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Emotional Responses to Wireless Emergency Alerts for COVID-19 and Predictors of Public Health Compliance

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ABSTRACT

This study explored perceptions and effects of the Wireless Emergency Alert (WEA) system for COVID-19 public health messaging after a message was sent to Pennsylvania residents in November 2020. Survey and interview research were conducted to understand the targeted publics' reactions to this message and factors impacting potential behavior change. Findings showed residents who received the WEA expressed greater feelings of anger and surprise about the COVID-19 threat compared to those who did not. Additionally, for participants who did not receive the WEA message, higher arousals of fear and perceptions of threat severity predicted a higher likelihood that they would have changed their Thanksgiving plans. Interview data suggested positive emotions toward using WEAs for public health crises in general.

KEYWORDS: wireless emergency alerts, COVID-19, public health, emotion, crisis communication

Introduction

The Wireless Emergency Alert (WEA) system became operational in the United States in 2012 as a way for authorized government agencies to send short messages regarding imminent threats to WEA-enabled mobile devices in specific geographic areas (Bean et al., 2016). This system provides an efficient way for government communicators to deliver instructing information (i.e., telling people how to physically protect themselves) to publics during a

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crisis (Coombs, 2007). Typically, WEAs have been sent for imminent crises such as natural disasters (e.g., tsunamis, tornadoes) or child abduction (i.e., Amber Alerts). In 2020, several U.S. states and counties began utilizing WEAs to issue messages related to the COVID-19 pandemic (Bean et al., 2021). For example, the day before the 2020 Thanksgiving holiday, and nearly a year since the COVID-19 pandemic was first reported in the United States, the Pennsylvania Emergency Management Agency (PEMA) sent out the following message to all WEA-enabled phones in the state:

> In PA, COVID-19 rates are rising & hospitals could soon be at capacity. Stay home if possible. If you must go out, maintain social distance, wear a mask, wash your hands for 20 seconds. Stay up to date on the spread of COVID in your community so you can protect your loved ones with the COVID Alert PA app.

Using the real-world context of this COVID-19-related WEA message sent at the state level in Pennsylvania, this study utilized both survey research ($N = 212$) and interviews ($N = 19$) to understand the targeted publics' reactions to this message and factors shaping post-message attitudes and behaviors. This study contributes to existing literature on COVID-19 and the usage of the WEA system by focusing on the emotional reaction to the message and predictors of public health message compliance through a mixed-methods approach.

The following literature review provides an overview of what is known about best practices in WEA message construction and the decision-making processes surrounding protective action taking. Next, research on emotional reactions to WEAs is reviewed. Finally, the latest research on WEAs and COVID-19 is summarized.

WEAs and Protective Action Taking

WEA messages are a form of short message alerts (also known as terse messages) (e.g., Sutton et al., 2015) sent to individual mobile devices by "authorized government alerting authorities" (Kuligowski & Doermann, 2018, p. 7). This has allowed for "disaster warnings in your pocket" (Bean et al., 2016, p. 136). WEAs are designed to encourage protective action taking, and past

research has identified five main types of information in alerting messages as being most effective for this: (1) source of the alert, (2) guidance on protective action, (3) time of event and actions needed, (4), location of event, and (5) hazard/consequence of the event (e.g., Kuligowski & Doermann, 2018; Mileti & Peek, 2000; Mileti & Sorensen, 1990; Sutton et al., 2014). There is a significant body of literature that explores the complex social and cognitive decision-making process that individuals go through after receiving an alert or warning (e.g., Lindell & Perry, 2012; Liu et al., 2017; Mileti & Sorensen, 1990; Wood et al., 2017). Mileti and Sorensen (1990) characterized the process as hearing, understanding, believing, personalizing, confirming, and responding. Similarly, Lindell and Perry (2004, 2012) developed the Protective Action Decision Model (PADM) that identified message reception, attention, and comprehension as critical pre-decision processes. In their revision of PADM, Lindell and Perry (2012) further identified three core perceptions—threat, protective action, and stakeholder—that influence decisions about how to respond to imminent or long-term threats. These have been the primary frameworks for understanding public responses to WEAs, which focus more on the cognitive than emotional aspects of message response. Yet, ample research supports the notion that emotions play an important role in how people interpret warnings and their resultant behavioral intentions (e.g., Liu et al., 2015; Liu et al., 2016; Sutton et al., 2018).

