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Giving Attention: Reflections on Severe Weather Warnings and Alerts on Mobile Devices

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Smartphones are an increasingly important channel through which to issue weather alerts and warnings. Yet it is important to consider the nature of these devices and the implications for alerts and warnings. Alerts have traditionally been designed to get the attention of recipients while warnings provide the information needed to decide if it is necessary to take protective action. Smartphones are distinct from traditional channels in that they do both. They can be incredibly effective at delivering alerts and are also able to deliver multiple streams of warning information simultaneously to a single person. Our work suggests that this reality can result in information flow fatigue if these message systems are not properly designed. In a process which we describe as setting up jigs, smartphone users report the importance of restricting or prioritizing information using their phone settings or even turning off notifications or shutting down their phones at specific times and places. Our analysis of focus group discussions concludes that storm alerts and warnings delivered through smartphones must prioritize personalized settings and messages that help recipients filter the information they want to give their attention to rather than designing them to forcibly get people's attention.

Key words: attention, weather warnings, smartphones, jigs

Introduction

Disaster scientists and emergency managers have long debated how best to deliver warnings for hazardous events. They are concerned with a number of dimensions of

warning messages, including how to reach the most people, what channels to use to send warning messages, and often how to word the content (Mayhorn and McLaughlin 2014; Mileti 1975; Sorensen 2000). For most, the primary concern is how to motivate people to take protective actions. Steady innovations in communication technologies, combined with scientific advances in weather forecasting accuracy, make possible the delivery of more accurate and timely information and allow for improved severe weather alerts and warning (Sorensen 2000). Two thirds of the U.S. population now receives a variety of news, information and entertainment through their smartphones (Rainie and Zickuhr 2015), including alerts for urgent action and warnings related to severe weather. While the prevalence of smartphone use would seem to make them a natural medium through which to issue severe weather warnings, questions remain about the warning system design that will best capture the attention of those receiving information via smartphones and what warning information will help them make their decisions (Tarasewich, Nickerson, and Warkentin 2002).

The potential that smartphones represent for improved disaster alerts and warnings is widely recognized (Leggiere 2011; Lindsay 2011; Sullivan and Häkkinen 2006) and there is a growing body of literature on smartphone based disaster messages. The U.S. government use of wireless emergency alerts (WEA) – text-based messages with a 90-character limit meant to prompt recipients to seek more information – has spurred studies that have explored optimal length and content of alert messages. Bean and colleagues (2015) found that messages longer than 90 characters are more effective than shorter ones. Other studies have found that including maps in mobile phone alerts adds a higher degree of personalization, which recipients seem to value (Bean et al. 2015; Casteel and Downing 2015), but were inconclusive as to whether personalization makes a message more effective in spurring protective action (Wood et al. 2014). Some research around mobile phone technology focuses on the role of social media in disasters rather than official warning delivery (Hughes, Palen, and Peterson 2014). Hayden et al. (2007) found that people have varied channel preferences for receiving warnings. Younger people showed a preference for mobile phones over more traditional disaster warning channels, and concluded that warnings should be tailored to prevalent demographics in neighborhoods. Mobile phones were found to have been used successfully to alert users to coming disasters, most notably in Japan, where the three major cell phone companies offer a warning distribution option free of charge to their subscribers (Doi 2011; Yamasaki 2012). In the 2011 earthquake in Japan, the Japanese warning system detected the initial P-waves and delivered a standard warning to thousands of cell phone users in the seconds before the earthquake's more destructive S-waves arrived.

In contrast to investigations that explore the potential of mobile technology or how social media can best be utilized, we ask whether mobile phone technology may cause changes in the way information is received and managed by smartphone users that might impact current approaches to rapid onset disaster alerts and warnings. Using information from focus group discussions carried out in 2014 in the tornado-prone Dallas/Fort Worth area, we explore how smartphone users discussed mobile phone warning preferences and examine some implications of issuing storm warnings through

smartphones. In particular, we focus on the function of smartphone based weather alerts to break into people's everyday lives and capture their attention. In this way they tend to function like sirens that are mostly intended to get the attention of their recipients. But unlike publicly owned and managed sirens, smartphones are both more intrusive, meaning that they succeed more often in getting people to look, and are also more susceptible to individual user preferences. In other words, users can more easily choose to give, or not to give, attention to incoming notifications than those who receive more traditional alarms. Users also have a greater control over them in terms of tone, or vibration, visual display, or even to turn them off altogether or delete an application and never be "bothered" again.

