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An Eye to the Sky: Describing Characteristics of Weather App Users Through Q Method

Danielle Wardinsky Hallows

A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of
Master of Arts

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ABSTRACT

An Eye to the Sky: Describing Characteristics of Weather App Users Through Q Method

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The world revolves around weather information - whether the need is to understand, prepare for, or navigate weather. Although traditional television viewership of weather forecasts are on the decline, mobile weather applications are becoming the new media medium for weather information. In fact, the total number of app downloads in the weather market reached 69.5 million at the end of 2021 (Statista, 2021). As a result, understanding the characteristics of weather app users and what those users are looking for is pertinent to research regarding weather communication. While weather is an ongoing phenomenon sought to be understood by people for many decades, the uses and gratifications of engaging in weather communication are under-researched in literature. Thus, this study aimed to identify the characteristics of weather app users and their motivations for checking mobile weather apps. Using substantial literature to build a concourse of opinions about weather apps (Armstrong & Towery, 2021; Eachus & Keim, 2019; Hoang, 2015; Liu, et al., 2020), subjects participated in a Q sort, a quantitative and qualitative method that reveals the subjectivity of audiences (Brown, 1993; Stephenson, 1995). Findings indicate that managing expectations, fulfilling practical needs, and satisfying personal concerns were strong motivators for using a weather app. Other weather app user qualities included being optimistic, controlling, reasonable, or private. Practical implications for weather communicators, as well as for app developers are also discussed.

Keywords: weather, mobile weather applications, users, Q method, characteristics, motivation

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Introduction

Whether through radio, television, or mobile applications, from professional meteorologists to everyday folk, people around the world tune into the weather. In other words, our society likes to keep “an eye to the sky.” Often used by TV meteorologists to encourage safety, “an eye to the sky” describes the cultural phenomenon of checking weather forecasts (Greenfield, *The Atlantic*, 2012). This phenomenon is understandable – simply because weather can impact anything, anytime. Just a slight rumble of thunder, drop of rain, or blustery wind can change the course of history. One author even argued that “on the shelf of quintessential American phenomena, weather fits quite comfortably next to jazz, baseball, and ice cream cones” (Henson, 2010, p. 1). As a geographic area, the United States is home to some of the most violent weather on earth (Henson, 2010). Recent fluctuations in U.S. weather, including major climatic changes, have led to increased public attention to weather in general, especially among digitally-savvy generations, such as Gen Z (Lang, 2014; Okeke, 2019). In fact, 70% of U.S. adults from ages 18 – 45 regularly use mobile weather applications (MWAs) to monitor atmospheric conditions (Statista, 2019). Despite viewership declines in traditional weather forecast segments, revenue for MWAs is expected to increase 11.64% between 2021 – 2025, with the number of total app downloads in the weather market reaching 69.5 million by the end of 2021 (Statista, 2021), demonstrating that the ancient desire to understand, access, and process weather information is still prevalent (Cahir, 2019; Greenfield, *The Atlantic*, 2012).

Currently, there is substantial literature that analyzes different motivations for tuning into the weather. Studies range in topics from checking weather for employment purposes (Frisvold & Murugesan, 2013), travel planning (Dye & Shaw, 2007; Hamilton & Lau, 2006), and even improving memory recall (Harley, 2003). Other studies have also indicated that people select

different mediums (broadcast television, National Weather Service radio alerts, and push notifications, MWAs) to receive forecast information. Depending on individual perception of the weather severity level, the act of physically tuning into, or checking the weather – severe or not – is performed by a variety of demographics (Armstrong & Towery, 2021; Eachus & Keim, 2019; Hoang, 2015; Liu et al., 2020). This repertoire of prior literature reveals that perceptions of weather can be highly subjective. Yet, these studies tend to take objective approaches or use objective research methods to measure something as subjective as checking the weather.

Thus, the purpose of this research study is to take a subjective purview of the personality characteristics and types of people who continue to check the weather via MWAs. With the theoretical lens of Uses & Gratifications theory, this study will adopt Q methodology, a method that provides a systematic study of any topic, to further understand the people who are motivated to check MWAs. A subjective look at motivations and characteristics of MWA users will 1) provide insight for the future of the weather journalism field as well as 2) offer practical implications for weather forecasters and app developers to evaluate when creating and producing new weather media.

Literature Review

To establish a theoretical and practical framework for this research, the following literature review will provide a brief history of weather forecasting and how it has evolved in the media, discuss research surrounding motivations for seeking weather information, and apply Uses & Gratifications theory to weather-related media.

History of Weather Forecasting

From as early as the time of the ancient Greeks, meteorology, or the scientific study of atmospheric occurrences, has been a regular subject of human discourse (Cahir, 2019). Over

time, some of the early Greek traditions, such as the idea that wind is not air in motion, were proven false, as instruments to measure the weather were slowly introduced (Cahir, 2019). In the 17th-century, an Italian physicist and mathematician, Evangelista Torricelli, invented the very first mercury barometer, leading the way for other weather instruments to surface (Cahir, 2019). By 1849, the Smithsonian institution was sending these weather instruments to telegraph stations across the U.S., establishing the first weather observation and recording network for the majority of the country (National Weather Service, 2022). Later on, weather forecasting as a profession finally became popular during World War II, when many soldiers were trained as meteorologists (Henson, 2010). The purpose of military meteorological training was for the sake of war, but as the soldiers returned home, they became station forecasters who would write a weather script for television anchors to read. As television sets became more popular in the average American household, so did the familial and habitual process of sitting down to watch the news and weather forecast (Henson, 2010). “Weathermen” were soon placed in front of stationary maps, explaining high-and low-pressure systems to an audience that loved the tools of “polish, appearance, and gimmicks” (Henson, 2010, p. 11). Shortly after the rise of the local weatherman, “weathergirls” and their sex appeal were introduced to audiences to increase viewership as early as 1952 (Laskin, 1996). Using women to hypersexualize the weather segment, exemplified by the wearing of swimsuits during the broadcast, led to issues in gender representation until recent years (Perryman & Theiss, 2014), where female meteorologists, especially in larger television markets are now represented more equally (Cranford, 2018; Hallows, 2020).

Trends in Forecasting Research

After both male and female weathercasters became popular in local and national television markets, a downpour of research was published regarding the perceived

credibility/trust of weathercasters (Brann & Himes, 2010), parasocial relationships with weathercasters (Sherman-Morris, 2005; Sherman-Morris et al., 2020), and graphic content of weather forecasts (Sutton & Fischer, 2021).

Brann and Himes (2010) reported that even with controls for physical attractiveness, male weathercasters were perceived as more extroverted, competent, composed, and more credible than female weathercasters. However, a substantial number of studies indicate that most people hear about severe weather crises from the local weathercaster – male or female – and not emergency weather alert systems (Drobot, 2007; Mitchem, 2003; Paul et al., 2003; Zhang et al., 2007), which means that during times of severe weather, people turn to a human source for information. Ultimately, this high level of trust that individuals can create with weathercasters has also led to parasocial relationships (PSRs), or a “communicative interaction taking place parasocially rather than interpersonally” (Schiappa et al., 2007, p. 302). Kathleen Sherman-Morris, the leading scholar on PSRs in weathercasting, discovered in multiple studies that PSRs have not been related to risk perception or protective actions, but that the perceived relationship does encourage viewers to turn on their television in an emergency rather than check a mobile device (Sherman-Morris, 2005; Sherman-Morris et al., 2020).

