Communicating Risk and Uncertainty of Extreme Weather and Flood Events

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N E S L

Overview

- Motivation and approach
- Examples of work to improve communication of weather risk and uncertainty
  - Interpretations and use of uncertainty information in everyday weather forecasts
  - Communication and use of hydrometeorological warnings: Myths and reality
  - Flash flood risk perceptions and warning decisions
- Summary

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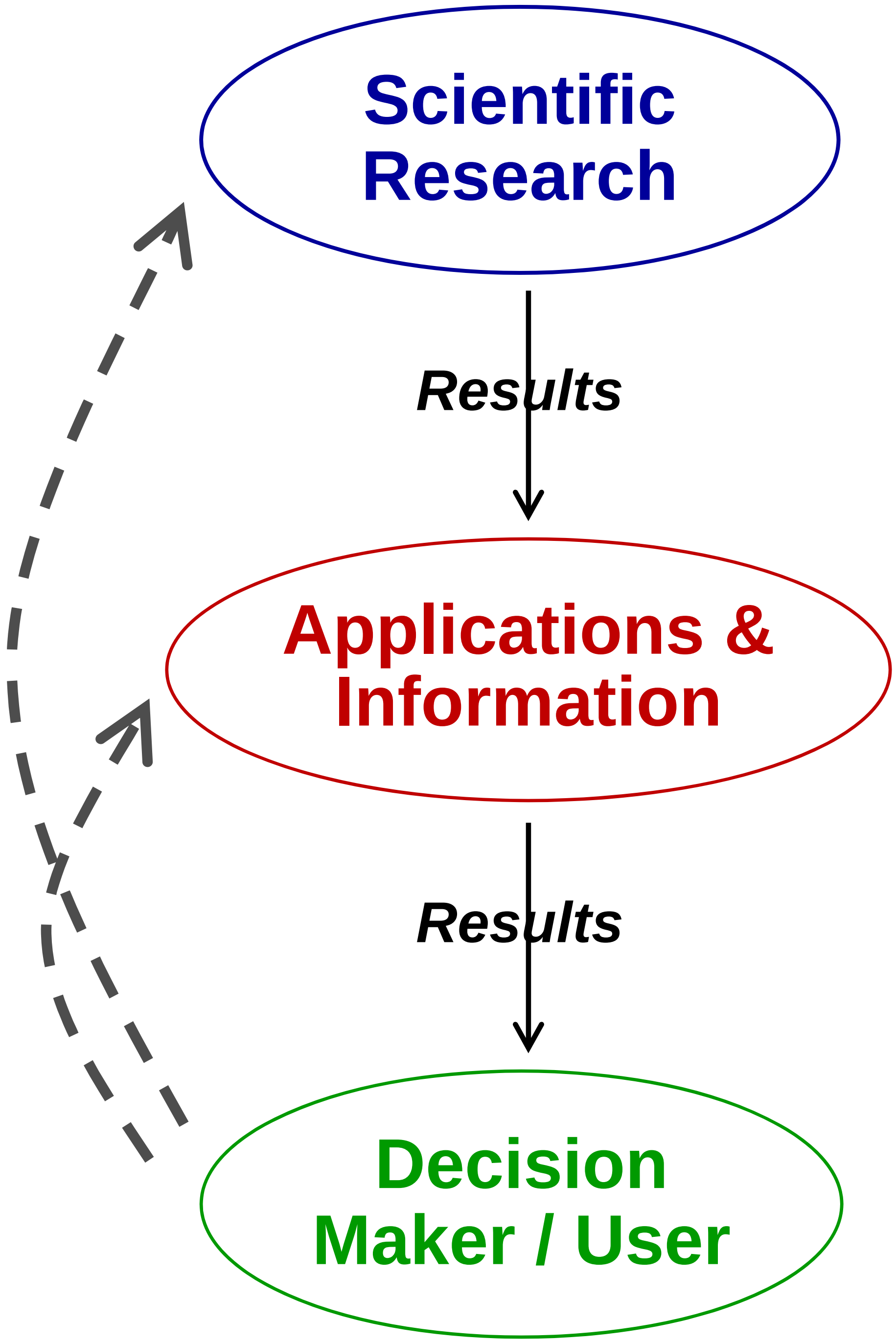
➡ How can we develop more beneficial weather-related risk information and communicate it in ways that benefit interpretation and use?

- How do people interpret weather-related risk information and use it in decisions?
- What weather-related risk information do people want & need?
- How do people perceive and respond to weather-related risk?

