Center for Research on Environmental Decisions
EARTH INSTITUTE | COLUMBIA UNIVERSITY

Social Science Perspectives on Extreme Events

Ben Orlove

Columbia Workshop
Extreme Weather and Climate: Hazards, Impacts, Actions
6 May 2015

Introduction

- Extreme events and social systems
- Assessing and reducing impacts
- Understanding and improving responses

Introduction

3 issues, with corresponding fields

- Assessment of impacts
  - Valuation
  - Geography, sociology, economics
- Individual decisions
  - Perception and motivation
  - Psychology, anthropology
- Collective responses
  - Policy actions
  - Political science

Introduction

- Extreme events in social science perspective
- What is an extreme event?
  - extremes vs non-extremes (normal conditions)
  - events vs non-events (trends, processes)
  - There are always definitional issues.
  - How do social systems influence the definitional issues?

Assessment | Valuation

- How much damage occurs?
- How is damage measured?
- Institutions, cultures shape measurement
  - Mortality
  - Property damage
  - Lost/foregone business
  - Missed development
- Vulnerability and resilience

Assessment | Valuation

Vulnerability

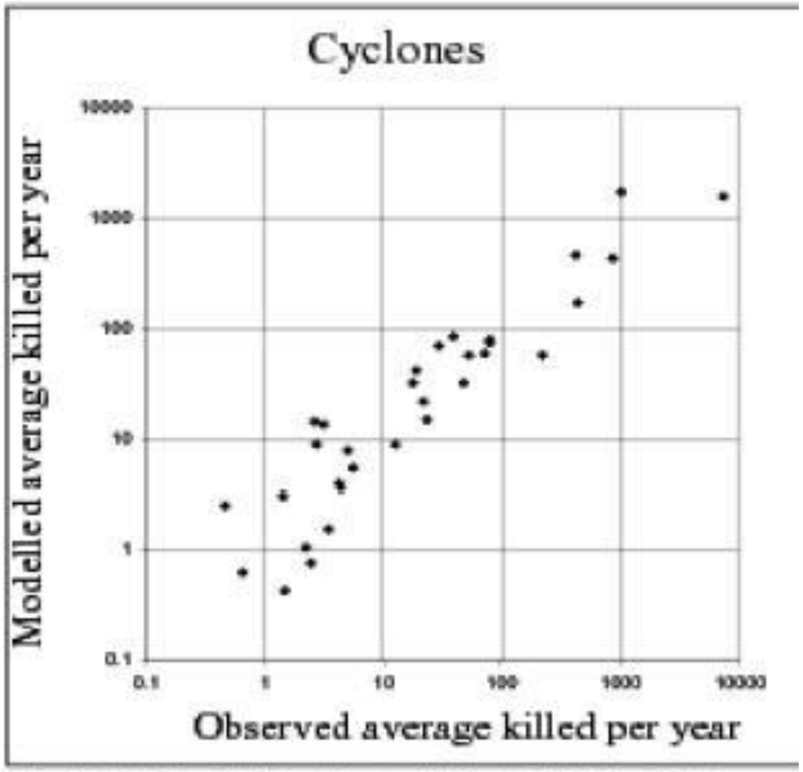
One definition in relation to mortality

- $R = H_{fr} \cdot Pop \cdot Vul$

Where:

- *R = number of expected human impacts [killed/year].*
- H_{fr} *= frequency of a given hazard [event/year]*
- *Pop = population living in a given exposed area [population affected/event].*
- *Vul = vulnerability depending on socio-economic factors [no units].*