Emotional Reactions to Receiving WEAs

Jin and colleagues have made great strides in understanding publics' emotional reactions to crisis situations (e.g., Jin, 2010; Jin et al., 2016; Jin et al., 2012). An even more specific body of research is emerging on emotional reactions to receiving WEA messages (e.g., DeYoung et al., 2019; Sutton & Woods, 2016). Using the real-world context of false alarm ballistic missile warning sent via the WEA system in Hawaii in 2018, DeYoung and colleagues (2019) found that fear emerged as a primary emotional response, although not to the level of panic and hysteria as reported by the media. Anger emerged as another prominent emotion in this study, which the authors argued has interesting implications for blame-seeking associations for this type of false alarm.

In research on tsunami warnings, Sutton and Woods (2016) found that anxiety motivated individuals to search for additional information or take protective action. Building upon this work, Sutton and colleagues (2018) argued that the relationship between fear and warning messages is just beginning to be studied. In their study, four items (afraid, scared, anxious, frightened) converged to form a mean scale labeled fear. Findings from this work showed a significant effect of message type on fear. Specifically, "participants who only saw a single, short message reported significantly less understanding, fear, and ability to decide, compared to participants who received the revised message" (Sutton et al., 2018, p. 82). Interestingly, a sequenced set of short messages was as effective as a single longer-length message. The authors concluded the potential value for sequenced short warning messages as opposed to a single short message.

Responses to warning messages are influenced by the type of hazard (Lindell & Perry, 2012). As Bean and colleagues (2022) wrote, "the WEA system was not explicitly designed with a pandemic in mind" (p. 187). Therefore, the usage of this system for instructing information during the ongoing COVID-19 pandemic provides a unique hazard context.

WEA Messaging and COVID-19

Bean et al. (2021) conducted an early study looking at the use of the WEA messaging system between March and April 2020 for the COVID-19 public health crisis by six states and 53 localities in the United States. Initial findings from this study suggested WEA messages might be effective in lowering COVID-19 transmission and growth rates, although the data were inconclusive. Of relevance to this study, though, is that of the 213 messages analyzed, only five included all the components of a complete WEA message (i.e., message sender, hazard type, location, protective action time frame, protective action guidance, link to additional information) (Bean et al., 2016). One reason for the variability in how WEA messages were constructed for COVID-19 may be the uncertainties around the threat.

Yeon and colleagues (2022) examined the effectiveness of wireless emergency alerts for COVID-19 communication in South

Korea. Notably, South Korea extensively uses mobile alerting as part of a COVID-19 mitigation strategy (Gold, 2020). Specifically, the amount of WEA messages sent out in 2020 due to COVID-19 was nearly 50 times as much as sent out the previous year (Yeon et al., 2022). Yeon et al. distinguished between WEA as warning and WEA as guidance messages, which offers insight into messaging efficacy around this particular threat. Their research found that warning WEA topics significantly correlated with reducing public foot traffic. These warning topics included messages about newly confirmed cases in communities and were seen as important information. In contrast, this research found that guidance WEA topics were not statistically correlated with reducing public foot traffic. Guidance information, such as wearing a face mask, was initially important but the content repetition reduced its efficacy. As such, this study concluded that "public officials should consider that the notice about the relevant risks directly concerning the recipients is more effective than repeating the same guidance" (Yeon et al., 2022, p. 5). Although research exploring WEAs in the specific context of COVID-19 is just beginning to be published, we contend that how publics react to WEA messages can influence health messaging compliance, and hence we turn to the literature on public health messaging. Additionally, as Kim et al. (2019) found, protective action in response to WEA messages is influenced by factors at the individual level. As such, we turn our attention to the individual level factors that predict public health message compliance.