Our research, grounded in Lindell and Perry's (2012) Protective Action Decision Model (PADM), proposes two important characteristics that may influence how storm warnings delivered through smartphones might be distinguished from more traditional channels: 1) human capacity for attention is more limited than a smartphone's ability to deliver information; 2) as has been suggested by prior research perception of weather that is mediated – in this case awareness of weather comes through the smartphone as a specific channel of information delivery – is different than direct interaction with environmental cues. Based on our data, we argue that severe weather notifications delivered through smartphones should be designed in ways that recognize that recipients must actively choose to *give* attention when notices come to them via mobile devices, in contrast to more traditional methods which use techniques such as sirens or program interruptions mostly designed to *get* the attention of their target audience. The notion of warning systems focused on how users give attention marks a subtle but critical difference in emphasis, one that fundamentally adjusts the current balance between user preferences and sender preferences. The implications of conceiving and designing notifications of severe storms with this notion in mind are many.

Attention

The study of attention has multiple currents that have not been unified into a single theoretical framework (Sheridan 2006), but which must be brought together for a more complete understanding. In his classic definition, William James (1890) wrote that attention is "taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought….[which implies the] withdrawal from some things in order to deal effectively with others…." (p. 403-404). Throughout the course of a day people sort through many incoming stimuli and give their attention to a wide variety of signals, although most are unable to focus their attention on more than one thing at time (Lee 2006).

The concept of attention is a way of describing the decision-making process that results in ignoring some stimuli in order to focus on another, often to improve knowledge or reduce uncertainty. It is often argued that this process leads to adaptive behaviors needed for new environmental conditions (Moray 2006). But which stimulus captures the focus of any given person is the result of a confluence of personal interest, emotional state, and their social group's judgment of importance. Past experience, loud

noises or hearing one's name called will elicit different reactions in different people. In an environment where celebratory fireworks have been going off for hours, another loud pop is unlikely to cause people to give their attention to its cause. Considering that most environments hold many potential attention-capturing stimuli, inability to pay attention to more than one stimulus at a time is an important limitation (Awh, Belopolsky, and Theeuwes 2012). Those hoping to attract others' attention need to consider it a scarce resource that people allocate among competing demands (Crawford 2015; Green 2013).

Many studies that attempt to understand how the attention process works have looked at the senses' reactions to environmental stimuli, focusing mainly on visual and auditory cues that capture a person's attention (Neo and Chua 2006). While abrupt stimuli are likely to catch people's attention, research has shown that it is also possible for people to ignore them, particularly if they are actively concentrating on a separate stream of stimuli (Folk, Leber, and Egeth 2002), suggesting that focusing attention is not an exclusively involuntary activity. Rather, depending on a person's perceived needs for particular kinds of information, both voluntary, conscious decisions and involuntary, unconscious processes can determine if attention is captured (Sheridan 2006). Emotionally charged stimuli normally cause people to involuntarily redirect attention. A person may be concentrating on a task, but upon hearing their name, seeing an angry face or hearing a fear-inducing clap of thunder will immediately change focus to the thing that raises their emotional level (Lee 2006). How attention is allocated has also been characterized as a process of bottom-up or top-down attentional control where bottom-up is determined by physical salience and top down by present needs, although past experience also appears to play a significant role in determining which items are worth diverting attention to (Awh et al. 2012). Crawford (2015) asserts that

> how we act is not determined in an isolated moment of choice; it is powerfully ordered by how we perceive the situation, how we are attuned to it, and this is very much a function of our previous history of shaping ourselves to the world in a particular way (p. 75).

The role of past experiences has also been shown in disaster literature; people are more likely to pay attention to storm warnings if they have had one or more previous disaster experiences (Anderson 1969; Perry and Lindell 1986).

From one perspective attention can be viewed as an intensely private thing that determines one's personal sense of reality (Crawford 2015). Attention grabbing events such as television commercials or storm warnings that come across the TV screen with an elevated volume are direct attempts to influence how people perceive the world around them. People will exercise their ability to pay attention selectively by noticing one particular aspect of their environment (Swets and Kristofferson 1970). Within themselves people decide how they will respond to such advances on their consciousness.

On the other hand, there is a significant social element to attention. In certain settings, a classical music concert, for example, a person needs to overcome social norms in order to turn attention from the orchestra in favor of giving it to their phone. In other situations, how one allocates attention may carry risk. Giving attention to a smartphone while driving a car has potential for devastating consequences for other drivers or pedestrians. Strayer and Drews (2006) found that drivers speaking on mobile phones had driving patterns much like driving while under the influence of alcohol. Similarly, a person who chooses not to heed disaster warnings may not only suffer personal injury, but lack of action could potentially result in harm to others in the person's social network, as well as cause additional work for emergency managers and first responders. If individuals appropriately direct their attention to disaster warnings there is great potential for preventing harm; this has long spurred disaster scientists to study the decision-making process and the role of attention allocation in that process.