The potential for strong relationships with local weathercasters has also led to research that examined whether the graphic content of weather forecasts has effects on the audience. For example, employees at a university were more likely to check weather alerts during a tornado warning on their larger desktop computers, whereas students at the same university tuned into broadcast weather segments (Sherman-Morris, 2010). Usually, the age cohort in which most employees would fit (35 – 65) are more likely to turn to a broadcast segment, but computer weather alerts were more quick and easier for the older demographic to read (Sherman-Morris,

2010). Additionally, eye-tracking and survey methods have been used to find that color, font, and message content can garner more audience attention on a social media or broadcasted forecast, depending on the style displayed (Ash et al., 2014; Ding & Millet, 2020; Klockow-McClain et al., 2020; Millet et al., 2020; Sutton & Fischer, 2021).

Moving to Mobile Forecasts

Today, many news organizations still rely on the weathercaster to bring in sponsorships, money, and followers for the station, much like a social media influencer. The weather segment of the news broadcast “continues to be the most watched part of a newscast” (Katz, 2017). To capitalize on this finding, most producers will structure their newscast in a way that keeps audiences “watching long enough to achieve consistent ratings” (Nix-Crawford, 2017, p. 9). However, overall viewership of newscasts is dropping (Pew Research Center, 2021), suggesting a shift in the way people seek out their weather information. Several scholars suggest that social media and MWAs are the new weathercast (Bryant et al., 2017; Wolf & Schnauber, 2015; Yuan et al., 2017), and that social media weather accounts serve both emergency responders and users during severe weather events (Rossi et al., 2018). In the last several years, researchers have studied MWA usage among varying age groups, leading to notable and practical information regarding mobile forecasts. Variables common among these studies include “ease of adoption, ease of use, trust, and value” (Bryant et al., 2017) as well convenience and aesthetic (Phan et al. 2018). These variables provide ideas on why mobile forecasts on-the-go are becoming more commonplace than traditional weathercasts. Nevertheless, *where* people turn to for weather information is not the purpose of this study. Instead, the objective for the current study is to discover *who* – who are the individuals still purposefully seeking for weather information on digital channels?

Motivations for Seeking Weather

Considerable literature has attempted to research the types of people who seek weather media, and findings indicate that a variety of reasons exist. Farmers use weather information in agricultural decision-making (Frisvold & Murugesan, 2013), tourists check weather when deciding travel locations and times (Dye & Shaw, 2007; Hamilton & Lau, 2006), and families look at weather media to prepare for potential severe weather events (Armstrong & Towery, 2021). Age, gender, and time of day are often popular variables to consider when examining the characteristics of who people seek out weather media. For example, baby boomers in Chicago were found using personal vehicles instead of traditional transit during storms, but millennials were different – the younger generation was more likely to use traditional transit rather than cars in a storm (Hyland et al., 2018). These findings were later supported by Wu & Liao (2020), who analyzed public transit users in Beijing, China. In another study, gender was positively correlated with severe-storm media use; more specifically, females were more likely to seek out a variety of media sources during a severe tornado warning, whereas males were more likely to use just one source (Perreault et al., 2014). Regardless of age or gender, 62% of consumers in a study reported that they regularly check the weather in either the early morning or the late morning (Statista, 2018). This finding implies that weather conditions may impact the daily activities of individuals, who want to check the weather before planning the rest of their day. While individual reasons for proactively accessing or using weather media may vary based on purpose, age, or gender, there have been specific uses found for engaging with weather information. Such uses for weather-related media can be explained through Uses & Gratifications theory (U&G).

Uses & Gratifications

The terms “uses” and “gratifications” were presented by Katz, Blumler, and Gurevitch (1973), who explained that individuals may *use* media to *gratify*, or satisfy certain personal needs and desires. Essentially, this theory attempted to describe how individual motivations for engaging with any type of media worked in various contexts (Katz et al., 1973). Many studies have adopted U&G theory since the landmark theoretical discourse was published. For example, U&G theory has been used to explore usage of social media platforms (Bossen & Kottasz, 2020; Pelletier et al., 2020; Punyanunt-Carter et al., 2020; Whiting & Williams, 2013) online shopping (Athwal et al., 2019; Lim & Ting, 2012), podcast listening (Perks & Turner, 2019) streaming service binge-watching (Steiner & Xu, 2020) organizational branding (Kujur & Singh, 2020; Qin, 2020), and video gaming (Bueno et al., 2020), to name just a few. U&G theory is particularly popular among Q method research because the measured subjectivity of audiences can often be contextualized by specific uses and gratifications that individuals seek after (Church et al., 2020; Robinson et al., 2014; Thomson & Greenwood, 2017). U&G theory acts as a foundation for this study, as the theory provides a basic understanding on why audiences continue to demonstrate the need for weather media through MWA downloads. Though Katz et al. (1973) asserted several stipulations within U&G theory, there are two stipulations worth noting within the context of the current study: 1) audiences are active, not passive participants in the media arena and 2) agency is essential in the U&G process.

Active Audiences

Crucial to U&G theory is the idea that audiences are active when selecting media, they are not just selecting media unawares. Noteworthy literature has applied this concept when examining weather-related media and communication. Take, for instance, Harley’s (2003)

analysis of the British cultural obsession with weather. Harley (2003, p. 115) asserted that engaging in conversations about the weather satisfied a need for “accessing and structuring memory” that other media could not help with. Simply put, audiences were actively and cognitively choosing to talk about the weather because it strengthened their mental ability to recall nostalgic memories (Harley, 2003). Seasonal changes in weather conditions, such as allergy season in the spring/fall or the first snowfall in winter, were found to be the strongest factor in audiences actively seeking out weather forecasts (Roe & Vandebosch, 1996). Other research indicates that audiences are most active in the U&G process when weather crises emerge. Depending on the perceived threat, severity, and communicated risk of an approaching natural disaster, audiences will actively select the specific news platforms they want to receive messages from (Eachus & Keim, 2019; Hoang, 2015; Liu et al., 2020). From another study, most survey respondents (N=1,030) said they would likely use social media to get essential information before a hurricane but actually turned to live broadcast weather reporting when the hurricane was close to landfall (Armstrong & Towery, 2021). Before and after the landfall of Superstorm Sandy, TV and radio were selected more often for weather information than social media sources (Burger et al., 2013). These results demonstrate that audiences are active – selecting their weather-media based on their perceptions of personal needs and crises.

Personal Agency

The stipulation that audiences are active when selecting media is indicative of personal choice, or agency (Katz et al., 1973). An assessment of MWA usage among college students from different universities demonstrated that the subjects had specific preferences about MWAs, and their features (hourly forecasts, potential precipitation percentages) based on how the subjects personally decided to use the app (Phan et al., 2018). Similarly, another study examining

MWA usage found that over half of the survey respondents chose to not to use a pre-installed weather app, but instead download a separate weather app to satisfy needs that the default app could not (Bryant et al., 2016). Thus, the agency employed in selecting a MWA for personal use, whether it be the default or another downloadable app, was important when weighing the uses of the app with the gratifications that the app provided.

Personal agency will be a key variable in the current study because 1) the study methodology allows for personal choice in the data collection and 2) because the ability to choose where, when, and how to get weather information is all based on agency. While U&G theory has been used in a plethora of media studies, adopting U&G for the topic of weather-media provides a unique framework to understand human engagement in weather communication and the theory strongly supports the chosen methodology.

Research Questions

When compared with U&G literature on the subject of weather media, a review of the literature surrounding new age weather media suggests the need to look more in-depth at the personality characteristics of individuals who are motivated to access and utilize weather information. Therefore, this study will examine those motivations and characteristics using Q methodology, which is used to identify specific attitudes, opinions, and beliefs that lead to such motivations and behaviors. The following research questions have been used to guide this study:

RQ1: What types of individuals, and their personality characteristics, use mobile weather applications?

RQ2: What kind of motivations do individuals have for using mobile weather applications?