Predictors of Public Health Message Compliance

There are numerous predictors of public health compliance. In this study we focus on two specifically: emotions and health belief factors.

Emotions

There are many factors that are associated with message compliance and merely providing the public with this information may not guarantee positive response. People's emotional responses to a message have been found to be predictive of protective health behaviors. According to appraisal theories of emotion (e.g.,

Lazarus, 1991), "emotions are elicited by evaluations (*appraisals*) of events or situations" (Roseman & Smith, 2001, p. 3). Each discrete emotion is associated with a core relational theme and an action tendency (Lazarus, 1991). For example, fear is associated with the core relational theme of an imminent threat, and the action tendency is to avoid the threat (Lazarus, 1991). In receiving the WEA, individuals may experience several emotions. With the message emphasizing the rising rates of COVID-19, fear, sadness, and sympathy may be aroused. Individuals may feel fearful of contracting the virus because the threat is now made salient, feel sad that the situation has not yet improved, and feel sympathetic to those who have been affected by the pandemic. However, because the WEA was sent out a day before Thanksgiving, its recommendations that individuals should change their plans might be considered too late, potentially arousing anger in message receivers. Finally, individuals may also experience surprise because there was no prior indication that they would receive the WEA on their mobile phones. As Chou and Budenz (2020) suggested, emotional responses can predict COVID-19 vaccine adoption. Therefore, we argue that this relationship could extend to other behaviors such as changing one's Thanksgiving plans.

Health Belief Factors

Whether an individual takes protective action can depend on their health beliefs. Protection motivation theory (PMT; Rogers, 1983) posits that in receiving a message, there are two cognitive mediating processes that influence message compliance. The first are threat appraisals, which involves an evaluation of whether the source of the threat is severe (the seriousness of contracting COVID-19) and one's susceptibility to it (the perceived risk of contracting COVID-19). The second are coping appraisals, which comprises evaluations of response efficacy (how effectively will changing one's Thanksgiving plans protect them from contracting the virus), self-efficacy (can one realistically change their Thanksgiving plans), and response costs (is one willing to give up family time to change their Thanksgiving plans). Hence, it is expected that when threat and coping appraisals are low, people tend not to follow the message's recommendations. This

proposition has been supported by a meta-analysis conducted by Floyd and colleagues (2000), which found a moderate effect of threat and coping appraisals predicting behavioral intentions and actual behavior across 65 studies and numerous health topics such as smoking and influenza inoculation. Specifically in the context of the COVID-19 pandemic, Kowalski and Black (2021) found perceptions of threat severity, response efficacy, and self-efficacy to be significant predictors of COVID-19 protective behaviors such as self-quarantining and maintaining social distance.

Therefore, this study seeks to bring together and expand upon two established lines of research: (1) public response to WEA messages and (2) predictors of public health message compliance. As such, this study was guided by the following research question and hypothesis:

> **RQ1:** What emotional reactions did targeted publics have to the COVID-19 WEA?

> **H1:** (a) Emotional responses, and (b) health beliefs, will predict COVID-19 protective action behavioral change.

Methods

This study had two parts and received Institutional Review Board approval. The first was an online survey. We recruited U.S. adult participants residing in Pennsylvania via CloudResearch, a recruitment system that helps researchers find participants on Amazon's Mechanical Turk platform. First, participants answered background questions related to demographics and general views on COVID-19. Next, all the participants viewed the WEA message. After viewing the message, respondents were asked questions related to their emotional response to the message, if it caused them to change their behavior, and the effectiveness of this system for such messaging. A total of 214 people started the survey, and after removing people who did not complete the bulk of the survey, our final sample size was $N = 212$. Respondents who reported receiving the message themselves prior to the study ($n = 92$) were analyzed separately from respondents who were unsure ($n = 72$) and reported not receiving the message prior to the study ($n = 48$). See Table 1 for full sample demographics.

