezuelan immigrant with LEP, admitted to this practice: “I have my phone in English because I live in the United States and well, you know... I have to learn English and practice it every day.”

Overall, all participants emphasized the critical need for clear messages to bridge existing gaps in understanding WEAs. Although the information was mostly accessible to Spanish speakers in their dominant language, slight variations in translation could have significantly improved participants' processing of the messages. Translations should not only transform words from one language to another but also convey the inherent *meaning* of the message (Trujillo-Falcón et al., 2022). Consistency in messaging is crucial to allow people to process the information without any barriers from conflicting sources (Williams & Eosco, 2021). Finally, it is crucial to address participant concerns about accessibility. Some participants knew about Spanish WEAs before the simulation, but most were unaware of this option, leading them to accidentally disable warning messages in their dominant language. Ensuring that everyone knows about Spanish WEAs should be a focal point in translation efforts. This will help people spend less time deciphering terms and more time taking protective action.

Belief. Spanish-speaking participants expressed strong trust in WEA messages, particularly when they understood the source. For the more vulnerable Spanish-speaking communities, such as those with LEP and foreign-born individuals, WEAs have become a crucial source of information, as it is one of the few sources that is automatically translated into Spanish nationwide. However, as mentioned earlier, many could not decipher the acronym SNM in the 90-character version, leaving them to guess the origin of the warning message. This confusion would often lead to so much distrust that some participants outright ignored the incoming WEA altogether. It is important to note that all participants that were interviewed were all documented; therefore, the perspectives of undocumented communities were not considered in these results.

Diego, a 59-year-old Guatemalan immigrant with LEP, lived in the Central American country for 51 years before moving to Florida. Since arriving in the United States, his mobile phone has become his most reliable source of weather information, and he continues to trust it heavily. When he first received the 90-character WEA message during the think-aloud interview, he could not understand what SMN meant and admitted that he would not have trusted the message if it were real, likely ignoring it. He discussed the negative consequences of this misunderstanding:

> [The WEA] is a credible message. But logically, I cannot confirm that I am receiving it from a reliable source. That really worries us a lot because the way they verify that they are a reliable source is by putting 'SNM,' but if we can't understand it then people are going to think they are receiving a spam message instead of the service.

Similarly, Gabriela, a 34-year-old Venezuelan immigrant with LEP, moved to New York a year ago. Her phone has also been instrumental in helping her navigate the challenges of adapting to a new climate and disaster subculture. She no longer used television for weather updates; instead, she relied on Google to find the information she needed as it is quick and efficient. With her

phone only set to Spanish, bilingual WEAs have become a crucial part of her trusted weather sources. She has received 360-character WEA messages in the past, which spell out the SNM acronym, and has expressed satisfaction with the warnings provided:

> The information source that I take most seriously as a recently arrived immigrant are the alerts that vibrate and make noise. Since everyone gets it at the same time, if one ignores it, the other reads it. Here we always, always take it most into account in my community.'

Gabriela's perspective reflects the sentiments towards WEAs among most participants interviewed. WEAs have become a reliable and trustworthy source for LEP communities, as they are one of the few resources guaranteed to be in their native language. Given that some areas in the United States lack any Spanish-language programming, WEAs help fill this information gap (Trujillo-Falcón et al., 2024). However, if the messages are not understandable, most participants may ignore or disregard them. This issue highlights the importance of crafting comprehensible messages to ensure communities not only receive the WEA but also act on it.

Personalization. Spanish speakers personalized WEA messages based on their disaster subculture and dialect. Participants who had never experienced extreme weather hazards in their home countries or their current locations in the United States noted that they would not feel particularly in danger during a tornado warning due to their unfamiliarity with the hazard and its implications. To increase the urgency needed to take the hazard seriously and prompt protective action, they suggested various strategies in WEA message design, including capitalization, color, images, and specific word choices, especially for the word "warning." Although all these suggestions are welcomed, the following quotes focus on suggestions that can be operationalized in the current IPAWS system. As of 2019, the WEA system was updated to allow alerting authorities to send messages up to 360 characters in length, written in Spanish, and including

URLs/hyperlinks and geotargeted mechanisms (FEMA, 2023). However, the software update did not support font color changes, images, or other formatting options.

Valentina, a 24-year-old Mexican immigrant with LEP, spent her teenage years in the borderlands region of San Luis Río Colorado, Sonora, Mexico before moving to Arizona 11 years ago. In both Mexico and the United States, she neither experienced tornadoes nor learned much about them. The most significant weather event she has encountered in Arizona was flooding. When she received the tornado WEA during the interview activity, she admitted that she would not perceive a high personal risk from a tornado, even if she were in a warning area and her phone alerted her. Valentina suggested incorporating elements from her Mexican disaster subculture to enhance urgency, such as using category information for tornadoes instead of ratings, similar to what she has learned about hurricanes. Although I do not recommend adding tornado categories to WEAs, I highlight this quote to demonstrate how individuals interpret warnings through their disaster subcultures:

> My personal risk would not be high because I have not experienced tornadoes. [To increase urgency], you could mention the category of the tornado or what it would be called. I think for people to be aware that it's not something simple but serious.

Another example is Juliana, a 47-year-old Mexican American who has lived in the United States all her life. After spending 45 years in El Paso, Texas, she recently moved to California. She noted that Californians do not take weather as seriously as Texans do due to differences in their disaster subculture (as discussed in RQ1). To enhance the urgency of tornado warnings for Californians, who typically do not experience them, she suggested continuing the practice of capitalization. In both the existing 90- and 360-character versions of tornado WEAs, the words "TORNADO WARNING" (or "AVISO DE TORNADO") are capitalized. Juliana found this practice effective, believing that if official alerting authorities use capitalization, it must signal

something important. She encouraged capitalizing other parts of the message, such as "TAKE SHELTER NOW" (or "REFÚGIESE AHORA"), to emphasize important protective actions to the population. She describes how capitalization drives her to take the situation more seriously:

> When AVISO DE TORNADO is capitalized, it tells me that this is serious. I have always known that when [official alerting authorities] use a capital letter, it is like they are yelling at you, "HEY, GET OUT OF HERE [and take action]!"

Another suggestion came from the word choice used in the translation of "tornado warning." Miguel, a 25-year-old immigrant with LEP, recently moved to Illinois after spending 20 years in Mexico. Growing up, he mainly experienced floods and occasional severe storms with hail but never a tornado. Upon moving to Illinois, he had to become prepared for tornadoes quickly, as the region is prone to them. He admitted that the disaster movies he watched when he was younger helped him prepare for the tornadoes he would face in Illinois. However, even with that preparation, he still rated his personal risk for tornadoes as low, even if he were under a tornado warning. The primary reason is that, although tornadoes occur in Illinois, they tend to dissipate by the time they reach his house. I asked him if there was any way to elevate the level of urgency of the warning altogether. Miguel suggested changing the translation of "tornado warning." Currently, the translation of "tornado warning" is "aviso de tornado." Miguel believes this translation lacks the necessary urgency, as "aviso" merely advises someone to do something rather than push them to take action. Instead, he recommended using a stronger word that would capture attention, that is, "alerta":

> "Aviso" sounds like no more [urgent] than a notification that comes to you or that you see on social media... but "alerta" is more like, "your attention is required. This is happening [to you right now] … it is not something you can take lightly."

Adriana, a 34-year-old Mexican immigrant with LEP, suggested an alternative approach. Having lived in the United States for most of her life (18 years), she has realized how confusing warning

jargon can be for multilingual speakers in her local community. Like Miguel, she agreed that "aviso" did not communicate the same level of urgency than "alerta" would. However, rather than suggesting an alternate translation for the WEA message, Adriana boldly advocated for eliminating the term "warning" altogether. She recommended that alerting authorities should instead use plain-language statements that could more effectively prompt action among Spanish-speaking communities:

> "Alerta" is a word associated with something dangerous. They are alerting you, but not many people give that much importance to that word. [Alerting agencies] just need to use words that inspire the Hispanic community to seek shelter. It does not need to be jargon.

Adriana did not provide specific examples, but her quote represented a common need expressed by most participants. Recently moving to the country and adapting to a new warning system and climate can be particularly challenging for individuals such as Adriana. Warning-specific jargon further hinders her ability to process the information effectively. Most participants in the dissertation study did not take tornado hazards seriously due to their disaster subculture, in which tornadoes were rare or nonexistent. All participants suggested ways to increase the urgency of warnings. Recommendations such as strategic capitalization and careful word choice can better serve these communities. They are eager to engage with warning information but lack the necessary resources and language to do so. Addressing these cultural and linguistic nuances is critical in ensuring the information is accessible among Spanish speakers.

Decision-Making and Milling Strategies through WEAs (RQ3)

Decision-making. The format of WEA messages largely determined the types of decisions Spanish speakers considered taking. The 90-character WEA messages effectively caught the attention of Spanish speakers. Participants familiar with tornadoes felt prompted to take protective actions they had previously reviewed in their emergency preparedness plans.

However, Spanish speakers from disaster subcultures unfamiliar with tornadoes reported that the 90-character WEAs often did not lead them to consider taking shelter. In contrast, the 360-character WEAs prompted responses across all groups. The additional context about the implications of a tornado, along with safety recommendations for various scenarios, encouraged participants to take the hazard seriously and become more prepared.

To provide a representative example, I highlight Gabriela's story. Gabriela moved to New York a year ago after living in Venezuela for 33 years. She grew up in the Venezuelan city of Maracaibo, where she mainly experienced heavy rain and strong winds from leftover weather systems that would never reach her. She admitted that the disaster subculture in Venezuela was indifferent to weather extremes due to the lack of reliable weather information and frequent inaccuracies in the few forecasts that are available. This apathetic attitude to weather extremes was evident in the way she responded to a 90-character WEA. After conducting the think-aloud activity, she confessed that, if she received a tornado warning, she would not take it seriously and not take any sort of protective measures:

> I would try to go on with my life as normal [if I received this WEA], but I would be watching to see if the wind increases, if it is going to rain, if there were some other types of change that would tell me if there were indeed going to be a tornado. Because there are times when you have so many things to do in your day that you do not get paralyzed by a warning. It is because you do not have the certainty that it is going to happen.

Her attitude toward the tornado hazard changed abruptly when I presented her with the 360-character WEA message. Gabriela noted that the safety recommendations in the 360-character WEA effectively conveyed the seriousness of the hazard and the urgency of seeking more information before it was too late. This context was crucial for her, as she lacked the cultural perspective to understand the potential impact of a tornado. She reflected on why she initially ignored the warning message, attributing it to her disaster subculture:

> [The 360 WEA] has more information about one should do in relation to what is going on around me and [outlines] the implications of the hazard. [Our immigrant community] does not really know what this phenomenon might mean. Because at the end of the day, one year is too little time to know all the things that can happen in this country. The only thing we know about tornadoes is what we see in the movies. And sometimes the movies are a bit exaggerated. So, one is very indifferent to [shorter alerts].

This finding is important, as 90-character WEAs may hinder the most vulnerable Spanish-speaking communities from making safe decisions in the most important moments of a tornado. In contrast, the 360-character WEAs provide the necessary context for immigrants to feel empowered to seek more information right before a tornado strikes and should be prioritized for this population. Ensuring these comprehensive alerts reach Spanish-speaking communities is likely to enhance their safety and preparedness significantly.

Milling. As the WRM states, most individuals do not make decisions based solely on one source. They mill, or create socially generated meaning, by seeking additional information both from official sources (e.g., television and Internet) and unofficial sources (e.g., family and friends). Nearly all participants reported engaging in milling processes after receiving a WEA message. However, the sources they relied on varied greatly depending on their disaster subculture and the length of time they had lived in the United States. Participants who recently moved to the United States mainly relied on more knowledgeable community members and media sources. Those who had spent the majority of their lives in the United States often became the trusted messengers that more vulnerable groups relied on, especially if the former were proficient in English. Nevertheless, even the most experienced English speakers expressed a desire for a one-stop shop for the best information on unfamiliar hazards. The following quotes describe the varied milling processes among Spanish-speaking populations.

Erendira, a 48-year-old Venezuelan with LEP, moved to Florida just six months ago. As she acclimated to the culture and climate of Florida, she relied on an extensive social network of

community members when she would receive a WEA message. She actively sought information and conducted her own research. Given the availability of bilingual programming in Florida, she comfortably consulted Spanish-language news outlets. Additionally, she frequently used Google to search for information. This combination of sources contributed to her milling process and has helped her navigate some recent hazards she has encountered:

> One person says to another, “Look, you know what I heard that there is going to be severe weather?”" Then you do your own research on Google... or you watch the news more often because “ah, look, so-and-so told me that this is going to happen.” So, you try to look for the information and the best way to get informed.

