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The Psychology of Uncertainty: Challenges to Communicating Risk

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BIOGRAPHICAL SKETCH

Elke U. Weber is the Jerome A. Chazen Professor of International Business in the Management Division of Columbia Business School and Professor of Psychology at Columbia University. Her MA and PhD (in Behavior and Decision Analysis, 1984) are from Harvard University. Over the past 20 years, she has held other academic positions in the United States (University of Chicago, University of Illinois, Ohio State University) and Europe (Otto Beisheim Graduate School of Corporate Management). She spent 1992/93 as a fellow at the Center for Advanced Studies in the Behavioral Sciences at Stanford, 2002 at the Wissenschaftskolleg (Center for Advanced Study) in Berlin, and 2007/08 at the Russell Sage Foundation in New York.

Weber is an expert on behavioral models of judgment and decision-making under risk and uncertainty. Recently she has been investigating psychologically and neurally plausible ways to measure and model individual differences in risk taking, specifically in risky financial situations and environmental decision-making and policy.

Weber is past president of the Society for Mathematical Psychology, the Society for Judgment and Decision Making, and the Society for Neuroeconomics. She has served on several advisory committees of the National Academy of Sciences in Washington, DC, related to human dimensions in global change. She has edited two major decision journals and serves on the editorial boards of eight other journals. At Columbia, she founded and co-directs the Center for the Decision Sciences (CDS), which fosters and facilitates cross-disciplinary research and graduate training in the basic and applied decision sciences and the Center for Research on Environmental Decisions (CRED), which investigates ways of facilitating human adaptation to climate change and climate variability.

ABSTRACT

A better understanding what uncertainty means to human decision makers and how they process information about possible outcomes in uncertain environments helps with the design of more effective risk communication. My presentation will provide an overview of the psychology of judgment and choice under uncertainty, including models modify and improve rational-economic formalizations, which often do not describe human behavior. My examples will focus on small probability events, relevant to extreme precipitation forecasts.
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The Psychology of Uncertainty: Challenges to Communicating Risk

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Outline/Preview

- Uncertainty as barrier to predictability
- Uncertainty as a way of life
- Models of how people (actually) deal with uncertainty
  - Predicting uncertain events
  - Choosing among actions with uncertain outcomes
- Multiple processes
  - Affective vs. analytic
  - Personal experience vs. statistical description
- Implications for communication of (weather or climate) uncertainty
  - Especially of extreme events

Predictability

- Powerful human skill and human need
  - result of evolutionary selection (or intelligent design)
- Provides control
  - avoid threats to physical and material well-being
- Allows to plan and budget for the future
  - Homo sapiens arguably the most successful species on earth

Need for Control

- So strong, it can lead to wishful thinking
  - "illusion of control" in situations that are obviously determined by chance
    - Superstitious behaviors
- Perception of control, even when illusory, has important psychological benefits
  - Langer & Rodin (1976): CT nursing home study

Unpredictability/Lack of Control

- Induces anxiety
  - Too much or too little anxiety are dysfunctional
    - Clinical anxiety disorders (repetitive hand washing, door checking)
    - Repression/denial
  - Some anxiety is positive in motivating behaviors to regain control
    - Personal information search, theory building
    - Science and technology development
      - Forecast developments for weather, climate, earthquakes, economy, etc.

And yet,
uncertainty is a way of life…….

… and will be increasingly so

- Real and perceived complexity of life has increased from evolutionary times
  - Increased option sets
    - lifestyle, occupation, procreation, breakfast cereals
  - Increased complexity
    - Globalization of economy and life
    - Anthropogenic influence on environment, nonstationarity
  - Increased information about inherent unpredictability
    - Quantum theory of physics, chaos theory

Uncertainty

- Unpredictability as the result of multiple possible outcomes
- Unpredictability due to time delay
- Need for probabilistic thinking
- Need to focus on *both*
  - Downside potential ***and*** upside potential
  - Challenge/threat ***and*** opportunity

Modeling Uncertainty I: Predicting uncertain events

- Normative models
  - Probability calculus
  - Bayesian updating and belief revision
- Descriptive reality
  - Deterministic/causal vs. statistical/probabilistic thinking
  - Use of cognitive heuristics that utilize stored personal experience
    - Availability heuristic: Ease of recall as indicator of likelihood
      - Rare events only get into memory storage after a long time
      - Rare bad event that occurs gets overweighted → recency effects
    - Representativeness heuristic: Similarity to category prototype as indicator of likelihood
      - Base rates are ignored altogether in favor of similarity