Method

Background on Q methodology

A scholar of both physics and psychology, William Stephenson, introduced Q methodology in 1953, hoping to bridge a divide between his seemingly polar fields of study (Stephenson, 1993). While Stephenson is considered the father of Q methodology, Stephen R. Brown is credited with popularizing the method. Brown (1993, p. 93) described Q methodology as “a foundation for the systematic study of subjectivity.” The method combines both traditional qualitative (in-depth interviewing) and quantitative (factor analysis) processes together to effectively analyze subjectivity among audiences.

By nature, weather forecasting is also a combination of qualitative and quantitative analyses. Atmospheric conditions are always quantitative measurements, but the way those measurements are presented is highly qualitative. From legacy weathercasts on television to newspaper columns with daily temperatures – there is some subjective decision-making on how to present weather information. Tones, colors, fonts, voice, order, and other factors are determined by human perspectives and not only the quantitative read-outs. Then, as individuals seek out weather information for their own uses and ensuing gratifications, they are likely imposing their own biases or perceptions on the weather media. Subsequently, Q methodology was selected as the method for this study.

Although Q is widely accepted in the academic community, Q method is still under-used by scholars, especially in the area of weather communication research. In 2019, Eachus and Keim (p. 595) stated that “it has been almost a decade since researchers assessed user preferences in gathering weather information.” These two researchers aimed to perform such an assessment using a generalized survey method, finding that the preferred channels of weather

information were now websites and social media (instead of legacy media) and the type of weather communication most wanted by participants was daily forecast information (Eachus & Keim, 2019). While these survey findings present notable implications for weather communicators about weather information audiences, Q method can, in detail and with “full confidence” (Brown, 1993, p. 120), uncover “distinctive ways of thinking” (Brown, 1993, p. 120) that exist among audiences. Q methodology does not claim to comprehensively find *all* ways of thinking, but finds any that are currently existing in an audience and compares them with one another (Brown, 1993). This ability to unveil subjectivity among digital weather information-seekers via Q makes the method a valuable research pursuit. Outside of basic statistics available through a survey, Q presents an opportunity to not only answer the call of Eachus and Keim (2019), but truly understand the audiences that engage with weather communication. For detailed information on the method, each process involved in Q is described in the following sections.

Collecting the Concourse

A Q study first begins by collecting a concourse of statements from a variety of sources. The concourse should represent a “random collection of self-referable statements about something, of statistical dimension” (Stephenson, 1993, p. 5). Statements can be collected from news articles, magazine articles, blog posts, academic literature, pop culture, social media, and via informal interviews (Brown, 1993). Depending on the topic of the study, a concourse can also include pictures, icons, art, and other visual representations. In some ways, the process of collecting concourse statements mirrors a traditional literature review. However, statements should come from “the ordinary conversation, commentary, and discourse of everyday life” (Brown, 1993, p. 94) and need to be understandable by a diverse audience (Stephenson, 1993).

Thus, the statements may be specialized for audiences familiar with the topic, but accessible to a variety of ages, genders, or ethnicities. Part of the task of Q-methodology is to uncover the discourse on a particular subject, but also to provide “inherent structure” on those subjects (Brown, 1993, p. 95). After collecting enough statements to reach a saturation point, statements are often then categorized based on content or theory.

The Q sample

Once a discourse has reached the saturation point, a sample set of statements from the discourse is then selected. Brown (1993, p. 94) suggested that “the goal in selecting a Q sample is to provide a miniature which, in major respects, contains the comprehensiveness of the larger process being modeled.” The process of selecting the Q sample has received some criticism, due to the variance or bias that can occur (Bolland, 1985). However, this issue of variance can be addressed in several ways, one being by asking participants what they would add to the sample during the interview portion of the Q sort that is not apparent from the statements. Another way to address the variance in the Q sample of statements is to vet the statements with other researchers, much like a qualitative coding process. By verifying the variance of statements with academics, other sampling errors can be fixed. However, there is some variation allowed in the number of statements selected for the final Q sample. Some scholars feel that a high number of statements can be overwhelming to participants, which is why most studies keep to about 25 – 50 statements in the final sample (Church et al., 2020; Robinson et al., 2014; Thomson & Greenwood, 2017).

The sample of participants for a Q study are generally recruited based on the topic at hand. For example, a Q method study that investigated the attitudes, opinions, and beliefs of Disney princess movie fans used a sample of adolescent girls ages 8 – 12 (Robinson et al., 2020).

Basically, criterion sampling is important to Q methodology to effectively measure the subjectivity inherent in the respective audiences.

The Q sort

At this point, the Q sample is numbered, printed on small index cards, randomized, and given to participants to sort into an inverted pyramid style deck. This process is called the Q sort. When scoring the sort, the ends of the pyramid are the strongest indicators, and the pyramid middle is considered neutral (0), shown in Figure 1. Participants are asked to perform a rank-order, designating their opinions as they sort statements into the columns. Researchers must record the sort pattern that the participants choose and later input the sort grid into a statistical analysis.

Figure 1

Example of Brown's Q sort Rank Order

Brown's Position						
-3	-2	-1	0	1	2	3
16	3	1	7	6	5	2
19	13	4	8	17	9	12
	15	11	10	18	14	
		20				

Following the Q sort, which provides breadth, researchers then interview the participants to also achieve depth. Interview questions generally ask about the participant's reasoning for rank-ordering the statements in certain positions on the scale, as well as other questions that amass additional insight. Interviews are later transcribed after a statistical analysis of the Q sort.

Current Study

To best assess the personality types of individuals who use weather apps and their motivations for said apps, Q methodology was used in the current study. Participants were first asked to rank-order, or sort (generally from most disagree - most agree) statements that represent a “random collection of self-referable statements” (Stephenson, 1993, p. 5) about MWAs. The sort itself is a “behavioral research approach” process whereby results are evaluated with a factor analysis, revealing subjectivity on any topic or situation (Church et al., 2020, p. 29). Consequently, “tests are not the variables” of interest in a Q study (Herrington & Coogan, 2011, p. 24). Rather, *people* are the variables of interest with each individual’s “vantage point” acting as a constant to use in comparison and inspection (Herrington & Coogan, 2011, p. 24).

The current study followed the Q method process detailed by Brown (1993), Herrington & Coogan (2011), and Stephenson (1993). First, a concourse of statements was gathered from a variety of sources that provided “inherent structure” on the topic of weather apps (Brown, 1993, p. 95). Again, concourse statements should come from “the ordinary conversation, commentary, and discourse of everyday life” (Brown, 1993, p. 94) and should be actual statements made by people who have opinions on the subject. In this study, statements all about, or related to weather app usage were collected from weather app reviews (Accuweather Weather Alerts, Dark Sky Weather, The Weather Channel Weather, WeatherBug – Weather Forecast, NOAA Weather, Weather Underground), social media comments (Facebook, Instagram), magazine and news articles (Fleming, The Guardian, 2018; Greenfield, The Atlantic, 2012; Pew Research Center, 2021; Statista, 2017; Statista, 2021), academic literature (including literature from the literature review above, such as U&G literature, PSRs with weathercasters, weather app preferences), and informal social media polls with potential participants. A total of 184 statements were initially

gathered before repetition and content saturation were apparent in new statements. Then, the concourse was complete and the researcher began organizing the statements into thematic and content categories.