Noelia, a 51-year-old Mexican immigrant, considered herself more American than Mexican. Born in Mexico City, she spent only the first four years of her life in Mexico before moving to the United States. She has not returned to Mexico since her quinceañera, which has strengthened her identification with American culture. Nevertheless, she deeply appreciated her Mexican heritage, as her parents still primarily spoke Spanish and have instilled these cultural values in her life. During extreme weather events, she relied on the precautions she has learned from the American disaster subculture. Her top priority when preparing for an extreme weather event has been ensuring the safety and well-being of her family, many of whom do not speak English. She shared that she would go one by one to make sure that everyone received the necessary information. As a result of this milling process, she has transformed from a recipient of lifesaving information into a messenger of such information in a relatively short period of time:

> If there's a tornado, then I would begin to prepare. I would be ready to seek shelter… I would call my family and let them know of what is happening [since they do not speak English]. Call every single one of my family members.

Another example is Teresa, a 51-year-old Mexican immigrant, who has spent 33 years in the United States. Having experienced disaster subcultures in both Mexico and the United States (see RQ1), she suggested that all WEAs should include a link to a comprehensive resource hub for

information sources. According to Teresa, even if people were familiar with the hazard, they might not know where to go for the most important information. This would establish a more equitable strategy within WEAs to encourage milling and ultimately lead to safer decisions:

> Now there is something that caught my attention when [the WEA] asked me to "check media" … if this is a mobile message, there should be a link [that outlines] where to go [to seek additional information]. Because by default, I would think the radio, NBC or CBS, but if you give me a reliable link with more data that could say something from Civil Protection, the Red Cross, that would be fantastic!

Thus, milling strategies varied significantly among different groups of Spanish speakers. All foreign-born participants milled extensively, verifying information with community members and media sources before making safety decisions. Although more familiar with extreme weather phenomena, most Spanish speakers in the United States continued to seek additional information, mainly for their more vulnerable family members. I found that milling times considerably decreased for all participants after they received clear and understandable messages, consistently provided by the 360-character WEA. These findings support the adoption of a full 360-character WEA message. The added contextualization not only supports healthy milling processes but also reduces milling times overall for all Spanish-speaking groups that were interviewed in this dissertation study. This added clarity benefits not only the most vulnerable members of society but also their caretakers and family members, who tend to elongate their milling process to ensure the safety of their loved ones.

Behavioral Intention and Change in Spanish-language WEAs (RQ4 and RQ5)

The final research questions (RQ4 and RQ5) examined perceptions of self-efficacy and response efficacy that affect a message receiver's perceived ability to perform the recommended action, which, in turn, can impact their decision-making (Sutton et al., 2021). This section goes beyond mere perceptions to explore possible behavioral intention and changes after a user has

read a WEA message. By understanding these factors, research can explore further how fear-inducing messages play a role in promoting (or discouraging) protective actions, such as sheltering (Maloney et al., 2011; Witte, 1992).

By analyzing responses to RQ4 and RQ5, I identified themes representing behavioral intentions and changes of Spanish-speaking participants after receiving a WEA message. RQ4 asked, "*In what ways do Spanish speakers in the United States believe the recommendations provided in a WEA would enhance their safety (response efficacy)?"* I found that, although most participants trusted safety recommendations provided by WEAs, some individuals distrusted infrastructure in the United States, leading them to doubt the safety recommendations. RQ4 highlights quotes from Eduardo (Mexican Immigrant) and Yolanda (Puerto Rican Immigrant) that illustrate the perspectives of two Spanish speakers who base safety recommendations on their disaster subculture, which includes systems of knowledge established through repeated exposure to disasters in their respective countries of origin and/or current area of residence. Again, it is important to acknowledge I interviewed only documented individuals, so the perspectives of undocumented immigrants were not considered.

RQ5 asked, "*In what ways do Spanish speakers in the United States feel empowered (or not) in their ability to take protective action (self-efficacy) after reading a WEA*?" I discovered that the 360-character WEA message significantly enhanced Spanish speakers' self-efficacy. The detailed sheltering instructions made them feel more empowered to take action. The 90-character WEA, however, made most participants feel resigned in the most critical times of the emerging disaster. The answer to RQ5 features compelling narratives from Valentina (Mexican Immigrant with LEP) and Andrés (Salvadoran American). Their stories vividly illustrate how a 90-character WEA message could have led to tragedy and highlight the greater utility and effectiveness of

360-character WEAs, respectively. A summary of all themes, along with explanations of each theme for RQ4 and RQ5 can be found in Table 6.

Table 6

Behavioral Intentions After Reading Spanish WEAs (RQ4 and RQ5)

Variable and RQ	Theme	Description
Response Efficacy (RQ4)	Most Spanish speakers believed sheltering instructions resulted in safety	The majority of Spanish speakers expressed a strong belief that following sheltering instructions by the NWS would ensure their safety during emergencies.
Response Efficacy (RQ4)	Some foreign-born Spanish speakers questioned the safety of their home structures, comparing them to Latin American infrastructure	Some Spanish speakers, especially those who were born outside of the United States, did not believe that their homes were a viable shelter. They compared American infrastructure to that of Latin America and perceived homes in the United States to have weak structures that could not ensure their safety.
Self-Efficacy (RQ5)	90-Character WEAs lacked necessary instruction for Spanish speakers to feel motivated to shelter	The brevity of 90-character messages did not provide enough information for Spanish speakers to feel confident in seeking shelter. Many, having never experienced a tornado before, admitted that a short message left them uncertain about what steps to take, rather than feeling assured.
Self-Efficacy (RQ5)	360-Character WEAs empowered individuals to choose the safest shelter options	Extended messages offered detailed instructions and helped Spanish-speaking respondents feel more motivated to respond appropriately.

Response Efficacy in WEAs

Tornado WEA messages establish response efficacy, or the belief that a protective action will result in safety, when participants read the safety recommendations from the NWS to seek shelter. However, a Spanish speaker's disaster subculture can significantly influence their belief in the recommended actions. Participants who lived in the United States for a considerable

amount of time or were born here understand that sheltering in an interior room, away from windows, in the center of a home is sufficient to stay safe during most tornadoes. However, participants who are not from the United States or do not share its disaster subculture may doubt these sheltering recommendations, comparing the infrastructure of their homes from Latin America to the ones here and deeming the latter unsafe. This skepticism reduces their belief in the safety recommendation and decreases the likelihood of taking the WEA message seriously. The following two quotes highlight two different disaster subcultures and how individuals from such cultures took into consideration sheltering instructions from the NWS.

Eduardo, a 48-year-old Mexican immigrant, moved to the United States at the young age of 13 years to pursue a career in the armed forces. His job has taken him to various states and climates throughout the United States, including California, Louisiana, Tennessee, Kentucky, and Alaska. He is now retired and has spent the last eight years in Oklahoma alongside his wife. The variable extreme weather he encountered during his career led him to develop a disaster subculture that prioritized safety and preparedness in advance for any type of meteorological disaster. When he read the 90-character WEA out loud during the activity, he immediately knew what to do based on his past experience with Oklahoma tornadoes. He emphasized how much he trusted the safety recommendations of officials, resulting in his high trust of WEA messages. He said, “From my experience having seen tornadoes, I would say that my pantry would be the safest place to take shelter.”

In stark contrast, Yolanda did not trust the sheltering recommendations provided by the WEA messages. Yolanda, a 45-year-old Latina with LEP, grew up in Puerto Rico and spent 34 years on the island before moving to Connecticut. When asked if she would feel comfortable seeking shelter in her home, she quickly said no. She believed homes in the mainland United

States to be flimsy and did not believe they were suited to handle a tornado. Even though she lived in a home with a permanent foundation, which would be a suitable and safe sheltering option, she indicated she preferred to drive somewhere during a tornado warning rather than stay at home, an action that could increase her chances of dangerous outcomes. This decreased response efficacy made her take WEA messages less seriously compared to Eduardo. Yolanda stated that, "[Houses in the United States] are cardboard houses, it is true. You cannot trust to seek shelter in [your home] because the truth is that these houses are different from those in our countries."

Overall, nearly all participants believed in sheltering recommendations. Foreign-born participants especially trusted the recommendations, as they made sense of new warning systems and how to respond to various disasters. People born in the United States also had high levels of confidence due to the variable hazards they have already experienced. The few exceptions, however, were not related to ancestry or ethnic origin, but rather to disaster subculture. Participants who were raised in cultures that taught them that homes in Latin America were sturdy enough for any disaster tended to make these comparisons with households in the U.S. This finding shows that cultural nuances can create barriers of trust, which must be addressed in future WEA messages.

Self-Efficacy in WEAs

Spanish-speaking participants also established their level of self-efficacy, or the belief that an individual can perform the recommended action, after reading sheltering instructions from a given WEA message. In the 90-character WEA version, the NWS recommends to "take shelter now" and "check media" (or "refugiese ahora" and "consulte medios informativos"), without providing additional details on what that entails. In contrast, the 360-character WEA

message offers more specific instructions: “Take shelter now in a basement or an interior room on the lowest floor of a sturdy building. If you are outdoors, in a mobile home, or in a vehicle, move to the closest substantial shelter and protect yourself from flying debris. Check media.” (or, in Spanish, “Busque refugio ahora en un sótano o en el interior de un cuarto en el nivel mas bajo de un edificio seguro. Si está al aire libre, en una casa movil, o en un vehiculo, debe ir al edificio seguro mas cercano y protegerse de proyectiles. Consulte los medios informativos.”).

Spanish-speaking individuals expressed varying levels of self-efficacy depending on which WEA message version they received. Participants who received the 90-character WEA felt empowered to take action only if they had previously experienced tornadoes and already knew what to do in such situations. Conversely, immigrants and those unfamiliar with tornadoes in their disaster subculture felt overwhelmed when they received the short warning message and spent considerable time trying to determine the best shelter location. All participants felt more empowered after reading the 360-character WEA, as the sheltering guidelines provided different options for various scenarios. This not only made the warning more prominent but also enabled multilingual speakers to take action against a hazard they might not be familiar with. Therefore, 360-character WEAs serve a better purpose for Spanish-speaking individuals, as they are more likely to encourage protective behaviors.

To illustrate how a slight change in a WEA message results in varying responses, I highlight the experience of Valentina, a 24-year-old participant with LEP previously mentioned when answering RQ2. Her background from the borderland region of San Luis Río Colorado, Sonora, Mexico contributed to her lack of personalization of extreme weather hazards. Never having experienced a tornado, she admitted that she would not know what to do if she ever received a tornado warning. During the talk-aloud activity, she first received a 90-character

WEA message that encouraged her to seek shelter but did not provide any specifics. Using this limited information, she outlined her preparedness plan, which included staying in her mobile home–one of the worst places to be during a tornado. She did not specify any sheltering instructions; instead, she mentioned that she would remain in her trailer with her family and hope that nothing would happen to them:

> I would have to buy flashlights, have enough water, have batteries ready, have our phones charged and not leave the house. Since I live in a trailer, I am afraid that it is going to be destroyed, because the foundation is loose and next to us there are about three trees that could fall on us.

When she received the 360-character WEA message, she expressed genuine shock. Her voice trembled as she realized what could have happened to her and her children if she had followed her initial plan. The 360-character WEA message encourages finding a nearby sturdy shelter if one lives in a mobile home. Valentina remembered a trustworthy friend in the neighborhood with a home on a permanent foundation that would keep her family safe during a tornado. She would have called them if she received that WEA message. From here on out, she indicated she planned on making this a priority for future tornado warnings:

> [The instructions] are very good because if we had known that this is not a safe space to shelter, my family and I would not have decided to stay in our mobile home. The tornado would have swept [my kids and I] along with our home

In conclusion, 360-character WEA messages boost the self-efficacy of Spanish speakers, particularly immigrants and those with LEP. They empower communities to take proactive sheltering actions, even when facing compounding inequities such as housing vulnerabilities. As best described by Andrés, a 26-year-old Salvadoran American, the 360-character WEA guides users through various scenarios and encourages them to seek safety, even in the most impossible (to them) situations:

I prefer the 360 version. It gives me more information on how to prepare [for tornadoes]. It is good to have more information, especially if I am not sure how to prepare, if I do not have access to the Internet or the radio, if I am driving, or if I am outside. It is more effective to send the long version because it's like a checklist that I have to do this, this and this to protect myself. The short version, however, has no checklist, it just leaves you alone [with no guidance].