TABLE 1 Sample Characteristics (*N* = 212)

Demographic	*M* (*SD*) or *n* (%)
Age	*M* = 40.50 (*SD* = 11.05)
Race	
White	195 (92.0%)
Black or African American	11 (5.2%)
American Indian or Alaska Native	5 (2.4%)
Asian	6 (2.8%)
Hispanic, Latino/a/x, or of Spanish Origin	1 (.5%)
Choose not to answer	1 (.5%)
Gender	
Male	86 (40.6%)
Female	123 (58.0%)
Something else	2 (1.0%)
Choose not to answer	1 (0.5%)
Income	
Under $9,999	6 (2.8%)
$10,000–$24,999	17 (8.0%)
$25,000–$49,999	44 (20.8%)
$50,000–$74,999	56 (26.4%)
$75,000–$99,999	42 (19.8%)
$100,000 or more	44 (20.8%)
Choose not to answer	3 (1.4%)
Education	
12th grade no diploma	2 (.9%)
High school or GED	24 (11.3%)
Some college	47 (22.2%)
College degree	96 (45.3%)
Graduate degree	42 (19.8%)
Choose not to answer	1 (0.5%)
Party Affiliation	
Republican	50 (23.6%)
Democrat	114 (53.8%)
Libertarian	5 (2.4%)
Green Party	1 (.5%)
Independent	41 (19.3%)
Choose not to answer	1 (.5%)

Voter in 2020 Presidential Elections	
Yes	194 (91.5%)
No	17 (8.0%)
Choose not to answer	1 (.5%)
Voting Choice	
Donald Trump	44 (20.8%)
Joe Biden	142 (67.0%)
Other/Write-in	7 (3.3%)
Choose not to answer/Missing	19 (9.0%)
Work in Healthcare Industry	
Yes	19 (9.0%)
No	192 (90.6%)
Choose not to answer	1 (.5%)
Essential Worker	
Yes	65 (30.7%)
No	146 (68.9%)
Choose not to answer	1 (.5%)
Personally diagnosed with COVID-19	
Yes	10 (4.7%)
No	202 (95.3%)
Someone in household with COVID-19	
Yes	16 (7.5%)
No	196 (92.5%)
Someone close with COVID-19	
Yes	151 (71.2%)
No	61 (28.8%)
Changed Thanksgiving plans	
Yes	5 (5.4%)
No	87 (94.6%)
Would have changed Thanksgiving plans	
Yes	52 (43.3%)
No	68 (56.7%)

Note. Participants were allowed to choose more than one race. Only respondents who received the WEA were asked if they had changed their Thanksgiving plans. Respondents who did not receive the message were asked if they would have changed their Thanksgiving plans if they had received the message.

Variables

Emotions. To measure respondents' emotional response to the WEA, participants were asked to report how much they felt the message made them feel a number of emotions on a scale from 1 (*not at all)* to 7 (*extremely*) (Dillard & Shen, 2005, 2007). An exploratory factor analysis was performed using a principal component analysis and varimax rotation. Three factors were revealed explaining 73.78% of the variance in the data, with a KMO value of .87, $p < .001$. The first factor is fear which consists of six items that were averaged including "Scared," "Anxious," "Fearful," "Nervous," "Tense," and "Terror-struck" (rotated variance = 40.38%, $M = 3.37$, $SD = 1.70$, $\alpha = .95$). The second factor is a combination of anger and surprise, consisting of four items that were averaged including "Outraged," "Angry," "Shocked," and "Confused" (rotated variance = 21.56%, $M = 2.05$, $SD = 1.23$, $\alpha = .77$). The third factor is a combination of "Sad" and "Sympathetic" (rotated variance = 11.84%, $M = 3.42$, $SD = 1.78$, $\alpha = .67$). No items were deleted.

Empathic concern. Empathic concern was measured with five items adapted from Davis (1983) on a 7-point Likert scale from 1 (*strongly disagree)* to 7 (*strongly agree*). An example item includes "When I think about people dealing with COVID-19 or its aftermath, I have tender, concerned feelings for them" ($M = 5.32$, $SD = 1.43$, $\alpha = .95$).