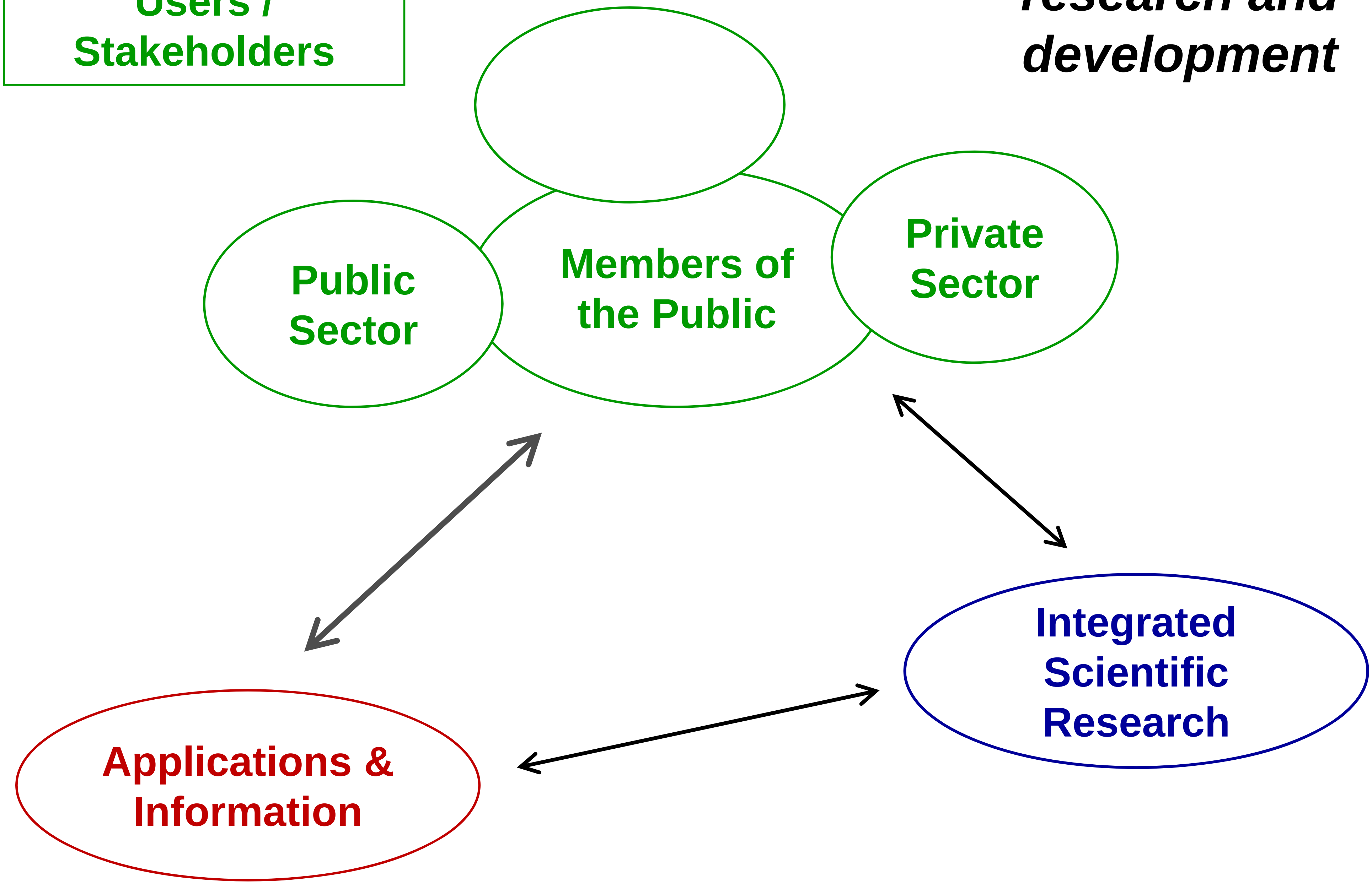
Research using social science & interdisciplinary methods, integrating perspectives



Linear model of research and development ("end to end")

“End-to-end-to-end” research and development

Decision Makers / Users / Stakeholders



Morss et al. (Bull. Amer. Meteor. Soc., 2005)