Assessment | Valuation



R= 0.93, R^2= 0.86, adjusted R^2= 0.85 N = 33 (count

Assessment | Valuation

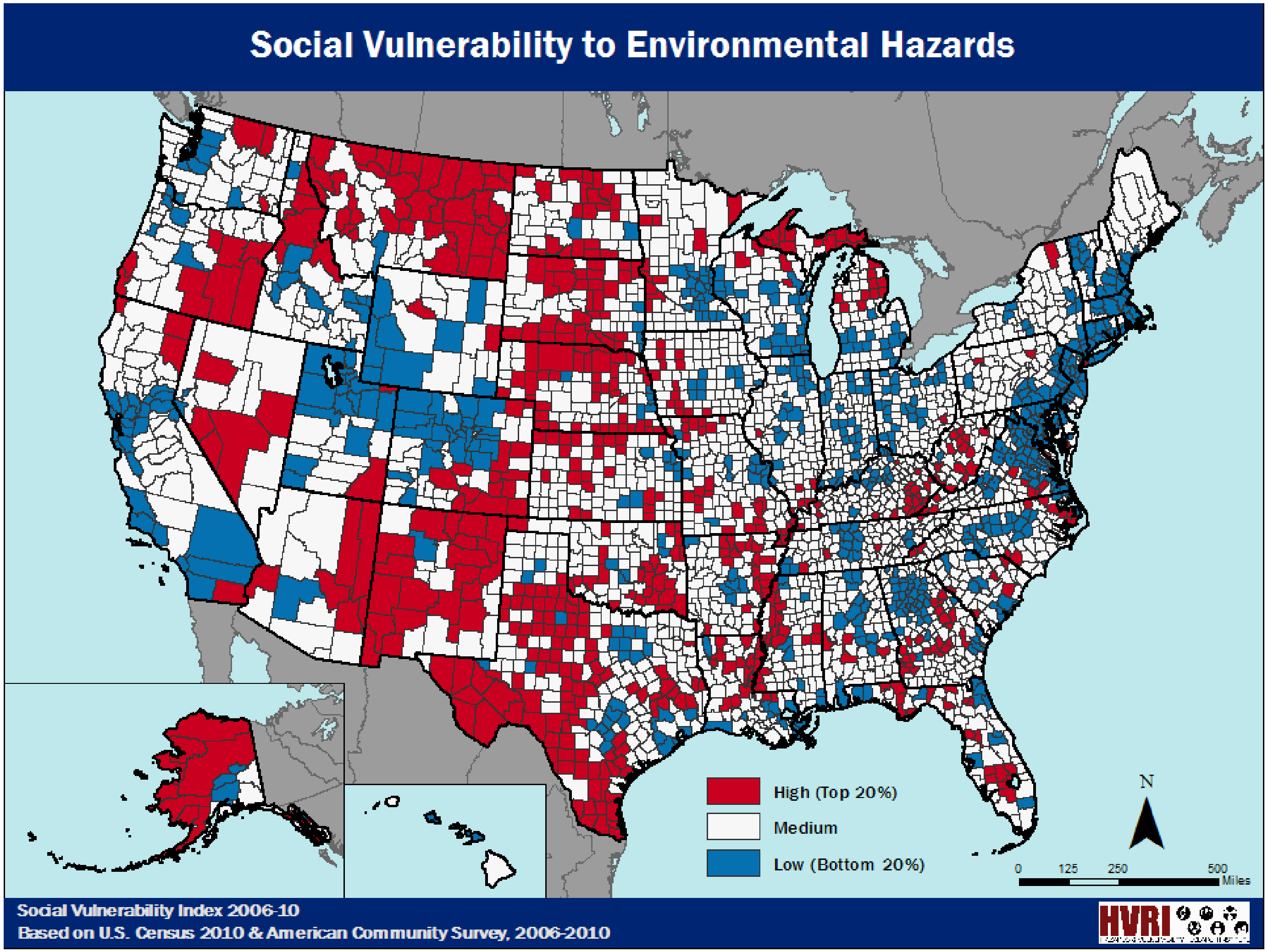
- Up to 119 millions of people in 84 countries are exposed each year to cyclone hazards, with a total death toll of 251,000 world-wide for the period 1980-2000.
- $\ln(K) = 0.63\ln(PhExp) + 0.66\ln(Pal') - 2.03\ln(HDI') - 15.86$

Where:

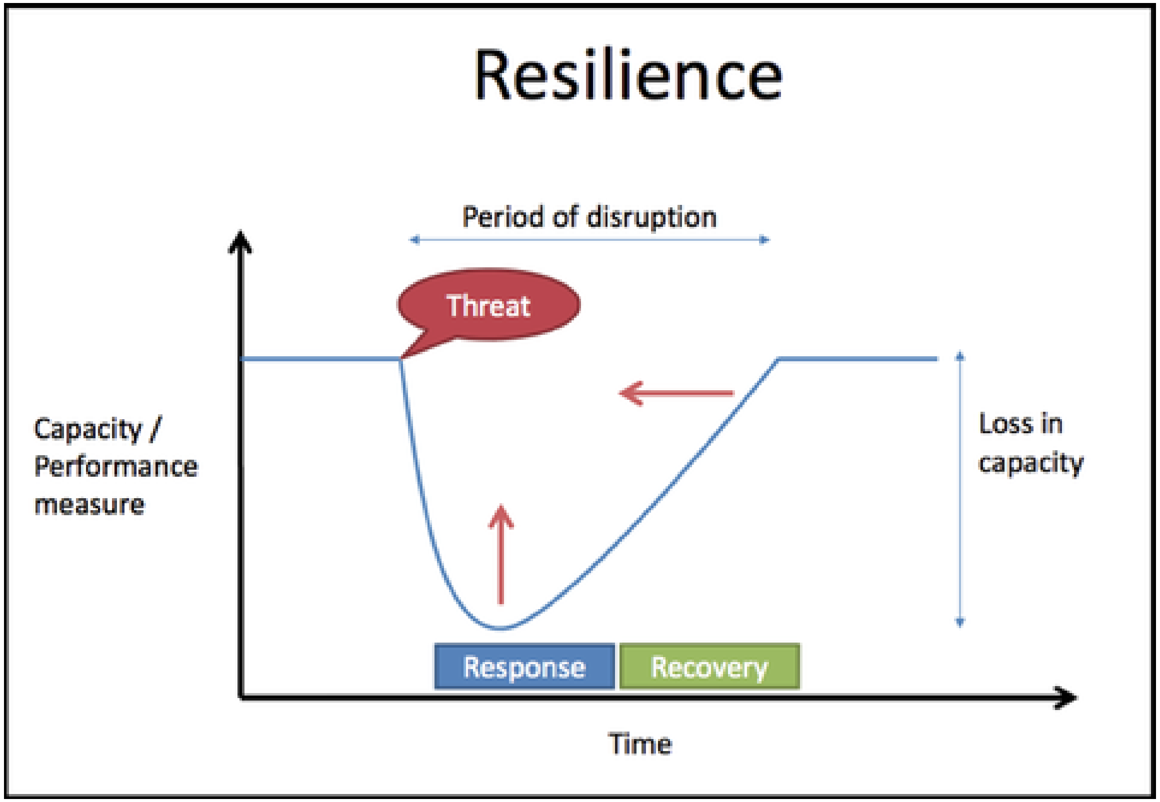
- *K is the number of killed*
- *PhExp is the physical exposure to cyclones*
- *Pal' is the transformed value of percentage of arable land*
- *HDI' is the transformed value of the Human Development Index*

Hy Dao, Pascal Peduzzi, "Global evaluation of human risk and vulnerability to natural hazards", Enviroinfo. 2004, Sh@ring, Editions du Tricorne, Genève, vol. I,

Assessment | Valuation



Assessment | Valuation



Source: http://www.iparametrics.com/solutions/infrastructure-resilience.html

Assessment | Valuation

Summary:

It’s important, but difficult, to assess impacts.

There are a number of different impacts which are hard to measure and hard to compare.

