Societal Response to Hurricanes: Risk Perception and Forecast Messaging

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TOPICS

• Why is the final step in forecasting so difficult?

• What are the elements of effective warning messages?

• What factors influence risk perception?

• How can social science improve forecast communication?
Forecast Accuracy
Earlier,
more accurate
warnings
Better protective actions available
Yet, people still die

82 Deaths

61 Deaths

55++ Deaths
Did these people receive the forecasts?
Did they understand the messages?
Did they know they applied to them?

Did they understand their risk?
“Do people get the message and understand what it means to them? That’s the only question that matters.”

Bryan Norcross Official Blog
04 September 2012
Steps To Effective Warning Response

1. Understand Hazard
2. Receive and Understand Message
3. Perceive Risk
4. Believe It Applies
5. Know What To Do

RESOURCES

Appropriate Protective Action
People in your region are most likely to underestimate the potential impacts of which TC hazard?

A. Rain
B. Wind
C. Surge
D. Tornadoes
Public Opinion on What Hazard Causes the Most Deaths


Understand Hazard

“Slow Rising Water”? 

“I’ll leave if it starts to get bad.”
## Misunderstanding of Storm Surge by Coastal Residents

<table>
<thead>
<tr>
<th>Incorrect Statement</th>
<th>Somewhat or Completely Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surge only affects within one mile of coast</td>
<td>25%</td>
</tr>
<tr>
<td>Storm category refers to wind and surge</td>
<td>41%</td>
</tr>
<tr>
<td>Surge caused by rain</td>
<td>20%</td>
</tr>
<tr>
<td>Surge and tsunamis are same</td>
<td>17%</td>
</tr>
</tbody>
</table>

Lazo, Jeffrey. 2010. *HFIP-SEIA Storm Surge Panel Survey.* NCAR. N = 1121-1168
SURGE EDUCATIONAL RESOURCES

https://www.nhc.noaa.gov/surge

ANIMATIONS

VIDEOS

HISTORICAL SLOSH RUNS

TIP SHEETS
Understand Hazard

Potential impacts from each hazard will be part of planned interactive website.
Receiving was more of a problem in the past

Galveston Hurricane - 1900

8000 Deaths
Where do you think most people in your region FIRST hear about a TC threat?

A. TV
B. Radio
C. Cable or national TV
D. Smart phones
E. Social contacts
F. Other
Where do you think most people in your region get MOST of their TC forecast information?

A. TV
B. Radio
C. Cable or national TV
D. Smart phones
E. Social contacts
F. Other
Receive and Understand Message

Information Sources Used Great Deal During Sandy:
- 62% local TV
- 53% national TV
- 48% The Weather Channel
- 29% local radio
- 21% Internet
- 8% social media
- 8% NOAA radio


<table>
<thead>
<tr>
<th>SOURCE</th>
<th>PERCENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Radio</td>
<td>41</td>
</tr>
<tr>
<td>Cable or Satellite TV</td>
<td>24</td>
</tr>
<tr>
<td>Local TV</td>
<td>20</td>
</tr>
<tr>
<td>Internet</td>
<td>6</td>
</tr>
<tr>
<td>The Weather Channel</td>
<td>1</td>
</tr>
<tr>
<td>NOAA Weather Radio</td>
<td>1</td>
</tr>
<tr>
<td>Friends or Family</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
</tr>
</tbody>
</table>

Understand?

- Tropical cyclone
- Tropical vs. Extratropical
- Convective structure
- Wind radii
- Global models, model consensus
- Barometric pressure

Interpreted by broadcast mets, local WFOs, officials

What about those received by internet or social media?
Understand?


<table>
<thead>
<tr>
<th></th>
<th>Louisiana</th>
<th>Alabama</th>
<th>Mississippi</th>
<th>Florida Panhandle</th>
<th>Florida Keys</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hurricane Watch</td>
<td>63</td>
<td>63</td>
<td>64</td>
<td>60</td>
<td>70</td>
<td>62</td>
</tr>
<tr>
<td>Hurricane Warning</td>
<td>40</td>
<td>35</td>
<td>43</td>
<td>40</td>
<td>41</td>
<td>40</td>
</tr>
</tbody>
</table>

Table 14. Respondents Correctly Defining Watches and Warnings (Percent)
Some Implications:

- Multiple channels of communication, including radio
- Simple language and messages with suggestions/links to more in-depth information
- Self-explanatory graphics and maps
Some Research Findings on Risk Perception:

- Socially constructed out of past experiences (mental models)
- Strong social component
- Affected by cultural differences in attitudes toward risk
- Affected by experience, but with diminishing effects
- Lots of “false” experience
Which factor do you think MOST influences whether people think they need to take protective action?

A. Strength of the wind (Category)
B. Size of the storm
C. Potential storm surge
D. Location of their home in relation to track
E. Characteristics of their home (shutters, etc.)
F. Their estimate of the probability it will happen
G. How much of a chance they’re willing to take
Do people understand their exposure?

Mississippi Behavioral Analysis. 2011. Morrow & Gladwin through Dewberry for FEMA and USACE
Do people understand their exposure?

Perceive Risk

Alabama Behavioral Analysis for Hurricane Evacuation Study. 2011. Morrow & Gladwin through Dewberry for FEMA and USACE.
Do people understand their exposure?