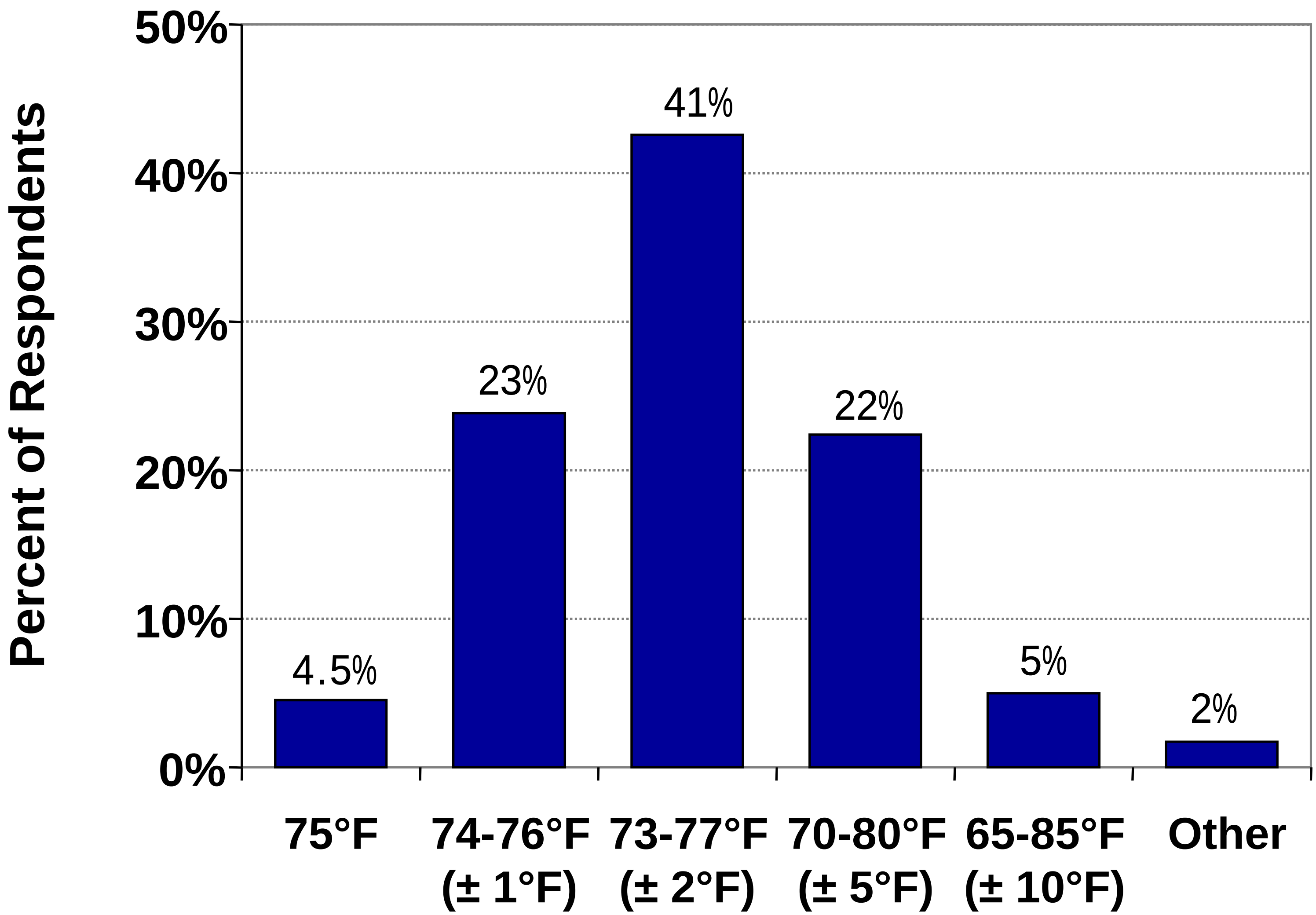
Uncertainty in weather forecasts

- Research questions include:
  - How do people perceive and interpret uncertainty in everyday weather forecasts?
  - What are people's preferences for uncertainty information in weather forecasts?
  - How do people use weather forecasts that include uncertainty information?
- Nationwide survey of U.S. households, implemented with controlled-access Internet sample in Nov 2006 (1465/1520 respondents)

Morss et al. (Weather and Forecasting, 2008; Met. Applications, 2010)
Lazo et al. (Bull. Amer. Meteor. Soc., 2009)
Demuth et al. (submitted to Weather, Climate, and Society)

Suppose the forecast high temperature for tomorrow for your area is 75°F.

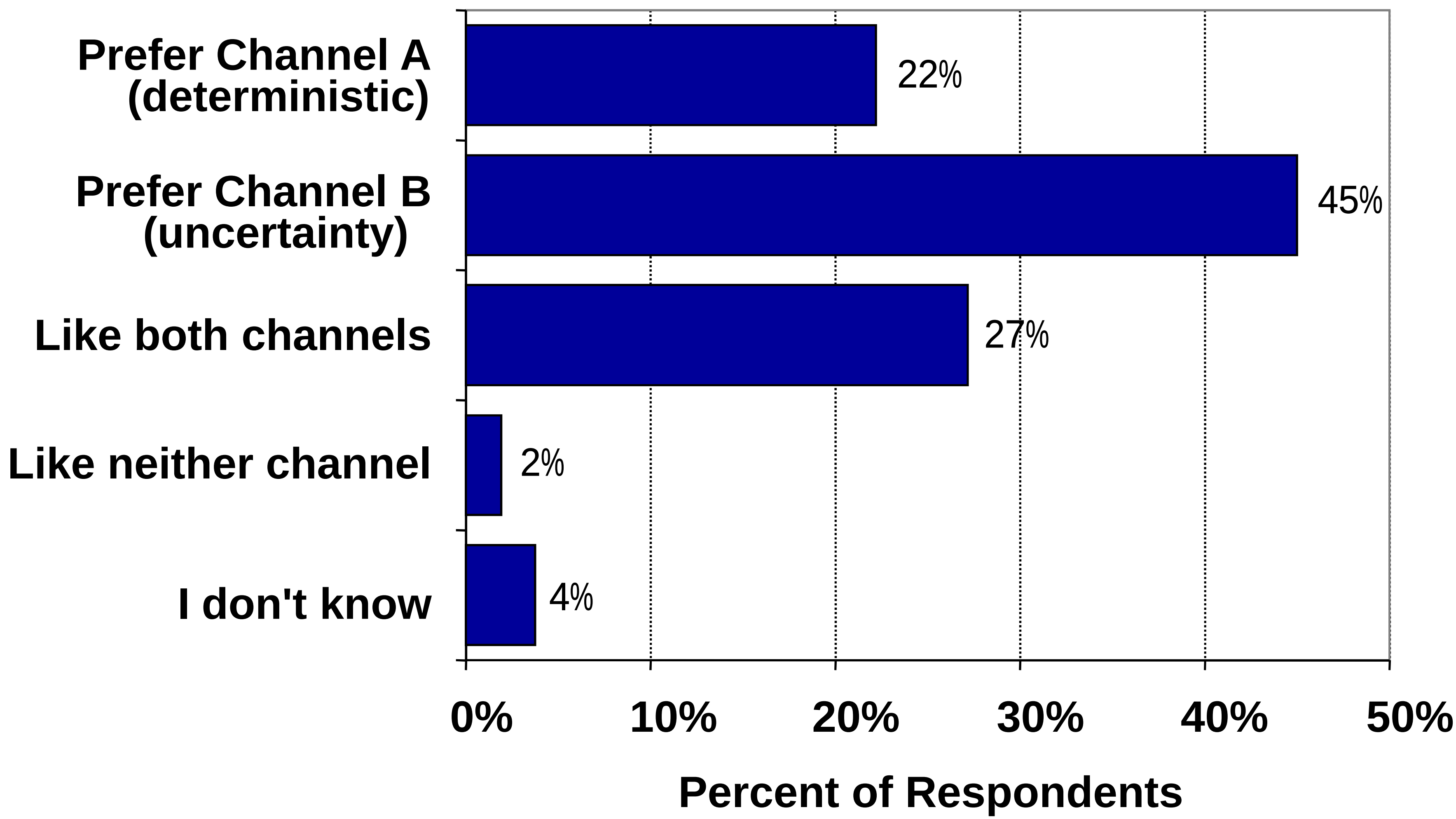
What do you think the actual high temperature will be?