Multiple Human Processing Systems

- Analytic system
  - effortful, slow, requires conscious awareness, and knowledge of rules
    - e.g., probability calculus, Bayesian updating, formal logic
- Association- and affect-based system
  - evolutionarily older, hard-wired, fast, automatic
    - greater emphasis on outcomes than probabilities
    - emotions as a powerful class of associations
      - risk represented as a “feeling” that serves as an “early warning system”

- Processing systems operating in parallel
    - Categorization example: “Is a whale a fish?”
  - When in conflict, behavior often determined by associative/affective processing system
    - Epstein study of two urns
- Discrepancy in two systems use often a at base of controversies about magnitude and acceptability of risks
  - e.g., nuclear power, genetic engineering
    - Technical experts use analytic processing system
    - Politicians and general public use associative/affective system

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      - Base rates are ignored altogether in favor of similarity
  - Description of probabilities as conditional frequencies can help make statistical information more concrete and imaginable

Modeling Uncertainty II: Choice among actions with uncertain outcomes

- Outcomes modeled as random variables
- Normative model
  - Expected utility theory
    - Shape of utility function as individual difference measure
      - Risk aversion/seeking

Prospect Theory (Kahneman & Tversky, 1979)

- Descriptive modification of EU theory
  - Introduction of reference point
    - Gain vs. loss segment to utility/value function
    - Risk aversion for gains, risk seeking for losses
  - Loss aversion
    - Asymmetry in responses to losses vs. gains
      - "Losses loom larger:" Loss of $100 hurts more than gain of $100 feels good
  - Value function explains effectiveness of outcome framing
  - Certainty effect
    - Certain outcomes get overweighed relative to probabilistic ones

Limited attention and processing capacity

- Need to attend selectively
  - Guided by expectations (past experience) and goals (fears or wishful thinking)
- Need to encode and evaluate locally
  - Thurber story
  - Buckets-of-water thought experiment
  - Hence Prospect Theory value function with reference-dependent encoding and framing effects
- Hardwired automatic emotion- and association-based processes often dominate effortful analytic processes
  - Hence certainty effects

Reactions to rare events

- Depends on how we find out about them
  - From personal experience
    - Like all other animals, by repeated sampling
    - Only outcomes are experienced, time after time
  - From description
    - Based on vicarious past experience or model predictions
    - Possible outcomes and their likelihood are described numerically or visually (pie chart, frequency distribution)

Rare events are…

- *Over*weighted (or ignored) in *decisions from description*
  - Captured by decision weight function of **Prospect Theory**

- *Under*weighted in *decisions from experience* (Hertwig et al., 2004)
  - Unless they recently occurred, in which case they are strongly *over*weighted
  - Captured by **reinforcement learning** models with strong recency weight

- Many decisions based on a combination of outcome distribution description and personal experience
  - Personal experience typically the stronger determinant of choice
    - More emotionally engaging, vivid

Expert vs. Public Disagreements about Importance of Risk

- Often explained by differences in how public vs. experts learn about the risk
  - Flood risks, airplane crash risk (flight insurance)
    - Experts by description (actuarial rates), public from experience
  - Vaccination side effect risks
    - Public by description (website, pamphlet), pediatricians from experience

Reactions to rare events

- Also depends on how we *feel* about them
  - No worry, no action
    - Risk is a "feeling" *(Loewenstein, Weber, Hsee & Welch 2001)*
    - Analytic concern neither necessary nor sufficient