CHAPTER 5: DISCUSSION AND CONCLUSION

The final chapter of the dissertation presents an in-depth discussion of the study's findings. The chapter is divided into four parts. First, I explore how cultural factors shape Spanish speakers' understanding of warning systems in the United States (RQ1). I detail the concept of disaster subcultures by incorporating intercultural communication theories to explain differences in how Spanish speakers adapt to new warning systems and climates. Second, I examine how participants respond to warning messages from Spanish-language WEAs (RQs 2-5). I contribute to the extended WRM by demonstrating that Spanish speakers undergo similar cognitive processes when interpreting warnings, although, importantly, they rely on unique factors based on their cultural and linguistic background. In both sections, I offer theoretical and practical recommendations for government agencies and practitioners aiming to improve communication with Spanish speakers in the United States. Third, I outline the limitations of the dissertation study and suggest future research to address them. Lastly, I provide a review of my dissertation research in the conclusion section. The following section begins the discussion of the findings, focusing on the main themes that have emerged from interviews, which can be reviewed in Tables 4 and 5.

Culture and Warnings Systems (RQ1)

Theoretical Contributions

Since its inception, the field of risk communication has focused on the dynamic exchange of information among individuals, groups, and institutions concerning the assessment, characterization, and management of risk (McComas, 2006). In the late 20th century, risk communication began exploring why people responded differently to similar disasters (Slovic, 1987). Initially concentrating on human responses, researchers in risk communication started

examining how cultural factors affected risk perception (Lindell & Perry, 2004; Morss et al., 2020). However, despite its significance in shaping society, culture has been largely overlooked and undertheorized in hazards and disaster research (Wu et al., 2022). This oversight has resulted in one-dimensional research designs and theories (Oliver-Smith, 2002). For instance, the widely-used EPPM in risk communication focuses on designing fear appeals by balancing threat and efficacy components (Maloney et al., 2011; Witte, 1992). However, recent studies have shown that these fear appeal variables may function differently based on cultural orientations (Zhang, 2021). A narrow focus that does not incorporate broader social, cultural, and contextual factors influencing risk perception and behavior limits the effectiveness of addressing the diverse ways communities understand and respond to risk.

My dissertation study is mean to correct this status quo by providing compelling narratives on how cultural factors shape Spanish speakers' understanding of warning systems in the United States from individuals' lived experiences. More specifically, I explore the experiences of foreign-born immigrants, individuals born in the United States, residents living along the United States-Mexico border, and undocumented immigrants. These insights reveal the nuanced ways in which cultural contexts shape risk perception and response behaviors, introducing improved strategies for engaging a vulnerable population in the United States.

The first research question asked, "*In what ways do Spanish speakers in the United States understand warning systems based on cultural factors, such as their disaster subculture, dialect, and immigration status?*" I identified four principal themes to answer this question, interweaving these cultural factors with the experiences of Spanish speakers who were foreign-born, U.S.-born, living in border communities, or undocumented. First, I found that foreign-born Spanish speakers, upon moving to the United States, often felt overwhelmed by unfamiliar warning

systems for extreme weather hazards they had never encountered before. This theme can be better understood through the lens of cross-cultural adaptation theory (CCAT), which explains how people who move from one culture to another adapt to the larger host culture in which they live after relocating (Kim, 1988). According to CCAT, cultural adaptation occurs incrementally, through a stress-adaptation dynamic, in which individuals experience significant initial stress due to being in a new environment. Gradually, though, as individuals adapt to their new culture, the stress tends to decrease (Gudykunst & Kim, 2003). This adaptation process involves constant personal reflection and decision-making, which extends into social interactions as immigrants engage in face-to-face encounters with both members of their own group and members of the host culture (Kim, 2001). Communication plays a crucial role in this adaptation, as traditional and social media are used to obtain information and understand the host culture (Gudykunst & Kim, 2003; Horton & Wohl, 1956).

I note processes like those described in CCAT in the findings of my dissertation, as participants became accustomed to the new disaster subcultures in the United States. Participants experienced emotional stress when they first moved to the country due to, for many of them, the significant variability of extreme weather hazards. Adapting to the U.S. culture involved managing the emotional stress associated with understanding warning systems with the mission of overcoming their initial shock in the face of such different weather patterns. For participants in my dissertation research, sociocultural adaptation required the acquisition of new skills to function effectively within the host culture's warning system, including finding reliable information sources for weather hazards by relying on social networks and/or media sources in the host culture. The process of adapting to the new disaster culture in the United States did not entail a linear progression but rather in a dynamic, cyclical pattern, similar to what CCAT

describes. Participants continuously faced new challenges and stressors, which they overcame and gradually adapted to over time, leading to incremental improvements in their understanding of emergency warning systems in the United States—that is, adaptation to their new disaster subculture.

My findings, then, suggest that developing a new framework based on CCAT can offer risk communication scholars a valuable conceptual tool for understanding disaster subcultural adaptation. Traditional CCAT has primarily focused on the sociopsychological adjustment of sojourners to their broader host culture (Gudykunst & Kim, 2003). To understand adaptation to emergency systems better, however, it is crucial to also consider factors such as cultural worldviews, geography, gender, socioeconomic status, and previous disaster experience, among other variables (Abukhalaf et al., 2022; Fitzpatrick & Spialek, 2020; Fothergill et al., 1999; Morss et al., 2020). These factors have previously revealed significant variations in how foreign-born individuals understand warning systems in the United States and could be useful in the case of foreign-born Spanish-speaking communities. In other words, individual characteristics may provide substantial influence on how individuals approach, experience, and ultimately succeed in their adaptation process to a new disaster sub-culture.

Studies in intercultural communication have applied adaptation theories to specific domains successfully, an approach that could be modeled to develop a framework in the bilingual risk communication space. For example, Reedy (2015) advanced our understanding of how immigrants develop a sense of political discussion in a new nation through his social contact model of immigrant political socialization, which examines influences from social networks. Creating a similar model for immigrant adaptation to warning systems could greatly enhance our understanding of how foreign-born populations make sense of new disaster subcultures, thereby

improving the effectiveness of emergency communications. Theoretically, applying adaptation models to risk communication addresses a critical gap in the literature by incorporating cultural and social factors into established frameworks and models.

Second, I found that Spanish speakers born in the United States make sense of their local warning systems through multiple cultural viewpoints. U.S.-born participants relied on their upbringing in the United States, local culture, and/or their heritage culture from their countries of origin to comprehend local warning systems. Previous research has noted that individuals in the United States become aware of warning systems through repeated weather hazards experienced in their local geographical locations (Ripberger et al., 2020; Stewart et al., 2012). Similarly, participants in my dissertation recalled disaster preparedness actions learned during their childhoods, which were tailored to the most common disasters in their regions. When they moved to new geographical locations in the United States, they often compared the climates and geographies of their past and present homes. This behavior suggests that U.S.-born Spanish speakers have a strong attachment to their local climate and environment (Stewart et al., 2012; Trujillo-Falcón et al., under review). The concept of nature connectedness, which refers to an individual's emotional and psychological relationship with their natural environment (Keaulana et al., 2021), can help explain this phenomenon. Previous research has linked nature connectedness to heightened psychological importance of weather hazards and systems (Bolton, 2023a, 2023b; Bolton & Lazzaro, 2021). This concept can explain why U.S.-born Spanish speakers tend to stay more connected to the climate of their home regions and are therefore better equipped to respond to warning systems in the United States than their foreign-born counterparts (Trujillo-Falcón et al., under review).

While climate and geography resonated with Spanish speakers born in the United States, local cultural connections also shaped how they understood warning systems. Research supports the importance of trusted local figures and community networks in effectively disseminating emergency information among bilingual populations (Hilfinger Messias et al., 2012; Peguero, 2006). A strong sense of community among those with similar backgrounds helps bilingual speakers navigate complex disasters and respond effectively, despite language barriers and documentation inequities (Fitzpatrick & Spialek, 2020). These concepts help explain why participants such as Juliana felt disconnected from her local geography and climate when she moved to California from Texas. Her experience highlights the critical role of community ties in fostering a sense of belonging and engagement with local warning systems (Aldrich, 2012), emphasizing the need for culturally relevant communication strategies in disaster preparedness.

Spanish speakers born in the United States also understood warning systems through the lens of their cultural roots, even if they rarely visited their countries of origin. Some Spanish speakers, such as Jorge, identified more with their heritage than with being American. This cultural viewpoint shaped their understanding of disasters. Stories about disasters in their countries of origin, heard during childhood, still resonated with participants today. It is evident, then, that disaster subcultures stemming from a Spanish speaker's cultural origin still hold a prominent role in helping them make sense of disasters in the United States, even if they were not born in that culture of origin (Anderson, 1965; Engel et al., 2022; Gaviria Pabón, 2022; Wenger & Weller, 1973).

Aware of the vulnerabilities their local communities face, some Spanish-speaking participants took on the responsibility of acting as sources of information, helping their foreign-born family members navigate through disasters. This sense of duty strengthened community

bonds, or social capital (Aldrich, 2012), which ultimately increased a community's resilience to disasters. Understanding these dynamics is crucial for developing effective emergency communication strategies that leverage cultural and social ties to enhance disaster preparedness and response.

Recognizing the various cultural factors that shape how Spanish speakers born in the United States understand warning systems, future research should explore *how* these factors affect their perceptions. Do some factors exert more levels of influence within Spanish-speaking communities than others? Does this influence vary between those born in the United States and those who are not? Trujillo-Falcón et al. (under review) highlighted potential differences among cultural groups by finding that Spanish speakers' attention to weather and its changes was influenced more by their ethnic origin than by local U.S. geography. Overall, developing more robust theoretical models can lead to the creation of more effective and inclusive communication strategies. These strategies can address the unique needs of diverse communities without categorizing them as a monolithic group.

Third, I found that Spanish speakers living in border communities integrated two warning systems that were often very different despite being only miles apart. Participants reported variability in how these systems identified the most significant risks and presented weather hazard information. This disparity may stem from differences in urban planning and geography between the two countries. Tiefenbacher (2006) explored this concept in the borderland "cuates," or twins, of Del Rio, Texas and Ciudad Acuña, Coahuila, Mexico. Using Census block data, he discovered that in Ciudad Acuña, like much of Latin America, wealthier individuals prefer living closer to the city rather than in the expansive suburban areas favored in suburbanization patterns in the United States. Therefore, in Ciudad Acuña, the less vulnerable live in flood zones, whereas

in Del Rio, the more vulnerable do. This difference can explain the variability in the urgency of messaging and the presentation of information across borderland communities, as explained by Teresa in the previous chapter. Despite their differences, borderland regions are often among the most vulnerable locations in the United States, lacking sufficient resources to remain resilient in disasters (Donner & Lavariega-Montforti, 2018). Understanding these nuanced differences can lead to more effective emergency messaging and better preparedness, ensuring that the unique vulnerabilities of borderland regions are addressed comprehensively.

Risk communication researchers should further incorporate understudied borderland populations in their future research. A changing climate and asymmetrical disparities between two regions present challenges in effectively communicating extreme weather risks and developing adaptation strategies (Wilder et al., 2013). In the realm of risk communication, understanding how the disaster subcultures of the United States and Mexico contribute to overall risk perception in the area would be beneficial for better tailoring messages to these diverse communities (Arlikatti et al., 2014). Do members of border communities trust one warning system over another? Where do they primarily seek information in a landscape with multiple warning systems? How do they navigate the cultural nexus to make sense of disasters? Addressing these questions can guide risk communication strategies to navigate more effectively the variable inequities that exists in the borderland regions of the United States-Mexico border.

Fourth, I found that undocumented immigrants, regardless of their time in the United States, distrusted and questioned the objectivity of warning systems. Unlike foreign-born individuals who eventually adapt to the new disaster subculture through a cyclical process, undocumented immigrants did not share the same adaptation process. Instead of following the process described by CCAT, they aligned more closely with what differential adaptation theory

(DAT) argues. DAT explains that immigrants adjust to communication challenges and opportunities differently, based on their cultural backgrounds and experiences (De La Garza & Ono, 2015). The authors of DAT critique CCAT's assumption that all immigrants adapt in the same way, emphasizing that adaptation varies significantly among immigrant populations.

Participants' stories revealed that not all individuals were interested in adapting to the host disaster subculture. Their distrust of warning systems often stemmed from an emergency system in the United States that prioritizes monolingualism and roots itself in systemic injustice (de Onís et al., 2020). Immigrants perceived emergency communication systems as extensions of the government institutions that have historically marginalized them (Fussell et al., 2018). This perception was often compounded by past experiences where official systems either failed to provide adequate support or actively contributed to their hardships, such as deportation (Ellcessor, 2022). This issue has prompted academics to pressure governmental agencies to re-evaluate their communication strategies targeted at undocumented immigrants (Donner & Lavariega-Montforti, 2018; Méndez et al., 2020, 2024). According to DAT, acculturation is a two-way process, with immigrants and the host culture influencing each other as they navigate complex processes. Therefore, for warning systems to be effective, they must move beyond a monolingual, one-size-fits-all approach and, instead, develop multilingual, culturally sensitive communication strategies that keep the interests of the community in mind (Smith et al., 2023).

