Optimizing imminent threat mobile alerts to motivate protective action

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Mobile Devices Project Overview

Phase 1
- Historical research
- Experts Workshop

Phase 2
- Experiments
- Interviews
- Focus Groups

Phase 3
- Survey

What is the optimized content & form for public alert/warning messages about imminent threats distributed over new & emerging technologies?
WEA message

- 90-character first alert message
- Content topics & order is set: Hazard, location, time, protective action, source
- Example:
  Radiological Hazard Warning in this area until 12:00AM PDT Take shelter now US DHS
## Message Lengths Tested

<table>
<thead>
<tr>
<th>90-character</th>
<th>140-character</th>
<th>1,380-character</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Current WEA</td>
<td>• Social media (i.e., Twitter)</td>
<td>• Current EAS/IPAWS/CAP</td>
</tr>
<tr>
<td></td>
<td>• Future WEA?</td>
<td>• Future WEA?</td>
</tr>
</tbody>
</table>
Methods

Experiments
- Internet & lab
- Eight total
- Simple regression
- Multiple regression

Think-Out-Loud Interviews
- 50 conducted
- Read one message to interviewee
- Asked for initial reaction
# Methods

## Focus Groups
- 7 conducted (6-8 participants each); emergency manager group
- One message per focus group
- Questions followed research topics

## Survey
- Test in a real-world event
- 9/13 Boulder, CO flood
- Telephone interview
- Two samples:
  - **WEA Recipients**: 496 adult city residents who received WEA message(s)
  - **General Population**: 597 adult city residents
Protective Action Behavior

MESSAGE
- Content Elements
- Content Order
- Length
- Maps
- URL
- More

MEDIATORS
- Understand
- Believe & Personalize
- Perceived risk
- Decisions & Emotions
- Milling (information seeking, sharing, confirmation)

PROTECTIVE ACTION TAKING
Research Topics

• Prime message elements tested:
  1. **Order:** Message contents
  2. **Source:** Local, state, federal
  3. **Maps:** None, impact area, receiver location
  4. **Content elements:** Relative importance
  5. **Generalizability:** Across hazard types & message lengths
  6. **Length effectiveness:** Comparisons
Research Topics

• Additional topics examined:

  7. **URL**: Use if available
  8. **WEA System**: Familiarity
  9. **Acronyms**: Words like CDC and NWS
  10. **Time**: Best way to express
  11. **Location**: Best way to express
  12. **Fear arousal**: Optimum level
  13. **Understanding**: Words like warning & shelter, etc.
  14. **Diffusion curve**: WEA messages
  15. **Mobilization curve**: Checking local media
Research Findings
Question 1

Is there an optimized message content order?
Experiment Findings

• Current order = lower outcomes:
  – Hazard, location, time, protective action, source
  – Radiological Hazard Warning in this area until 12:00AM PDT Take shelter now US DHS

• Another order = slightly better outcomes:
  – Source, protective action, hazard, location, time
  – US DHS Take shelter now Radiological Hazard Warning in this area until 12:00AM PDT
# Qualitative Findings

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<th>90 &amp; 140-characters</th>
<th>1,380-characters</th>
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<td>• Placing source first aids interpretation</td>
<td>• Placing the protective action before describing the hazard yielded confusion</td>
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<tr>
<td>• Placing protective action up front increases understanding</td>
<td></td>
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1,380-character text:

- Placing the protective action before describing the hazard yielded confusion.
Conclusions

• A different content order would *slightly* improve public response outcomes:
  – For short messages (90 & 140-characters)
  – Not for longer messages (1,380-characters)

• Current short messages order:
  – Hazard, location, time, protective action, source

• Revised short messages order:
  – Source, protective action, hazard, location, time
Question 2

Is there an optimized single source?
Experiment Findings

• **Historical research concludes:**
  – No credible source for everyone, use multiple sources

• **One source worked “best” but not for everyone:**
  – A “local & familiar” source enhanced interpretation (understanding, believing, deciding) & personalization
  – But the relationship is *weak* and *unstable*
Qualitative Findings

Source challenges for diverse publics:

- Different sources viewed as credible & believable
- Lack of understanding of source acronyms

If you have to pick one source:

- A “local & familiar” source works best
Survey Findings

Where WEA Recipients Received Messages From

- Personal source: 74%
- Local government source: 58%
- State government source: 6%
- National government source: 31%
Conclusions