The Protective Action Decision Model and Smartphones

Lindell and Perry's (2012) PADM gives a widely accepted theoretical framework for understanding how people make decisions when facing an impending storm and lends theoretical grounding to our work with smartphones and alerts and warnings. The model outlines a number of factors that feed into protective action decisions. Our concerns, attention and smartphones, revolve primarily around the pre-decision conditions indicated in the model. Although "it is still not entirely clear what motivates people to take protective action" (Lindell and Perry 2012:625) it is known that before decisions are made people get signals about oncoming hazards from a variety of sources which influence their ultimate sheltering actions. The PADM highlights receiver characteristics, environmental and social cues as sources of incoming information that feed into three pre-decisional elements, exposure, attention and comprehension. As data gathered from focus groups will show, personal characteristics, which feed into the pre-decision processes and which ultimately influence the actions that a warning recipient takes, may play a different role in time when warnings are expected to arrive on a smartphone. Lindell and Perry (2012) observe that "whether or not people heed the available information is determined by their expectations, competing attention demands, and the intrusiveness of the information" (p. 619).

Those issuing storm warnings have used a variety of methods to get the attention of their target groups and motivate them to direct their attention to the severe weather that may be coming. Once alerts or warnings from a variety of traditional weather information sources, such as television, radio, an audible siren, or even the morning newspaper's weather forecast succeed in getting their audience to pay attention, people tend to watch the weather around them, as well as see what others are doing, as they make their own decisions. Similarly, today's smartphone users may turn their attention to the weather outside because of a notification from their weather app. Once they start to pay attention to the upcoming storm, whether they decide to take protective action depends on incoming cues, as well as individual characteristics and their view of risk;

some people have a lower threshold for action than others. Regardless of individual characteristics and the information channels used, disaster research suggests that faulty decisions usually are the result of faulty information (Lindell and Perry 2012). Getting the correct information into the awareness of people who might be in the way of a hazardous storm is key in the ability to deliver warnings.

Smartphones have great potential to deliver up-to-the-minute information to their owners, but personal attributes will likely manifest themselves long before a disaster decisional process begins – starting when potential warning recipients choose the settings on their phone and decide how and how much they want to give attention to their phones. Depending on their personal predilections, smartphone owners can set their notifications preferences to vibrate, or use audible notification, or only show warnings when the phone user opens the correct app. The social context of potential warning recipients will also play a role. In some settings it is acceptable for people to check their phones frequently, while in others, looking at one's phone may be frowned upon. Given the variables that affect how people use their phones, if a smartphone is the primary device through which to receive weather alerts, those delivering weather messages should take note of how phone users allocate their attention among the many sources attempting to capture that interest.

Ironically, in an age when it is possible to funnel many sources of information through the single channel of a smartphone without interaction with the external environment it may be more complicated than ever to issue storm alerts and warnings. To illustrate the point, one of the authors of this paper recounted his morning routine. He wakes to an alarm set on his phone the evening before. Upon turning off the alarm he looks at the weather app, glances through both local and national morning headlines on a news app, and taps the email icon to see what emails may have come overnight that may affect the day's activities. He may check up on his social groups by taking a quick look at Facebook or Twitter and finally opens the NPR app to stream the morning news audibly while he showers and dresses. He makes basic decisions about appropriate attire based on the day's temperature and precipitation, decides whether the roads are safe for driving, begins to formulate the day's agenda and is up to date with news events in the first few minutes of the day without ever having any direct interaction with the outside world, sometimes even before throwing back the blankets and getting out of bed.

The smartphone functions as a primary mediator between many phone users and the world outside, funnelling information to the phone's user that prior to the advent of smartphones would have required interacting with multiple aspects of the physical environment: to get the same information as the phone made possible in the list above people would need to bring in the morning newspaper, turn on the TV, look out the window to see if it's sunny or rainy and check the thermometer hanging on a tree close to the house to decide how to dress for the day. To remind themselves of the day's activities they would need to pull their agendas out of their office bags and open it to today's date. Only when they were in their cars and on the road would they know for sure about traffic conditions on their daily commute.

All that information and more can be found in a few minutes on a smartphone and with little actual interaction with the external environment or physical activity, aside from a few thumb clicks. A device that is capable of delivering so much information about the outside world would seem the logical channel through which to deliver storm information. However, if a warning needs to compete with all other incoming information to gain the attention of the intended recipient there are likely implications for how warnings are conceived and delivered. Smartphone owners may need help sorting through incoming information in order to be certain that they are directing their attention to where it is most needed.