Referring to my earlier call for a framework to explain the experiences of immigrants adopting new warning systems, I want to emphasize that such a framework must not treat all immigrants as one homogeneous group. Undocumented immigrants face significant barriers to trusting government agencies and embracing new cultures of emergency preparedness (Fussell et al., 2018). Specifically, for extreme weather hazards, it is crucial to recognize that many agencies

responsible for communicating disaster impacts are part of the Department of Homeland Security, which also oversees the U.S. Border Patrol and FEMA (Méndez et al., 2024). This association, especially given the NWS' collaboration with these organizations (Moreland et al., 2019), can create deep rifts in the adoption of new emergency systems (Trujillo-Falcón et al., 2024). A new framework must consider these inequities and avoid overgeneralizing the experiences of immigrants. By doing so, we can better understand and address the unique challenges faced by some of the most vulnerable members of foreign-born populations.

Practical Recommendations

My study offers practical recommendations for improving our current monolingual emergency system. To begin with, I recommend that emergency communications should expand their services to include languages other than English. I found that foreign-born participants were especially vulnerable when they arrived in the United States, particularly if they had not experienced extreme weather hazards before. The culture shock of encountering a new warning system can overwhelm multilingual speakers, delaying their response to weather hazards (Nelson, 2015; Trujillo-Falcón et al., 2024). However, providing multilingual information can reduce the time needed to adapt to the new disaster subculture (Abukhalaf et al., 2022). For example, Jackie quickly adapted to the new warning system thanks to communications in Spanish and access to brochures and written information in her dominant language. These supplemental materials—written, visual, and auditory—are critical for those without ready access to technology or those who cannot read (Morales et al., 2023).

Although these resources are a strong starting point, I also recommend addressing systemic issues in translating extreme weather hazards. Currently, there is no established English-to-Spanish dictionary for weather, climate, and warning terminology, leading to

inconsistencies that can confuse Spanish-speaking communities (Trujillo-Falcón et al., 2021, 2022). Jargon and confusing terminology can impede the understanding of warning systems, making critical information inaccessible to those who may need it the most (Federici, 2022). Policymakers should advocate for improved policies that reduce jargon in warnings and explore messaging strategies that more effectively meet the needs of underserved populations, such as Spanish speakers in the United States (Smith et al., 2023).

Furthermore, I recommend that emergency agencies reconsider how they categorize Spanish-speaking communities. Traditionally, Spanish speakers have been categorized as a monolithic group sharing the same language (Bethel et al., 2013; de Onís et al., 2020). However, my research revealed significant variability in how Spanish-speaking populations understood warning systems. Depending on their nativity, ancestry, and immigration status, Spanish speakers bring diverse experiences and disaster subcultures that shape their perception of warning systems (Gaviria Pabón, 2022; Méndez et al., 2020; Stewart et al., 2014; Trujillo-Falcón et al., 2024). Future bilingual risk communication should not only be translated but also tailored to the cultural backgrounds of Spanish speakers.

To achieve this goal, agencies should consider the composition of communities before developing effective messages. Recent efforts in the weather enterprise have visualized Census data with Geographic Information Systems (GIS) to understand the composition of multilingual communities within NWS jurisdictions (Llewellyn et al., 2024). Using GIS resources, risk communicators can better tailor their messages to specific cultures. For instance, in Arizona, a meteorologist can acknowledge that most of the population comes from Mexico and Central America and can review weather hazards these groups might not be familiar with based on their

disaster subculture. This approach can enhance personalization and encourage Spanish speakers to learn more about the warning system in the United States through equitable engagement.

Tailoring messages to diverse audiences presents significant challenges, however. Practitioners often face constraints related to time, resources, and capacity, making it difficult to create customized communications (Smith et al., 2023). Despite these challenges, the ongoing demand for more personalized and localized weather risk communication necessitates additional effort and resources. Future policymaking should prioritize these needs (Tripati et al., 2024). To address these challenges, it is crucial for policymakers and practitioners to prioritize several key areas. First, investment in technology and infrastructure that supports the rapid creation and dissemination of tailored messages is essential. This might include advanced data analytics tools that can quickly segment audiences based on linguistic and cultural factors, as well as automated translation services that ensure accuracy and relevance. Artificial Intelligence is emerging as a promising solution in the field of weather communication (Lawson et al., 2024), with the NWS investing millions to develop automated translations in multiple languages (Bozeman et al., in progress). Second, fostering partnerships with local community organizations can enhance the effectiveness of tailored messages. Within Spanish-speaking communities, these organizations often have deep connections with the most vulnerable groups and can provide valuable insights in the creation and dissemination of multilingual messages (Trujillo-Falcón et al., 2024). Collaboration with trusted local entities can also help to build trust and credibility among governmental agencies (Méndez et al., 2020). Finally, future policymaking should prioritize funding for research and development in multilingual weather risk communication. Grants and incentives for innovative projects that focus on tailoring messages to diverse populations can stimulate progress in this field. Policymakers, alongside researchers, should also consider

establishing guidelines and best practices for creating inclusive communication strategies that address the needs of all community members.

Finally, I recommend that emergency agencies increase their collaboration with partners in Latin America. The lack of coordination with weather and climate agencies in Latin America has left the NWS with limited perspectives on how to interact with diverse Spanish-speaking communities (Trujillo-Falcón et al., 2021). Weather agencies in Latin America have a rich history and established approaches to engaging their publics (Lohigorry et al., 2018). As Mariela described, SMN Argentina uses an alerting system based on colors (e.g., green, yellow, red). Familiarizing themselves with these and other risk communication strategies across Latin America can help communicators and researchers in the United States understand how Spanish speakers currently interpret warning systems from their cultural viewpoint. Incorporating these approaches into risk communication in the United States may also resonate more with bilingual speakers and help them become accustomed to a new warning system.

It is especially important for the NWS to establish a closer connection with Servicio Meteorológico Nacional of Mexico, given the vulnerabilities reported by borderland communities in this dissertation study. Despite forecasting similar weather conditions, participants noted that the neighboring agencies used completely different communication strategies. This lack of coordination was evident among my participants and currently affects how people understand warning systems and their lifesaving recommendations. Although these communication differences may be due to variations in urban planning and local geography (Tiefenbacher, 2006; Wilder et al., 2013), Spanish-speaking communities have not been informed about why these differences exist. Coordination with international partners can help bridge these differences and can facilitate embarking on educational campaigns with joint forces

to address the needs of a diverse community. This way, borderland communities do not feel they have to choose between warning systems but can, instead, embrace a collaborative approach that integrates both cultures.

WEA Warning Response Among Spanish Speakers (RQs 2-5)

Theoretical Contributions

Since their inception in 2019, Spanish-language WEA messages have provided a direct means for public safety officials to reach underserved populations via mobile devices and communicate information about extreme weather hazards (National Weather Service, n.d.a). These messages generally adhere to the rules established by the WRM, offering information about the hazard, location, source, guidance, and time (Mileti & Peek, 2000; Mileti & Sorensen, 1990). The 360-character tornado WEA messages is considered “complete” as it includes all these components (Bean et al., 2022; Olson et al., 2024; Sutton et al., 2024). The 90-character tornado WEA message meets almost all recommendations, except for location information, as character limits prevent the translation of "in this area" from English (Table 3). “Complete” warning messages, overall, significantly increase the likelihood that recipients will take protective action in a timely manner (Doermann et al., 2021).

For multilingual communities, however, message completeness must also account for linguistic and cultural factors, which can create hurdles for warning response. I describe how these factors contributed to increased vulnerability using the extended WRM (Mileti & Sorensen, 1990; Sutton et al., 2021) and examined how Spanish speakers in the United States (1) **understood**, (2) **believed**, (3) **personalized**, (4) **milled**, (5) **made decisions**, (6) **evaluated response efficacy**, and (7) **assessed their self-efficacy** after reading a multilingual WEA message.

First, Spanish speakers in the United States faced challenges **understanding** WEA messages due to confusing acronyms, inconsistent communication of time zones, misinterpretation of key terms caused by dialectical differences, and inaccessibility due to phone settings. Warning messages, in general, should be clear and free of ambiguous or unfamiliar terms (Sharon & Baram-Tsabari, 2014). For Spanish WEA messages, the term SNM, meant to represent "Servicio Meteorológico Nacional" (the equivalent of NWS in English), confused many people in the 90-character WEA. The ambiguity caused delays in their response as they tried to figure out the source of the message. This uncertainty can often result in decreased trust of the organization and increased concerns of future messages, should another warning be issued (DeYoung et al. 2019).

Another critical component to consider is the communication of time zones. Some Spanish speakers, raised in countries with only one time zone, expressed confusion when they first encountered time zone abbreviations, as the concept was unfamiliar to them. The way time zones are presented in Spanish within the United States often leaves many people unsure about terms such as “EST,” “CST,” and “PST.” Spanish-language networks in the United States often communicate these time zones inconsistently, as noted in the previous chapter, which further exacerbates misunderstandings. Williams and Eosco (2021) define message consistency as the requirement for two or more messages to achieve an optimal level of similarity to avoid adverse effects. In other words, even though individual features of the messages may differ, they must convey the same overall information. I found that, although most participants ignored time zones they did not understand, some Spanish speakers spent time trying to decipher the confusing acronyms (e.g., Javier thought “PST” meant “Priority Storm Time”). This inconsistency hindered Spanish speakers from taking protective actions and impeded their comprehension of WEAs.

Dialectical differences of key terminology further exacerbated confusion among Spanish-language WEAs. Specifically, the term “proyectiles” (translation for “flying debris”) caused significant misunderstanding among some Spanish-speaking groups. “Proyectiles” typically refers to objects that are thrown, shot, or otherwise propelled through the air. This word has been a suitable translation for “flying debris,” used in areas that experience extreme weather hazards to describe objects projected by forces such as tornadoes or hurricanes. However, for those from countries with histories of war and strife, the word is more commonly associated with bullets, missiles, or any objects launched with force, completely altering the intended meaning of the tornado WEA message. This linguistic misunderstanding underscores how dialectical differences complicate emergency messaging and can lead to varying risk perceptions among Spanish speakers (Abukhalaf & Meding, 2021; Bitterman et al., 2023; Trujillo-Falcón et al., 2022).

A final barrier to understanding bilingual warning messages resulted from the inaccessibility of Spanish-language WEAs. The most vulnerable Spanish speakers, specifically those who have LEP and are immigrants, often accidentally disable warnings by setting their phone language to English. These individuals are frequently motivated to learn English in the United States because the host culture is generally more accepting and willing to interact with those who have integrated or assimilated into American culture (Montgomery et al., 2021). Consequently, they prefer English settings on their devices, not realizing that this approach can disable crucial Spanish-language emergency alerts. This inadvertent action leaves them without vital information during emergencies, increasing their risk and vulnerability in extreme weather events (Santos-Hernández & Morrow, 2010; Trujillo-Falcón et al., 2021).

Second, Spanish speakers in the United States reported high levels of **belief** in bilingual WEA messages when all message elements were clear and easy to understand. However, when

these criteria were not met, participants perceived WEAs as spam rather than important instructional messages. Warning systems in the United States often face high levels of mistrust among Spanish speakers due to their association with federal agencies responsible for deportations among these communities (de Onís et al., 2020; Ellcessor, 2022). The finding that WEAs are reputable and trusted among particularly vulnerable populations, such as foreign-born individuals, is significant. It highlights new opportunities for multilingual speakers to engage more actively with emergency warning systems and take them more seriously.

To establish credibility, however, alerting authorities must ensure that WEAs are clear and tailored to the needs of Spanish speakers, echoing recommendations from Sutton et al. (2021). Participants recognized the NWS as a credible source in WEA messages only if they could clearly identify it in weather warnings (i.e., spelling out "SMN" as Servicio Meteorológico Nacional). Despite this important finding, it is important to recognize that all participants interviewed were documented. Undocumented immigrants may not resonate with this perspective, as previous research has shown that these populations did not adequately receive information from official sources, such as FEMA, during significant tornadic events due to fear and skepticism toward government officials (Trujillo-Falcón et al., 2024). Future research should prioritize studying this specific vulnerable group to determine if WEAs are an effective medium of information for them (or not).

Third, participants expressed varying levels of **personalization** of tornado risks after reading a bilingual WEA message. The disaster subculture of participants shaped how they eventually assigned urgency to the simulated event. Strategic capitalization and reduced use of jargon helped them better personalize the risk at hand. Recently arrived immigrants to the United States heavily relied on generational knowledge from their countries of origin when dealing with

disasters. Given that many Latin American countries do not experience tornado hazards, many immigrants struggled to contextualize and personalize weather information about such events, leading them to not take the situation seriously. This finding supports previous research indicating that the disaster subculture of an immigrant's country of origin plays a major role in disaster personalization in the United States (Gaviria Pabón, 2022; Trujillo-Falcón et al., 2024).

