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Optimizing imminent threat mobile alerts to motivate protective action

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Research Team

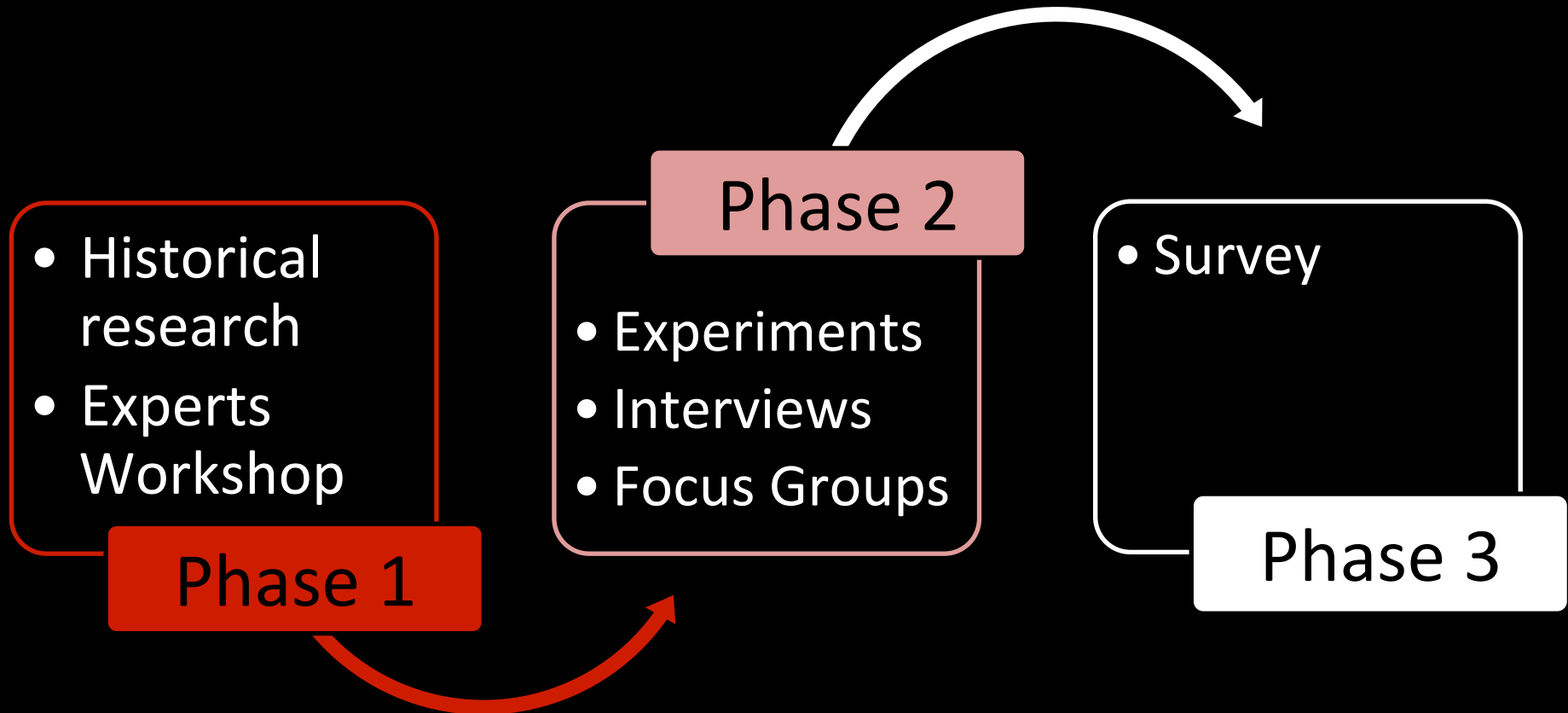| **Hamilton Bean**, Univ. of CO, Denver | **Brooke Liu**, Univ. of MD | **Stephanie Madden**, Univ. of MD | **Dennis Mileti**, Univ. of CO, Boulder | **Jeannette Sutton**, Univ. of KY | **Michele Wood**, CA State Univ., Fullerton |

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Mobile Devices Project Overview

Phase 2

- Experiments
- Interviews
- Focus Groups

- Historical research
- Experts Workshop

Phase 1

- Survey

Phase 3

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

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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

90-character	140-character	1,380-character
• Current WEA	• Social media (i.e., Twitter) • Future WEA?	• Current EAS/ IPAWS/CAP • Future WEA?