After content saturation was reached with the statements, the author reviewed and narrowed the statements down to a set that provided “a miniature which, in major respects, contains the comprehensiveness of the larger process being modeled” (Brown, 1993, p. 99). As part of selecting the final Q sample, the researcher shared potential statements with a group of graduate students at a local university. The graduate students assisted the researcher in obtaining secondary opinions about the resonance, as well as overall understandability of the statements. A final number of 38 statements were selected for the Q sample to be sorted by participants. This number was high enough for the statements to remain comprehensive, but small enough to not be overwhelming for participants to sort (Church et al., 2020; Robinson et al., 2014; Thomson & Greenwood, 2017). The statements were then edited for clarity to ensure they would be understood by a diverse audience and printed on individual cards (i.e. - one statement per sorting card). A full list of the 38 statements employed in this study are available in Appendix B, divided by emergent themes, with sourcing information and citations accompanying each statement.

To capture the subjectivity of participants and their individual perspectives, the researcher recruited the same demographic that most often uses weather apps. Before the recruitment period began, the author was approved by the local IRB to conduct this research ethically (ID: IRB2021-404). A total of 37 participants qualified for this research based on criterion sampling. According to Brown (1993, p. 182), “all that is required are enough subjects to establish the existence of a factor for purposes of comparing one factor with another.” Thus, the number of 37 was enough to provide several factors to compare. Individuals ages 18 – 65

have been the focus of other studies on weather app usage (Bryant et al., 2017; Wolf & Schnauber, 2015; Yuan et al., 2017), because these are the most likely mobile weather application users, as well as the cohort that cares the most about changes in weather patterns due to global warming (Lang, 2014; Okeke, 2019). Subjects qualified for participation by 1) fitting into the above age demographic and 2) responding to an informal survey question about how often they check their MWA. Individuals who did not check their MWA at least 2x a week were excluded from the study. The resulting participant sample demographic was 54% female and 46% male, the oldest participant at 63 years of age, with the youngest at 19 years of age. The mean age of participants was approximately 34 years old. For the sake of removing potential limitations to this study, the researcher recruited participants from two different states – Texas and Utah. These states are demographically diverse, but they are also diverse in their climatic weather phenomena, allowing the ensuing data collection to attain a more robust set of opinions regarding weather apps.

With direction from the researcher, each participant completed their Q sort by ranking statements along a 9-point scale (“Most Like Me” +4, “Least Like Me” -4). Figure 2 depicts the actual Q sort grid used in this study. Immediately after the sorting, individual interviews were conducted, using a semi-structured, flexible interview guide. The interviews gave participants an opportunity to express their opinions about personal motivations for following influencers, as well as an opportunity to explain their decisions about ranking different statements high or low. Appendix A displays the full interview guide, which included questions such as: 1) *Why did you agree with those two statements the most?* 2) *Why did you disagree with those statements the most?* and so on. Time needed to complete the Q sort and interview varied by participant, generally between 20 – 60 minutes.

traditional manner, as that is not necessary in Q method. Rather, the interviews were first classified by the factor that individual participants fit into. Then, the interviews were analyzed to draw out ideas, reasonings, and examples that describe the factors and particular statements that were meaningful to the factors. Together, the statistical analysis and interviews were used to explore RQ1 and RQ2. Initially, five factors were present in the data, but the researcher felt that the last two factors were not as statistically significant as the factors described in the Results section.

Results

To best understand the results, a chronicle of each factor is detailed, with particular names and details offering information on the subjectivity of MWA audiences. By describing each factor that emerged from the factor analysis, insight is given on RQ1, which sought to answer what types of individuals and their personality characteristics use MWAs as well as RQ2, which asked about the motivation individuals have for using MWAs.

Factor 1: Fair Sky Forecasters

Participants in this factor (see Table 1) were individuals who were highly interested in how the weather changed day-to-day – ranking their strongest reasons for using weather apps as 1) to know daily temperatures or changing conditions and 2) see sunrise and sunset times. This group wanted to constantly keep an *eye on the sky*, personifying the title of this study. Interviews with the participants who fell into this category confirmed the author's understanding of this group. For example, Participant 32 related, “the temperature gives me the information that I need to get through my day.” Knowing the daily temperature also helped Participant 32 “know what to do to expect from the day.” This sentiment was again echoed by other participants, who said, “I need to prepare myself mentally, even just to walk outside,” (Participant 17). Hence, this group

is motivated to check a weather app because they want to manage their expectations every day. For many of the Fair Sky Forecasters, they liked “feeling in control” (Participant 17) so that they were not forced to be uncomfortable in inclement weather (Participant 31). In fact, Participant 13 said, “I have to check the spectrum [of high/low temperatures], plot it like a bell curve in my mind, and then decide what I want to wear or bring along [jacket, umbrella, etc.] for the day.”

Table 1

Factor 1: Fair Sky Forecasters

Statement Number + Statement	z-Score
29 The most important reason I check a weather app is for the daily temperatures.	2.108
27 I check a weather app because I want to know what to wear.	1.632
26 I like using features on a weather app where I can see just a couple hours ahead to plan for changes.	1.447
15 I check the weather app because I want to know the sunrise/sunset times for my specific location.	1.221
10 I'm really into astronomy so I use a weather app to keep track of the moon phases or stars.	1.209
34 Weather apps are just so much more convenient for me to get weather information, I don't want to watch TV.	1.205
3 Getting notifications from a weather app is even better than getting notifications from my significant other.	-1.075
4 After I delete social media apps on my phone, I click on my weather app because I just need something to scroll through.	-1.076
35 I feel like weather apps exaggerate stuff because they think it's entertaining.	-1.175
1 I check a weather app so I know what to make small talk about.	-1.341
14 I'm fine with my location constantly being tracked if it means I get accurate weather information on my app.	-1.477
24 My job revolves around me checking the weather.	-1.873
23 I don't feel like weather apps help me know what to do about commuting or driving around in bad weather.	-1.981

While themes of practical use towards weather apps emerged in multiple factors, the distinguishing characteristic of the Fair Sky Forecasters was their strong interest in astronomy. As Participant 16 explained, “I track whether it's going to be clear skies or cloudy skies, or what time of night is going to be clearer than others.” He added, “But I don't know if it's just

astronomy... I just like the night sky. I like knowing when the sun rises and when the sun sets, so I can watch it happen.” Participant 33 also described this desire to be connected to fair skies, who said: “There’s a sense of comfort and amazement with just checking out the night sky. It kind of puts things in perspective.”

The negative z-scores that were significant for the Fair Sky Forecasters further demonstrated both their need to manage expectations for the day and participate in their hobbies of astronomy and sunrise/sunset watching. Statement 23, “I don’t feel like weather apps help me know what to do about commuting or driving around in bad weather” was the highest ranked negative z-score (-1.981) among this factor, suggesting that these participants feel their weather apps do aid them in making decisions about their daily needs. Participant 33 related, “I’m very particular with how I take care of myself, that’s probably why I look at weather apps... It’s not necessarily like self-care, but in a physical sense, I am choosing to take care of myself.” This feeling is backed by the second highest ranked negative statement, “My job revolves around me checking the weather” ($z=-1.873$). Clearly, the Fair Sky Forecasters do not need to check weather apps in their current employment, but they do see checking the weather app as a form of caring for and protecting themselves; thus, checking a weather app does not feel like a job to them. Instead, “it gives [them] the freedom to choose how [they] will go about their day” (Participant 33).

Interestingly, this factor did not like their location being tracked, despite wanting specific sunrise/sunset times and hour-by-hour features on weather apps. Participant 33 said, “I’m not really into my location being tracked, even though I understand it’s a free service.” Additionally, this factor did not use weather apps to know what to make small talk about ($z=-1.341$). “I don’t use the weather to build my social repertoire,” said Participant 16. Participant 17 considered

herself to be a “quiet person” and felt that “it’s nice to just check an app without actually having to communicate with someone.” Overall, the forecasters want to be informed, comfortable, and connected to what is happening around them. Simply, they want the weather to be good – “I tend to be optimistic about the weather, I’m always hopeful” (Participant 31).