In contrast, Spanish speakers who had lived in the United States for longer periods were more adept at personalizing tornado hazards. Participants with more experience with tornadoes had better tools to make sense of the event, as they knew to take the hazard more seriously than those who had not experienced it before. In other words, individuals with higher levels of weather salience—the importance they assign to weather and its changes—have greater confidence in and reliance on extreme weather forecasts (Stewart, 2009; Stewart et al., 2012). Regardless of whether they resided in a tornado-prone area or not, the 360-character WEA messages enhanced personalization by detailing the potential impacts or consequences of the hazard (Potter et al., 2018; Sutton et al., 2024). Findings suggest that 360-character WEAs are more effective for bilingual communities as they help contextualize the hazard. This recommendation will be further supported in subsequent paragraphs of this section.

To increase urgency, especially for those who have never experienced tornadoes, participants recommended strategic capitalization. They suggested capitalizing specific words such as "TORNADO WARNING" and "TAKE SHELTER NOW" to emphasize urgency and promote protective action. This approach is particularly effective, as previous research has linked capitalization and the imperative voice with an increased sense of urgency among warning message users (Sutton & Fischer, 2021). Additionally, reducing jargon was a strong recommendation, as it ensures that messages are clear, easily understood, and facilitate

personalization. Participants emphasized reconsidering the technical jargon "tornado warning," as its translation to "aviso de tornado" can communicate different levels of urgency among Spanish-speaking communities (Aguirre, 1988; Ahlborn et al., 2012). While some Spanish speakers supported Trujillo-Falcón et al.'s (2022) recommendation to change "aviso de tornado" to "alerta de tornado" for increased urgency, others proposed eliminating warning jargon altogether. My findings support the latter recommendation. Although "alerta de tornado" communicates more urgency than other translations, participants still struggled to understand its meaning in the context of an incoming tornado. Eliminating jargon from warning messages and embracing plain language statements can help the public feel more immersed in the message and prioritize their safety, rather than trying to decipher the terminology (Sivle & Aamodt, 2019; Sutton et al., 2021).

Fourth, **decision making** strategies among Spanish speakers largely depended on WEA format (i.e., 90- or 360-character WEAs). The 90-character limit in WEA messages hindered proper personalization and failed to provide essential safety information needed to promote protective actions. Additionally, the absence of location information in the Spanish-language version of the 90-character WEA prevented many Spanish speakers from recognizing the urgency of the situation. This lack of specificity about the hazard, impacts, and timing led individuals to spend more time milling and confirming warning information rather than making an actionable plan for how to respond (Wood et al., 2018). The 360-character WEA offered more detailed information about the hazard, prompting Spanish-speaking participants to take the threat more seriously and consider seeking shelter. This added contextualization is especially crucial for individuals unfamiliar with a hazard, as it helps them understand the necessary protective actions (Sutton et al., 2021; Trujillo-Falcón et al., 2024). My findings in this dissertation align

with established research on English WEAs, showing that 90-character messages are more effective as *alerts* that are intended to capture attention, whereas 360-character WEAs serve as informative *warnings* that offer guidance and motivate protective action (Bean et al., 2016; Olson et al., 2024).

Fifth, **milling**, or the process of seeking additional information, conducted by Spanish speakers depended on their adaptation to the warning system in the United States. Foreign-born Spanish speakers relied extensively on knowledgeable community members and established media sources to make sense of incoming warning messages. The WRM explains that consuming both official and unofficial sources of information is central to warning reception (Mileti & Sorensen, 1990; Wood et al., 2018). Spanish-speaking immigrants, however, tend to rely more on unofficial sources due to the scarcity of official information in their dominant language (Reedy, 2015; Trujillo-Falcón et al., 2024).

Spanish speakers born in the United States spent less time milling for information than their foreign-born counterparts. However, instead of immediately considering protective actions, they quickly shifted from being message receivers to acting as messengers, which prolonged their overall response time. More privileged members of Hispanic and Latino groups often assume the role of knowledge brokers within their community, helping make decisions for more vulnerable members or assisting them in understanding extreme weather hazards, even without expertise in the subject matter (Gudykunst & Kim, 2003; Reedy, 2015; Robinson et al., 2019). The decision to seek shelter only after their entire family has been accounted for illustrates the collectivist culture of these familial units. In collectivist cultures, the needs and goals of the group take precedence over those of the individual (Hofstede, 2011). Such behavior reflects a strong emphasis on family unity and interdependence, in which individuals prioritize the safety

and well-being of their family members over their own immediate actions (Morss et al., 2020). This collectivist approach to decision-making should be further studied in risk communication research, as it may provide insights into designing more effective and culturally sensitive messaging strategies for Spanish speakers in the United States.

The primary goal of emergency warning messages is to reduce milling periods, giving people more time to take protective actions (Bean et al., 2016). Gaps in understanding, exacerbated by confusing messages, can increase the likelihood of milling for information (Doermann et al., 2021). As explored in this and previous sections, participants spent additional time seeking more information due to unclear WEAs, an overreliance on unofficial sources, and/or taking on the role of knowledge brokers within their communities. For many Spanish speakers, bilingual WEAs are the only official source of information, especially if they do not live in a bilingual media market (Trujillo-Falcón et al., 2024). Improving these products should be a priority to achieve the goal of reducing milling time and enhancing protective actions.

Sixth, **response efficacy**—or the belief that a protective action will result in safety—remained high among Spanish speakers, overall, with the notable exception of a few foreign-born participants. Nearly all Spanish speakers expressed confidence that sheltering recommendations provided by the NWS would result in positive outcomes for themselves and their families. This is a welcomed finding, as increased response efficacy correlates with a higher likelihood that individuals take protective action and accept a WEA message, overall (Maloney et al., 2011; Sutton et al., 2024; Witte, 1992). However, foreign-born participants expressed lower levels of response efficacy due to the belief that homes in the United States were not sturdy enough to withstand tornado damage. Influenced by perceptions and disaster subcultures from Latin America, where homes are built to withstand earthquakes, some participants believed

this myth (Engel et al., 2022). Established research shows that fatality rates in the worst tornado outbreaks are quite low if individuals seek shelter in permanently anchored homes (Daley et al., 2005). In fact, most people do not need to leave their residence to be safe during most tornadoes, as homes provide formidable shelter—unless they are mobile or manufactured homes (Klockow-McClain & Brooks, 2020). Addressing this misconception among foreign-born Spanish speakers is crucial so that disaster subcultures and misperceptions do not inadvertently impede lifesaving actions.

Lastly, Spanish speakers reported differing levels of **self-efficacy**– or the belief an individual can perform the recommended action–depending on the WEA format they received. As previously mentioned, 90-character WEAs felt incomplete to many Spanish-speaking participants due to their lack of contextualization and sheltering information. This led to lower levels of self-efficacy, which led participants to perform actions contrary to what is recommended (Mileti & Peek, 2000). Valentina's example illustrated the potential for fatal mistakes, as she would have chosen to stay in her mobile home, mistakenly believing it was the safest place to seek shelter during a tornado, due to the lack of information advising otherwise.

It is important to note that lower levels of self-efficacy were not due to participants' ambivalence. Most Spanish-speaking participants actively sought information and wanted to know the best way to keep their families safe. However, when messages lacked detailed sheltering recommendations for an unfamiliar hazard, participants expressed distress and felt pressured to make quick decisions. This underscores that 90-character WEAs are merely alerts and are not meant to engage individuals in protective actions (Bean et al., 2016; Olson et al., 2024). For participants, this limitation would have put them in dangerous situations.

The 360-character WEA message, however, resulted in higher self-efficacy for all Spanish speakers due to it outlining protective actions in various scenarios (e.g., outdoors, at home, driving). Previous risk communication research has noted that, when guidance is included and focuses on protective actions, one's self-efficacy increases and delays in protective action decrease (Fischer et al., 2023; Sutton et al., 2021; Wood et al., 2018). This is especially crucial for foreign-born Spanish speakers or those with limited experience with extreme weather hazards, as they may feel a heightened urgency to act (Adeola, 2007).

The WRM (Mileti & Peek, 2000; Mileti & Sorensen, 1990) proved valuable in examining how Spanish speakers understood, believed, personalized, made decisions, and milled for information during a simulated tornado event. Spanish speakers also based their responses on the principles of the EPPM (Maloney et al., 2011; Sutton et al., 2021; Witte, 1992), with fear-inducing messages prompting protective actions when they were clearly formatted and included empowering recommendations. This supports the extended WRM, which integrates all variables from the original framework with response and self-efficacy from the EPPM (Sutton et al., 2021). Overall, when messages were tailored to the linguistic and cultural nuances of Spanish speakers, participants noted that they would embrace the warnings and enhance their protective actions. In an emerging digital era, risk communicators can rely on WEA messages to effectively reach and engage Spanish-speaking audiences.

Practical Recommendations

Based on my findings, I provide recommendations for alerting authorities and policymakers to enhance their engagement and reach with Spanish-speaking audiences. Consistently, whether considering personalization or self-efficacy, the longer format 360-character WEA message resonated most with Spanish speakers in my dissertation. In contrast,

90-character WEAs were deemed to be insufficient for proper contextualization and often hindered effective protective decision-making. Therefore, I recommend phasing out outdated 90-character WEAs and leveraging new smartphone technology to fully implement 360-character WEAs. According to the Pew Research Center (2024), 97% of Americans own a cellphone, and 90% own a smartphone, enabling WEAs to become more modernized. Prioritizing 360-character WEAs should be the focus, as they are more effective not only for English speakers (Olson et al., 2024; Sutton et al., 2024) but also for Spanish speakers, based on my dissertation results. This policy change can pave the way for WEAs to include other languages, as most non-English languages require additional space to provide contextualization for extreme weather hazards that may not be familiar globally (Abukhalaf & Meding, 2021). In the following paragraphs, I concentrate on recommendations for the 360-character WEA message (Figure 2), as the character limits of the 90-character version restrict the scope of feasible improvements.

Figure 2

Recommendations for an Improved Spanish-Language WEA



Note. Improvements suggested by participants in this study are marked in bold red on the left, whereas the change I propose are in dark green on the right.

First, I proposed changing the translation of "tornado warning," currently rendered as "aviso de tornado." As discussed in the previous section, I recommend that the NWS replace technical jargon with plain language statements to ensure Spanish speakers fully understand the warning. However, recognizing that such a systematic change may require years of evaluation and implementation, I suggest an interim solution: changing the translation of "tornado warning" to "alerta de tornado." This adjustment, supported by previous research, has been found to convey the highest sense of urgency to Spanish speakers (Trujillo-Falcón et al., 2022). This added urgency can significantly increase their motivation to take action, particularly if accompanied by clear protective instructions (Sutton et al., 2021).

Second, I recommend that alerting authorities coordinate with other agencies and partners to create a collective plan for communicating time zones in other languages than English. I do not advocate for removing time zone information from WEAs, as warnings can sometimes overlap time zones depending on the jurisdiction of the alerting authority (National Weather Service, n.d.b). Instead, there should be a consistent plan for defining time zones in non-English languages. Standardizing time zones in Spanish can facilitate educational campaigns, in collaboration with media outlets, to explain what time zones are and how they are abbreviated in Spanish. Ideally, time zones could be spelled out, though I acknowledge that character limits might necessitate prioritizing more critical information.

Third, I encourage alerting authorities to incorporate strategic capitalization in their messaging to enhance urgency and prompt protective actions. Capitalizing phrases such as "BUSQUE REFUGIO AHORA" (the translation of “TAKE SHELTER NOW”) in the 360-character WEA can emphasize the importance of sheltering during tornado hazards. Following this urgent message with specific protective actions can increase users' self-efficacy and lead to

positive behaviors (Potter et al., 2018). The outlining of sheltering information could be extremely beneficial for foreign-born Spanish speakers and those with limited experience with tornadoes.

Fourth, I recommend re-evaluating the term “edificio seguro” (translation: “safe building”). The vagueness of this term can leave Spanish speakers unsure about what it entails. As discussed in the previous section, some foreign-born Spanish speakers question what constitutes a "safe building" due to their disaster subcultures. By specifying what a “safe building” consists of, we can reduce milling time. A possible alternative is “edificio con fundación” (translation: “building with a foundation”), which clearly directs users to seek shelter in a home with a foundation, eliminating the ambiguity of the term "safe building." In subsequent mentions within the alert, the translation could be “refugio seguro” (translation: “safe shelter”), referring back to the initial use of “edificio con fundación.” Providing clear and specific instructions would ensure that Spanish speakers believe in sheltering recommendations, ultimately enhancing their safety during extreme weather events (Sutton et al., 2021).