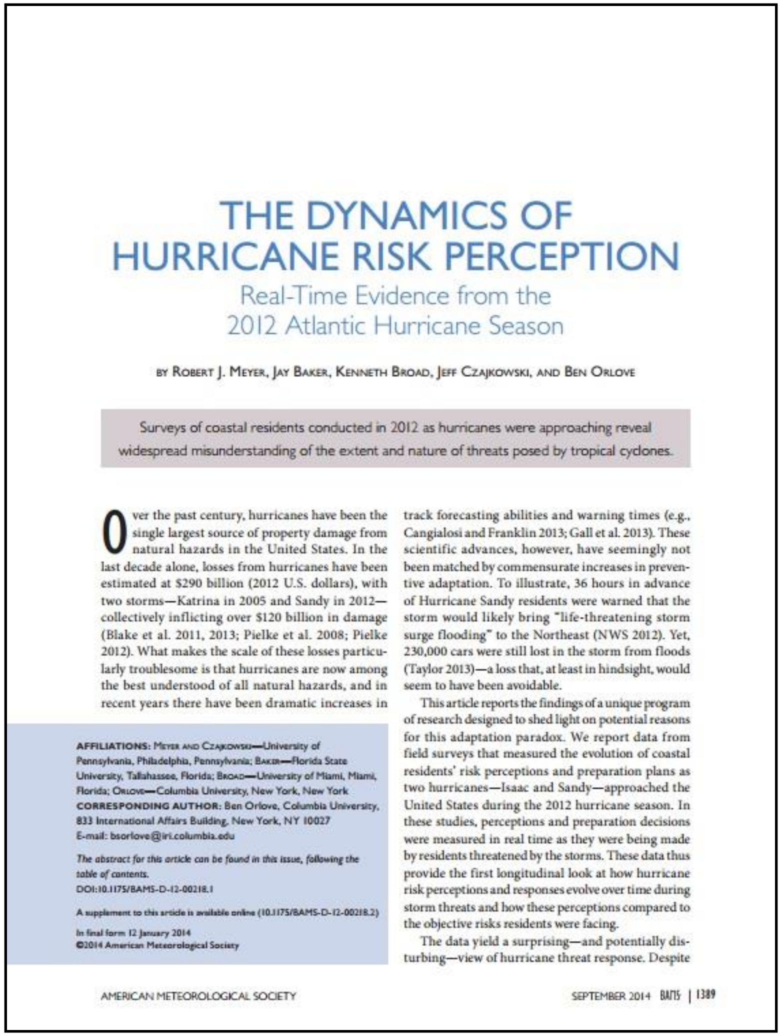
The concepts of vulnerability and resilience are slippery.

Assessment is advancing, though slowly.

Decisions | Perception and Motivation

- What risk of damage do individuals perceive?
- What motivations do these perceptions stimulate?
- What responses do individuals take?
- Cognitive and affective processes influence all three.
- They can be used to promote planning and preparedness.

Decisions | Perception and Motivation



THE DYNAMICS OF HURRICANE RISK PERCEPTION

Real-Time Evidence from the 2012 Atlantic Hurricane Season

BY ROBERT J. MEYER, JAY BAKER, KENNETH BROAD, JEFF CZAJKOWSKI, AND BEN ORLOVE

Surveys of coastal residents conducted in 2012 as hurricanes were approaching reveal widespread misunderstanding of the extent and nature of threats posed by tropical cyclones.

Over the past century, hurricanes have been the single largest source of property damage from natural hazards in the United States. In the last decade alone, losses from hurricanes have been estimated at $290 billion (2012 U.S. dollars), with two storms—Katrina in 2005 and Sandy in 2012—collectively inflicting over $120 billion in damage (Blake et al. 2011, 2013; Pielke et al. 2008; Pielke 2012). What makes the scale of these losses particularly troublesome is that hurricanes are now among the best understood of all natural hazards, and in recent years there have been dramatic increases in track forecasting abilities and warning times (e.g., Cangialosi and Franklin 2013; Gall et al. 2013). These scientific advances, however, have seemingly not been matched by commensurate increases in preventive adaptation. To illustrate, 36 hours in advance of Hurricane Sandy residents were warned that the storm would likely bring "life-threatening storm surge flooding" to the Northeast (NWS 2012). Yet, 230,000 cars were still lost in the storm from floods (Taylor 2013)—a loss that, at least in hindsight, would seem to have been avoidable.

This article reports the findings of a unique program of research designed to shed light on potential reasons for this adaptation paradox. We report data from field surveys that measured the evolution of coastal residents' risk perceptions and preparation plans as two hurricanes—Isaac and Sandy—approached the United States during the 2012 hurricane season. In these studies, perceptions and preparation decisions were measured in real time as they were being made by residents threatened by the storms. These data thus provide the first longitudinal look at how hurricane risk perceptions and responses evolve over time during storm threats and how these perceptions compared to the objective risks residents were facing.

The data yield a surprising—and potentially disturbing—view of hurricane threat response. Despite

AFFILIATIONS: MEYER AND CZAJKOWSKI—University of Pennsylvania, Philadelphia, Pennsylvania; BAKER—Florida State University, Tallahassee, Florida; BROAD—University of Miami, Miami, Florida; ORLOVE—Columbia University, New York, New York
CORRESPONDING AUTHOR: Ben Orlove, Columbia University, 833 International Affairs Building, New York, NY 10027
E-mail: bsorlove@iri.columbia.edu

The abstract for this article can be found in this issue, following the table of contents.