Morss et al. (Weather and Forecasting, 2008)

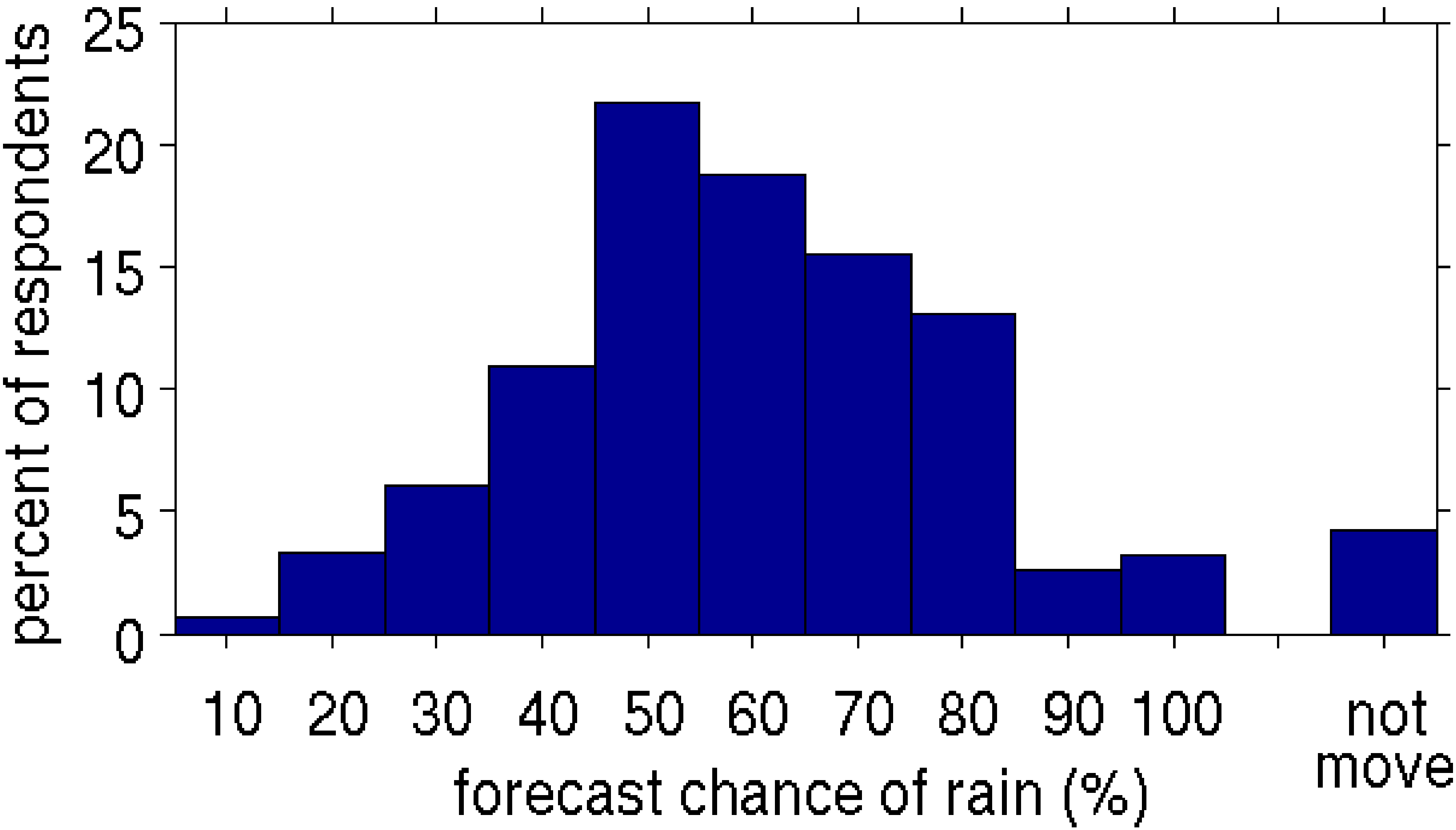
Suppose you are watching the local evening news

- Channel A: high temperature will be 76°F tomorrow
- Channel B: high temperature will be between 74°F and 78°F tomorrow.