Fifth, the translation of "flying debris" from "proyectiles" must be changed. Some Spanish speakers reported that, in their dialect, "proyectiles" is associated with missiles and machinery. Instead, I recommend using the term "escombros voladores," which more clearly conveys the danger of objects being carried by the wind during a tornado. However, we should first test this proposed translation with empirical research to account for other dialect differences and ensure the recommendation resonates with the United States Spanish-speaking public. This approach follows established protocols from risk terminology studies in the bilingual weather enterprise (Bitterman et al., 2023; Trujillo-Falcón et al., 2022).

Lastly, instead of suggesting that users simply check media ("consulte los medios informativos"), I suggest that alerting authorities capitalize on the modern WEA system by incorporating a URL in their message. Studies have shown that including URLs in WEA messages can enhance completeness by enabling recipients to easily obtain and verify additional information easily (Kuligowski et al., 2023). Additionally, URLs that direct to .gov or other trusted domains are often perceived as more credible, increasing the likelihood that users will click on them when they need more information (Sutton et al., 2018). The proposed WEA format in Figure 2 allocates 15 characters for a URL, allowing for NWS domains like "weather.gov/ESP" while still adhering to the 360-character limit. This webpage could serve as a one-stop shop for preparedness recommendations and detailed explanations of weather hazards unfamiliar to multilingual speakers. By doing so, WEAs would become more accessible and equitable for the most underserved multilingual speakers in the United States.

Limitations

This dissertation enhances our understanding of how Spanish speakers in the United States comprehend warning systems and bilingual WEA messages. However, several limitations should be noted. First, my recruitment strategy had limitations of its own. I recruited participants from a previous online survey disseminated via Qualtrics. Using online survey tools excludes individuals without Internet access or those less inclined to participate in online surveys (Brown, 2015). Hispanic and Latino communities, in particular, are often wary of the surveying process, and many refuse to take surveys altogether, as this practice is uncommon in their cultures of origin (De La Rosa et al., 2012). Consequently, I may have interviewed a more literate sample, more familiar with the resources needed to understand warning systems and WEAs. Future research should prioritize on-the-ground recruitment, actively engaging members of the Spanish-

speaking community who may be illiterate or lack Internet access, as these populations are often marginalized and among the most vulnerable in disaster contexts (Santos-Hernández & Morrow, 2010). This approach will ensure a more comprehensive understanding of how these communities interact with warning systems and WEAs.

Second, although I translated the questionnaire utilizing my degree in Spanish and had it reviewed by a panel of diverse Spanish speakers representing different dialects, I did not use back-translation for cross-cultural validation. Back-translation involves translating the survey from the original language into the target language and then having a different translator translate it from that target language back into the original language, then checking for inconsistencies (Berkanovic, 1980). Without this process, discrepancies in Spanish-language translation can lead to differences in question comprehension and increase confusion among individuals participating in a study (Agans et al., 2020). I recommend that future studies incorporate back-translation methods to ensure the methodology adheres to best practices in the social sciences.

Third, I conducted retrospective interviews that required foreign-born participants to remember experiences from their country of origin prior to analyzing how they understood warning systems and WEA messages in the United States. Human memory is often unreliable, with gaps frequently filled by inaccurate information; however, research shows that impactful experiences are more likely to be vividly and accurately recalled (Sosniak, 2006). Despite some Spanish speakers having moved to the United States decades ago, many could vividly recall their experiences in Latin America. Rather than focusing on detailed descriptions of the weather, foreign-born participants often recounted major historical events in their home countries. These significant events are key influences in developing an individual's disaster subculture (Engel et al., 2022), making retrospective interviews particularly useful in this scenario. However, I also

inquired about the common types of information sources they used for weather updates in Latin America. That information may be inaccurate, as many participants could not remember. Future research should focus exclusively on Spanish speakers who have recently moved to the United States, ensuring their recollections are more likely to be reflective of their actual experiences.

Fourth, interviews incorporated simulations in which participants received a WEA in real time and were asked to talk-aloud their thoughts as they made sense of the warning message. Although this approach aims to capture genuine reactions from participants (Bean et al., 2023), it can also introduce biases and affect the authenticity of responses due to the artificial nature of the environment (Tracy, 2020). Moreover, the simulated event included only at most two WEA messages, which does not reflect the reality of imminent threats where multiple warnings are typically issued from various sources beyond WEA (Lindell & Perry, 2012). Additionally, recruitment factors, such as the fact that they were compensated for completing the previous questionnaire, may have also introduced pressure for participants to answer in a certain way during these simulations. Hispanic and Latino respondents, in particular, are more likely to provide socially desirable answers compared to other ethnic groups (Hopwood et al., 2009). During this dissertation research, I observed instances where participants appeared to give socially desirable answers. For example, some individuals rated WEAs higher on the scale of 1 to 5. By incorporating follow-up questions after each rating, I encouraged Spanish speakers to justify their decisions. In many cases, participants adjusted their ratings after discussing their initial responses with me. To completely erase this possible bias, researchers should consider ethnographic studies in the future so that participants are situated in their everyday environments and able to vividly experience warning systems.

Fifth, interviews were based solely on WEAs disseminated by the National Weather Service (n.d.a), which are considered "complete" warning messages based on recent criteria (Bean & Grevstad, 2023; Olson et al., 2024). Although the NWS issues the majority of WEA messages in the United States, they do not represent the typical WEA message, as most messages from other alerting authorities lack established templates and cover various non-weather hazards, such as health threats and terrorism (Bean et al., 2015, 2016). Additionally, my simulations only included tornado WEAs, whereas the NWS sends more than nine different types of WEAs for various weather hazards, from dust storms to snow squalls (National Weather Service, n.d.a). Each of these warning messages has different templates, though most are considered "complete." Future research should investigate other translated WEA messages and assess whether they resonate with local multilingual communities. Non-weather hazards should also be explored, as cultural factors may influence how people perceive these threats.

Lastly, my personal biases as a bilingual meteorologist and foreign-born Peruvian may have influenced my analyses. This unique lens might result in different interpretations and conclusions compared to those of another Latino researcher. Using constant comparative analysis, I continuously compared my findings with existing literature and data to mitigate these biases and ensure a comprehensive understanding of the data (Glaser & Strauss, 1967; Lindlof & Taylor, 2019). However, it is important to acknowledge that my background and experiences inevitably shaped my analytical lens, highlighting the value of diverse perspectives in research to capture the full complexity of the data presented.

Conclusion

Representing nearly one in ten Americans, Spanish speakers come from diverse parts of the world, including Latin America, Europe, and Africa. Despite this diversity, Spanish-speaking

populations in the United States are often homogenized into a singular group. This dissertation highlighted complexities and nuances within these communities, illustrating the varied cultural backgrounds, dialects, and experiences that shape their interactions and responses to warning systems and bilingual WEA messages. This dissertation aimed to achieve two main objectives: (a) to examine how Spanish speakers in the United States understand warning systems, and (b) to assess how they interpret, believe, personalize, make decisions, engage in milling, and evaluate their efficacy when encountering a bilingual WEA message.

I found that various cultural factors, including a participant's ethnic origin, nativity, and immigration status, shaped how Spanish speakers understood warning systems in the United States. For immigrant populations, a dynamic acculturation process was evident, illustrating the complex journey of adapting to a new warning system. Meanwhile, participants born in the United States had to navigate multiple, sometimes overlapping, cultural viewpoints as they made sense of warning systems and determined how to respond to them. Findings also highlighted inequities that arose when Spanish speakers receive bilingual WEA messages. Cultural and linguistic nuances underscored the importance of developing clear, jargon-free, consumable messages that empower and motivate even the most vulnerable individuals to take action.

This dissertation made three unique contributions to the fields of intercultural and risk communication. First, it explored how Spanish speakers interpret warning systems through the lens of their culture, suggesting that incorporating intercultural theories can enhance our understanding of how people adapt to new warning systems. Second, it provided evidence that existing risk communication models, such as the WRM and EPPM, offer a useful framework for understanding how Spanish speakers make sense of fear-inducing messages. Third, the findings

were supplemented with recommendations that can directly improve the dissemination of warning messages across FEMA, NWS, and other alerting authorities.

I firmly believe that evidence-based research can create meaningful solutions for multilingual communities nationwide. By studying Spanish-language warning systems and messages, this dissertation offered an initial glimpse into what an equitable multilingual emergency communication system could look like for diverse communities. Incorporating these recommendations can lay the groundwork for an emergency communication system that represents *all* people in the United States and embraces their cultural upbringings.

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Appendix A
WEA Questionnaire for Spanish Speaking Individuals

Ice Breakers (Disaster Subcultures)

- ¿Nació usted en los Estados Unidos? En caso negativo, ¿cuál es su país natal? ¿Cuánto tiempo vivió en ____ antes de llegar a Estados Unidos?
    - ¿Qué tipos de catástrofes meteorológicas experimentó en su país de origen?
- [Si nació fuera de EE.UU] En su país de origen, ¿cómo se informaba sobre las catástrofes meteorológicas? ¿Había recursos, como sirenas, radio y/o televisión, en los que confiaba para informarse?
- [Si nació fuera de EE.UU] Hablemos de su vida aquí en los EE.UU. ¿Qué tipo de catástrofes meteorológicas experimenta aquí? ¿Son diferentes de las de su país natal?
- ¿Qué fuentes de información utiliza para mantenerse informado sobre las catástrofes meteorológicas en EE.UU.? Por ejemplo, alertas telefónicas, televisión, radio, etc.

WEA Talk Aloud Interview

Gracias. Ahora pasaremos a la siguiente parte de la entrevista. En esta siguiente parte, le enviaré una alerta por correo electrónico o texto. Primero, quiero que lea ***en voz alta*** *la alerta que reciba. Segundo, le pido que diga* ***en voz alta*** *los pensamientos que le vienen en el momento en que recibe la alerta y todo lo que le viene a la mente a medida que le va dando sentido a la alerta. Describa sus pensamientos mientras interpreta, relee, o cuestiona sobre la alerta. A lo largo de este proceso, no estaré disponible para responder a ninguna pregunta. Si necesita que le aclare algo, menciónelo verbalmente. Mi silencio no debe interpretarse como una opinión sobre si sus respuestas son correctas. Simplemente quiero escuchar su proceso de pensamiento. Cuando haya*

terminado con el proceso de pensamiento, hágamelo saber y pasaremos a las preguntas de seguimiento.

Se encuentra en [Condado] cuando recibe el siguiente mensaje en su teléfono móvil:

90-character WEA

SNM: AVISO DE TORNADO hasta las 12:15PM CST. Refugiese ahora. Consulte medios informativos

360-character WEA

Servicio Nacional de Meteorologia: AVISO DE TORNADO en efecto hasta las 12:15PM CST. Busque refugio ahora en un sotano o en el interior de un cuarto en el nivel mas bajo de un edificio seguro. Si esta al aire libre, en una casa movil, o en un vehiculo, debe ir al edificio seguro mas cercano y protegerse de proyectiles. Consulte los medios informativos.

Follow-Up Questions (WRM/EEPM)

- En una escala del 1 al 7 (siendo 1 muy bajo y 7 muy alto), califique su comprensión del mensaje que recibió. ¿Por qué ha elegido ese número? ¿Hay algo de este mensaje que no haya entendido? En caso afirmativo, explíquelo.
- En una escala del 1 al 7 (siendo 1 muy bajo y 7 muy alto), califique su creencia en el mensaje que recibió. ¿Por qué ha elegido ese número? ¿Hay algo sobre este mensaje que cuestione su creencia en la alerta? En caso afirmativo, explíquelo.
- En una escala de 1 a 7 (siendo 1 muy bajo y 7 muy alto), por favor califique su riesgo personal de impacto de tornado basado en el mensaje. ¿Por qué ha elegido ese número? ¿Hay algo en este mensaje que haya influido en esta calificación del riesgo? En caso afirmativo, explíquelo.

- ¿Qué medidas cree que debe tomar en respuesta a este mensaje?
    - ¿Le incitaría esta alerta a buscar información adicional? En caso afirmativo, ¿a quién o que recurriría (por ejemplo, televisión, radio, amigos o familiares)?
- En una escala del 1 al 7 (siendo 1 muy bajo y 7 muy alto), por favor, valore el grado de confianza que tiene en que su decisión/acción que tomó es apropiada para el riesgo al que se enfrenta.
- [Para las personas que hablan inglés] En su pantalla, verá la versión en inglés de esta alerta que también habría visto junto a la versión en español en un desastre. ¿Traduciría alguna de las palabras de este mensaje de forma diferente?
- [Para las WEA de 90 caracteres] En su pantalla verá la versión 360 de esta alerta WEA. ¿Le resultó más útil esta versión de la alerta? Por favor, explíquelo.