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Methods

Experiments

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

Think-Out-Loud Interviews

- 50 conducted
- Read one message to interviewee
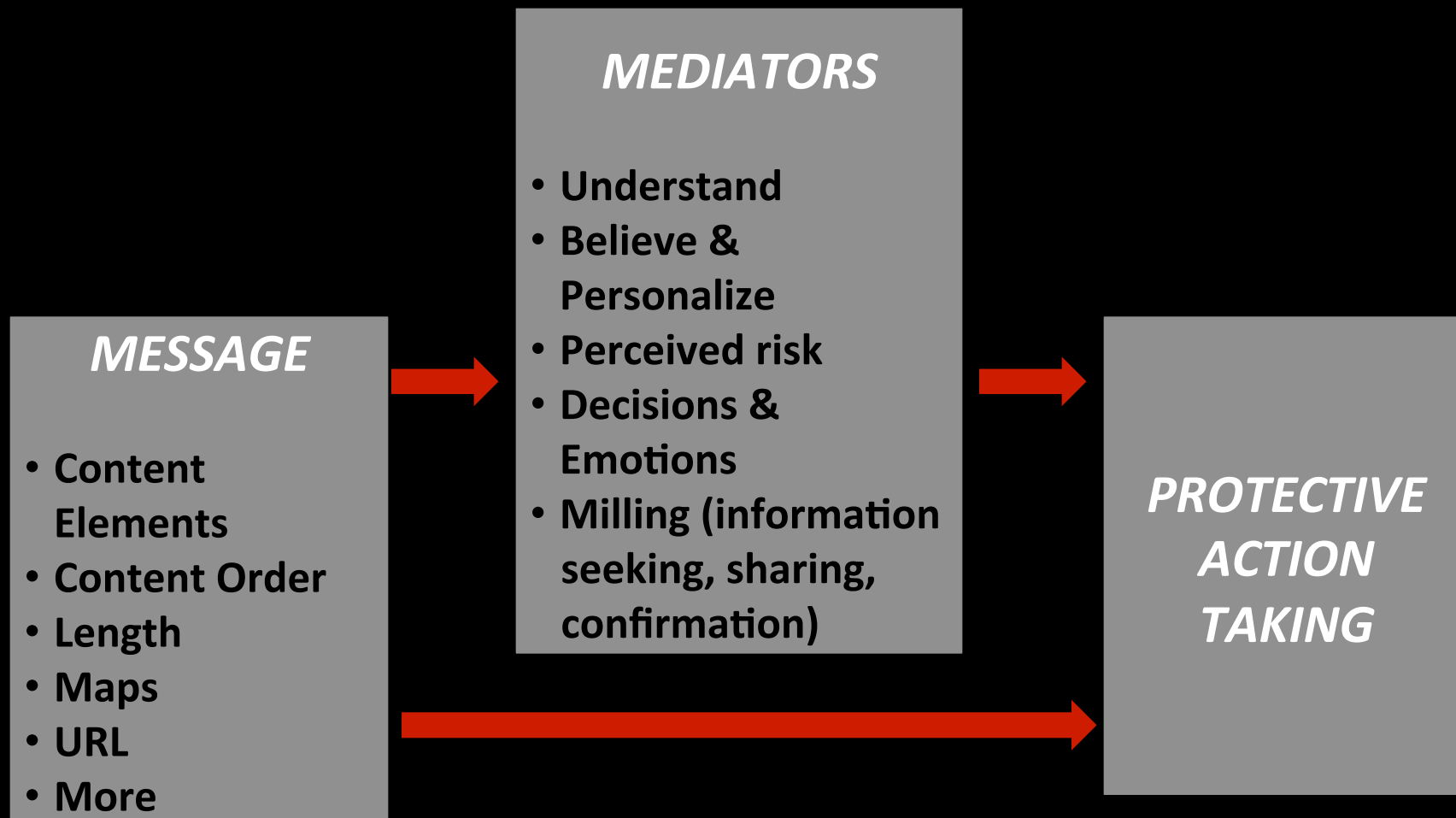- Asked for initial reaction

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

90 & 140-characters	1,380-characters
• Placing source first aids interpretation • Placing protective action up front increases understanding	• 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*

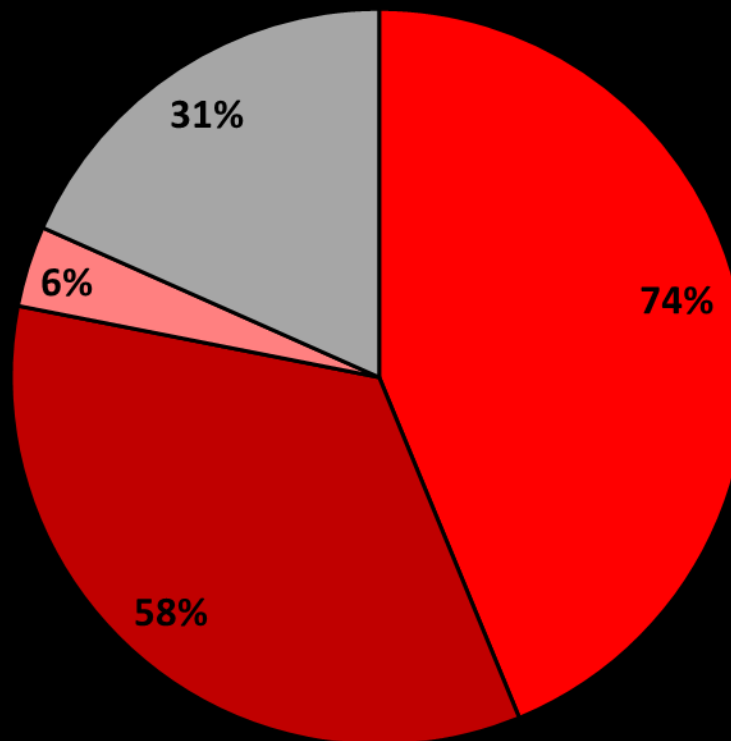# Qualitative Findings

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 Recipeints Received Messages From

- ■ Personal source
- ■ Local government source
- ■ State government source
- ■ National government source

Conclusions

Local & familiar sources work best

Source acronyms generally unknown
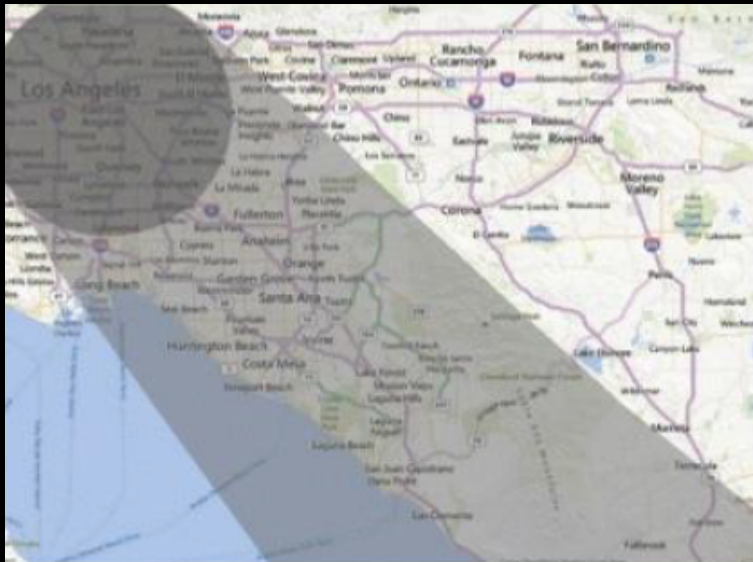
Public education about WEA needed

