Graphical Communication of Hurricane Risk for Vulnerable Populations

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Interdisciplinary Team ("HURAKAN")

Risk Perception, Data Visualization, Community Psychology, Hurricane Prediction, Human Factors

Collaborators and Stakeholders:

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Craig Setzer (CBS4 Miami)

Other University of Miami participants:

Jennifer Amendola, Morgan Asmussen, Andrew Carter, Carolina Diaz, Qinyu Ding, Qian Ma, Sav Olivas, Leigh Rauk, and the Tropical Weather and Forecasting class (ATM 244)

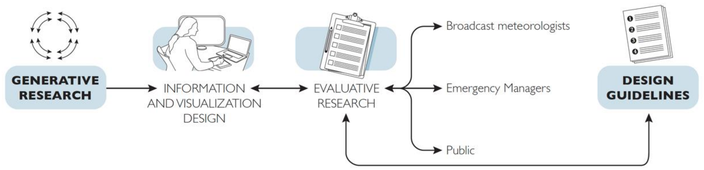
Long-Term Goal

To contribute to the design of an information provision system that communicates the minimal critical pieces of information to the maximum number of people from diverse backgrounds.

- People have difficulty interpreting probabilistic forecasts and making decisions based on them
- Risk is not allocated equally, with the poorest communities often bearing a disproportionate burden of natural disasters

Challenge in **visually** communicating risk and potential threats

Project Flow and Progress

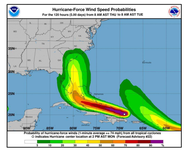


- Cross-Disciplinary Literature Review
  - Millet et al. (2020): "Hurricane Risk Communication: Visualization and Behavioral Science Concepts". *Weather, Climate and Society.*
    - A review of research concerning visual communications and the way in which individuals process, understand, and make decisions regarding them.
    - A review of the ways in which vulnerable communities understand and interact with hurricane forecast communications.
    - Suggestions of areas in hurricane risk communication that merit increased research and draw lessons or guidance from the broader hazards/social science realm.
- 8 Focus Groups (54 residents)
- Online Survey of 2847 FL Residents
- Visualization Design and Evaluations (2 experiments)
- Video Interviews with 13 Broadcast Meteorologists
- Workshops with Expert Stakeholders
- Community Outreach (e.g., Miami Science Museum)

Focus Groups

Methods

- 54 Miami residents
- 8 groups with 3 in Spanish
- Conducted in Little Havana and Downtown
- Short questionnaire; discussed forecast products



Descriptive Findings

- Participants mostly female Latina renters with income <$50,000
- Use mobile devices most frequently to access storm info
- Use multiple sources: TV, websites, social media

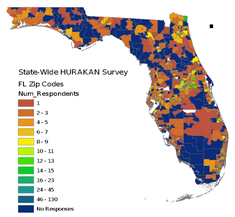
Interpretive Findings

- Difficulty interpreting graphics due to sheer amount of information on cone products
- Frequent misinterpretation of intended message
- Participants interested in receiving clear information that would help them make informed decisions about what to do and when

Survey of FL Residents

Methods

- Launched through Amazon Mechanical Turk (MTurk)
- 2847 responses
- 68% White
- 40% household income under $50,000
- 51% less than Bachelor's degree
- Exploring sources of information and interpretation of cone graphic



Examples of Misinterpretations

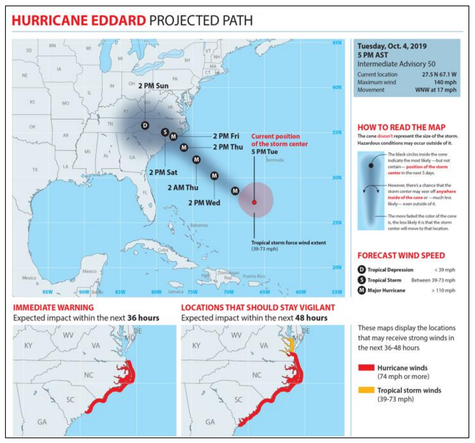
Q1 - The CONE graphic shows that the areas outside the cone are not predicted to be damaged by the storm or hurricane: **41% said "TRUE"**

Q2 - In the FULL PICTURE, one can find the forecasted size of the storm or hurricane: **44% said "TRUE"**

Main Findings

- **Social vulnerabilities** that contribute to risk are not always considered in forecast products: language, literacy, age, socioeconomic factors
- **Systematic misinterpretations**: cone & surrounding elements
- TV, Internet/Apps, Social Media most used **sources**

Visualization Design & Experiment 1: Cone Redesign



Exploring how visualization design influences visual attention and interpretations of track uncertainty

Methods

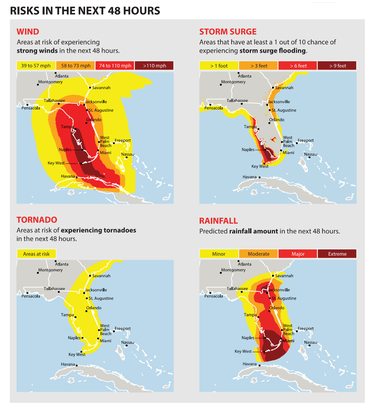
- 9 tropical cyclones
- 3 visualizations
- Eye tracking
- Probabilistic estimation
- Perceived ease of use
- 43 non-experts participated
- Eye-tracking

Main Findings

- Prior experience with NHC Cone visualization drove the participants' preference.
- Graph literacy, visualization format, storm characteristics influenced users' interpretations.

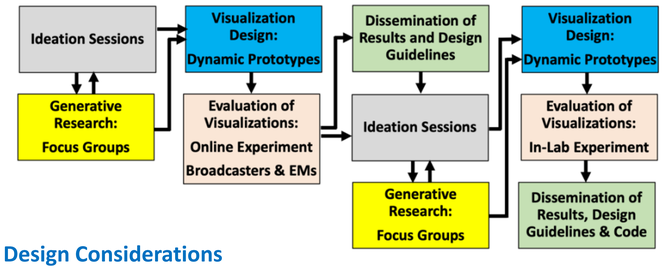
Visualization Design & Experiment 2: Threats

- Goal: To explore how different types of forecast information on threats and impacts affect users' comprehension
- Prototype static redesigns based on NWS Hurricane Threats and Impacts (HTI)
- Online Experiment (Qualtrics)
- Evaluations are under way



New NOAA Grant

Dynamic Communication of Weather Risk: A User-Centered Design Approach



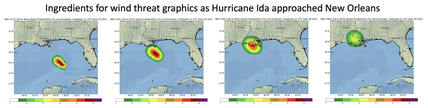
Design Considerations

- **Control.** Current National Weather Service graphic.
- **(Priority) Multiple hazards in one weather event over multiple forecast times**. Vary for **different lead times (0-5 days)**.
- **Multiple types of weather event**. Uniformity in the designs for each hazard.
- **Variations of multiple hazards in space and time across an area.**
- **The appropriate amount of information** that can be cognitively processed.
- **Communicating "expected" impacts versus "reasonable worst case" impacts**.
- **The social conditions that lead to differing levels of community vulnerability**.
- **Communicating the level of uncertainty** in the amount of potential impact.

Current Work

- **Design charrettes** with local community groups
- **Redesign** of dynamic graphical products (changing with time)

Ingredients for wind threat graphics as Hurricane Ida approached New Orleans



Ingredients for rainfall threat graphics as remnants of Ida moved across the United States

Future Work

- Extend design principles and guidelines
- Expand to types of weather events
- Explore applicability to climate risk communication.