Threat severity. Threat severity was measured with three items on a 7-point scale from 1 (*strongly disagree)* to 7 (*strongly agree*) adapted from Huang and Yang (2020) and Witte (1996). Example items include "I believe that getting infected by the COVID-19 virus (the coronavirus) is dangerous" and "I believe that getting infected by the COVID-19 virus (the coronavirus) is serious." The items were averaged to form a composite scale, with higher scores indicating greater perceived threat severity ($M = 5.91$, $SD = 1.48$, $\alpha = .98$).

Threat susceptibility. Threat susceptibility was measured and averaged with three items on a 7-point scale from 1 (*strongly disagree)*

to 7 (*strongly agree*) (Cohen, 2020; Witte, 1996). Example items include "I am at risk to catch the COVID-19 virus (the coronavirus)" and "It is possible that I will catch the COVID-19 virus (the coronavirus)" ($M = 4.62$, $SD = 1.43$, $\alpha = .82$).

Self-efficacy. Self-efficacy was measured and averaged with three items on a 7-point scale from 1 (*strongly disagree)* to 7 (*strongly agree*) (Yang et al., 2015). An example item includes "I feel confident in my ability to handle problems related to the COVID-19 pandemic" ($M = 5.13$, $SD = 1.34$, $\alpha = .92$).

COVID-19 protective behavior. COVID-19 protective behavior was measured with a dichotomous variable (yes/no). Respondents who received the WEA message were asked "I changed my Thanksgiving plans after receiving this message" (94.6% no). Respondents who did not receive the message or were unsure if they did were asked "I would have changed my Thanksgiving plans if I had received this message the day before Thanksgiving" (43.3% yes).

In-Depth Interviews

The second part of this research study involved conducting 19 short interviews ($M = 16$ minutes) with residents of Pennsylvania using convenience and snowball sampling separate from the survey data collection. People who had received the alert in Pennsylvania on their phones were eligible to participate, and participants were given a $5 Amazon e-gift card for their time. Participants were recruited via researcher social media channels and StudyFinder, a web-based recruitment tool sponsored by the researchers' university. Participants ranged in age from 20–68 ($M = 39$), with 18 identifying as White and 15 as female. Interviews were transcribed through the Otter.ai program and edited for accuracy by an undergraduate research assistant.

Interview transcripts were read in a close line-by-line manner by the lead researcher and initially open coded by using the comment function in Word to highlight portions that provided insight into the study's research question and hypothesis

(Lindlof & Taylor, 2011). After this initial phase of data analysis, an axial coding approach was used in an Excel document to begin grouping similar findings together across interview transcripts as they related to emotional reactions to the WEA and factors associated with COVID-19 protective behavior (Lindlof & Taylor, 2011). Examples of codes at this phase included "comparison to Amber Alerts," "reassurance that the threat was being taken seriously," and "fear." These codes were then compared with findings from the survey research to see which results were supported and where new insights were shed. The results of this process are integrated with the survey findings in the results and representative quotes are included.

Results

Emotional Reactions to the COVID-19 WEA

A series of independent samples *t*-tests were conducted to understand people's emotional responses to the WEA. Respondents who had received the message on their own phones prior to the survey reported greater anger and surprise ($M = 2.24$, $SD = 1.28$) than respondents who did not receive the message ($M = 1.90$, $SD = 1.18$), $t(210) = -2.02$, $p = .05$). However, there were no significant differences in fear arousal between those who received the message and those who did not, $t(210) = -.26$, $p = .79$, or in the amount of sadness and sympathy felt, $t(210) = -1.00$, $p = .32$.