Likelihood Would Be Flooded in Major Hurricane:

- Not Very Likely
- Somewhat Likely
- Very Likely

Each dot = one interview

Coastal Georgia Evacuation Study. 2010. Morrow & Gladwin through Dewberry. 2009 for FEMA and USACE.
Hampton Road VA Evacuation Study. 2010. Morrow & Gladwin through Dewberry for FEMA & USACE
Vulnerability can be increased by:

- Rapid population growth
- Poverty
- Lack of access to adequate land
- Lack of access to safe housing
- Deforestation
- Urbanization
- Tourism
- Cultural beliefs
Do you think the public understands forecast probability?

A. Not at all
B. Sometimes
C. Usually
D. Most of the time
Some findings related to communicating forecast uncertainty

• Public is used to uncertainty in rainfall forecasts
• People infer uncertainty from deterministic forecasts
• More likely to reduce exposure when uncertainty information provided
• Broadcast mets are in unique position to explain level of uncertainty
• More research needed on the best ways to express TC forecast uncertainty especially in web and social media
Low Probability, High Impact Events Are Challenging

Compare:
A. 10% chance of precipitation
B. 10% chance of TC winds
C. 10% of life-threatening surge

What are some examples of people taking protective actions against low probability events?
What is the best way to distinguish between a POSSIBLE vs. EXPECTED event?

A. Warning, Urgent Warning
B. Watch, Warning
C. Alert, Warning
D. Other
73% EMs said they Always or Frequently use this map

PERSONAL FACTORS
Individual Differences in Risk Taking

- Personality?
  - Impulsive sensation seeking
  - Aggression

- Biological traits?
  - Sensation seeking
  - (dopamine receptor gene)

- Age Differences

- Gender Differences
Believe It Applies to Them

Personalizing the Hazard

Relationship between forecast and their location needs to be clear
Personalizing the Hazard
Personalizing the Hazard
A Little Bit of Psychology

**DO I REALLY NEED TO LEAVE?**

Must evoke strong FEELINGS to overcome the reasons NOT to leave
Complexities of Personal Safety Decisionmaking

MIND MAP OF A SURGE ZONE RESIDENT

COGNITIVE
- Knowledge
- Experience
- World View
- Personality Traits
- Mental Models
  - Sees world as safe or scary
  - Self efficacy
    - "Surge is like a flood."

SOCIAL
- Relationships
- Interactions
- Networks
  - "What are they going to do?"

AFFECTIVE
- Feelings About:
  - Hurricanes
  - Forecasts
  - Home safety
  - Travel, Etc.
  - Risk
Know What To Do

Policy Question:
Who should be responsible for advising the public about protective actions?
Do you agree that weather service forecasters should include Protective Action recommendations to citizens as part of their TC forecasts?

A. Strongly agree  
B. Somewhat agree  
C. Somewhat disagree  
D. Not sure
Preparations should be aggressively made for the potential of devastating to catastrophic impacts. If realized, extremely dangerous life-threatening winds may cause well-built framed structures to incur major to severe damage, including partial to complete roof and exterior wall failures. Numerous trees snapped or uprooted. Near total loss of power across extensive areas, with outages lasting from many days to weeks or months. In worst cases, places could be uninhabitable for extended periods with immense human suffering. Generalized descriptions are consistent with damage caused by major hurricane force winds of Category 3, 4, or 5 intensity (111 mph or greater). No preparations needed at this time; little to no impacts as wind should remain below tropical storm force.
Hurricane Katrina - 2005

Good Forecast
56 hours before landfall
Some Wanted To Leave
But Couldn’t ….

• Insufficient resources
  – Transportation
  – Cash for gas
  – No place to go
Steps To Effective Warning Response

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RESOURCES

Appropriate Protective Action
Social scientists are your friends!

Do people understand TC hazards, such as surge?
Do they understand forecast messages?
Do they understand uncertainty and probabilities?
How do they react to various text and colors?
What factors are associated with risk perception?
Do they recognize their vulnerability?
How much confidence do they have in forecast?
Do they know what the potential impacts and what protective actions to take?
One Social Science Research Model

DISCUSSIONS, TASK FORCES, PROTOTYPES

STAKEHOLDER INTERVIEWS

REVISED PROTOTYPES

FOCUS GROUPS

FOLLOW-UP INTERVIEWS

REVISED PRODUCTS

EXPERIMENTAL

OPERATIONAL

PRODUCTS:

STORM SURGE FLOODING MAP

STORM SURGE WARNING

Work completed through Eastern Research Group & National Center for Atmospheric Research and funded by HFIP and NOS Surge Roadmap.
Storm Surge Map Survey Results

Positive Ratings*

• Ease of understanding
  • 96% by Media
  • 86% by EMs
  • 77% by Public
  • 90% by WCMs

• Usefulness
  • 94% by Media
  • 84% by EMs
  • 98% by Public
  • 83% by WCMs

* Excellent, Very Good or Good

• Preference for this map over solid blue one or graduated blue one

• Problems with using “low” to describe storm surge hazard

Note: Some indication that people pay more attention to legends when at lower left
Other Surge-Related Findings

• Use Above Ground Level datum
  – Describe how derived and what it includes

• Refer to HEIGHT, not depth, when describing levels
• “1 to 3 feet high”
Another Product Under Development Using Social Science
Bottom Line:

• Risk perception and response is very complex.

• Forecast only as good as the extent to which it results in appropriate response.

• Only scientific way to know how stakeholders interpret and use is to test messages.

• Ideal model is an iterative testing process using rigorous social science methodologies during message development with periodic retesting.
AND THAT CONCLUDES THE POWERPOINT PORTION OF MY PRESENTATION. THANK YOU, MAURICE.

NO PROBLEM, MR. DAVENPORT.
Comments or Questions?

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