Question 3
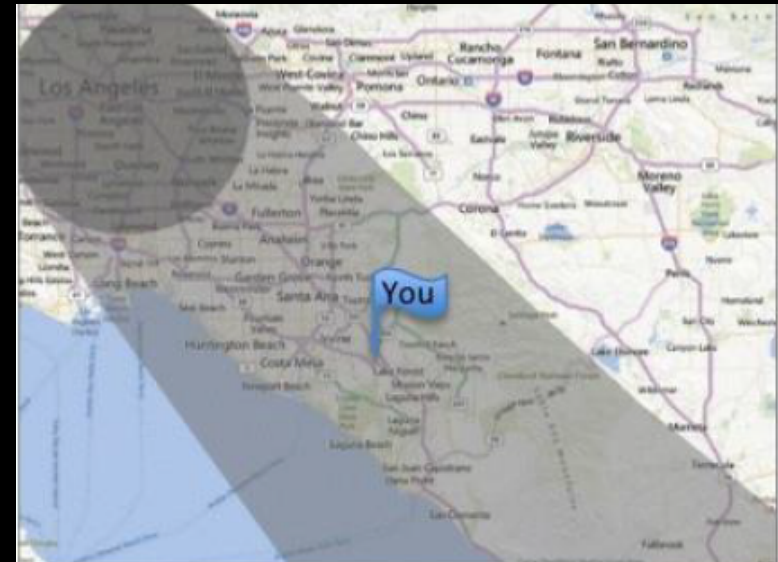
Would a map optimize outcomes?

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

Survey Findings

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	Not include
• High information maps	• 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

1,380-characters

- 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

1380-characters — Optimize public perception & response outcomes

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140-characters — 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: **1/2 "*not knowledgeable*"**

WEA survey sample: **1/3 *"not knowledgeable"*** about public alerts & warnings

Conclusions

Consideration should be given to:	Public WEA system familiarity would likely:
• A national public education campaign to familiarize people with WEA	• 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

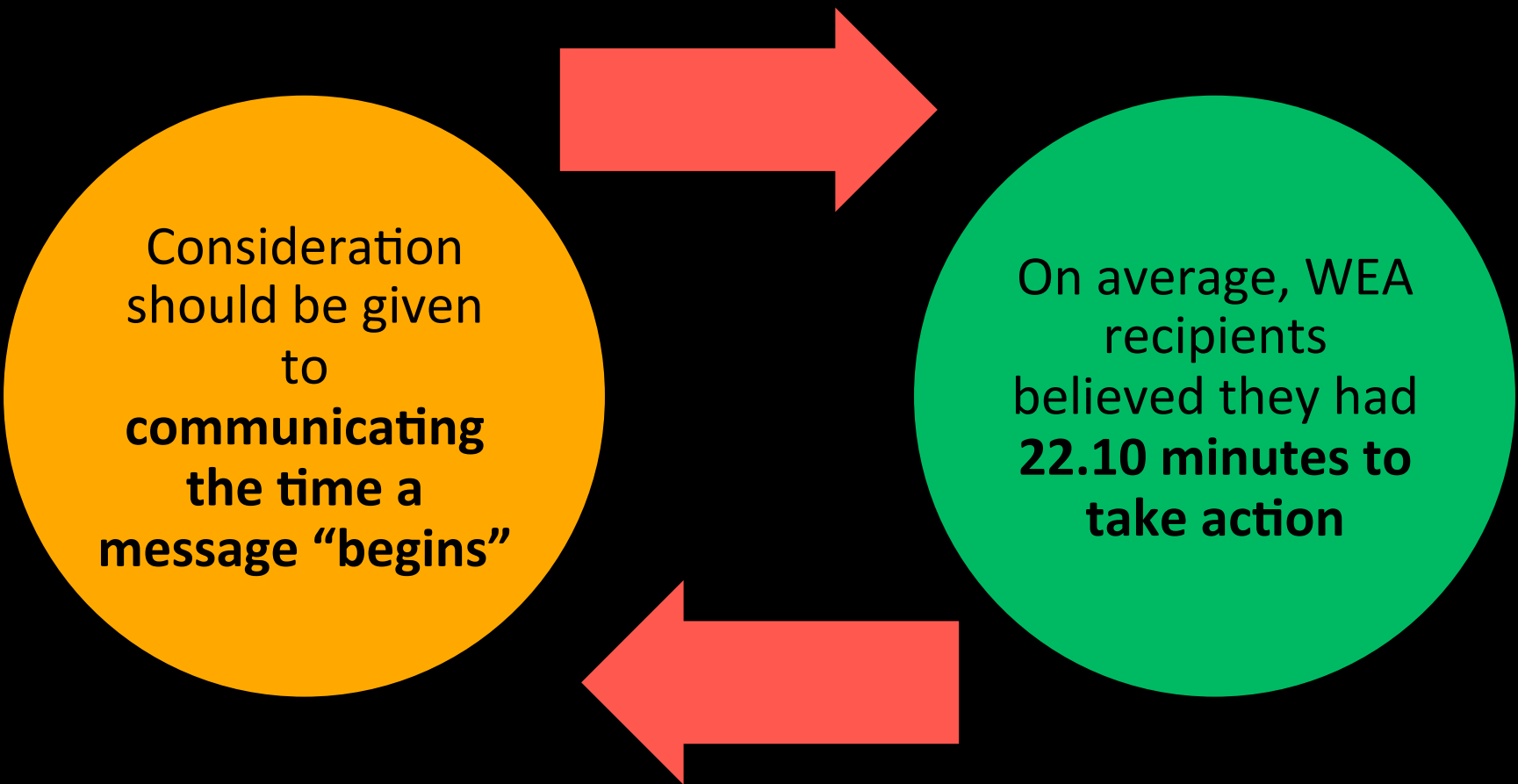# Question 10

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

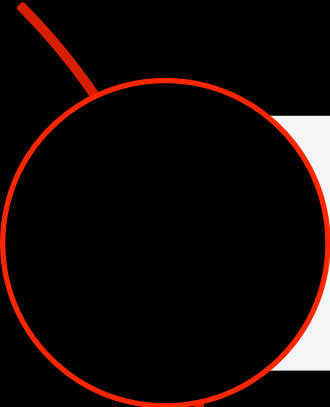**Communicating message expiration time confuses public about action taking**