Final Questions

- Cuéntenos más cosas sobre su dispositivo móvil. ¿Cuál es su operador de telefono móvil? ¿Cuál es su idioma principal en los ajustes de su teléfono?
- ¿Tiene activadas las alertas móvil en su teléfono, conocido como WEA? [guíeles por el proceso] Si sus WEAs están desactivadas, ¿por qué las desactivó?

APPENDIX B

English Translation of WEA Questionnaire

Ice Breaker (Disaster Subcultures)

- Were you born in the United States? If not, where is your hometown? How long did you live there prior to arriving in the United States?
- [If born outside the US] What types of weather disasters did you experience in your country of origin?
- [If born outside the US] In your country of origin, how did you get information about weather disasters? Were there resources, like sirens, radio, and/or television, that you relied on for information?
- Let's talk about your life here in the United States. What kind of weather disasters do you experience here? Are they different from the ones from your hometown/home country?
- What information sources do you use to stay informed about weather disasters in the U.S.? For example, phone alerts, television, radio, etc.

WEA Talk-Aloud Interview

Thank you! We will now transition to the next part of the interview. In this next portion, I will be sending you an alert via email or text. First, I want you to read out loud the alert you receive. Second, I ask that you talk out loud the thoughts that you are thinking the moment you receive the alert and everything that comes to mind as you make sense of it. Describe your thoughts as you interpret, re-read, question, or puzzle over the message. Throughout this process, I will not be available to answer any questions. If you need clarification on something, verbally mention it: that is what we are trying to learn more about! My silence should not be interpreted as feedback

on whether your responses are correct. I simply want to listen to your thought process. When you are done with the think aloud process, let me know and we will move on to the follow up questions.

You are in [County] when you receive the following message on your mobile phone:

<u>90-character WEA</u>

SNM: AVISO DE TORNADO hasta las 12:15PM CST. Refugiese ahora. Consulte medios informativos

<u>360-character WEA</u>

Servicio Nacional de Meteorologia: AVISO DE TORNADO en efecto hasta las 12:15PM CST. Busque refugio ahora en un sotano o en el interior de un cuarto en el nivel mas bajo de un edificio seguro. Si esta al aire libre, en una casa movil, o en un vehiculo, debe ir al edificio seguro mas cercano y protegerse de proyectiles. Consulte los medios informativos.

Follow Up Questions (WRM/EEPM)

- On a scale of 1 to 7 (with 1 being very low and 7 being very high), please rate your <u>understanding</u> of the message. Why did you select that number? Is there anything about this message that you are unsure about? If so, please explain.
- On a scale of 1 to 7 (with 1 being very low and 7 being very high), please rate your <u>belief</u> in the message. Why did you select that number? Is there anything about this message that would question your belief in it? If so, please explain.
- On a scale of 1 to 7 (with 1 being very low and 7 being very high), please rate your <u>personal risk</u> of tornado impact based on the message. Why did you select that number?

Is there anything about this message that influenced this rating of risk? If so, please explain.

- What action do you think you are supposed to take in response to this message?
    - Would this alert prompt you to find additional information? If so, who or what would you turn to (e.g., television, radio, friends or family)?
- On a scale of 1 to 7 (with 1 being very low and 7 being very high), please rate how confident you are that your decision/action in question 4 is appropriate for the risk that you face.
- **[For individuals who speak English]** On your screen, you will see the English version of this WEA message that you would have also seen alongside the Spanish version. Would you translate any of the words in this message differently?
- **[For 90-character WEAs]** On your screen, you will see the 360 version of this WEA alert.

Closing Questions

- Tell us more about your mobile device. Who is your mobile carrier? What language is the primary language in your phone settings?
- Are your WEA alerts turned on? If no, walk them through the process of turning them on if they wish to learn how to. If they turned them off or do not want them on, ask why not/why they shut them down.

APPENDIX C

English and Spanish Translation of Participant Quotes

For full transparency, I am providing the quotes provided by participants in their original language, followed by the translation I employed in my dissertation. If the interview was conducted in English, there is no translation provided. All participants' names are pseudonyms.

*RQ1: In what ways do Spanish speakers in the United States understand warning systems based on cultural factors, such as their **disaster subculture**, **dialect**, and **immigration status?***

Participant	Original Quote	Translation for the Dissertation
Jackie, Venezuela Immigrant with LEP (Participant #4)	"Bueno, donde yo vivía n pasaba nada. Eso sí, el calor era terrible. En Venezuela lo único que ha pasado que todo el mundo se ha dado cuenta fue la tragedia de Vargas, que fue un deslave en una montaña. Eso queda lejos donde yo vivía específicamente pero sí fue una tragedia y mucha gente murió ahí."	"Well, where I lived [in Venezuela] nothing ever happened. The heat was terrible. In Venezuela, the only event that received worldwide attention was the tragedy in Vargas, which was a landslide in a mountain caused by heavy rain. That happened far away from where I lived specifically but it was a tragedy and many people died there."
Jackie, Venezuela Immigrant with LEP	"El clima severo… todo el mundo se enteraba cuando ya	"[In Venezuela], people only learn about severe weather after

(Participant #4)	era algo ya extremo, no antes. Por lo menos con lo de Vargas, toda la población general se enteró ya cuando fue cuando era una catástrofe... Cuando ya había muerto ya era algo horrible, justo en el mismo momento en que el resto del mundo se enteró también.	it has already become extreme, not before. At least with Vargas, all the general population learned about it when it was already a catastrophe, when there were already deaths [reported], when it was already horrible… right around the same time the rest of the world found out too."
Jackie, Venezuela Immigrant with LEP (Participant #4)	"Aquí en Florida sí hay una época del año muy famosa acá de los huracanes. Yo estoy muy feliz con la parte de que se avisa de que te mandan folletos y con todo lo que las previsiones que tú tienes que tomar en esa época. Ellos son muy eficientes en ese aspecto. Me ayudó mucho cuando me mudé aquí por primera vez mientras me acostumbraba al nuevo clima."	"Here in Florida, there is a very famous hurricane season. I am very happy with the fact that they send you brochures and all the precautions you have to take during that time of the year. They are very efficient in that aspect. It helped me a lot when I first moved here as I got used to the new climate."

Mariela, Argentinian Immigrant with LEP (Participant #11)	"Pasaba lluvias fuertes e inundaciones en la ciudad [de Buenos Aires], está al borde de un río. Entonces lo que le llaman sudestada, que es cuando el viento corre para el lado del río, y se sube el agua. Pero no hay huracanes, tornados, nieve, no hay nada. O sea, sería más básicamente lluvias, vientos, y algunas veces granizo.	"I used to experience heavy rain and floods in the city [of Buenos Aires], which is on the edge of a river. This is all due to what they call the "sudestada," or when the wind runs to the side of the river and the water rises. But there are no hurricanes, tornadoes, snow, there is nothing [like that in Argentina]. In other words, we usually experience rain, wind, and sometimes hail."
Mariela, Argentinian Immigrant with LEP (Participant #11)	"Te enterás cuando pasaba [el tiempo extremo] yo veo muchas noticias de Argentina porque me interesa por mi familia. Y yo vi que habían dicho, lo dicen en los diarios, la persona que hace el clima, dice 'alerta naranja... hay alerta naranja' y que va a venir o que hay probabilidades de que va a	"You find out about [extreme weather] right when it happens... I watch a lot of news from Argentina because of my family. And I saw that the person who does the weather said in the headlines, 'warning, level orange... there is warning, level orange' for the probability of heavy rain with winds. But

	venir una lluvia fuerte con vientos. Pero la gente no le presta mucha atención, dice 'bueno, lluvia, viento, y listo.' Después resulta que era súper fuerte y hay consequencias."	people do not pay much attention to the warning, they say 'well, rain, wind, and that's nothing.' Then it turns out that it was super strong and there were consequences."
Mariela, Argentinian Immigrant with LEP (Participant #11)	"En Argentina nunca nadie vive un huracán. Yo vine acá y tuve que vivir los huracanes y me muero de miedo porque el viento te da miedo. En comparación con Argentina, me parece como que la cultura meteorológica acá es como mucho más seria y más obviamente mejor organizada… sí veo la diferencia cuando desde el momento que me mudé la primera vez y vine acá. Al principio me llamaba la atención, ahora me parece	"In Argentina nobody ever experiences a hurricane. I moved [to Florida] and I had to live through hurricanes, and I am scared to death because of the [extreme] winds. Compared to Argentina, the meteorological culture [in Florida] is much more serious and obviously better organized... I did notice the difference when I moved here for the first time. At the beginning, it took me by surprise… now it seems normal to me. But well, it's like a cultural thing, isn't it?"

	normal. Pero bueno, es como cultural, no?"	
Jorge, Salvadoran American (Participant #6)	"Yo desde que estaba pequeño, las escuelas aquí en Los Ángeles siempre nos han preparado para los terremotos. Por ejemplo, cuando sonaba el timbre, que era un test, teníamos que irnos debajo de la mesa o pararnos así donde está la puerta o salir fuera del edificio."	"Ever since I was a kid, the schools here in Los Angeles have always prepared us for earthquakes. For example, when the bell rang, which was a test, we had to go under the table or stand like this where the door is or go outside the building."
Jorge, Salvadoran American (Participant #6)	"Me han dicho familiares que me dicen 'para qué te estás preparando?!' Pues uno nunca sabe. Pero son los primeros diciendo, "ay tienes algo. Algo que me prestes ahí?" Pues ahí voy. Sí."	"I have had family members tell me 'What are you preparing for?!' Well, you never know. But they are also the first to say, 'Oh, you have something I can borrow from [your preparedness kit]?" Well, of course, here you go!"
Juliana, Mexican American (Participant #14)	"El Paso, había más bien tormentas de arena y granizo de vez en cuando. Estaba muy	"In El Paso, there were sandstorms and hail from time to time. It was very large hail

	grande el granizo como el tamaño de casi como una pelota de golf y el a qué más experimenté ahí una vez fue un tornado. Y acá en California, también se pone como arenoso a veces, pero no tanto como allá. Los terremotos es lo más pesado aquí en California"	about the size of a golf ball. I also once experienced a tornado. But here in California, it sometimes gets kind of sandy but not as much as [El Paso] ... earthquakes are the most intense thing here in California."
Juliana, Mexican American (Participant #14)	"En El Paso, yo vi Univisión y al meteorologo Aldo Acosta cada día. Él es el que nos mantenía informados de cómo estaba el tiempo . En California, más bien suelo usar mas las aplicaciones. Es que aquí la tele se trabaja con el internet y es como hasta ahorita nada esta en vivo, segun dicen. Es que yo vivo muy retirado de Los Angeles. Si he visto meteorólogos pero no tengo uno como Aldo Acosta."	"In El Paso, I watched Univision and meteorologist Aldo Acosta every day. He is the one who kept us informed of the weather. In California, I tend to use the mobile apps more. [Where I live,] the TV needs internet connection and so like nothing is live, so they say. I live very far away from Los Angeles… so I have seen meteorologists on TV but I do not have one like Aldo Acosta."

Teresa, Mexican Immigrant (Participant #19)	“Pues estando en México era efectivamente la televisión. Más que nada. Como uno se daba cuenta y también en aquel entonces que los periódicos impresos eran mucho más comunes. Había un recuadro del pronóstico de la semana que lo imprimían. Pero también tenemos acceso a las noticias norteamericanas porque la señal llega. Entonces uno oía con mucho más detalle y había un enfoque diferente. Entonces el efecto era muy interesante. [Por la infraestructura], decian [en los EE.UU.], ‘esto va ocurrir. Estén al pendiente.’ y [en Mexico] decian ‘corre por tu vida,’ jajaja”	“In Mexico, we tuned into the television [for weather information]. At that time, printed newspapers were much more common. There was a section of the week's forecast that they printed. But we also had access to American news because the signal came through. So, one heard [weather information] in much more detail and there was a different approach between the two countries. The effect was very interesting. [Because of the infrastructure], they were saying [in the United States], 'This [weather event] is going to happen. Stay tuned,' while [in Mexico] they were saying 'run for your life,' hahaha."
Teresa, Mexican Immigrant	“Deben mantenerse neutrales porque están otorgando un	“[The National Weather Service] should remain neutral

(Participant #19)	servicio y no quieren que al rato digan que son una parte del gobierno interesada en deportación, no tanto en informarle. Mhm, no que vaya a un sitio para darme calle."	because they are providing a service and they do not want [the immigrant community] to say later that they are a part of the government interested [in deporting them], not so much in informing them."