Factor 2: Reasonable Rainiacs

The second factor (see Table 2) that emerged from the factor analysis included individuals who are highly practical about their approach towards weather information. Selecting statements such as “I consider myself a nerd – I just find the weather interesting”, “The weather app I used is based on how easy it is to use”, and “I don’t want to pay extra to look up information about the weather” as some of their highest positive z-scores, these participants were highly practical about their approach towards weather apps. As a result, the researcher aptly named this group as the “Reasonable Rainiacs.” At the top of their rankings, the Rainiacs felt that checking a weather app was not a focus of their daily routine ($z=2.094$), yet Participant 4 stated, “I check it every day, at least in the morning when I drive to work... just to see where storms are or if it looks like bad weather.” In comparison, Participant 9 had similar habits – “I check the weather all the time, I check it when I get up in the morning, I check it throughout the day. I don’t know why that is, but I think I just like to know what is coming maybe.” Perhaps the Rainiacs do not see checking the weather app as a set part of a routine, but almost as a compulsion they need to partake in daily. Without checking the weather, the Reasonable Rainiacs struggled to make sense of their day. To illustrate, Participant 1 shared:

“Because I live in a more Southern part of Texas, near the Gulf Coast where storms are rolling in, you could be having lightning and you could be having flash floods and two or three inches of rain in a very short period of time. So, you don’t

want to be out during those times. I make a lot of decisions based on weather because the freeways here are so busy and I wouldn't do an hour's worth of travel when it's raining. Where I'm going and what I'm going to do is based on what I've seen from my daily check of the weather.”

Table 2*Factor 2: Reasonable Rainiacs*

Statement Number + Statement	z-Score
6 Checking a weather app isn't a big part of my daily routine.	2.094
21 I don't really use my weather app for emergency weather alerts.	1.315
14 I'm fine with my location constantly being tracked if it means I get accurate weather information on my app.	1.311
9 I consider myself a nerd – I just find the weather interesting.	1.307
31 The weather app I use is based on how easy it is to use.	1.303
26 I like using features on a weather app where I can see just a couple hours ahead to plan for changes.	1.051
34 Weather apps are just so much more convenient for me to get weather information, I don't want to watch TV.	1.051
17 I don't want to pay extra to look up information about the weather.	1.047
10 I'm really into astronomy so I use a weather app to keep track of the moon phases or stars.	-1.043
1 I check a weather app so I know what to make small talk about	-1.043
36 I get a kick out of seeing if the weather app accurately forecasts the weather or not.	-1.311
15 I check the weather app because I want to know the sunrise/sunset times for my specific location.	-1.315
3 Getting notifications from a weather app is even better than getting notifications from my significant other.	-1.571
13 If I don't check the weather of the native places where I have plants from, I can't keep my plants alive.	-1.830
12 I'm concerned about climate change, so I check the weather to keep tabs on that issue.	-2.094

The sensible, or reasonable, characteristic of this factor was evident in other statement rankings. Different from the Fair Sky Forecasters, the Rainiacs were fine with their location being tracked because they wanted features that precisely followed changes in the weather. It was not at all entertaining for this group to see whether or not the weather was predicted

accurately ($z=-1.311$). If the weather is such a practical part of the day, getting a kick out of weather forecasts was not an interest of the Reasonable Rainiacs. However, they did want weather apps to be accurate AND user-friendly. Participant 9 explained this preferred level of convenience, who said:

“I think for the most part, weather apps are fairly user friendly. Aesthetically, some are easier for me to look at than others. It sounds really dumb, but one app is an all-black background with the white writing. Another app is a colorful cloud, and for some reason it’s visually much easier for me to just glance at it quickly and see what the weather is. The other one, with the black background, I have to distinguish – is that a cloud? Or a rainstorm? I just don’t have time for that. I need it to be really easy.”

Although this factor described themselves as nerds who found the weather interesting, this group was not interested in astronomy nor climate change. Essentially the Reasonable Rainiacs did not associate “nerdiness” with specific interests or hobbies, but more with a general interest in weather phenomena. Checking the weather to keep up with climate change ($z=-2.094$) was the highest ranked negative statement among the negative z-scores. As explained by Participant 9, “I care about climate change. But that’s not why I check the weather. Like, I don’t ever check it because I think ‘Oh my gosh, the glaciers are melting.’” For other participants as well, they were “not interested in how climate change is going to affect the weather in [their] area every day” (Participant 4). Ultimately, climate change did not “have any bearing on *[their]* weather” (Participant 4).

In contrast with their almost robot-like convenient approach to using weather apps, this group was also somewhat tied to emotions with the weather. Out of all of the

factors, the Rainiacs had the highest z-score for Statement 16 “I often check the weather for other areas where my family lives” ($z=0.783$). Although not high enough to match their interest in weather or ease of use with weather apps, the inclusion of this statement revealed that checking the weather is not only a sensible compulsion, but a compulsion that connects them to their loved ones. Participant 1 said:

“I check the weather where my children are, all the time. Because I want to know if there’s a storm coming for them and if there’s anything they need to prepare for. Even just to send a little text like ‘are you okay?’ – my momma's heart needs to know what the weather looks like for them, and a weather app makes that much easier. I can’t watch the weather report from their local people.”

One notable distinction to make about this finding is the fact that the Reasonable Rainiacs stay sensible about using weather apps to check on far away locations, rating 0 as a group on Statement 7: “I find myself checking the weather of places I miss or want to travel to.” Hence, their purpose for checking the weather app of locations beside their immediate area is not to be overly nostalgic, only to connect to people for whom they are concerned.

Another finding worth noting about the Rainiacs is that the majority of individuals who fell into this group were over the age of 35, suggesting that age may play a part in the nuances of people who use weather apps. In summary, the Rainiacs need weather apps to be easy to use, because the process of checking the weather on a MWA is a convenient and essential part of their everyday lives. Like the Fair Sky Forecasters, the Rainiacs want weather information to help them make decisions. Yet, the Reasonable Rainiacs are motivated to use weather apps simply for the practicality they provide –

“everything else in my life tends to neatly fall into place when I check the weather every day” (Participant 9).

Factor 3: Inclement Inquirers

The final factor, labeled the “Inclement Inquirers,” is a group of individuals who are driven to check weather apps because of their various daily concerns. For instance, the top four significant statements sorted by the Inquirers pertain to health concerns, fashion concerns, social awareness concerns, and social conversational concerns (see Table 3). The health concerns, related to allergies ($z=1.912$), and knowing what to wear ($z=1.912$) were equal motivators to regularly check weather apps for the Inquirers. Participant 19 clarified how her concerns were the driving motivator for using a weather app:

“Even though I know the weather is not a real person, it feels like it [the weather] controls a lot of my life. So when I check the weather, I get to be in control instead of letting some unknown thing control my life. That way, I can know what days to take my allergy stuff, what days I can wear flats or what days I need to wear boots and socks. It’s not so much about being fashionable, I just don’t want to feel like I’m not in the know.”

Indeed, being able to be in control of outcomes related to the weather also directly determines what apps the Inquirers chose to use. Participant 10 shared, “I’ve tried other [apps] and it seems like they’re less detailed. A lot of the ones I’ve tried don’t have the allergy stuff, so I always go back to the ones that have good allergy details.”

Another theme evident in the statements ranked highly by the Inquirers revolved around social matters. The Inquirers felt smarter by checking a weather app and used it to

know what to make small talk about. As discussed by Participant 19, “I feel like I just need the weather as a backup, almost like a wingman? I’m not always the best with people, and the weather can just be easy for me to bring up when I’m feeling awkward.” In other words, this group uses weather app information to leverage themselves socially.