Need to be clear when danger & the need to take protective action begin & end

Question 11

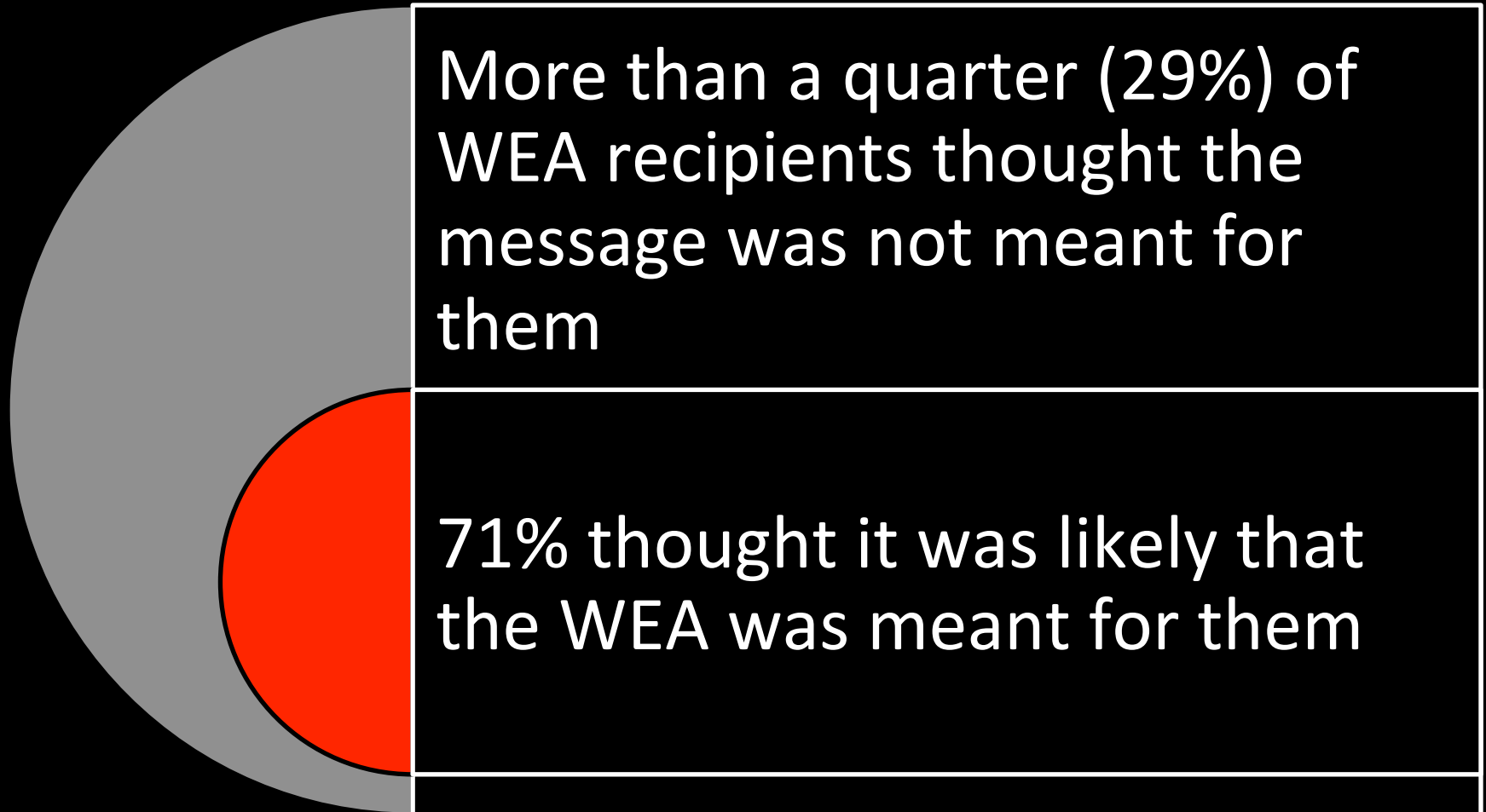How is location best described in a WEA?

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

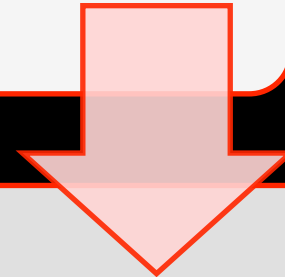Is there an optimal level of fear arousal?

Experiment Findings

Fear and lament were consistent emotion factors

All message lengths & most message content factors had significant relationships with fear & lament

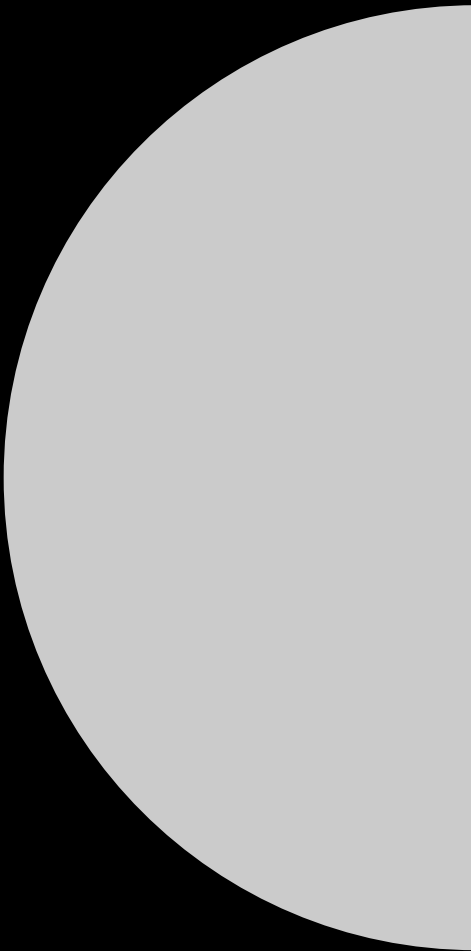**Response could not be measured in the experiments**