Interview data offers additional support and contextualization to the survey findings. Part of the surprise in receiving this WEA message was because of people's familiarity with the system for sending Amber Alerts, which have a clearer urgency and direction to the public. The message was surprising to people because it did not seem to convey any new information or protective action, which participants had expected from an emergency alert system. Related to conceptualizations of the type of information generally disseminated via the WEA system, the initial reaction by some to the alert was fear because, as one participant said, "I thought there's been a massive outbreak." While survey data indicated no significant difference on fear arousal for those who received the message versus those who did not, interview participants overwhelmingly interpreted the intention behind this message as a "scare tactic" by

the government to prevent gatherings on Thanksgiving. To some participants, this was an effective strategy "to bring seriousness to it . . . they almost had to present it in like a fear invoking way in order to get that point across. And it worked because I definitely took it more seriously." However, one interview participant reflected that for those who were not already following the protective actions outlined in the WEA message, it could come across as "propaganda."

Interestingly, despite some initial negative reactions to the message, the interview data suggested positive emotions toward the idea behind the message because "it was reassuring" that the threat of COVID-19 was being taken seriously by the state government. Others mentioned feeling "happy that this was sent out . . . [because] this is going to everybody's phones so hopefully this is a good reminder for some people who might be again letting their guard down." For those who had decided to cancel their Thanksgiving plans before the alert was sent, the "message maybe made those of us who were staying home feel better."

The WEA message included a direction to download the COVID Alert PA app to search for more information. None of the interview participants had downloaded this app, and most, if not all, had no knowledge of the type of information included in the app. Several participants discussed the additional anxiety having this app on their phones would cause them. One participant said, "I was just thinking like, if I were to download that app, then I would just have more regular information about how bad things are getting, which would make my anxiety worse." Much of this had to do with participants' feelings of agency around what to do with additional COVID-19 information. Another participant stated, "we're just being deliberate about balancing what is directly relevant to us and what is going to feel overwhelming, but really isn't the most relevant information and it's not anything that we can do anything about."

Factors Associated with COVID-19 Protective Behavior

To test H1 that emotional responses and health beliefs will predict COVID-19 protective action behavioral change, we computed logistic regressions predicting a change (yes versus no), or a

potential change, in one's Thanksgiving plans. We conducted direct logistic regressions separately for participants who received the WEA message and those who did not, but each analysis included the same predictors (fear, anger/surprise, sad/sympathetic, empathy, threat severity, threat susceptibility, and self-efficacy).[1]

For participants who received the WEA message, the analysis predicting a change in Thanksgiving plans was not statistically significant $\chi^2(7) = 5.63$, $p = .58$. The Hosmer and Lemeshow goodness-of-fit test indicated adequate fit for the model ($p = .23$). None of the variables in our model was a statistically significant predictor of a change in Thanksgiving plans (see Table 2).

For participants who did not receive the WEA message, the analysis predicting a potential change in Thanksgiving plans

TABLE 2 Logistic Regression Analyses Predicting a Change in Thanksgiving Plans (Those Who Received the WEA Message) and a Potential Change in Thanksgiving Plans (Those Who Did Not Receive the WEA Message)

	Received message ($n = 92$)			Did not receive message ($n = 120$)		
Variables	**OR**	**95% CI**	*p*	**OR**	**95% CI**	*p*
Fear	1.55	[0.65, 3.68]	.32	**1.45**	**[1.02, 2.08]**	**.04**
Anger/Surprise	0.94	[0.42, 2.11]	.88	0.74	[0.46, 1.18]	.21
Sad/Sympathetic	1.35	[0.74, 3.20]	.49	1.16	[0.86, 1.57]	.35
Empathy	0.48	[0.19, 1.22]	.12	0.92	[0.62, 1.36]	.48
Threat severity	1.22	[0.52, 2.87]	.64	**1.89**	**[1.09, 3.27]**	**.02**
Threat susceptibility	0.84	[0.38, 1.82]	.65	1.21	[0.83, 1.76]	.33
Self-efficacy	0.95	[0.41, 2.18]	.90	1.34	[0.93, 1.95]	.12

Note. Significant values are in bold.