Local & familiar sources work best

Source acronyms generally unknown

Public education about WEA needed
Question 3
Would a map optimize outcomes?
Maps Tested

- No map compared to:
  - Low Information Map
  - High Information Map
Experiment Findings

All outcomes factors affected positively:

• Increased interpretation & personalization
• Decreased milling

Rank of alternatives based on outcomes:

• Best: High information map
• Middle: No map
• Worst: Low information map
Qualitative Findings

Confirmed that a high information map would:

• Enhance interpretation
• Increase personalization

Clarified that a high information map would:

• Not completely eliminate milling
For those who reported having seen a map as part of 1 or more flood messages, there was a statistically significant relationship between reported map effectiveness & personalization.
Conclusions

**Include**
- High information maps

**Not include**
- Low information maps
Question 4

Does some message content matter most?
Experiment Findings

Guidance & hazard matter most

• Enhances protective action & risk interpretation
• Reduces response delay

Put two items up front in message
Qualitative Findings

Confirmed guidance & hazard matter most
Survey Findings

**Guidance When Expected to Take Action**
- Most important message factors for interpretation and personalization

**Time Until Event**
- Negatively correlated with delay in checking local media
Conclusions

Guidance & hazard most important

Best if up front in short messages

Source, expiration time & location less important

Time until event, which can be understood as part of guidance, is quite important
Question 5
Do findings generalize across hazards & message lengths?
Experiment Findings

90 & 140-characters
- Too short to overcome preconceived perceptions

1,380-characters
- Overcome preconceived perceptions
- Yield standardized outcomes across hazard type
Qualitative Findings

Emergency managers held the opinion that one message content order across lengths and hazards was preferable.
Conclusions

Short messages (90 & 140-characters):
• Too little info to overcome pre-event hazard-specific perceptions
• Function more like a siren than warning

Longer messages (1,380-characters):
• Enough information to shape public perception & response to the event
• Works across hazard type
Question 6
Do longer messages work better?
Experiment Findings

- Increased interpretation & personalization
- Decreased milling
- Enhanced public protective action taking response
Qualitative Findings

Confirmed conclusion that:

• Longer messages improve understanding and reduce milling

Revealed an interesting complication:

• Preference for 140-character messages vs. 90 or 1380-characters
Conclusions

Optimize public perception & response outcomes

Preferred in qualitative findings

How to balance the tension between these findings?
Question 7

Would including a URL be useful?
Qualitative Findings

Most participants were favorable to including a URL

Useful in a message of any length

Would use to find more event information
Survey Findings

Those who received a message containing a link had a shorter delay (i.e., less milling) before beginning to avoid flood areas (compared to those who did not receive a message containing a link)
Conclusions

Consideration should be given to:

• Including a URL in 90-characters WEA and longer messages

URL inclusion may:

• Support the public’s tendency to mill
• Reduce delay time between message receipt and taking a protective action
Question 8

How familiar are people with WEAs?
Qualitative Findings

- Pre-event familiarity with alerts & warnings important
- Very few were familiar with WEAS
- Disbelief that such a system is possible
Survey Findings

General population survey sample: \(\frac{1}{2}\) “not knowledgeable”

WEA survey sample: \(\frac{1}{3}\) “not knowledgeable” about public alerts & warnings
Conclusions

Consideration should be given to:

- A national public education campaign to familiarize people with WEA

Public WEA system familiarity would likely:

- Help people interpret and personalize WEAs
- Foster more timely & appropriate protective action response during an event
Question 9
How well do people understand acronyms like CDC and NWS?
Qualitative Findings

Lack of acronym knowledge

“Isn’t USDHS how they grade the quality of meat in stores?”

“Does MDT have something to do with time?”

Rare exceptions may exist

NWS in tornado alley
Survey Findings

Among WEA recipients, 72%* indicated that before receiving the WEA, they believed ‘NWS’ stood for the National Weather Service.