Qualitative Findings

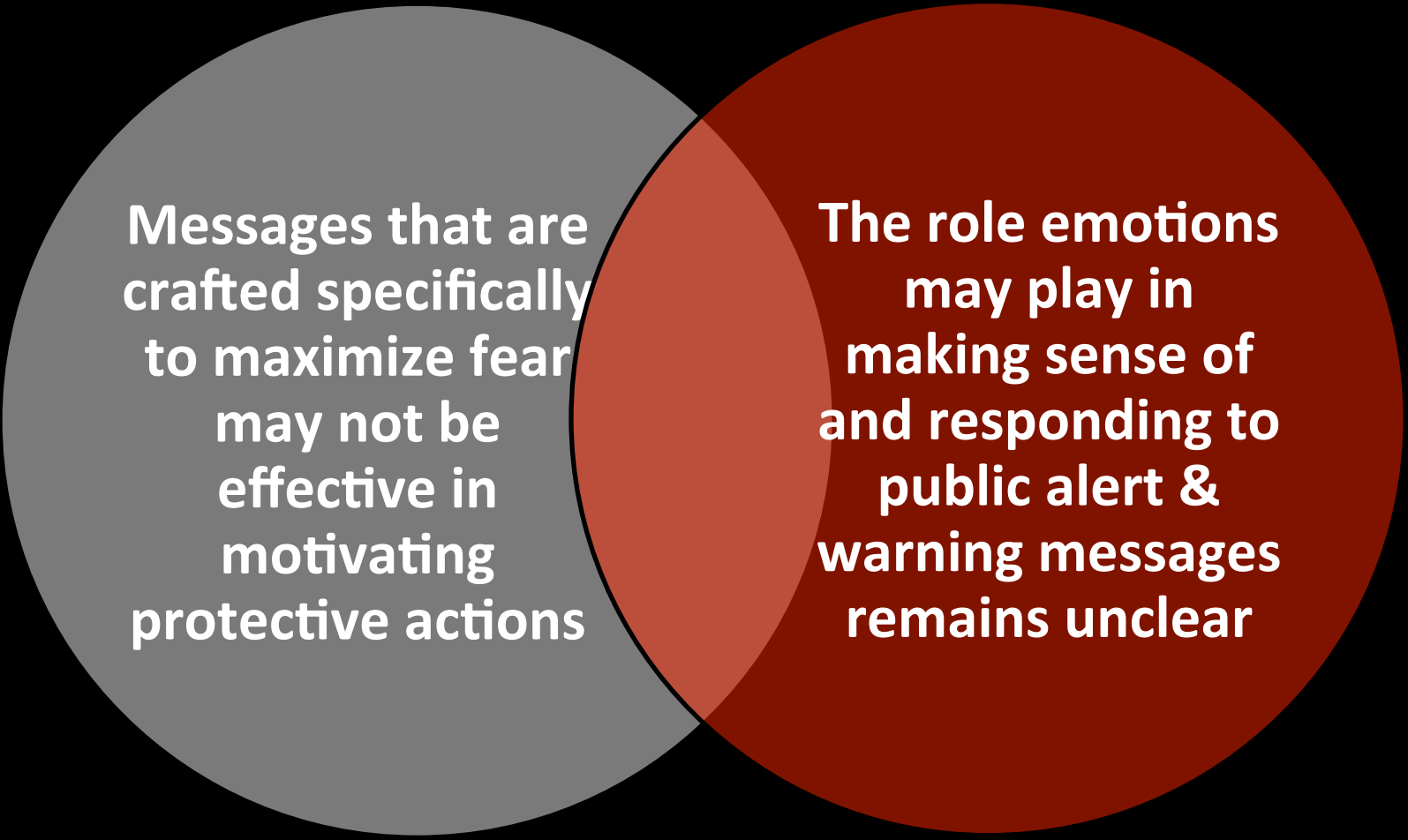**All message lengths
do impact fear &
other emotions**