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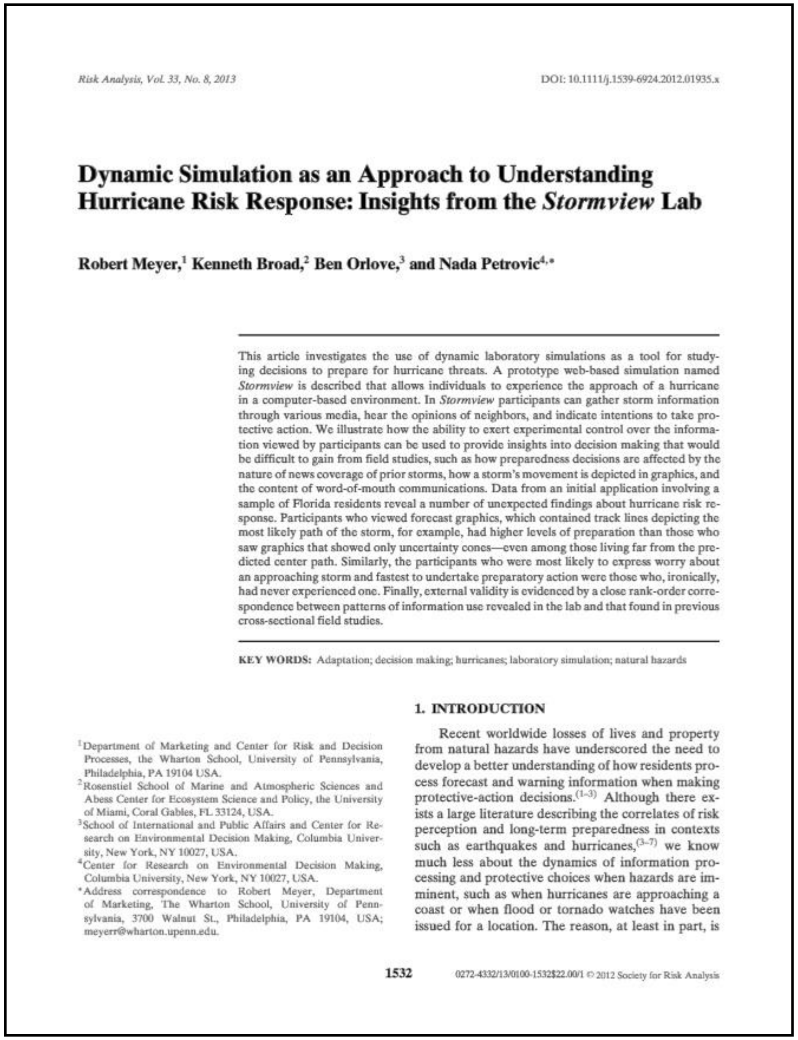

Risk Analysis, Vol. 33, No. 8, 2013 DOI: 10.1111/j.1539-6924.2012.01935.x

Dynamic Simulation as an Approach to Understanding Hurricane Risk Response: Insights from the *Stormview* Lab

Robert Meyer,[1] Kenneth Broad,[2] Ben Orlove,[3] and Nada Petrovic[4,*]

This article investigates the use of dynamic laboratory simulations as a tool for studying decisions to prepare for hurricane threats. A prototype web-based simulation named *Stormview* is described that allows individuals to experience the approach of a hurricane in a computer-based environment. In *Stormview* participants can gather storm information through various media, hear the opinions of neighbors, and indicate intentions to take protective action. We illustrate how the ability to exert experimental control over the information viewed by participants can be used to provide insights into decision making that would be difficult to gain from field studies, such as how preparedness decisions are affected by the nature of news coverage of prior storms, how a storm's movement is depicted in graphics, and the content of word-of-mouth communications. Data from an initial application involving a sample of Florida residents reveal a number of unexpected findings about hurricane risk response. Participants who viewed forecast graphics, which contained track lines depicting the most likely path of the storm, for example, had higher levels of preparation than those who saw graphics that showed only uncertainty cones—even among those living far from the predicted center path. Similarly, the participants who were most likely to express worry about an approaching storm and fastest to undertake preparatory action were those who, ironically, had never experienced one. Finally, external validity is evidenced by a close rank-order correspondence between patterns of information use revealed in the lab and that found in previous cross-sectional field studies.