1. The logistic regressions were conducted both with and without demographic control variables included. None of the demographics were significant. Furthermore, due to our lower sample size, it was not advisable statistically to include both the demographic and psychological predictors. Guided by both theory and the desire for parsimony, we included only emotion and emotion-related cognitive variables as predictors in our analyses but suggest that future research with larger samples and more demographic diversity may want to include those variables.

was statistically significant $\chi^2(7) = 30.58$, $p < .001$. The Hosmer and Lemeshow goodness-of-fit test indicated adequate fit for the model ($p = .96$). As Table 2 shows, variables that significantly ($p < .05$) predicted a potential change in Thanksgiving plans if participants had received the WEA message were fear (OR = 1.45, CI [1.02, 2.08], $p = .04$) and threat severity (OR = 1.89, CI [1.09, 3.27], $p = .02$). In partial support for H1a and H1b, those who felt more fearful and greater threat severity reported that they would have been more likely to have changed their Thanksgiving plans if they had received the WEA message.

Interview data supports the finding that the WEA message had little, if any, impact on people taking protective actions that they were not already taking. As one participant said, "I think people had their minds made up beforehand." All interview participants discussed following CDC guidelines regarding hand washing, masking, and social distancing prior to the WEA. Most, but not all, interview participants also discussed having canceled their Thanksgiving plans prior to the alert. Yet, even those who had Thanksgiving gatherings felt that they were proceeding with caution.

Discussion

Although the WEA message was consistent with other public health guidance (i.e., to wash your hands, stay socially distanced, and wear a mask), the use of an emergency alert system to provide the same information caused a negative emotional response. By November 2020, recipients of this WEA message in Pennsylvania had potentially been exposed to this guidance multiple times (although not through a previous WEA message) since the start of the pandemic in March 2020. As Yeon and colleagues (2022) found in the South Korean context, guidance information was initially important, but content repetition reduced its efficacy. Our study findings are consistent with these results.

We asked about the public's reactions to the COVID-19 WEA and found that people generally had negative affective responses. For individuals who received the WEA, there were greater feelings of anger and surprise as compared to those who did not receive the alert. This may be in part because they felt psychological

reactance (Brehm, 1989) as the message may have been perceived to threaten their behavioral freedoms as many COVID-19 messages often are (Ma & Miller, 2021). Although the message did not specifically reference the need for residents to change their Thanksgiving plans, the fact that it was sent a day prior to the holiday may have prompted survey respondents to make that connection. Additionally, the anger felt by these individuals could also be attributed to the time in which the message was sent, which would not have allowed much opportunity to change their plans even if they wanted to. This is further supported by interview data which suggests that Thanksgiving plans were made well in advance of the message's dissemination. Similar to the work by DeYoung and colleagues (2019), which found anger as a prominent emotion in the false alarm WEA sent in Hawaii, the usage of this system for a guidance message may have been perceived as a false alarm.

Participants in our study were also surprised to have received the message on their mobile phones. Since the COVID-19 pandemic was only added in 2020 to the list of hazards for which WEA messages are issued (Bean et al., 2021), the novelty of seeing such health messages pushed to their mobile phones might have elicited surprise and can be explained by expectancy violation theory (EVT; Burgoon, 1993). As expectancy violation theory predicts, depending on how favorably the violation is perceived by the individual, this can influence how positively or negatively one feels toward the exchange, or in this case, the emotional reaction to receiving the message. For example, for some participants, this may evoke fear that an outbreak has occurred, since people are more familiar with Amber Alerts and typically associate them with an emergency. On the other hand, while surprised, some participants felt reassured that the government was taking the pandemic seriously and that it was a good reminder to take safety precautions.