Risk communication models call for disaster warnings to get people's attention soon enough to allow them to take protective action if necessary, a concept that puts the onus of capturing the attention of the intended recipient on the warning system. Competing with other stimuli for the attention of people in the way of a storm is not new; risk communication has always had to compete with other types of information that for one reason or another may be more interesting than a storm warning (Tierney 1993). Smartphone users' access to so much information coming through a single channel appears to intensify the competition, as well as alter the way in which phone users allocate their attention.

Before the advent of computers, the internet, and smartphones, the inability to simultaneously focus on multiple stimuli coincided with available technology – people needed to choose to pay attention to one of a variety of different channels such as radio, television, or phone calls. Since information flowed in single streams through a variety of devices and one had to choose which device to turn on, focusing on one stimulus at a time seemed logical. In contrast, the multiple lines of data that stream continuously into smartphones give their owners simultaneous access to many different kinds of information. Human capacity to focus on only one stimulus at a time has not changed (Lee 2006), however. At any given time smartphone users need to continually make decisions about which information stream they will heed, while ignoring others. This continuous decision-making process became evident in the conversations of the focus groups summarized below. As the research team examined the transcripts of focus groups held to explore the intersection of weather, warnings and smartphones, they found group members talking of their experience with their smartphones in ways which pointed toward larger implications for how alerts and warnings are issued.

Methodology

Researchers collected data for this project in six focus groups conducted over a three day period in northern Texas, one of the areas in the midwestern United States considered to be particularly vulnerable to tornadoes and other storms (Wurman et al. 2007) making it an apt location to study perceptions of severe weather. Participants confirmed the area's susceptibility for severe weather by recounting many experiences with tornadoes and flash floods over the course of the interviews. Focus group discussions were held both in urban areas and in a more rural community.

Focus groups are commonly used to carry out "exploratory investigations into emerging areas of interest, research intended to generate new ideas or question" (Berg and Lune 2012:164). Research presented in this article is a preliminary qualitative study segment of a larger multidisciplinary investigation funded by the National Science Foundation designed to develop improved warning systems for rapid onset hazards with a specific focus on improving tornado and flash flood warnings. As often happens when researchers prod people to explore aspects important to them in a semi-open way new concepts emerged. Qualitative research carried out in focus groups is adept at bringing to the surface the complex ways in which people perceive their day to day reality (Denzin and Lincoln 2011). Focus groups offer potential for a variety of findings as they take advantage of the social interactions that occur among their participants, even though they are not naturally occurring social engagements (Warren and Karner 2009). In spite of their artificial character they allow different perspectives to surface as participants respond to each other during the conversation. In this case, guided by a three-person research team using a semi-structured discussion format, people reflected on their individual perceptions of their smartphone use, as well as how they responded to severe weather events. The diversity of opinion and the interactions among group members gave researchers the opportunity to observe the rich and complex meanings that people give to their reality as each person experiences it (Kamberelis and Dimitriadis 2011).

Focus group participants were recruited through a mix of calling random telephone numbers, using contacts in the area and through Facebook pages of members of the North Central Texas Council of Governments. A sample group of 29 smartphone users responded to recruiting efforts by volunteering to participate in the focus groups. They were primarily white (86%) with approximately one third of the sample group reporting annual family incomes of more than $100,000. One third had studied in college or had associate's or bachelor's degrees. Fifty-five percent were male and 45% were female. The group skewed young in age, although there was good representation from all age groups. Almost a third of the participants (9) were between the ages of 34 and 44. Eight (27%) were between the ages of 45 and 65, while 12 (41%) were under 34.

All focus group conversations were audio recorded and transcribed and the research team then coded the data using both inductive and deductive coding methods. Although the conversation guide used with the groups was designed to probe spatial and temporal aspects of smartphones and storm perceptions in order to design more in-depth research in the future, when the research team pored over the transcripts inductively, they found not only comments on how participants perceived places and times in relation to storms, they also detected group members describing how they directed their attention to their smartphones in ways that seemed distinct from conventional disaster warning literature concepts of attention. This led to further explorations of the meaning of attention, its interaction with smartphones and how it is applied to disaster warnings. The summary of findings on attention presented below reflects the richness of personal experiences and perceptions which allowed the research team to discover unanticipated themes. As such themes emerged, we employed alternative searches to look explicitly for evidence

that contradicted emerging patterns. We also have been careful to illustrate the variation in respondents' views where such variation existed.

Findings

My phone is always on

Many participants in this set of six focus groups responded with energy when they were asked how they used their smartphones. Most people in the groups felt they were using their phones a great deal and for a variety of purposes. Their smartphones functioned as a window to the world beyond their immediate area of perception. Many seemed self-conscious about how much they depended on their phones. Group participants were likely to give an uncomfortable laugh when asked how much they used their phones, followed by describing their phones as a device that they kept in their possession at all times, a constant part of themselves. Some people talked about using their phones more when they were at home, some said they used them more outside of their homes. Most checked their phones often for new notifications, although participants defined "often" differently, ranging from every five minutes to every half hour. Many described checking for new notifications regularly whether or not they had detected a signal of incoming information. There often was at least one person in every group that referred to their phone more neutrally and felt that they did not check it so regularly – one person had turned the mobile phone on silent and discovered two days later that it was still on silent. But the majority talked about their phones in more emotionally charged language, describing their mobile devices as body parts, an addiction, a security blanket.