Morss et al. (Weather and Forecasting, 2008)

At what forecast chance of rain would you decide to move a picnic indoors?



Morss et al. (Meteorological Applications, 2010)

Use of hydrometeorological warnings

Myths

- There is a “correct” decision as a threat approaches (i.e., evacuate)
- Warning decisions are individual, one-time, yes-no decisions
- There is one “best” way to communicate risk messages
- If you only give people more / more accurate / more detailed forecast information, they will understand and make better decisions

People make protective decisions based on their situation and perception of risk

- People’s decisions are influenced by experience and a variety of risk-related perceptions
- Hindsight is 20-20
- Some people will make “unwise” decisions
- Each decision situation is unique

Damage on the Bolivar Peninsula in coastal Texas after Hurricane Ike (September 2008)

(Ray Asgar)

Warning decisions are complex, multi-dimensional, interactive, and evolving

- Many decisions are household/family-based
- When making decisions, people have a variety of considerations and constraints
- Decisions involve trade-offs (e.g., between time for preparation and evacuation)
- Most decisions unfold as an event and information about it evolve

Risk should and will be conveyed in different ways to different audiences

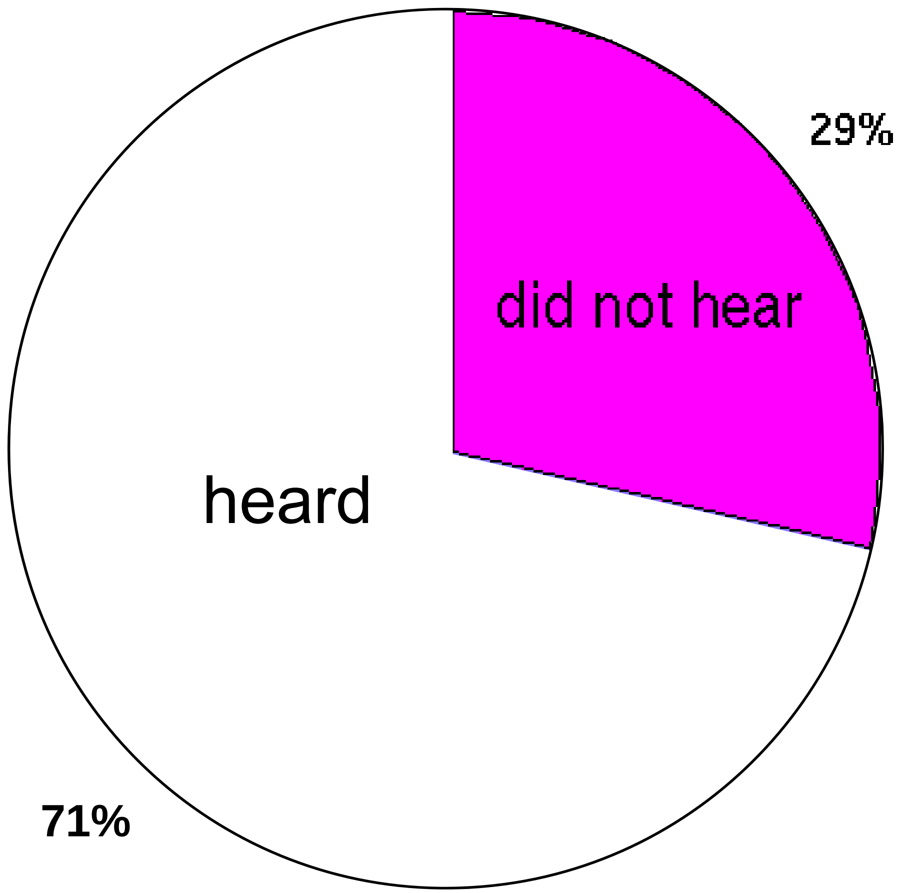
- Different people have different decision criteria and information capacities, interests, and needs
- People obtain information from different sources — sources are diversifying and often not first-hand
- People want to know how an event will affect them

Giving people more / more accurate information from a scientific perspective is often not the answer

Communicating risk more effectively requires understanding how people obtain and interpret information and use it in decisions

Hurricane Ike: Local National Weather Service office: *"Persons not heeding evacuation orders in single family, one or two story homes will [may] face certain death."*