Our data show that emotional responses and health belief factors predicted our outcome variables differently depending on whether participants received the WEA message or not. For participants who received the WEA message, neither emotional responses nor health belief factors predicted COVID-19 protective behavioral changes. As our interview data suggested, people had already "made up their mind" as to whether to cancel their

Thanksgiving plans, or to proceed with caution. Hence, there may be other factors that went into the decision-making process that we did not measure. However, for participants who did not receive the WEA message, but were shown the message that was sent out in Pennsylvania, fear and threat severity significantly predicted a potential change in Thanksgiving plans. As previously argued, individuals may feel fearful of contracting the virus since the threat is made salient when participants saw the WEA message. Because they had not received this message in the moment, they may have retroactively perceived the crisis as more unpredictable and uncontrollable than those who received the alert in real time and expressed feelings of anger (Jin, 2010). Additionally, meta-analyses show that fear appeals, or messages intended to arouse fear, tend to be an effective messaging strategy to promote attitudinal and behavioral change (Rains et al., 2018). As PMT (Rogers, 1983) postulates, high threat severity should also increase message persuasiveness (if other half belief factors are high as well). This is supported by meta-analytical findings that show that perceived threat severity is often associated with health behaviors (Rains et al., 2018), which is in line with our findings.

While the WEA alert was largely perceived to be ineffective by participants in our study, the WEA system does hold some promise. WEAs were intended to be a warning siren in one's pocket (Bean et al., 2016) which interview participants acknowledged as an effective channel for information dissemination. It is therefore important for government leaders to continually reevaluate their message strategies.

Theoretical and Practical Implications

This study has several notable theoretical and practical implications. Theoretically, contrary to predictions from PMT (Rogers, 1983), threat and coping appraisals were not significantly associated with actual behaviors to change one's Thanksgiving plans. It may be that there are other considerations that individuals have (beyond that of the variables measured in PMT) in making such decisions. As such, further theorizing to extend the range of PMT may be needed in this context. By conducting a mixed-methods study, we were able to rigorously describe this unique context of

WEA alerts and how Pennsylvania residents perceive such alerts. This provides a foundation for which theory could be developed.

Practically, our study highlights the importance of authorized government alerting agencies to improve their crisis communication message strategies. Our data show that the public does see promise in the alert system to provide them with useful information. Hence, we would urge government agencies to adhere to the best practices of effective public warning messages (Bean et al., 2021; Mileti & Sorensen, 1990) to include information about who sent the alert, who is at heightened risk of contracting the virus, a specific time frame for protective action, as well as to embed links for further information or to download an app. Based on the results of this study, embedding a link may be preferred as study participants indicated not wanting to download an app as it was described as overwhelming and anxiety-provoking. Additionally, since findings from our study suggest that fear and threat severity are significant predictors of a potential change in Thanksgiving plans, message characteristics meant to elicit fear and highlight threat severity should be incorporated in future message development. We also believe this study shows support for the work by Sutton and colleagues (2018) that argued for the value of sequenced short warning messages as opposed to just one single short message.

Limitations and Future Research

As with all research endeavors, this study has several limitations that future research could overcome. First, we conducted this research roughly 3 months after the WEA was sent out, and because of this time lag, many of our participants could not recall their immediate reactions upon receiving the message. Due to the time sensitivity of this work, it would benefit researchers to have ongoing, long-term relationships with governmental agencies such as PEMA to allow for timely data collection. Second, the limitations of our samples must be considered. Both the survey and interview samples are nonrepresentative of the general population as they are regionally based, demonstrate a higher education level, are more democratic, and are predominantly White. While our study lacks generalizability, it does offer important insights into

emotional reactions to public health WEAs that can be expanded upon in future research.

Finally, because we were interested in public perceptions of the WEA alert, we did not collect data from PEMA officials who may have additional information about the intentions and purpose of the alert. Future research could complement data from the public with governmental agencies to provide a more complete picture of the purpose and effectiveness of WEA messages, as well as the decision-making processes that go into sending such an alert for an ongoing public health threat.

Conclusion

Emotional reactions to WEA messages is a growing area of research, and one that is vital to better understanding and predicting public health behavior. Findings from this research support decades of research that one message by itself, in this case the WEA message sent the day before Thanksgiving, will not have much effect on behavioral intentions. Yet, there seems to be support for the usage of this system in general for public health alert messaging.

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