**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)**
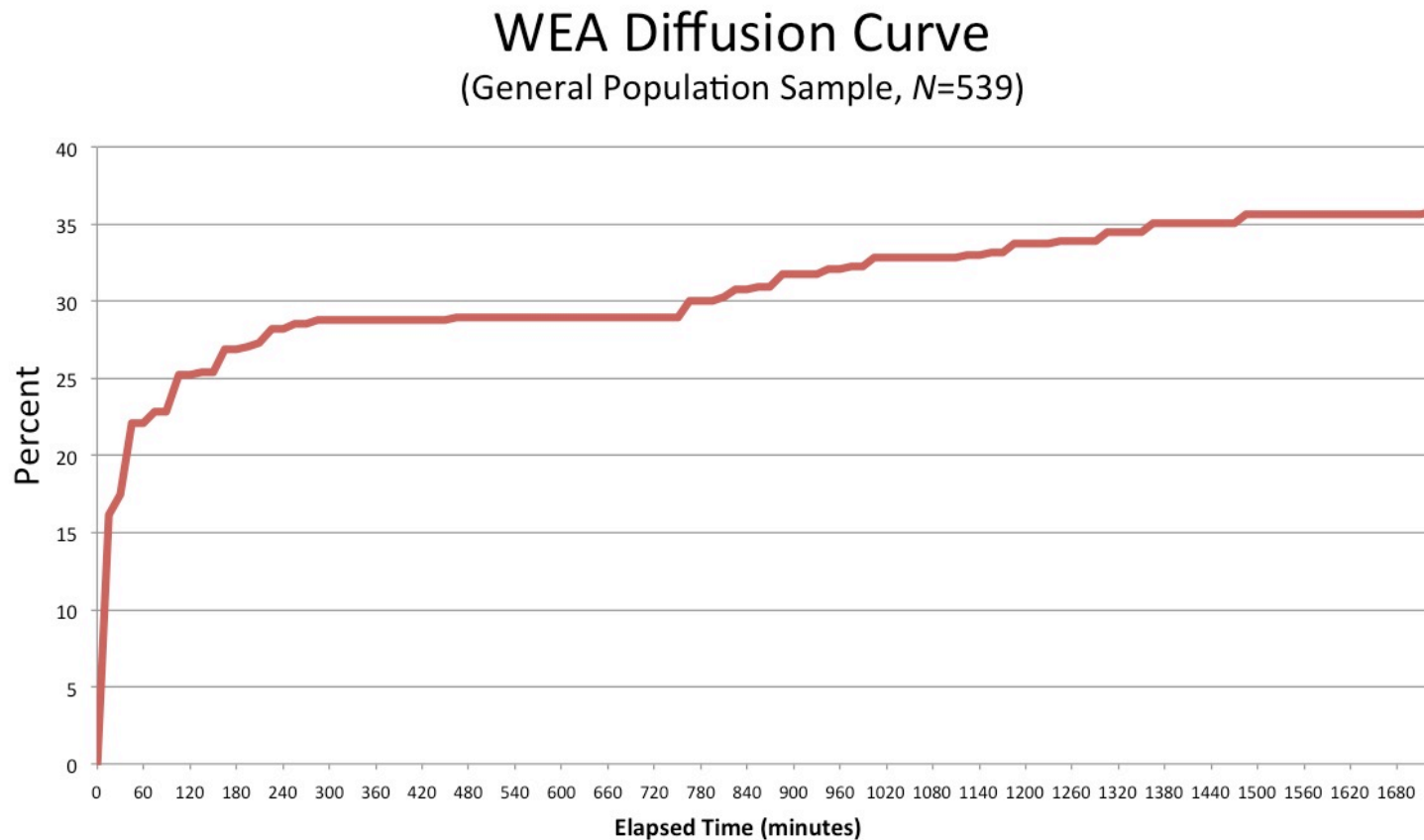
Conclusions

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).

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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
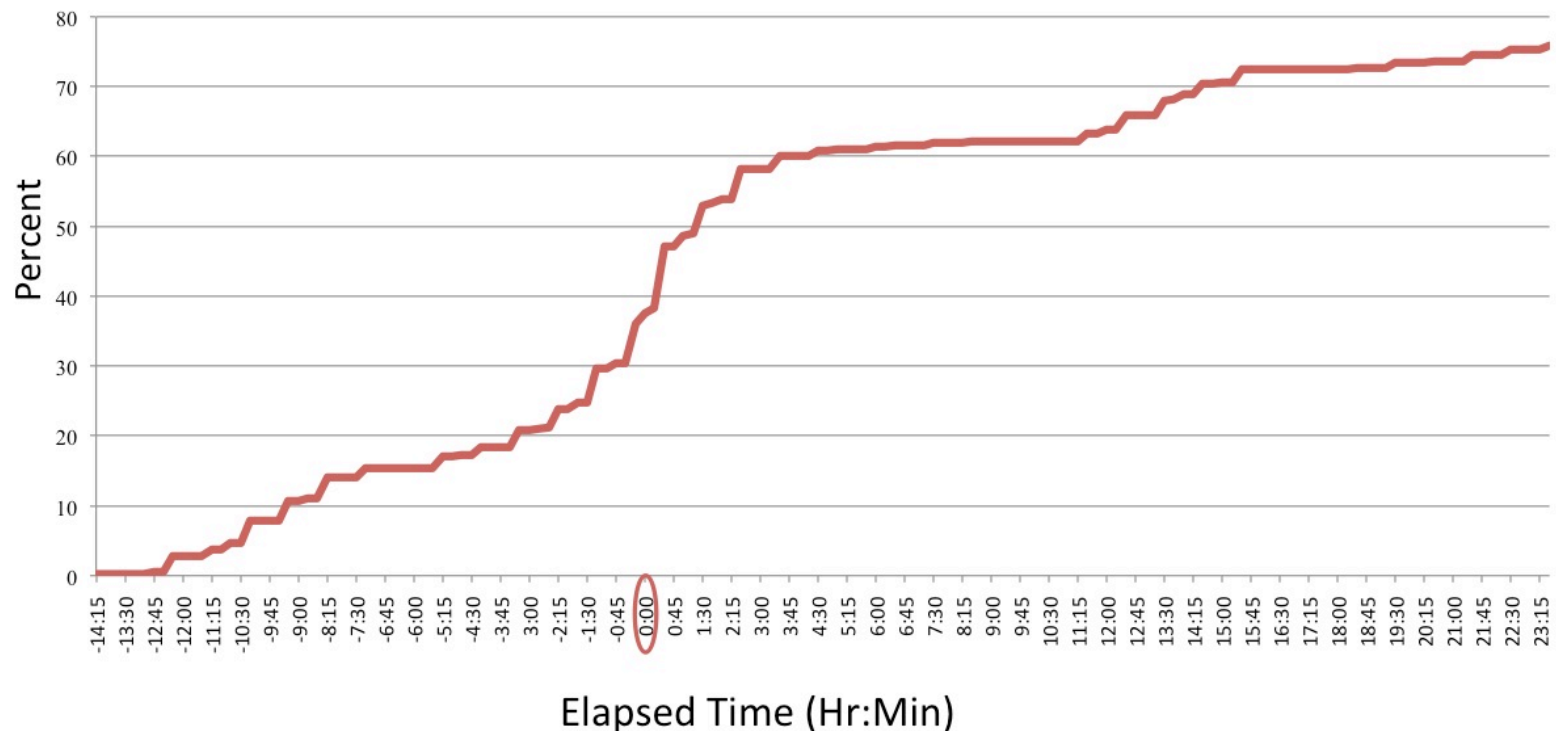
Question 15

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.