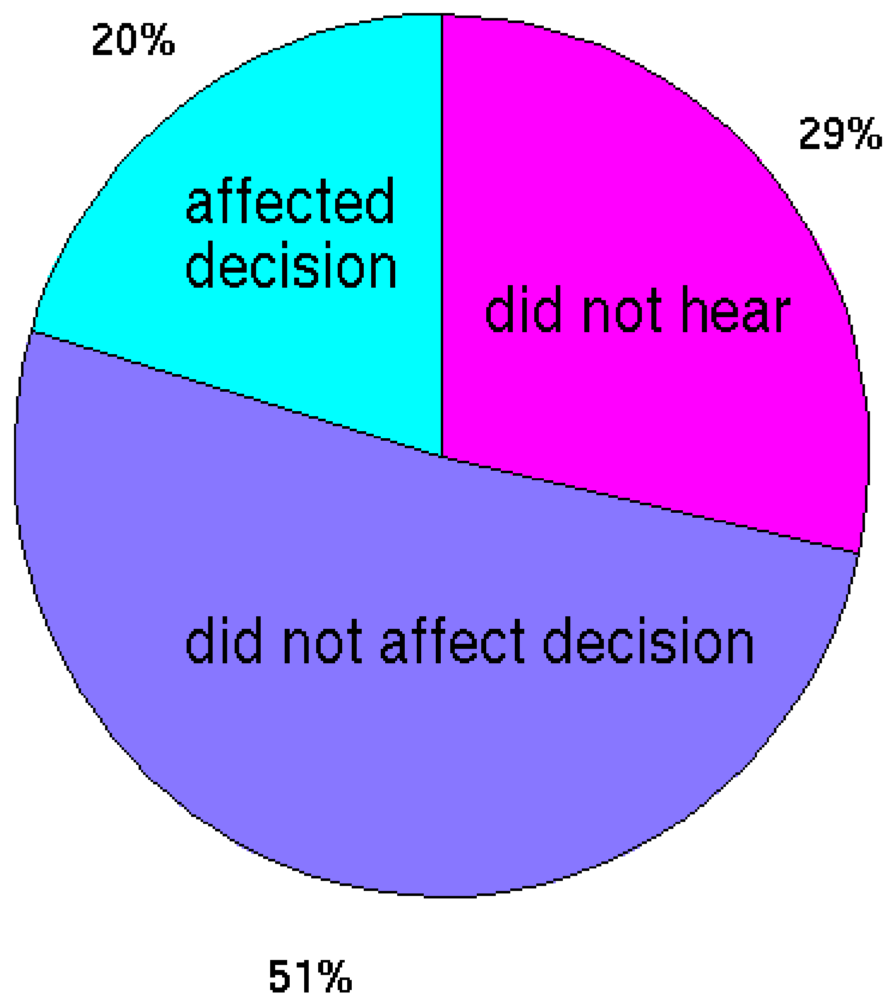
Did you hear this statement before Hurricane Ike hit the coast?



(Morss and Hayden, Weather, Climate and Society, 2010)

If heard statement prior to Ike:

- What was your opinion of this statement?
- Did it affect your decision to prepare or evacuate? How?



(Morss and Hayden, Weather, Climate and Society, 2010)

Warning Decisions in Extreme Weather Events project

- Multi-disciplinary study of 4 groups in the warning process (forecasters, public officials, media, public) in 2 parallel cases (flash floods, hurricanes)
- Research questions include:
  - How are extreme weather warnings created, interpreted, and used in decision making?
  - What factors (risk perception, uncertainty, etc.) influence warning decision making?

Damage along Spring Creek after a flash flood in Fort Collins, Colorado (July 1997)

Collaborators: Jeff Lazo, Julie Demuth (NCAR); Kathleen Tierney and colleagues (Univ. of Colorado); Ann Bostrom and colleagues (Univ. of Washington)

Mental Model Approach

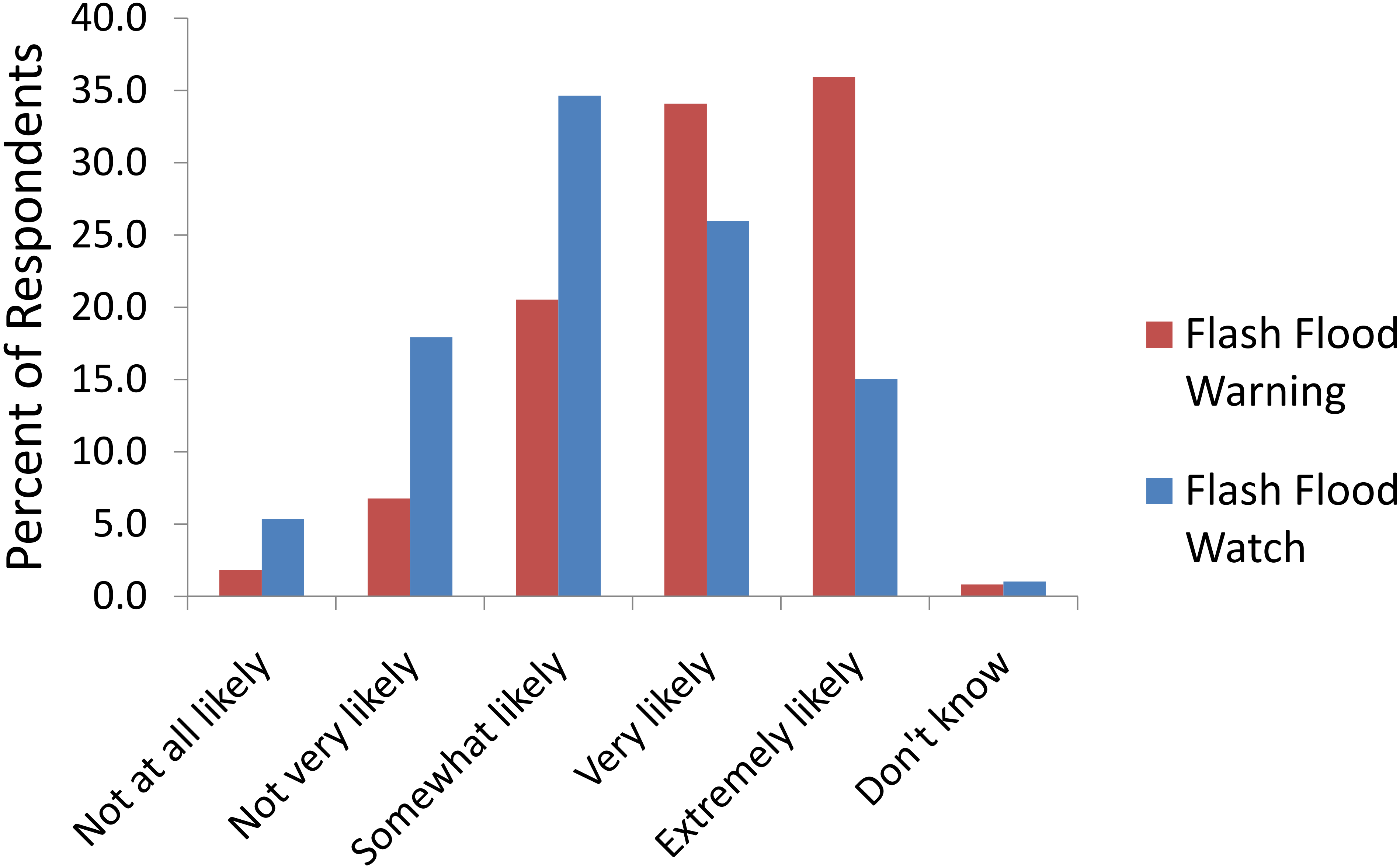
- Compare experts’ mental models (forecasters, media, local officials)
- Compare laypeople’s mental models with expert model
- Use results to:
  - Identify gaps in how expert groups create, communicate, interpret, and use warnings
  - Identify gaps in how laypeople (members of the public) interpret and use warning information
  - Design more effective risk communication messages