Another defining characteristic that did not appear in other factors was the top negatively ranked statement by the Inclement Inquirers – “I don’t go out of my way to download a new weather app, I just use my phone’s default app” ($z=-1.912$). Reinforcing the idea that this group wants to feel in control (much like Factor 1), the Inquirers were the only group that specifically wanted to control what app gave them weather information. Specifically, the Inquirers sought out apps beyond the typical default weather app, because “some apps just don’t cut it” for them (Participant 19). She continued, “I’ve done a lot of research and realized that most apps you can download are better than the default ones, and in my experience, they are better – by far.” In contrast with the Reasonable Rainiacs, the Inquirers did not value the user-friendliness of the app, ranking that statement in the Neutral (0) category. Evidently, the Inquirers are more concerned with what they need in the app than the ease of the app (Participant 19). Along with their need to find the best weather apps, this group’s eating habits and food selection was in fact impacted by weather information. “I just don’t feel like having soup on a hot day, or vice versa, like grilled food in the winter. I actually look at a weather app sometimes when I’m meal planning for the week just to see what’s changing before I go buy the food” (Participant 19).

For the Inclement Inquirers, weather apps are a means to an end, with the end being control. “The weather – I got to get to the end of that. I have to figure out what it is because I have to decide” (Participant 10). Through the Inquirer’s perspective, checking a

weather app is like the beginning of a daily quest, and as they complete the inquiry, they are better prepared to combat any inclement weather coming their way.

Table 3

Factor 3: Inclement Inquirers

Statement Number + Statement	z-Score
11 I use weather apps because I'm concerned about health issues.	1.912
27 I check a weather app because I want to know what to wear.	1.912
8 I feel smarter when I check my weather app.	1.434
1 I check a weather app so I know what to make small talk about.	1.434
14 I'm fine with my location constantly being tracked if it means I get accurate weather information on my app.	1.434
10 I'm really into astronomy so I use a weather app to keep track of the moon phases or stars.	-1.434
13 If I don't check the weather of the native places where I have plants from, I can't keep my plants alive.	-1.434
4 After I delete social media apps on my phone, I click on my weather app because I just need something to scroll through.	-1.434
25 Weather app information doesn't affect what I want to eat or cook for the day.	-1.912
32 I don't go out of my way to download a new weather app.	-1.912

Discussion

The purpose of this study was to identify specific groups of weather-app users and their unique characteristics for using weather apps, which ultimately provided details about individuals who are still motivated to seek out weather information in the digital age. RQ1 sought to uncover the types of individuals who use MWAs and their inherent personality characteristics, while RQ2 sought to understand the motivations to use MWAs. Using the Q sort method allowed the researcher to empirically understand subjectivity among weather app users and fill the need to study modern perceptions of weather communication (Eachus & Keim, 2019). Study results, while in support of previous literature, also provided new findings and practical implications for weather communicators to adopt.

Understanding Motivations and Characteristics within U&G

Motivations

In this study, the factor analysis indicated that individuals who deliberately incorporate hobbies, such as astronomy, into their lifestyle, are more motivated to check and tune into the daily aspects of weather. This finding was evident from the strongest factor, the Fair Sky Forecasters. Within their top rankings, the Forecasters expressed a need to know daily temperatures, what to wear, hourly changes in the forecasts, as well as sky forecasts for moon phases or clear skies. Clearly, the Forecasters are actively looking for these specific uses on weather apps to gratify personal needs. In this way, findings about the Forecasters substantially reinforce the U&G stipulation that audiences are active and purposeful in their media selections (Katz et al., 1973). More specifically, this study bolstered another study which demonstrated that seasonal changes in weather conditions were found to be the strongest factor in audiences actively seeking out weather forecasts (Roe & Vandebosch, 1996).

The factor analysis also revealed personal motivations from the second factor, the Reasonable Rainiacs, who saw checking the weather not as a part of their daily routine, but as a necessary compulsion that dictated the way they perceived the weather. A nationwide survey published in 2012 found that weather salience was stronger among individuals who regularly tuned into weather forecasts and who lived in continental, temperate climates (Stewart et al., 2012). Interestingly, the individuals who fell into the Reasonable Rainiacs were participants all from the state of Texas and not Utah. The Texas participants experience a more temperate and continental climate than the Utah participants. Stewart et al. 's (2012) study analyzed psychological perspectives of weather, whereas this study analyzed personality-based perceptions of weather, but both studies received similar results. For example, the Rainiacs were

the only factor to be associated with Statement 9 – “I consider myself a nerd – I just find the weather interesting.” Although the wording “interesting” and “salient” are fundamentally different between the two studies, the participants living in Texas in this factor demonstrated that location can increase the motivation to check the weather and how interesting the weather is perceived to be.

Another notable finding from Factor 2 that contradicts previous literature regards attitudes about climate change information available on MWAs. In one study, consistent weather fluctuations around the location of residence was a predictor, specifically of climate change concerns (Lang, 2014), whereas age was a predictor for using MWAs to address climate change concern in another (Okeke, 2019). Again, with all of the participants in Factor 2 hailing from Texas, where weather fluctuations are common, this study revealed that location was not associated with how the users felt about climate change information from their MWA. The Rainiacs felt that their MWAs were instead, designed to gratify more local uses.

Likewise, the third factor, the Inclement Inquirers, were the only group to purposefully download a different app than the default weather app that is standard on most mobile phones. Other studies have indicated that some individuals will download a separate app to fulfill needs (Bryant et al., 2016; Phan et al., 2018). Yet, this study was able to acutely define the characteristics of these individuals and understand exactly what needs they are looking for when they download a new weather app. In particular, the Inquirers wanted to know about health information on weather apps. While conducting interviews, each participant clarified what health information was important to them. For some, it was allergy information (Participant 2, 6, 10), for others it was air quality information pertaining to asthma (Participant 19). A second characteristic of the Inquirers that has surfaced in prior literature was that weather information

can assist individuals socially. In Britain, Harley (2003) found that people actively chose to discuss the weather with others to strengthen their mental facilities, but that the weather was also associated with nostalgic memory. The Inquirers are similar, wanting to know weather information to feel comfortable making small talk with others, as well as wanting to feel smarter. Together, this study and Harley's study (2003) show that the active usage of weather apps helps fulfill individual needs based on the priority of those needs (Katz et al., 1973).

Characteristics

Along with motivations, several characteristic commonalities surfaced between the three groups. One such commonality demonstrated was that each factor ranked Statement 26 ("I like using features on a weather app where I can see just a couple hours ahead to plan for changes") close to, or within the ± 1.0 range. Here, it is evident that MWA users tend to be individuals who plan ahead, as well as individuals who welcome frequent updates to obtain accurate information. In Phan et al.'s (2018) study, it was revealed that university students were highly dependent upon weather app features for planning ahead – whether for activities or for simply knowing what to wear. The current study revealed that first, among all ages, the hour-by-hour information on the weather app and its ability to update any incoming changes is valuable for weather app users, giving insight into personality characteristics of the demographics who are using MWAs. However, by seeing how each group ranked this statement in comparison with other characteristics in their factors, more context is provided to Phan et al.'s (2018) research. Factor 2 appreciates practical updates, while Factor 1 and 3 want detailed updates to satisfy either their recreational habits or their health/social concerns, respectively.

While the factors discussed were, in many ways, similar to each other, the factors were also uniquely different in their characteristics. For instance, age was a varying demographic

among the segmented publics. Each participant in the Fair Sky Forecasters factor was younger than the average age of participants (34), while each Reasonable Rainiac participant was older than the average age. The Q sort method analysis does not analyze correlations of ages or gender, but it does provide the groupings to compare with overall demographics. With the Fair Sky Forecasters being younger, it suggests that weather is closely tied to the hobbies that younger MWA users appreciate. In contrast, the Reasonable Rainiacs have more weather experience in their lifetime, and find MWAs to be a more practical way to engage with weather communication than other methods they have tested previously. The Inclement Inquirers were a combination of all ages, which may imply that health and social concerns are important to resolve with MWAs among several demographics.

