Proportional Tornado Warnings
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Background and Research Goals

- Current tornado warning polygon is deterministic, implying a tornado will occur inside and outside.
- However, forecasters know that tornado likelihood varies within the polygon.
- Research shows people have greater trust and make better decisions when an uncertainty estimate, for their location, is provided (Joslyn & LeClerc, 2013).
- We tested whether these advantages extend to graphics showing the likelihood of a tornado at one’s own and surrounding locations.

Pilot Study

- Comparing the current deterministic polygon to color coded uncertainty polygons or tables depicting likelihood by location, we found:
  - Improved perceived likelihood
  - Better improvement in decision quality: People with probabilistic forecasts were reluctant to shelter when probability of strike was 10%
  - What accounts for the lack of improvement in decision quality (contrary to previous research)?

Current Study Research Questions:

1) Will decision quality improve with probabilistic graphics if the threshold for sheltering is raised from 10% to 30%?
2) Does likelihood information for surrounding areas affect the perception of risk for a specific location and shelter decisions as a result?

Experimental Procedure

- Scenario: Imagine that you were traveling in the Southeastern US and received tornado warning from a cell phone app. The potential windspeed of the tornado was 86-135 mph per hour.
- 68 trials in total
- Severity held constant (wind speed 86-135 mph)
- Participants: 232 (47% female) Amazon Mechanical Turkers

Key experimental variables:

- Probability format
- Likelihood information for surrounding areas

Dependent Measures:

- Perceived Likelihood
- Perceived Severity
- Post Decision Trust
- Decision (Shelter, Do Not Shelter)

Results

- Probabilistic formats led to most accurate perceived likelihood
- Deterministic formats led to uniform ratings inside the polygon
- Red format led to overestimation especially at lower probability levels

Conclusions

- Here, where the warning was issued at 30% chance of a tornado or higher, explicit likelihood information improved participants’ sheltering decisions, compared to the deterministic polygon.
- However, when the optimal decision threshold for decision was low, at 10% in the pilot study, although participants sheltered more often at high likelihood and less at low likelihood than those with the deterministic polygon, there was no improvement in decision quality overall.
- An interview study conducted among tornado-experienced residents, revealed that at low likelihoods (10%) within the polygon boundary, while people are reluctant to shelter, they take other precautionary actions such as monitoring information and staying close to home.
- Issuing a tornado warning when there is a 30% chance of a tornado or higher means there is a substantial chance that a tornado would occur outside of the polygon but go unwarned, which has important practical implications.
- Thus, although moving the warning boundary to 30%, may improve decision quality, it may not be the best option from a practical perspective.
- Color-coding can lead to misunderstandings: Red color-coded likelihood
- Led to likelihood overestimation
- Was confused with an expression of severity
- Probabilistic text format, without color or information on surrounding area led to the best understanding:
  - Perceived likelihood closest to the intended values
  - Least confusion between likelihood and severity
  - Highest trust
  - Best decision quality
- Thus, although explicit likelihood can be beneficial, it depends on the situation and how it is presented

References

Qin, C., Joslyn, S., Savelli, S., Demuth, J., Mors, R., Ash, K., (2019, November 15th) Probabilistic Tornado Warnings [Conference Session]. Psychosocial: Psychology Annual Meeting 2019, Montreal, Quebec, Canada

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