Survey in Boulder

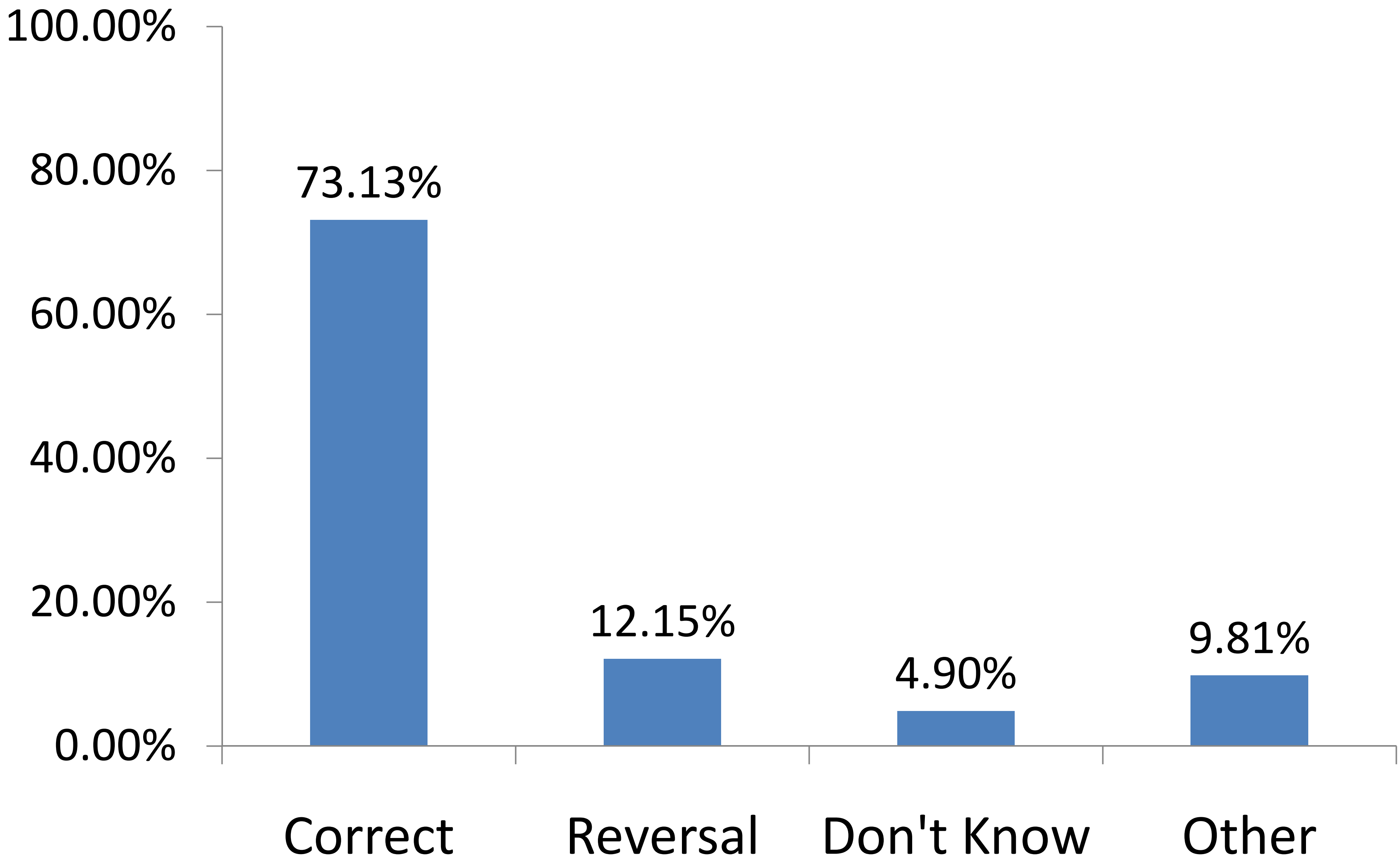
- Initial survey instrument was developed and pre-tested in Boulder as part of mental model interviews for project
- Survey was then revised (in collaboration with Univ. of Oklahoma students) and implemented with a larger Boulder population (497 respondents)
  - Distributed to Boulder residents by mail, to students, and on Pearl Street Mall