Perhaps one of the most surprising results of this study was that none of the factors indicated a tendency to create parasocial relationships with weather apps. Rather, the MWAs users were more likely to use the app to facilitate connection. This new finding signals a potential shift in the placement of trust that users afford to human weather communicators versus digital weather communicators. Previous literature has consistently suggested that human weathercasters are a unique source of trust and connection for weather-seekers (Brann & Himes, 2010; Drobot, 2007; Mitchem, 2003; Paul et al., 2003; Zhang et al., 2007), but this study submits that MWAs are not providing untrustworthy direct human connection, just *facilitating* trustworthy connection. Several statements in the Q sample were designed to evaluate PSRs, trust, and connection – specifically Statements 1, 2, 3, 5, 6, 7, and 16 (see Appendix B). Statements 2 – “I feel like my weather app is my friend,” and Statement 3 – “Getting notifications from a weather app is even better than getting a text from my significant other” focused on PSRs, while the others evaluated how MWAs helped individuals connect with family

members, find topics for small talk, and feel nostalgic towards certain places. Statement 2 was extracted from prior literature regarding PSRs with broadcasters (Schiappa et al., 2007; Sherman-Morris, 2005; Sherman-Morris, 2010; Sherman-Morris et al., 2020), and Statement 3 was a direct quote from a Weather Channel app reviewer. Typically, PSRs with weathercasters are very strong, and the weathercaster will be the number source of weather information for many people in crisis (Sherman-Morris, 2005; Sherman-Morris, 2010; Sherman-Morris et al., 2020). However, none of the factors felt even a connection or attachment to the weather app (Participant 3). Although the research had no expectations for potential PSRs with the weather app, the collection of concourse statements indicated that individuals did sometimes create a PSR with an inanimate entity such as an app. Still, during interviews, several participants indicated that in the event of a severe weather crisis in their area, they wanted someone to “tell [them] what [they] needed to do” (Participant 8). In essence, although the factor analysis revealed no significant relationship with the weather app, some participants did indeed want human connection when a weather crisis arose, confirming the research of Sherman-Morris (2005, 2010). These participants were all over the age of 35. Younger participants said they would instead stick to the weather app or online weather information in a severe weather event. The other statements (1, 5, 6, 7, 16) regarding connection towards family and friends were only ranked in Factors 2 and 3, but were strongly unique to these two factors, indicating that weather app usage fits into the framework of personal choice from U&G Theory.

Personal Choice

Depending on the perception of the weather event, audiences will actively and personally choose where their information comes from (Bryant et al, 2017; Katz et al., 1973; Perreault et al., 2014). The current study strongly supported this stipulation from U&G Theory (Katz et al.,

1973). Factor 1, the Fair Sky Forecasters, chose specific features from weather apps to determine their daily activities. Factor 2, the Reasonable Rainiacs, actively selected apps where the interface was easy to use and practical for the information they wanted. Factor 3, the Inclement Inquirers, supported recent literature where audiences deliberately sought out weather apps that were different from the standard weather default app on mobile phones (Bryant et al., 2-16; Bryant et al., 2017; Phan et al., 2018). Traditional U&G Theory emphasizes personal choice as part of the media selection process (Katz et al., 1973), and according to Katz et al. (1973), audiences are not selecting media on personal whims, but for personal needs. Within each grouping, the factor analysis and interviews, manifested that there are indeed personal, particular needs that shape their active day-to-day MWA usage.

Practical Implications

A number of practical implications are provided from the results of this study. For weather application developers or weather website designers, MWAs can 1) designed with U&G stipulations in mind to better help users gratify their motivations for seeking weather information and 2) precisely address the unique characteristics and needs that emerged from each factor. In particular, study participants placed high value on MWAs containing features that tracked changing weather patterns accurately (Factor 1, Factor 2), MWAs that were easy to use (Factor 2), and MWAs that answered questions, or anxieties about everyday life (Factor 3). In other words, accurate updates, ease of use, convenience, and detailed information were identified as advantages of using a weather app by study participants. Apps need to now employ features that attract all the factors, or create apps targeted to each factor. Some disadvantages to using weather apps based on the factor analysis were related to location tracking (Factor 1) and accuracy (Factor 2, Factor 3). However, interviews with participants revealed more disadvantages to using

MWAs – namely, the loss of direction during times of severe weather. Any subject who was over the average age of participants (34) claimed that they needed more direction, or guidance from a human communicator when severe watches/warnings arose in their area. Thus, adding in a human element to an app, such as a quick message from a local weathercaster, may resolve this concern. This idea would be easier for local news station apps to implement, but may be even more beneficial to implement in the widely known and commonly-used apps discussed in this study.

Current study results are also applicable to broadcast meteorologists or social media meteorologists. Within a live forecast, meteorologists can include graphics that specifically address the needs and concerns of the factors. Graphics about daily temperatures and what to wear are already commonly used among weathercasters, but all with different effects (Ash et al., 2014; Ding & Millet, 2020; Klockow-McClain et al., 2020; Millet et al., 2020; Sutton & Fischer, 2021). Hence, knowing both the effect of the graphic and to which factor it is gratifying would hopefully increase overall viewership and returns to that station. Though U.S. meteorologists are often the “target of innumerable jokes about their accuracy – or presumed lack of it – they have also saved thousands of lives” (Henson, 2010, p. 1). Continuing to connect with the public through MWAs or targeted live forecasts may help budding generations mitigate unexpected weather crises and save lives.

Limitations and Future Research

Although the participants in this study were diverse in age, gender, and geographic location, the participants were not racially diverse. All participants, with the exception of two, were Caucasian. To understand even more nuances among weather app users and their personalities, future research should focus on identifying the perspectives of a more

representative sample, which may provide even more information on the types of personalities and individuals who purposefully seek out weather information. Additionally, it would be interesting to conduct Q sorts among specific age groups of weather app users. This study took a general approach, hoping to find patterns across all ages, with people acting as the variable (Brown, 1993; Herrington & Coogan, 2011). The interviews revealed that age was often the determinant of where the participants would go when they needed severe weather information. Therefore, conducting Q sorts with certain age groups may reveal where changes occur from using MWAs, as well as reveal when weather apps may be the only source of severe weather information needed.

In conclusion, an array of studies have demonstrated that individuals who seek weather information are dependent upon personal needs, perceptions of weather events, and factors such as age and gender when selecting the mode of communication. However, these studies have often failed to succinctly describe the types of individuals who use weather apps and their underlying personality characteristics. This study presents new findings for the world of weather communication, identifying three distinct groups of individuals who are either focused on staying up-to-date with the weather (the Fair Sky Forecasters), are practical, yet intrigued by the weather (the Reasonable Rainiacs), or who use detailed weather information to combat social or personal concerns (the Inclement Inquirers). By providing names and details of each group, this study contributes to the growing interest in the changing future of weather news. Even as the mode of receiving weather communication continues to adapt, the findings of this study can guide both public and private sector weather communicators, including app developers, to create and present forecasts that satisfy each type of weather-seeking individual.

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Appendix A

Interview Guide

RQ1: What types of individuals, and their personality characteristics, use mobile weather applications?

RQ2: What kind of motivations do individuals have for using mobile weather applications?