"My phone is an appendage."

"Mine is always attached."

"I almost feel panicked if I don't have my phone."

"Whether I need it or not, I bring it with me – security."

The initial laughter when discussing how much people used their phones suggested some unease with how much attention they perceived themselves giving to their phones. Occasionally someone would make an overt comment expressing discomfort with their phone use.

> "I've noticed personally that I am way more active on my phone this past six months at home than I ever have been. I'm like, I have an issue that I need to stop doing this. [laughter]. I just had this conversation with somebody this week."

Facilitator: “How frequently do you look [at your phone]?

Participant One: “Way too much.”

Participant Two: “Always.”

If the phone is perceived as a bodily extension, it is not surprising that many people said their phones are always on.

> “Mine is on all the time. I talk to people all day. Games, everything.”

> “Like she said, the battery’s usually dead at the end of the day [laughter in the group]. Outside of that particular circumstance, I’ve got the phone on.”

> “I’m on it constantly just whether I’m sitting around surfing the web, Instagram, social anything online. It’s a constant.”

> “I don’t ever turn my phone off or on silent.”

> “Mine is always on vibrate, and depending on the time of day, I have it where it has sound and no sound, but it always has vibrate.”

The bulk of these conversations were centered on weather and weather warnings and most discussion themes revolved around some aspect of participants’ experiences of weather. Yet the conversations revealed that participants used their smartphones for much more than weather forecasts. They were used for things such as a navigating device, a shopping aid, to negotiate social encounters, to play music, or even as an antidote to boredom.

> “Yes, I do [a] grocery list and I have different coupon apps that I’m keeping up with and [a] calculator, and you know we’re on a budget, so I keep a very tight eye on what we’re doing. So [my phone is] pretty much in my hand or right beside me the whole time we’re in the grocery store.”

> “I always have my phone on me and if I ever find myself bored or anything like that, I’m on it.”

> “I get a lot of twitter alerts.”

> “I’m already doing enough in the car – checking Facebook, tweeting, texting and talking on the phone, listening to music, everything else…”

"My phone is my main source of information for anything."

Funneling multiple streams of information through a single device means that the device may demand more attention than many people want to give it. While people perceived that they had their phones with them and turned on at all times, many also acknowledged that there are times and places when they do not wish to be interrupted by the buzzing of their phones. One person regularly spent time in a dance studio where he did not want to be disturbed by phone notifications. Several mentioned outdoor activities such as horseback riding or hiking when they did not have their phones with them. Others said they turn their phones off when they are with friends or are engaged in sporting activities. A teacher said she does not want her phone sending her notifications while she is in the classroom.

A second consequence of the steady streams of information flowing to people through a phone reflected a kind of notification fatigue.

> "People are always being inundated, just bombarded, overloaded with a bunch of information"

> One person suggested that too many messages "dilute" their ability to get the attention of the phone's owner.

> "The more you add to it the more you're diluting it, the more you're risking the credibility, the whole – just, you're tainting it, the validity for it. And people, before you know it, don't even pay mind to it…I don't pay much attention."

Controlling the information flow

Notifications "diluting" themselves by their sheer numbers, a feeling of being overwhelmed by the volume of information available and decisions to turn off the phone for periods of time point to a need to maintain some control over the flow of information. Some focus group participants said they welcomed a weather warning app, but wanted to maintain the option of turning notifications off, conscious of the limitations of their phones and often recalling the intrusiveness which they had experienced in AMBER alerts, the U.S. Department of Justice child abduction alarms sent to smartphones through the WEA program.

> "I would probably want to be able to turn off push [notifications] if my battery is dying or if I'm running low on data that month or something."

Many participants showed a kind of notification fatigue as they described receiving AMBER alerts that had no relevance to them personally; many had turned off those notifications. But most described receiving multiple streams of information and wanted ways to choose the information to give their attention to. Some chose to turn their

phones off at times in order to better focus on other activities. When asked about receiving storm warnings on their phones they wanted to be certain that the alerts applied to them and they would need to give their attention to it.

> "The ideal situation for me would be to have my phone know where I am and be able to set an alert based on exactly where I am."

> "If we're truly talking about an alert situation, then it's going to be stuff that I need to be alerted about...Last thing I need to do is have an additional 'it's kind of raining and it looks dark down south.'"