Collaborators: Jeff Lazo, Julie Demuth (NCAR); Kelsey Mulder; Curtis MacDonald; Kim Klockow, Gina Eosco (Univ. of Oklahoma); Randy Peppler (CIMMS); Ann Bostrom (Univ. of Washington)

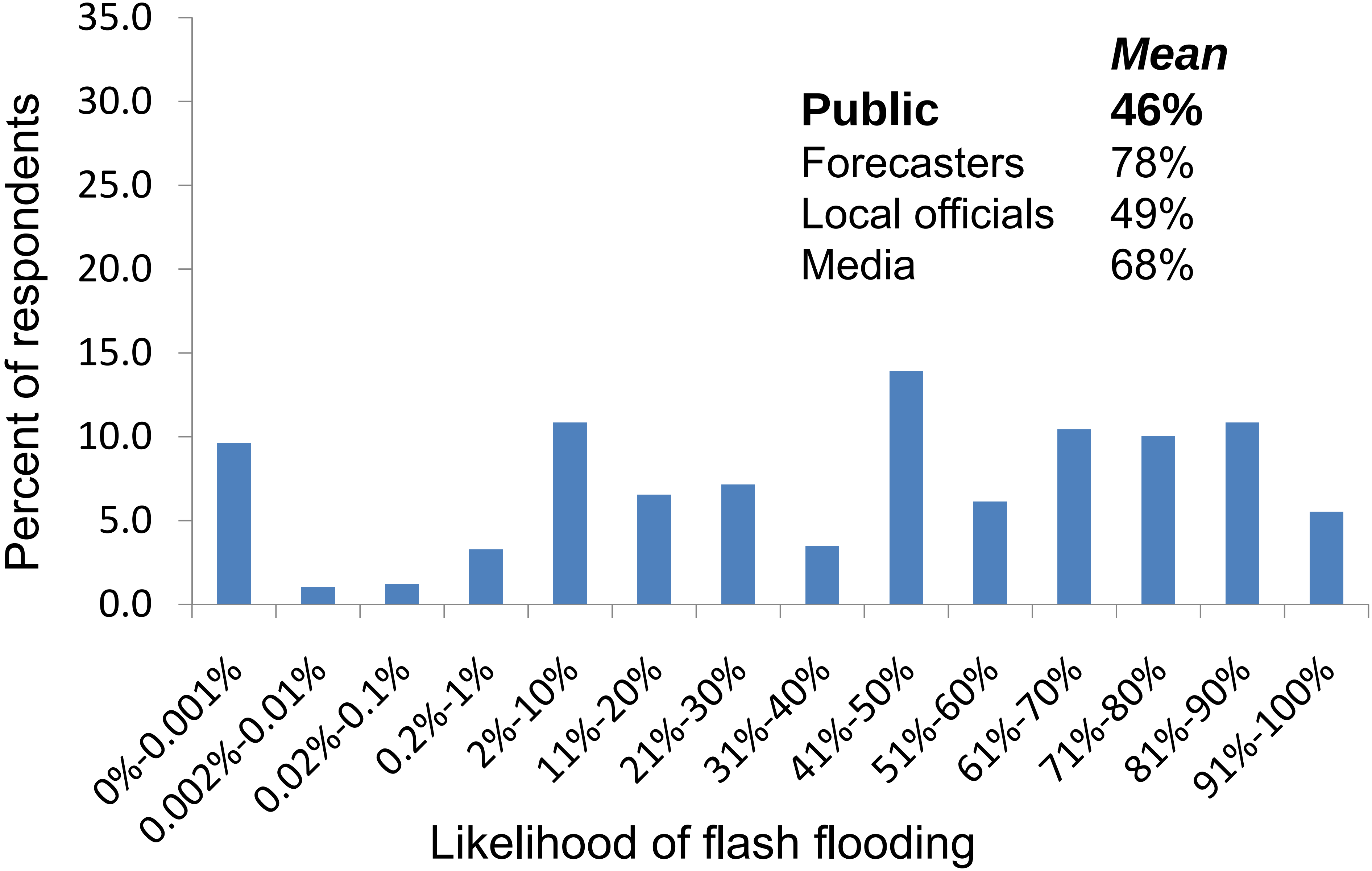
How likely is it that you would take protective action if you were to receive the following flash flood notifications for your location?



What differences, if any, are there between a flash flood warning and a flash flood watch?



If a warning is issued, how likely is flash flooding in the next 24 hours?



Summary

- Improving audiences' understanding of extreme weather and flood risk information is important
  - Empirical research is needed to understand how audiences interpret and use weather-related risk information, in different contexts — and why
  - Findings can be used to improve development, provision, communication, and use of information
- Integrate social science methods and approaches with hydrometeorological knowledge to develop more "effective" communication formats $\Rightarrow$ Iterative process that connects learning from forecast users with product development

Thanks!

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