1. Why did you agree with those two statements the most?
2. Why did you disagree with those two statements the most?
3. What specific app or apps are you currently using?
4. What has been your experience with your preferred weather app?
5. How reliable or accurate would you consider your weather app to be?
6. If an emergency weather event was headed your way, would you still use the app as your main source of information? If not, where else would you go?
7. How would you describe the impact that a weather app has on your everyday life?
8. When considering your personality, do you feel like your personality impacts the way you perceive the weather?
9. Is there a belief, attitude, or opinion you have that you would add to these statements?

Appendix B

Q Statements and Sourcing Information

PSRs/Social Connectedness:

1. *I check my weather app so I know what to make small talk about* (Accuweather: Weather Alerts App Review, 2021; Social Media Comment, 2021).
2. *I feel like my weather app is my best friend* (Dark Sky Weather App Review, 2019; Greenfield, The Atlantic, 2012; The Weather Channel App Review, 2020).
3. *Getting notifications from the weather app is even better than getting a text from my significant other* (Sherman-Morris, 2005; Sherman-Morris, 2010; Sherman-Morris et al., 2020; The Weather Channel App Review, 2020).
4. *After I delete social media apps on my phone, I click on my weather app a lot because I just need something to scroll through* (Social Media Comment, 2021; Whiting & Williams, 2013; Pelletier, 2020).

Emotion/Comfort:

5. *I check the weather because it gives me a sense of control over my day* (Greenfield, The Atlantic, 2012; Social Media Comment, 2021).
6. *Checking a weather app isn't a big part of my daily routine* (Bryant et al., 2016; Statista, 2021).
7. *I find myself checking the weather of places I miss or want to travel to – it makes me a little sad* (Harley, 2006; Social Media Comment, 2021).

Educational:

8. *I feel smarter when I check my weather app* (Dark Sky Weather App Review, 2019; Accuweather: Weather Alerts App Review, 2020; The Weather Channel App Review, 2020).
9. *I consider myself a nerd – I just find the weather interesting* (Accuweather: Weather Alerts App Review, 2020; Dark Sky Weather App Review, 2019; Greenfield, The Atlantic, 2012; Social Media Comment, 2021).
10. *I'm really into astronomy so I use a weather app to keep track of the moon phases or stars* (Accuweather: Weather Alerts App Review, 2020; Social Media Comment, 2021).
11. *I use weather apps because I'm concerned about health issues, like allergies if I don't regularly check mold, pollen, etc.* (Accuweather: Weather Alerts App Review, 2020; Social Media Comment, 2021; The Weather Channel App Review, 2020).
12. *I'm concerned about climate change, so I check the weather to keep tabs on that issue* (Lang, 2014; Okeke, 2019).
13. *If I don't check the weather of the native places where I have plants from, I can't keep my plants alive* (Social Media Comment, 2021).

Location:

14. *I'm fine with my location constantly being tracked if it means I get accurate weather information on my weather app* (Accuweather: Weather Alerts App Review, 2020; The Weather Channel App Review, 2020; WeatherBug – Weather Forecast App Review, 2019).
15. *I check the weather app because I want to know the sunrise/sunset times for my specific location* (Dark Sky Weather App Review, 2020; Social Media Comment, 2021; The Weather Channel App Review, 2020).
16. *I often check the weather for other areas where my family members live* (Social Media Comment, 2021; The Weather Channel App Review, 2020).

Purists:

17. *I don't want to pay extra to look up information about the weather* (Accuweather: Weather Alerts App Review, 2021; Social Media Comment, 2021; The Weather Channel App Review, 2020; WeatherBug – Weather Forecast App Review, 2019).
18. *I just want to see a forecast and temperatures – I don't need any other add-ons* (Social Media Comment, 2021; The Weather Channel App Review, 2020).
19. *I believe weather apps should have a minimum standard of accuracy, otherwise, they're useless* (Accuweather: Weather Alerts App Review, 2020; Fleming, The Guardian, 2018; Social Media Comment, 2021; The Weather Channel App Review, 2020).

Severe Weather:

20. *I want to be able to get details from my weather app about the chances, precise location, and timing of severe storms* (Accuweather: Weather Alerts App Review, 2022; Dark Sky Weather App Review, 2019; Eachus & Keim, 2019; Phan et al., 2018; Social Media Comment, 2021; The Weather Channel App Review, 2020; WeatherBug – Weather Forecast App Review, 2019).
21. *I don't really use my weather app for emergency weather alerts* (Eachus & Keim, 2019; Social Media Comment, 2021; The Weather Channel App Review, 2020).

Planning:

22. *I use my weather app to know what to pack for a vacation* (Accuweather: Weather Alerts App Review, 2021; Hamilton & Lau, 2006; Social Media Comment, 2021).
23. *I don't feel like weather apps help me know what to do about commuting or driving around in bad weather* (Accuweather: Weather Alerts App Review, 2020; Social Media Comment, 2021; Wu & Liao, 2020).
24. *My job revolves around me checking the weather and making decisions about what to do because of the weather* (Accuweather: Weather Alerts App Review, 2020; Social Media Comment, 2021; The Weather Channel App Review, 2020).

25. *Weather app information doesn't really affect what I want to eat or cook for the day* (Harley, 2006; Social Media Comment, 2021).
26. *I like using features on a weather app where I can see just a couple hours ahead to plan for changes* (Accuweather: Weather Alerts App Review, 2021; Phan et al., 2018; WeatherBug – Weather Forecast App Review, 2020).
27. *I check a weather app because I want to know what to wear* (Greenfield, The Guardian, 2018; Social Media Comment, 2021).
28. *I like outdoor activities (exercising, hunting, fishing, skiing, snowmobiling, hiking, etc.), so I check lots of things on the app that might affect those activities* (Accuweather: Weather Alerts App Review, 2021; NOAA Weather App Review, 2020; Social Media Comment, 2021).

Practicality:

29. *The most important reason I check a weather app is for the daily temperatures* (Eachus & Keim, 2019; Social Media Comment, 2021).
30. *I feel like the weather app is a godsend for everyday life* (Social Media Comment, 2021; WeatherBug – Weather Forecast App Review, 2020).
31. *The weather app I use is based on how easy it is to use* (Accuweather: Weather Alerts App Review, 2021; Dark Sky Weather App Review, 2019; Phan et al., 2018; The Weather Channel App Review, 2021; WeatherBug – Weather Forecast App Review, 2019).
32. *I don't go out of my way to download a new weather app, I just use my phone's default app* (Bryant et al., 2016; Phan et al., 2018).
33. *I will get rid of weather apps that keep updating all the time* (Accuweather: Weather Alerts App Review, 2020; Social Media Comment, 2021; The Weather Channel App Review, 2020; WeatherBug – Weather Forecast App Review, 2019).
34. *Weather apps are just so much more convenient for me to get weather information, I don't want to watch TV* (Eachus & Keim, 2019; Social Media Comment, 2021; The Weather Channel App Review, 2020; Wolf & Schnauber, 2014).

Entertainment:

35. *I feel like weather apps exaggerate stuff because they think it's entertaining* (Accuweather: Weather Alerts App Review, 2021; Fleming, The Guardian, 2018).
36. *I get a kick out of seeing if the weather app accurately forecasts the weather or not* (Greenfield, The Atlantic, 2012; Social Media Comment, 2021; The Weather Channel App Review, 2020).

Visual:

37. *I use weather apps because I need to visualize the weather, I'm not a graphs or numbers person* (Accuweather: Weather Alerts App Review, 2020; Ash et al., 2014; Fleming, The Guardian, 2018).
38. *It's all about the font and the colors for me - if I don't like it, I'll find another weather app* (Accuweather: Weather Alerts App Review, 2020; Phan et al., 2018; WeatherBug – Weather Forecast App Review, 2020).