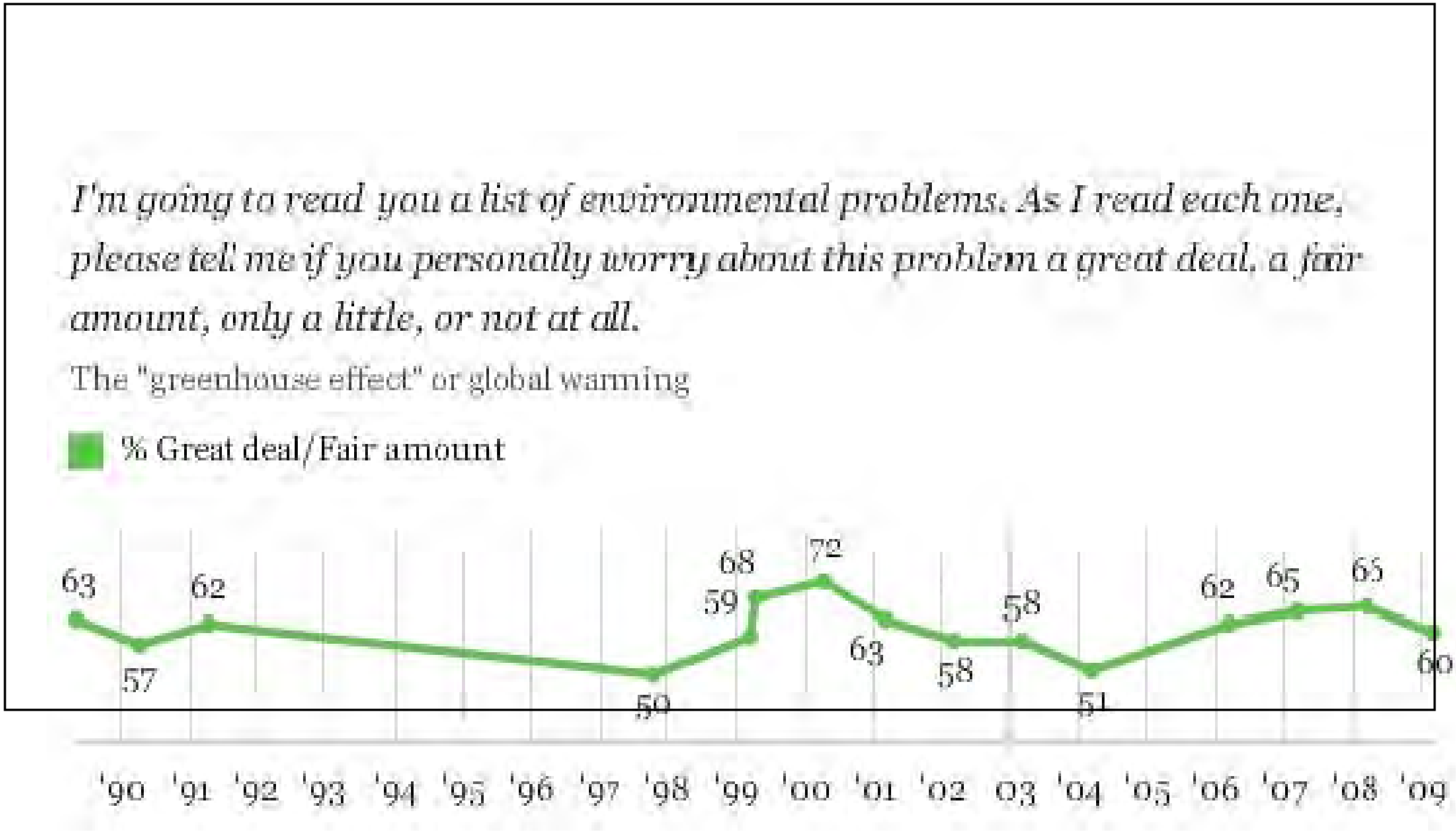
- Psychological risk dimensions
  - Multidimensional scaling analysis of health and safety risks (Slovic et al, in 1970s and 80s)
    - "dread" risk and "unknown" risk

  - Risks scoring high on two factors are attended to and receive social amplification (e.g., by media)
    - Flood risk is in lower left psychological risk space: no dread, well known

Limited emotional capacity

- Single action bias
  - Tendency to engage in a single risk reduction or risk management behavior when action is triggered by concern (rather than analysis)
    - Farmers who are concerned about climate change engage in either production, pricing, or policy path to protection, but not all three (Weber, 1999)
- Finite pool of worry
  - Increases in concern about one risk are accompanied by decreases in another

Variation in concern about global warming over time → finite pool of worry (Weber, 2006)



How to deal with people's affective processing and aversion to uncertainty?

- Help people plan for uncertainties
  - Scenario analysis to reduce complexity
    - Worst case, best case, most likely case scenarios
  - Contingency plans, especially for worrisome worst and bad case scenarios
    - Real benefits
      - Increased response speed; better responses
    - Psychological benefits
      - Perceived preparedness reduces anxiety