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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
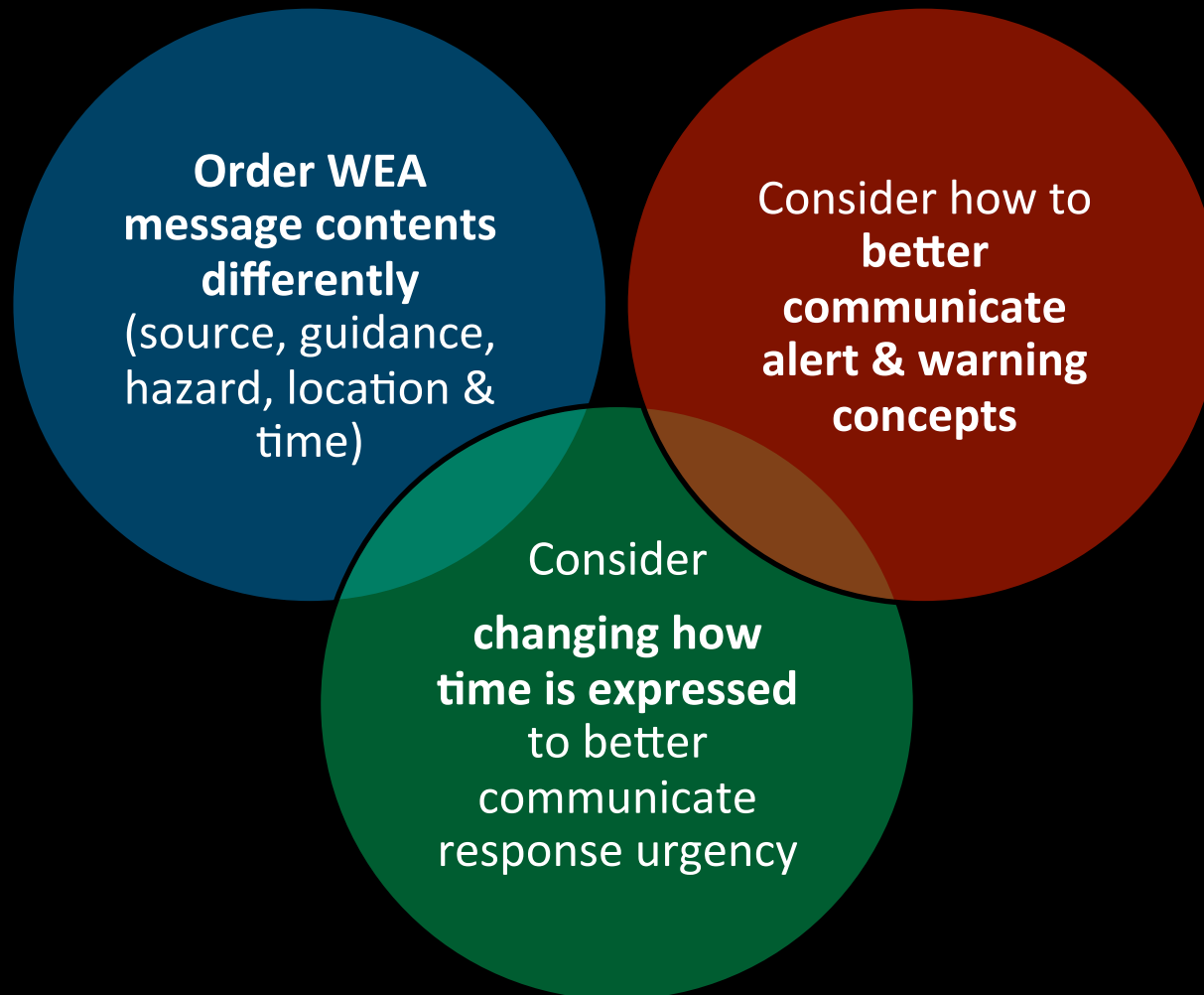
Conclusions