> "Not to be callous but I could care less about what's going on around….So if I'm at those areas, I guess one thing is I didn't want an alert system that was so far out it didn't really have a direct impact on me."

> "If it was personalized and it was programmed to let me know. Not everybody know, just me…know my route from here to here, what's it look like today."

Not everyone wanted to restrict the information flow. Two participants suggested that they would like to know more, especially if they could choose when to look at it.

> "Sometimes I do want to know even if I have no use for the information. If I could go in and on, like when you're searching property listings…. possibly go in and look at something specific. That would be interesting. I like that idea."

> "It would have to be far [away from me] for me not to care personally."

Much of the personalization that participants found attractive in a weather warning app was the ability to set distance parameters, determining for themselves the area within which they would receive a warning. They stated in various ways that they would want themselves to be at the center of a warning area, no matter where they happened to be located, although they also wanted to set the app to give them notifications of specific places.

> "I'd like my location to be the center and then how close everything radiates out from exactly where I'm at."

> "To me, the best…would be let me set a perimeter around my certain areas to alert me if there's a warning in that area, but also while I'm out of those areas give me the ability to set a three-mile, a five-mile, a 10-mile radius and if I, if there's a warning or something in that area let me know where it is, what it is and I can make my determinations based on that."

Just as most focus group participants stated that they wanted a weather warning app that could sort through incoming information and deliver only what they thought necessary for themselves, they also wanted the ability to decide what kind of information they would receive and how they would receive it. Some people wanted a warning that indicated how far away the storm was in time and some wanted it given to them in distance.

"I'd want distance. Give me a miles warning that down the road there's an issue."

"I feel like 20 minutes maybe would be reasonable."

"I'd want it smaller than [county level]. I'd want to know at least 10 minutes ahead of time."

Another person said that they would like a warning to be given in terms of place names.

"See, I would say the place name because distance and time are both up to the perception of individuals. Twenty-five minutes away to one person might be very serious, but another one it's not."

The group also expressed a variety of opinions about how they wanted to be notified of a weather alert. Some wanted a loud noise similar to an AMBER alert. Many said they would like to vary the kind of alarm they would receive depending on the time of day – at night they would want more advance time notice and a louder warning than in the day – or how far away from them the storm was. Some said they preferred a warning to be made in a map format, others said they wanted a warning to come through a text message.

Researcher: "So what I'm hearing you say is that you would like to have notification that's loud and gets your attention if it's within that circle that you're talking about."

Participant: "Yes."

"If it's like a low probability, just like a notification, just a little pop-up."

"I need a map."

"I would want text notification."

The research team had expected that location tracking would be controversial among focus group participants. But questions about whether they would want a severe

weather warning app to track location seemed to garner a collective shrug. People were accustomed to having phone app companies know their location. The ability for an app to sort through information and deliver only relevant material seemed to trump concerns for privacy.

> "But as far as location, it doesn't matter. They – I'm OK with sharing that information."

> "Really it's so much easier to have those decisions made for you sometimes. Convenience is well above privacy."

On the other hand, sharing their location information with others in their social or family networks who might be concerned about their whereabouts in a storm was more controversial. Many welcomed the possibility of seeing where family members were in the event of a storm. However, some seemed more reluctant to share their own location information with family or friends even as they expressed little concern about an impersonal weather app tracking their location.

If focus group participants were fairly clear that they hoped a weather app would pass along specific information that they knew merited their attention, they were not as uniform in how much information they might want. Since current forecast technology predicts weather in probabilities, researchers asked whether participants preferred more warnings with a lower certainty of the forecast actually happening or fewer warnings with a higher certainty of the forecast event happening as well as a higher probability of missed events. Some wanted the former while some preferred the latter.

> "I feel like if it was just warnings all the time about potential – you become numb to it… So I would be more on the side of the fewer warnings knowing that there are things that could happen in that 25% percentile."

> "It's going to eventually be part of your life, to where you're constantly, you'll see it but you won't pay attention to it. It'll just integrate and turn into a habit, and you'll just like dismiss it rather than look into it."

> "I think that I would prefer fewer…. really be viewed as credible, and to be accurate."

> "I'd rather sift through a bunch of warnings that may get upgraded to a full-fledged storm or tornado than have one just spring up in the middle of nowhere that I didn't know about."

> "I think I view on the side of caution. Rather have more and it not really happen."

> "Me personally I understand if you're wrong 60, 70% of the time or not necessarily wrong but you warned me and nothing too bad happened, I get it. I'm OK with that. You can send me those warnings; I'll be fine with it."