Psychological Contributions to Solutions

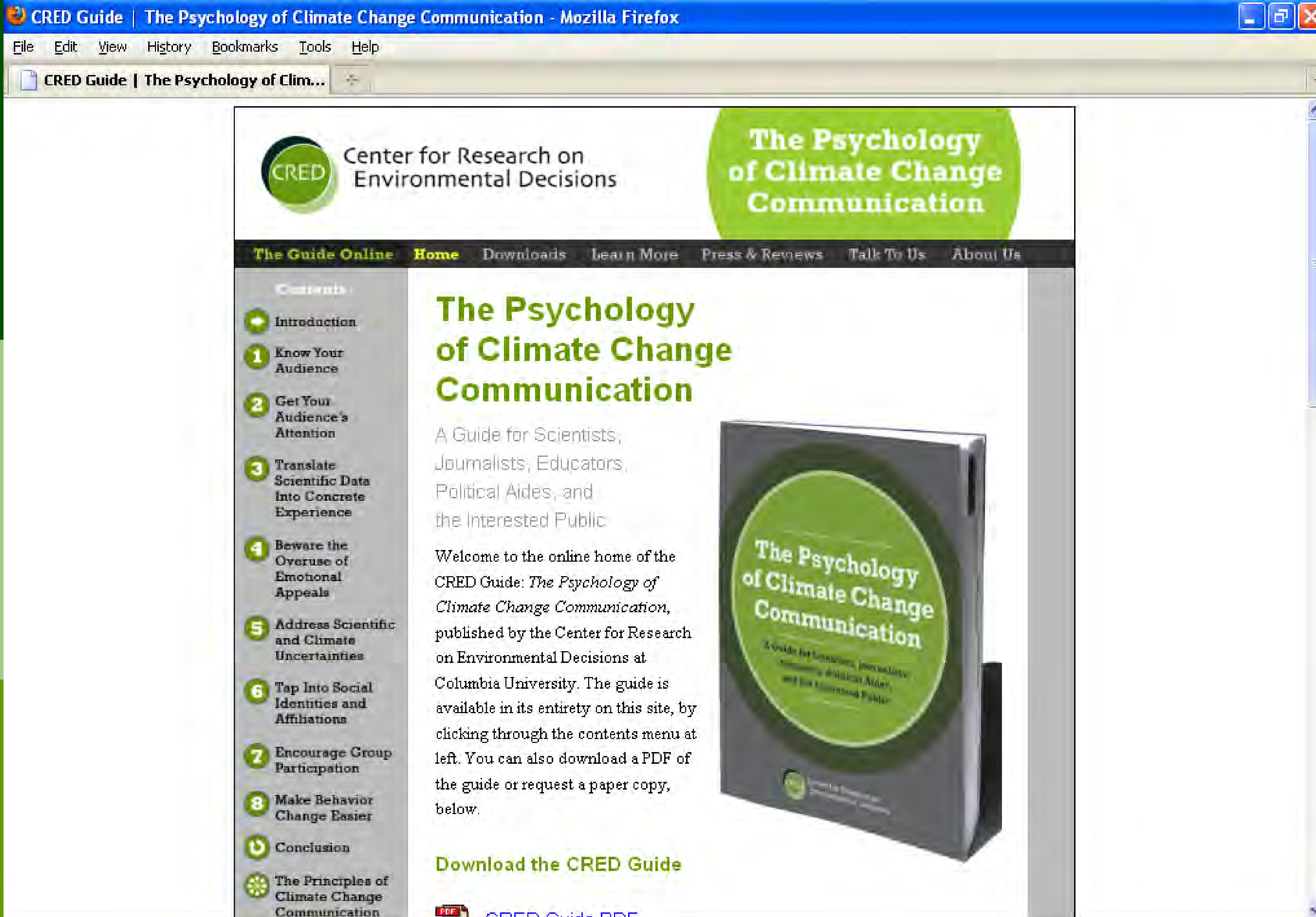
- Capitalize on flexible nature of information processing
  - Multiple ways to represent information (framing)
    - Prospect theory (Kahneman & Tversky)

- If all encoding is relative, then you can change people's reference point ("compared to what?")
  - Prospect theory
    - Different risk attitudes
    - Loss aversion

- Know about effects of providing information about events in different ways
  - By description or by direct experience (e.g., in simulation games) depending on goal
- Provides readiness to capitalize on effects of rare events when they occur
  - Hurricane Katrina and other potential game changers in public attitudes and willingness to act

Conclusions

- Consider affective and cognitive processes to motivate forecast usage and other actions
  - Provide accurate degree of confidence in given forecast
  - Elicit optimal level of worry/concern
    - Develop envisioning tools to concretize temporally and spatially distant forecast events
  - Concretize statistical forecast likelihood information
    - Provide analogies to previously experienced situations
    - Provide finite number of scenarios
      - Best case, most likely case, worst case



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