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

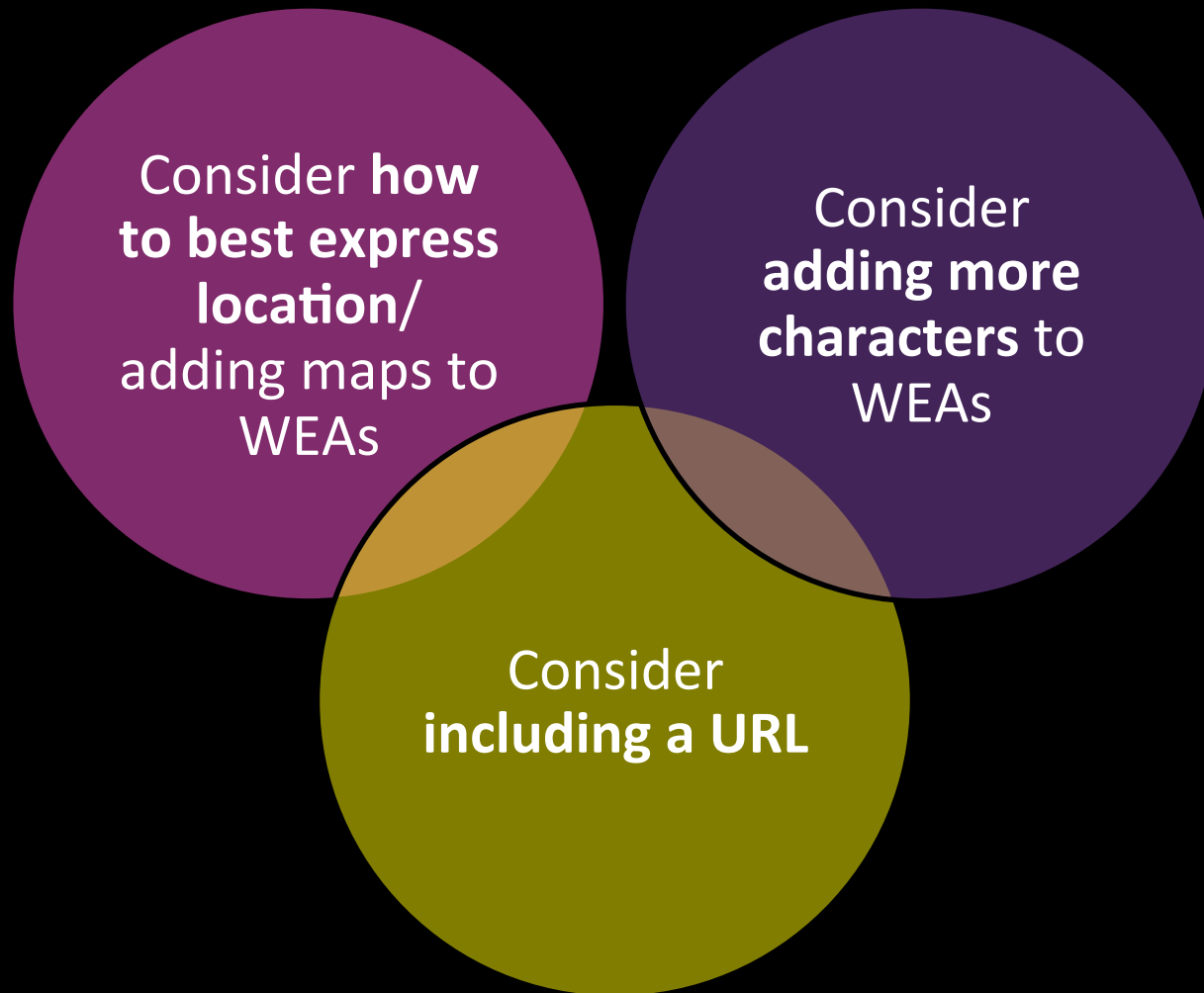**We have the first evidence that WEAs move people to check media**

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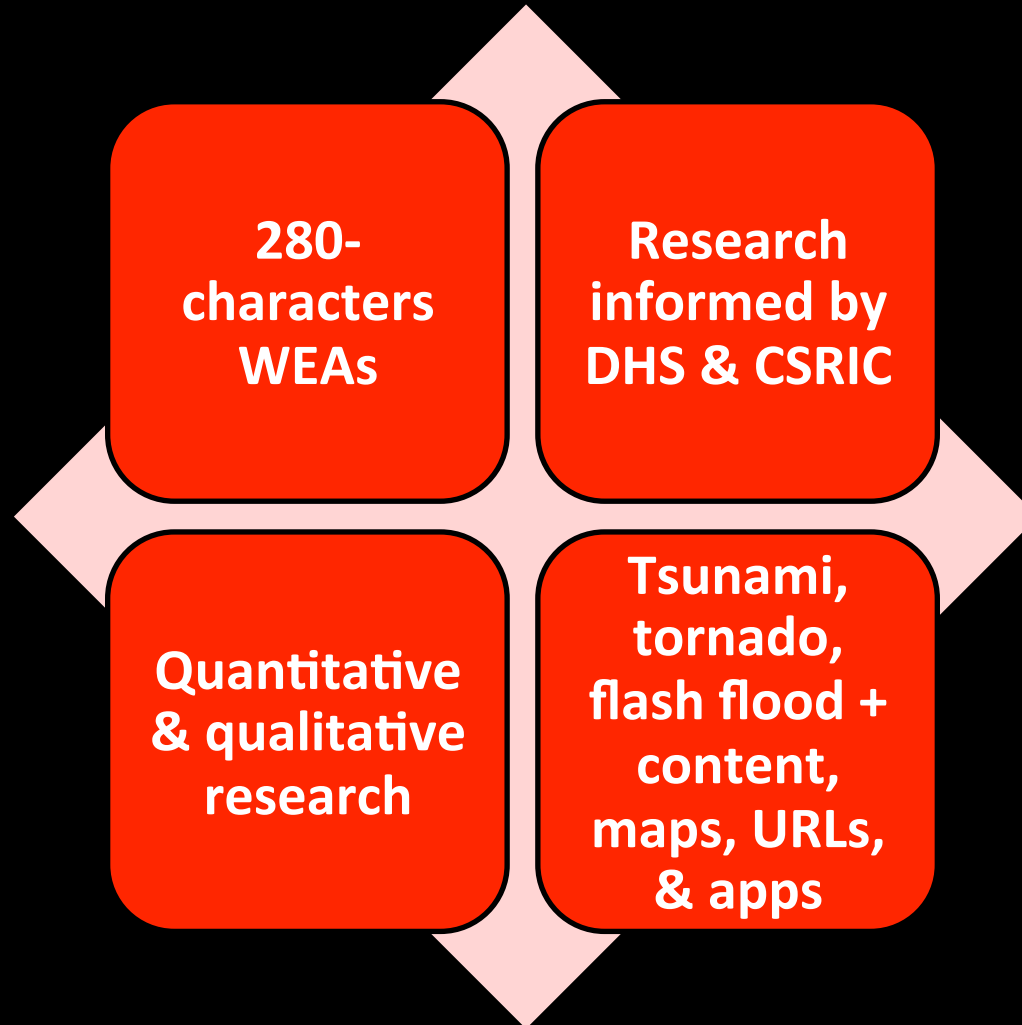
What is the effect of message sounds, color, size, shape & style on message interpretation & response?

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-characters WEAs

Research informed by DHS & CSRIC

Quantitative & qualitative research

Tsunami, tornado, flash flood + content, maps, URLs, & apps

START

National Consortium for the Study of Terrorism and Responses to Terrorism

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