RQ2: How do Spanish speakers in the U.S. ***understand***, ***believe***, *and* ***personalize*** *information presented by Wireless Emergency Alerts?*

Participant	Original Quote	Translation for the Dissertation
Adriana, Mexican Immigrant with LEP (Participant #12)	"No tengo idea que significa SNM. Pues sí recibí un mensaje con 'SNM,' voy a Google y veo qué significa que es. [Visita Google] Veo que dice Síndrome neuroléptico maligno, eso no es, jajaja."	"I have no idea what SNM means. I would go to Google and see what it means… [Visits Google]… I see [SNM] stans for Neuroleptic Malignant Syndrome, that is not it, hahaha."
Javier, Nicaraguan Immigrant with LEP (Participant #23)	"No sé [que significa SNM]. Seguro significa sinonimos."	"I do not know [what SNM means]. I am sure it means synonyms."

Lucia, Mexican Immigrant (Participant #5)	“Ese ‘SMN’ me suena como otra cosa, como BDSM o algo así, la verdad.”	“SMN sounds like something else to me, like BDSM, really."
Gabriela, Venezuelan Immigrant with LEP (Participant #17)	“EST de verdad que no tengo la menor idea que significa. Estado situación del tiempo?”	“EST? I really have no idea what it means. State of the weather?”
Erendira, Venezuelan Immigrant with LEP (Participant #3)	“Aviso de tornado hasta las 9:45... CST? Ese ‘CST’ no entiendo… simplemente le pasé por encima.”	“Tornado warning until 9:45.... CST? I do not understand 'CST’… I kept reading [the warning] and ignored it.”
Javier, Nicaraguan Immigrant with LEP (Participant #23)	“No, yo solo se que "PM" es de la tarde. Lo otro he visto varias siglas así, pero no sé que es… Priority Storm Time?”	“I only know that PM means the afternoon. [As for PST], I've seen several acronyms like that, but I don't know what it is… [maybe] Priority Storm Time?”
Mauricio, Mexican Immigrant with LEP (Participant #8)	“Yo entendí bien la palabra proyectil como si fuera por decir que el tornado desarme una casa y todo lo que dañe vuela. Hay muchas personas en otros paises que lo pueden entender como balazos. Eso es	“I understood the word *proyectile* as if it were to say that the tornado dismantled a house and everything it damaged flew away. There are many people in other countries who understand it as bullets.

	a lo que más están acostumbrados”	That is what they are most used to.”
Andrés, Salvadoran American (Participant #13)	“‘Proyectiles’ puede causar confusión, ya que evoca imágenes de bombas o tiroteos, y no tiene relación alguna con un tornado. Yo escucho la palabra 'proyectiles' y pienso que se refiere a un tiroteo o a un acto criminal."	“The word *proyectiles* is like a bomb, like a shooting. I would see the word *proyectiles* and think there is a gunfight, and they are using armed weapons. I would think someone is committing a criminal act.”
Jackie, Venezuela Immigrant with LEP (Participant #4)	“Tengo mi telefono en inglés porque como vivo en Estados Unidos y bueno, también tú sabes... aprender el inglés y practicarlo todos los días.”	“I have my phone in English because I live in the United States and well, you know... I have to learn English and practice it every day.”
Diego, Guatemalan Immigrant with LEP (Participant #15)	“Es un mensaje creíble. Pero lógicamente, no puedo confirmar que lo estoy recibiendo de un medio confiable. Pues eso de realidad nos preocupa bastante, porque la forma en cómo verifican que si es un medio confiable es	“[The WEA] is a credible message. But logically, I cannot confirm that I am receiving it from a reliable source. That really worries us a lot because the way they verify that they are a reliable source is by putting 'SNM,' but if we

	poniendo ‘SNM,’ pero si no lo podemos entender pues la gente va a pensar que me está mandando un mensaje de texto spam en vez del servicio.”	can't understand it then people are going to think they are receiving a spam message instead of the service.”
Gabriela, Venezuelan Immigrant with LEP (Participant #17)	“La fuente de información que me tomo más en serio como inmigrante recién llegado son las alertas que vibran y hacen ruido. Como todos la reciben al mismo tiempo, si uno la ignora, el otro la lee. Aquí siempre, siempre lo tenemos más en cuenta en mi comunidad.”	“The information source that I take most seriously as a recently arrived immigrant are the alerts that vibrate and make noise. Since everyone gets it at the same time, if one ignores it, the other reads it. Here we always, always take it most into account in my community.”
Valentina, Mexican Immigrant with LEP (Participant #7)	“Mi riesgo personal no seria tanto porque no lo he experimentado. [Para aumentar el riesgo], podría decir qué tipo de tornado es qué categoría o no sé cómo se llamaría. Pues yo pienso que para que la gente se tome en cuenta de que no es algo simple pero serio.”	“My personal risk would not be high because I have not experienced tornadoes. [To increase urgency], you could mention the category of the tornado or what it would be called. I think for people to be aware that it's not something simple but serious."

Juliana, Mexican American (Participant #14)	"Cuando está en mayúscula AVISO DE TORNADO, me dice esto es en serio. Yo siempre he sabido que cuando usan la mayúscula es algo como que te están gritando, 'EY, SALTE DE AQUI'"	"When *AVISO DE TORNADO* is capitalized, it tells me that this is serious. I have always known that when they use a capital letter, it is like they are yelling at you, 'HEY, GET OUT OF HERE [and take action]!'"
Miguel, Mexican Immigrant with LEP (Participant #10)	"Aviso suena como de no más que una notificación que te llega o que ves. Hablando de las redes sociales, "ey está pasando esto, o puede pasar esto," pero ya alerta es como, "tu atención aquí. Está sucediendo esto." No es grave, pero no es algo que puedas tomar a la ligera.	"*Aviso* sounds like no more [urgent] than a notification that comes to you or that you see on social media... but *alerta* is more like 'Your attention is required. This is happening [to you right now] … it is not something you can take lightly.'"
Adriana, Mexican Immigrant with LEP (Participant #12)	"Alerta es una palabra asociada con algo peligroso. Te están alertando, pero no much gente le da tanta importancia esa palabra. Solo necesitarían usar	"*Alerta* is a word associated with something dangerous. They are alerting you, but not many people give that much importance to that word.

	palabras que le inspire la comunidad hispana que tenga que buscar refugio. No tiene que ser jerga.”	[Alerting agencies] just need to use words that inspire the Hispanic community to seek shelter. It does not need to be jargon.”

*RQ3: How do Spanish speakers in the United States engage in **decision-making** and **milling** processes based on information presented by Wireless Emergency Alerts?*

Participant	Original Quote	Translation for the Dissertation
Gabriela, Venezuelan Immigrant with LEP (Participant #17)	“Yo trataría de seguir mi vida con normalidad, pero estaría pendiente de ver si el viento aumenta, si va a llover, si hay algún otro tipo de cambio que me diga a mí si efectivamente va a haber un tornado. Porque hay veces que uno tiene tantas cosas que hacer en su día que uno no se paraliza por una alerta. Es porque no tienes la certeza de que va a ocurrir.”	“I would try to go on with my life as normal [if I received this WEA], but I would be watching to see if the wind increases, if it is going to rain, if there were some other types of change that would tell me if there were indeed going to be a tornado. Because there are times when you have so many things to do in your day that you do not get paralyzed by a warning. It is because you do

		not have the certainty that it is going to happen."
Gabriela, Venezuelan Immigrant with LEP (Participant #17)	"[La Alerta 360] tiene más información sobre lo que uno debe hacer en relación con lo que ocurre a mi alrededor y [describe] las implicaciones del peligro. [Nuestra comunidad] no saben realmente qué es lo que pueda significar este fenómeno. Porque al final de cuentas, un año es muy poco tiempo para conocer todas las cosas que pueden pasar en este país. Nosotros de tornado lo único que conocemos es lo que vemos en las películas. Y a veces las películas son un tanto exageradas. Así que uno es muy indiferente [a las alertas]."	"[The 360 WEA] has more information about one should do in relation to what is going on around me and [outlines] the implications of the hazard. [Our immigrant community] does not really know what this phenomenon might mean. Because at the end of the day, one year is too little time to know all the things that can happen in this country. The only thing we know about tornadoes is what we see in the movies. And sometimes the movies are a bit exaggerated. So, one is very indifferent to [shorter alerts]."
Erendira, Venezuelan Immigrant with LEP (Participant #3)	"Una persona le comenta a otra, 'Mira, sabes que escuché que va a haber tiempo severo?'	"One person says to another, 'Look, you know what I heard that there is going to be severe

	Entonces uno investiga por su cuenta, como sea en Google... trata de investigar por su cuenta o ve el noticiero más seguido porque "ah, mira, fulano me dijo que va pasar esto." Entonces uno trata de buscar la información y la mejor manera de informarse.”	weather?' Then you do your own research on Google... or you watch the news more often because ‘ah, look, so-and-so told me that this is going to happen.’ So, you try to look for the information and the best way to get informed.”
Noelia, Mexican Immigrant (Participant #25)	N/A	“If there's a tornado, then I would begin to prepare. I would be ready to seek shelter… I would call my family and let them know of what is happening [since they do not speak English]. Call every single one of my family members.”
Teresa, Mexican Immigrant (Participant #19)	“Ahorita hay algo que me llamó la atención cuando me dice consulte las medias informativos. Si esto es un mensaje, debería incluir un link	“Now there is something that caught my attention when [the WEA] asked me to’ check media’… if this is a mobile message, there should be a link

	para saber dónde ir. Porque por default yo voy a poder pensar en el radio, en CBS, pero si me dan un link confiable con más datos que pudiera decir algo de Protección Civil, la Cruz Roja, qué sé yo, eso estaría fantástico."	[that outlines] where to go [to seek additional information]. Because by default, I would think the radio, NBC or CBS, but if you give me a reliable link with more data that could say something from Civil Protection, the Red Cross, that would be fantastic!"

*RQ4: In what ways do Spanish speakers in the United States believe the recommendations provided in a Wireless Emergency Alert would enhance their safety (**response efficacy**)?*

Participant	Original Quote	Translation for the Dissertation
Eduardo, Mexican Immigrant (Participant #27)	"Yo por experiencia y eso que tengo pues que he visto tornados y eso, pues diría que la mi pantry sería el lugar más seguro para refugiarme."	"From my experience having seen tornadoes, I would say that my pantry would be the safest place to take shelter."
Yolanda, Puerto Rican (Participant #22)	"Son casas de cartón, es verdad. No se pueden confiar [refugiarse en su casa] porque la verdad es que estas casas son	"[Houses in the United States] are cardboard houses, it is true. You cannot trust to seek shelter in [your home] because the truth is that these houses are

	diferentes a las de nuestro país.”	different from those in our countries. “

*RQ5: In what ways do Spanish speakers in the United States feel empowered (or not) in their ability to take protective action (**self-efficacy**) after reading a Wireless Emergency Alert?*

Participant	Original Quote	Translation for the Dissertation
Valentina, Mexican Immigrant with LEP (Participant #7)	“Yo tendría que comprar linternas, tener agua suficiente. Tener baterías listas, tener los telefonos cargados y pues no salirnos de la casa más bien porque como yo vivo en una trailer pues a mí si me da miedo que se vaya a destruir, porque pues la fundacion están pues sueltas y al lado de nosotros pues hay como tres árboles que nos vaya a caer encima.”	“I would have to buy flashlights, have enough water, have batteries ready, have our phones charged and not leave the house. Since I live in a trailer, I am afraid that it is going to be destroyed, because the foundation is loose and next to us there are about three trees that could fall on us.”
Valentina, Mexican Immigrant with LEP (Participant #7)	“Está muy bien [las instrucciones] porque si sabiamos que este es un lugar	“[The instructions] are very good because if we had known that this is not a safe space to

	inaproporiado para buscar refugio, nuestra familia no se hubiera quedado en nuestra casa movil. El tornado nos hubiera llevado junto con el trailer."	shelter, my family and I would not have decided to stay in our mobile home. The tornado would have swept [my kids and I] along with our home"
Andrés, Salvadorian American (Participant #13)	"Yo prefiero la versión 360. Me da más información en cómo prepararse. Es bueno tener un poquito más de información, aún si no estoy seguro cómo prepararme, si no tengo acceso a Internet o a la radio, si estoy manejando, si estoy afuera. Es más efectivo mandar la versión larga porque es como un checklist que tengo que hacer esto, esto y esto para protegerme. Pero la versión corta no tiene checklist, no mas te deja solo."	"I prefer the 360 version. It gives me more information on how to prepare [for tornadoes]. It is good to have more information, especially if I am not sure how to prepare, if I do not have access to the Internet or the radio, if I am driving, or if I am outside. It is more effective to send the long version because it's like a checklist that I have to do this, this and this to protect myself. The short version, however, has no checklist, it just leaves you alone [with no guidance]."