KEY WORDS: Adaptation; decision making; hurricanes; laboratory simulation; natural hazards

1. INTRODUCTION

Recent worldwide losses of lives and property from natural hazards have underscored the need to develop a better understanding of how residents process forecast and warning information when making protective-action decisions.[1–3] Although there exists a large literature describing the correlates of risk perception and long-term preparedness in contexts such as earthquakes and hurricanes,[3–7] we know much less about the dynamics of information processing and protective choices when hazards are imminent, such as when hurricanes are approaching a coast or when flood or tornado watches have been issued for a location. The reason, at least in part, is

[1] Department of Marketing and Center for Risk and Decision Processes, the Wharton School, University of Pennsylvania, Philadelphia, PA 19104 USA.
[2] Rosenstiel School of Marine and Atmospheric Sciences and Abess Center for Ecosystem Science and Policy, the University of Miami, Coral Gables, FL 33124, USA.
[3] School of International and Public Affairs and Center for Research on Environmental Decision Making, Columbia University, New York, NY 10027, USA.
[4] Center for Research on Environmental Decision Making, Columbia University, New York, NY 10027, USA.
[*] Address correspondence to Robert Meyer, Department of Marketing, The Wharton School, University of Pennsylvania, 3700 Walnut St., Philadelphia, PA 19104, USA; meyerr@wharton.upenn.edu.

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Decisions | Perception and Motivation

- Research in social and cognitive psychology on information processing
  - Focus on gains vs focus on losses
  - Certainty vs uncertainty
  - Near vs distant time horizons
  - Known vs unknown risks
    - Frequency
    - Prior experience
    - Predictability
- These lead to people paying attention to extreme events, but not necessarily in quite the right way.

Decisions | Perception and Motivation

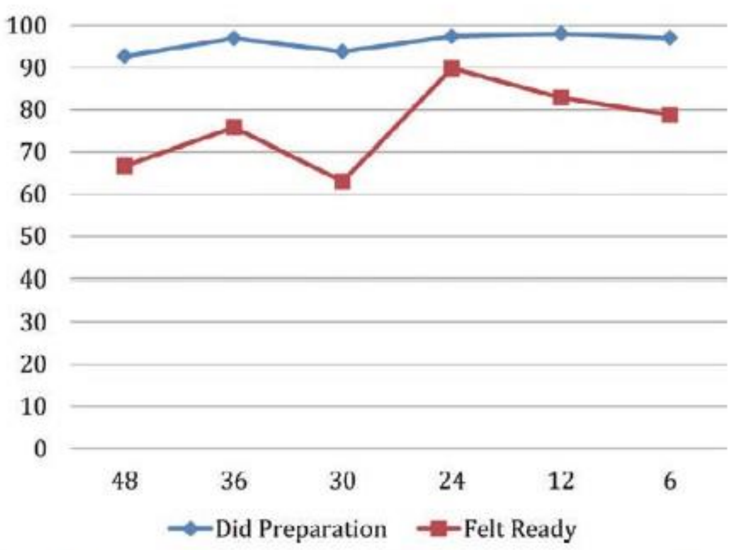


Fig. 7. Percentage of respondents who indicated taking some kind of protective action (blue line) and who felt that they had enough supplies on hand should the storm strike today (bottom line) in hours until landfall, pooled over storms.