*Survey respondents answered the question: When you first read the message, what did you think NWS meant? Response options: (1) National Weather Service; (2) Some other phrase; (3) Don’t know; (4) Refused to answer
Conclusions

Modify WEAs so that:

• Only a few widely known acronyms are used
• Increase message length so full text descriptions can replace acronyms

Educate the public about the meanings of acronyms
Question 10
How is time best expressed in a WEA?
Qualitative Findings

- Including message expiration time creates confusion
- Unclear when the danger & need to take action begin & end
- People do not start acting when the message is received
Survey Findings

Consideration should be given to communicating the time a message “begins”

On average, WEA recipients believed they had 22.10 minutes to take action
Conclusions

Communicating message expiration time confuses public about action taking

Need to be clear when danger & the need to take protective action begin & end
Question 11
How is location best described in a WEA?
Qualitative Findings

“In this area” not interpreted as meant for receiver

The act of receiving a message does not equal personalization
Survey Findings

More than a quarter (29%) of WEA recipients thought the message was not meant for them

71% thought it was likely that the WEA was meant for them
Conclusions

Need finer geo-spatial targeting

Messages should only reach people at risk

People who receive WEA messages may be trained to think they do not apply to them
Question 12

Is there an optimal level of fear arousal?
Experiment Findings

1. Fear and lament were consistent emotion factors.
2. All message lengths & most message content factors had significant relationships with fear & lament.
3. Response could not be measured in the experiments.
Qualitative Findings

All message lengths do impact fear & other emotions

Patterns revealing how could not be discerned
Survey Findings

No relationship between level of fear & the amount of delay before respondents initiated checking local media & avoiding flood areas
Conclusions

Messages that are crafted specifically to maximize fear may not be effective in motivating protective actions.

The role emotions may play in making sense of and responding to public alert & warning messages remains unclear.
Question 13
Do people understand words like warning and shelter?
Qualitative Findings

The short answer is NO

• Room for different interpretations
• Ex., shelter means “drive to shelter” for many
Survey Findings

Wide Range of Interpreting “Higher Ground”

- WEA message recipients who also reported hearing the outdoor warning sirens & messages along Boulder Creek, reported that moving to “higher ground” meant 0 to 500 feet (Mean=20 feet)
Conclusions

Need to describe warning concepts in messages longer than 90 & 140-characters

• Example: Shelter in the building you’re in or in the one closest to you if you’re outside
Question 14
What does a WEA diffusion curve look like?
Survey Findings

WEA Diffusion Curve
(General Population Sample, N=539)

Note: Of the 539 general sample respondents who remembered whether or not they received a WEA message, 59% did not receive the first WEA message (316/539), 36% received a message and remembered the time (193/539), and 5% remembered receiving the first WEA, but could not remember the time (30/539).
Survey Findings

- Just over 15% of survey city residents received & read the first WEA message when it was issued.
- More than 20% read it within the first half hour.
- Just over a 1/3 eventually read the message.
Conclusions

WEA worked in Boulder to distribute the message on a steep trajectory

WEAs hold great promise for becoming the alert/warning technology of the future

WEA effectiveness is expected to grow as more people learn about WEA and obtain WEA compatible cell phones
Question 15

What does a WEA mobilization curve look like?
Survey Findings

Guidance Mobilization Curve: Check Local Media

(WEA Sample, N=428)

Note: Of the 428 WEA sample respondents who remembered whether or not they checked local media (428/496, 86%), 87% (374/428) reported that they did check local media, and 13% (54/428) reported that they did not. Thirteen percent (54/428) did not check local media, 76% (325/428) remembered when they checked local media, and 11% (49/428) remembered checking local media, but could not remember when they did so.
Survey Findings

About 1/3 of survey respondents had been checking local media prior to the issuance of the first WEA message, with an increase to almost 50% within the first 15 minutes following the message delivery.
Conclusions

The Boulder initial WEA was successful in getting people to follow the recommended guidance—check local media.

We have the first evidence that WEAs move people to check media.

WEAs hold great promise for mobilizing communities.
Project Synthesis
Primary Implications

Order WEA message contents differently (source, guidance, hazard, location & time)

Consider how to better communicate alert & warning concepts

Consider changing how time is expressed to better communicate response urgency
Primary Implications (Continued)

Consider how to best express location/adding maps to WEAs

Consider adding more characters to WEAs

Consider including a URL
Future Research

- Optimized order of message contents for messages longer than 90-characters
- WEA public education campaign needed with formative, process & outcome evaluation research components
- How to best visualize hazard & receive location in maps
Future Research (Continued)

What is the effect of message sounds, color, size, shape & style on message interpretation & response?

Public education to upgrade public response to short messages

How to best include potential additional information with WEAs (e.g., URLs, apps, etc.)
Next Steps
Next Steps ("Phase 4")

- 280-character WEAs
- Research informed by DHS & CSRIC
- Quantitative & qualitative research
- Tsunami, tornado, flash flood + content, maps, URLs, & apps
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