Discussion

Smartphones as Jigs

As prior research on media and audience participation predicted, focus group participants did not consider themselves passive recipients of information but took an active role in deciding which source of information they would give their attention to at any given time. Studies utilizing approaches such as the uses and gratifications perspective have long observed that people directly participate in media information flows (Rubin 2009). The specific way in which focus group participants used their smartphone settings to choose where to give their attention resembled how a woodworking jig lessens the need to make multiple decisions while crafting a product. A jig most often refers to a custom-made tool that guides how craftspeople fashion the materials they are working with. It is commonly used in woodworking to ensure that each piece of cut or shaped wood is exactly the same as the last one. When needing a number of identical pieces, the woodworker measures the first one and positions a guide so that the saw blade will hit the wood at the same place on each piece to be cut. After the first careful measurement and setting up the jig the woodworker no longer needs to carefully think through how to cut each piece (Salaman and Walker 1990). Crawford (2015) points out that the idea of a jig which restricts the movements and measurements needed to make something can be used in other areas, illustrating it first with Kirsh's (1995) study of how a cook arranges kitchen space.

In his study of efficient use of space, Kirsh highlights various ways in which people manipulate space in order to make it easier to manage their tasks, from clustering arrangements of like objects to lining things up in the order in which they will be used. If chefs start their cooking preparation by laying out vegetables needed for their dish in the order in which they will be used, during the actual cooking procedure they do not need to expend time and energy deciding in which order to throw them into the pot. They merely reach for the next vegetable needed, chop and cook. Arranging raw products to be put into a dish functions as a kind of jig taking away the need to stop and consider which food to use while the actual cooking process is taking place.

The settings apps of smartphones also have the capacity to act as a kind of jig, eliminating their owners' need to make decisions about where to direct attention every time they look at their phones. Human ability to give attention is easily outstripped by the capacity of smartphones to deliver facts, figures and friends' feelings concurrently. Like cooks putting their vegetables in a row, each user can direct their phone settings to sort through the torrents of information smartphones make available in order for them to give their immediate attention to information they have deemed a priority in their settings app. Focus group participants seemed to recognize their limitations by their

eagerness to receive personalized notifications of weather threats in certain places and within distances that they had specified. The need to make an immediate decision about whether or not to give attention to an incoming weather alert or warning would be eliminated. They could be confident that the settings of their smartphone had already filtered out information they did not want. The phone app would have managed their limited ability to give attention to multiple incoming streams. But notifications, like any information that comes through a smartphone, differ from direct experience with the real world environment, a reality that raises other questions.

Smartphones as mediators

As convenient as setting up jigs may be, relationships with one's environments that are mediated through a third device do seem to carry a risk: indirect perceptions of the environment gained through a third object alter the first-hand connections with one's surroundings. Students of communication have found that communication carried out through computers has potential to distort perception, both making it more likely in some cases to breach stereotypical boundaries, as well as more likely to reinforce them in others (Postmes, Spears, and Lea 1998). In some intangible way, sitting across from a friend in a coffee shop is a qualitatively different experience than seeing a picture of them posted online or even having a video conversation. Crawford (2015) illustrates this by describing the difference between gauging the speed of a motorcycle by the sound and the feel of wind on the body and the speed of the scenery zooming by or determining one's speed by observing the numbers on the speedometer. He suggests that "overreliance on the speedometer may slacken the bonds between action and perception (p. 58)," and goes on to cite experiments carried out by Boysen et al. (1996) with chimpanzees which show that "when our attention is diverted to symbolic representations, it can have…a loosening effect (Crawford 2015:58-59)" between perceiving and acting. This research cautions that excessive reliance on a third object for information about the outside world may relax the links between a person and the real environment, a disconcerting idea when contemplating increased use of smartphones as channels of weather alerts.

The potential for a loosening effect can be anticipated in focus group participants' readiness to personalize their weather alerts apps in order to apply them specifically to their own needs. While this would appear to increase the ability of weather warnings to capture the attention of smartphone users, it is also easy to imagine that uniquely personalized settings could decrease how much people feel the need to give attention to weather happening outside in real time and space. Weather forecasting is improving; however it is still made in probabilities, meaning that an event with a low probability forecast occasionally will take place and with it the chance that there will not be a notification on the smartphone. Some focus group participants wanted more warnings with lower probabilities; some wanted fewer with higher probabilities. As weather apps allow for more personalization and have increased use in weather alerts and warnings, more research is needed to determine if smartphone users, dependent on their

personalized weather apps to notify them in the case of threatening weather, will be less likely to keep an eye on the weather patterns around them.