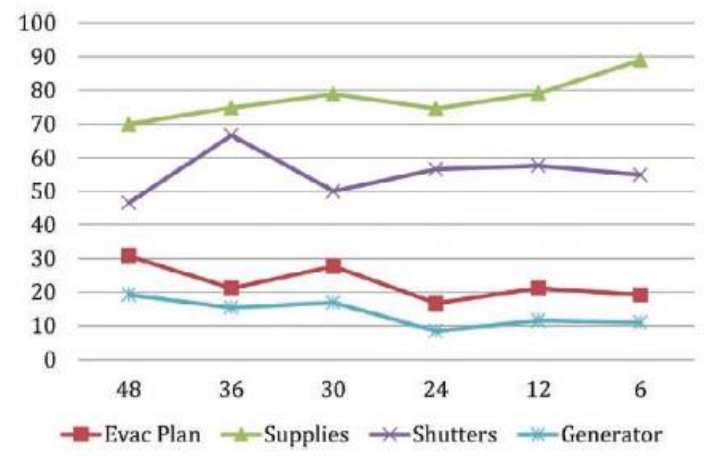


Fig. 8. Percentage of respondents taking different preparation actions as a function of hours until expected landfall, pooled over storms. "Evac plan" refers to making plans for where to go should evacuation be ordered or needed; "supplies" refers to purchased supplies for the home, such as food, water, and batteries; "shutters" refers to any removable window covering conditional on ownership; and "generator" refers to purchasing or readying a backup generator.

Decisions | Perception and Motivation

Summary:

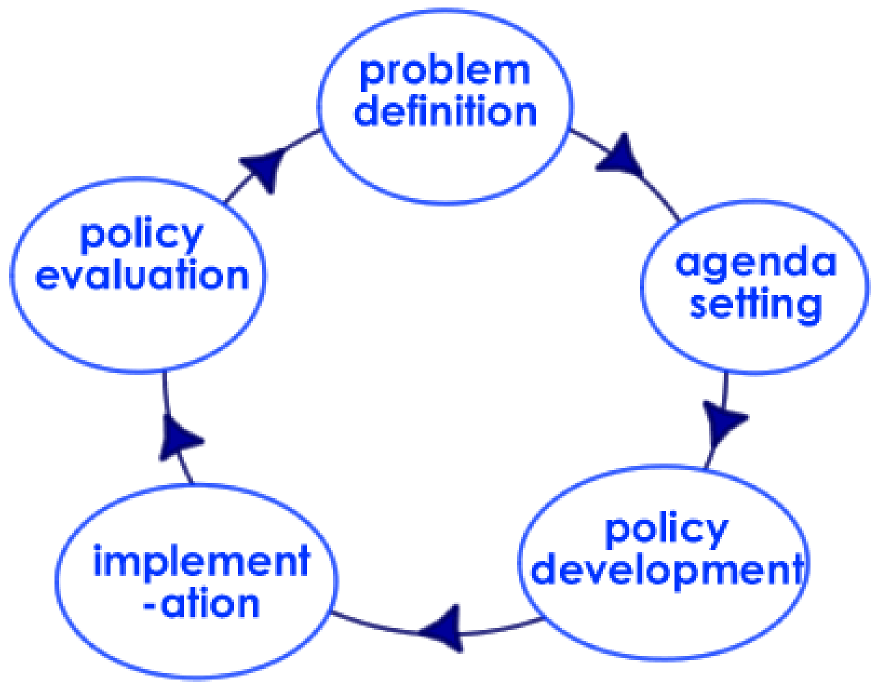
People pay attention to extreme events.

They are not always motivated to prepare for them well.

People learn, though sometimes slowly and incompletely.

Collective responses | Policy

- How does the policy process select and address issues?
- Policy cycle



Collective responses | Policy

- Extreme events
  - Disasters
  - Locus of responsibility
- Specialized organizations
  - Humanitarian vs development organizations
  - Emergency managers/civil defense vs. economic growth
  - Disaster risk reduction
- Budgeting:
  - For extreme events
  - For preparedness

Collective responses | Policy

- Promoting vulnerability reduction and resilience
  - Overcoming inertia
  - Maintaining preparedness and awareness

Collective responses | Policy

- The case of fires
  - – Fire alarms
  - – Smoke alarms
  - – Fire drills
  - – Building codes
  - – Insurance

Collective responses | Policy

Summary:

Like individuals, public bodies do not easily sustain attention to extreme events.

Public bodies respond to emergencies, though they respond better to routine, familiar conditions.

They sometimes prepare for emergencies as well.

They learn, sometimes slowly.

Overview

There are several bodies of work in social science.

- Assessment: valuation
- Decisions: perceptions and motivations
- Collective responses: policy

There has been some progress in academic and applied research.

More could be useful.