Conclusions

Participants of these focus groups may have disagreed on how frequently they would want to receive weather warnings, but all seemed to indicate that weather notifications delivered on their phones would be helpful. In this way the discussions confirmed the potential of smartphones as a channel for delivering weather warnings. As the literature suggests, however (Crawford 2015; Lindell and Perry 2012), there were several indications that utilizing smartphones as a channel for storm alerts may be more complicated than might be expected by the fact that smartphone users carry their phones and have them turned on almost all the time. The underlying tenor of many comments gave a sense of wanting access to all the information the phones could give, but also wanting to control incoming streams to make information they did receive conform to their individual preferences. Smartphone users seemed to realize the limitations of their own attention capacity (Lee 2006). They also described turning off certain notifications or leaving their phones behind for certain activities, often during outdoor recreation such as camping, when it might be argued that phones were most needed for storm warnings.

The desire to limit incoming information streams implies that those issuing severe weather notifications should not assume that weather alerts on smartphones will automatically get the attention of smartphone owners. Instead it seems to call for rethinking how warnings are conceived and issued. Rather than trying to get the attention of people through smartphone notifications, emergency managers may need to design warnings that smartphone users will give their attention to. Focus group participants already were using their settings app as a jig, that is, they were prioritizing information streams that were competing for their attention. If they felt that a notification was of no interest or was not relevant to them they adjusted their settings so they would not receive that alert. If they thought it was important they used their settings so that they could give it attention as soon as they were able.

How they set app preferences and which notifications they gave their attention varied with each person as discussions showed about how a weather warning would be set up. Some wanted themselves located in the center of an area that was defined by a distance. If a storm system came within a defined number of miles they wanted to be notified. Others wanted their area defined by time. They wanted the weather warning to estimate how fast a storm was moving and deliver a warning when it was calculated that the storm would reach them in the number of minutes they had defined as their area of interest. Some wanted a warning only if it applied to them, others wanted to be able to define more than one area so they could be aware of storms that might threaten family members or others. All seemed animated by the possibility of being able to set individualized notification parameters, including both how the notification would be

delivered on their phone, and setting distance parameters whether that might be defined spatially or in time.

Lindell and Perry (2012) include individual characteristics as one factor determining how people respond to warnings. The possibility of the settings app of a phone functioning like a jig enabling smartphone users to sort through competing information streams, allowing only selected notifications to be delivered means that individual characteristics will come into play long before an actual weather alert or warning might be sent. Weather notifications delivered by phone will get the attention of people through a voluntary process that begins when smartphone users set up their alert preferences. As prior research has shown, attention is both voluntary and involuntary (Folk et al. 2002). Subsequent warnings may involuntarily divert the attention of the smartphone owner to a warning, but in a dynamic mix of voluntary and involuntary reactions, smartphone owners in the focus groups appeared to be more ready to give a warning their attention if they were confident that it applied to them in the ways that they had specified. In order to ensure that smartphone users will give attention to weather notifications, weather notification systems will need to take a longer term approach to storm warnings and alerts. They can take advantage of the combination of voluntary and involuntary responses to stimuli by designing smartphone weather apps with the flexibility that allows each notification recipient to set the individualized parameters they prefer on their phone notification system.

Analysis of focus group data left open the question of whether dependence on one device to channel so much incoming information, that is, to mediate between the smartphone user and external reality, may alter one's perceptions of the outside world. Crawford (2015) suggests that depending on instruments rather than direct observation will result in modified overall perception of the external environment. Focus group participants' comments did not seem to contain awareness that perceptions gained through their phones might have different qualities from direct observations. Disaster scientists have shown that warning recipients usually confirm weather information by making direct observations (Quarantelli 1990). As people increase their dependence on weather warning apps and as apps become more refined social scientists will need to continue to explore whether increased comfort with mediated information alters decisions and actions taken or causes people to pay less attention to other environmental signals. In the meantime it would seem advisable to encourage recipients of severe weather notifications to confirm the forecast with actual outdoor weather.

Smartphones are a logical channel for storm warnings. Phones funnel continuous streams of information to their owners who tend to keep their phones turned on and close at all times. However, both the literature reviewed and the focus group conversations recounted above suggest that there may be unique advantages and challenges for weather alerts. Smartphone users in these focus groups were attracted to the wealth of information available at all times, while also reporting often feeling overwhelmed. The contradiction between a smartphone's ability to simultaneously transmit multiple streams of information about the external environment and participants' ability restricted to processing information sequentially means that they needed to decide which piece of information they would give their attention to each

time they used their phone. Consequently, they sometimes self-limited their access to information by using settings apps as jigs which allowed them to give attention to their phones when and where they chose. Designers of severe weather apps should begin to conceptualize weather warning apps as providing information that recipients give their attention to, rather than thinking of smartphone warnings as getting the attention of the phone owner. Effective weather notices will need to find ways to oblige smartphone users to give their attention to the alerts and warnings coming through their phones.

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