Role of Scenarios in Decision Support Under Deep Uncertainty:
Psychological Evidence and Anthropological Possibilities

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DMDU Makes Strong Claims About Improving Decisions – How Can We Test Them?

From Monday's training session:

- Our times pose challenges for democratic societies, but DMDU can help (Popper)

- Exploratory scenario thinking central to DMDU (Kwakkel)

  - *Premature aggregation is the root of all evil in decision support*

Quantitative analysis crucial to good decisions, but predict than act approaches can promote overconfidence, gridlock, and misplaced focus

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Collaborators

- Min Gong,

- Andrew Parker,

- Lauren A. Mayer,

- Jordan Fischbach,

- Matthew Sisco,

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- David H. Krantz,

- Howard Kunreuther

- Ryan Brown

- David Kennedy

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Outline

- **Testing the Scenario Hypothesis**

- **From scenarios to world views**

Do Scenarios Stimulate Exploratory Thinking?

Scenarios Hypothesis

Decision support processes that employ scenarios, as opposed to forecasts, to characterize deep uncertainty will help decision makers consider a wider range of futures. This broader vantage will encourage the choice of more robust options

Gong, M., R. Lempert, A. M. Parker, L. A. Mayer, J. Fischbach, M. Sisco, Z. Mao, D. H. Krantz and H. Kunreuther (2017) "Testing the Scenario Hypothesis: An Experimental Comparison of Scenarios and Forecasts for Decision Support in a Complex Decision Environment." Environmental Modeling and Software 91

Which Is Better for Decision Support -- Scenarios or Forecasts?

Why forecasts?

- Probabilistic forecasts concisely provide all information needed for normative choice

BUT

- People sometimes ignore worst cases
- Probabilities may be imprecise
- Attempts to agree on assumptions may foster gridlock

Why scenarios?

- Scenarios can help
  - Expand the range of futures considered
  - People who disagree with one another nonetheless engage with the implications of alternative futures

BUT

- Scenarios don't provide all the relevant information needed for decisions

Scenarios focus on decision structuring task, while probabilistic forecasts focus on choice task

Experiment Presents Decision Challenge and Gives Participants Scenarios or Probabilistic Forecasts

- Participants asked to recommend a fishery management strategy that balances economic and environmental goals

- Participants use decision support tool that lets them:
  - Specify alternative management strategies one at a time
  - Observe time series showing consequences of each strategy
  - Save and compare summaries of selected strategies in Summary Table

- Employ a two x two experimental design with 467 participants:
  - Dyads vs. individuals
  - Scenario vs. Forecast Condition

- In running the experiment, we observe:
  - Which strategies participants examine,
  - Which strategy participants recommend, and
  - Participants' reports on their experience using the tool and their decision processes

Decision Challenges Aims to Highlight Decision Structuring Task

Attributes of decision challenge include:

- Two objectives, profits for fishers and preserving fish population

- A large and complicated set of alternative management strategies that require significant effort to explore

- Significant uncertainty regarding outcome of any management strategy

- Only a small number of strategies (4 of 79) that perform reasonably well for both objectives over the entire range of uncertainty
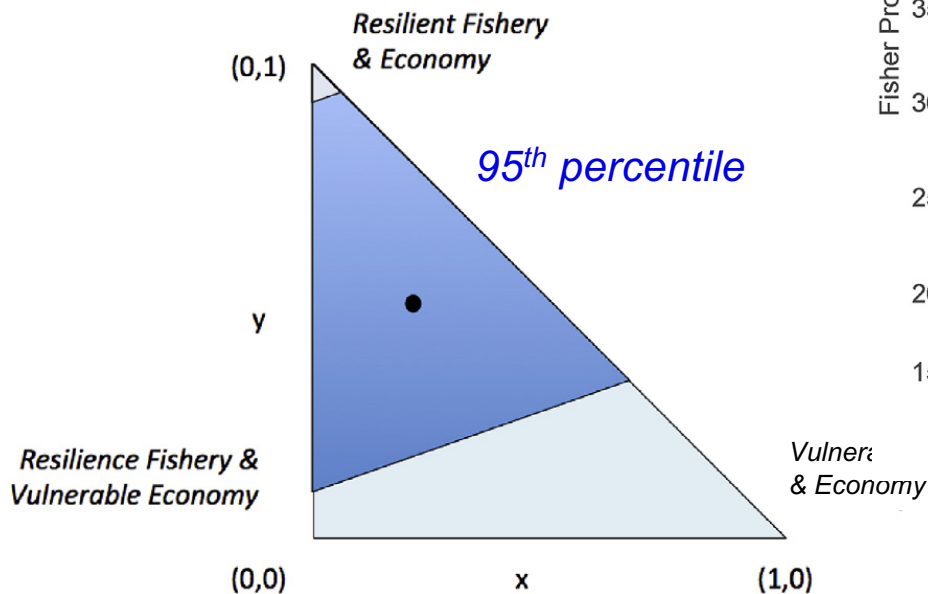
Supported by:

Strategies' Expected Performance Has Wide Range

Options

Instrument	Level	Monitoring frequency	Population trigger	Adaptive response
1. Open	n/a	n/a	n/a	n/a
2. Catch limit 3. Fleet size 4. Individual quota	1. 20 k (L) 2. 40 k (H)	1. No monitoring	n/a	n/a
		1. 1 year 2. 5 years 3. 10 years	1. Low 2. High	1. Low 2. High

- **Uncertainties** arrayed over a triangular space

- Best-estimate probability distribution yields high expected value strategies

95th percentile
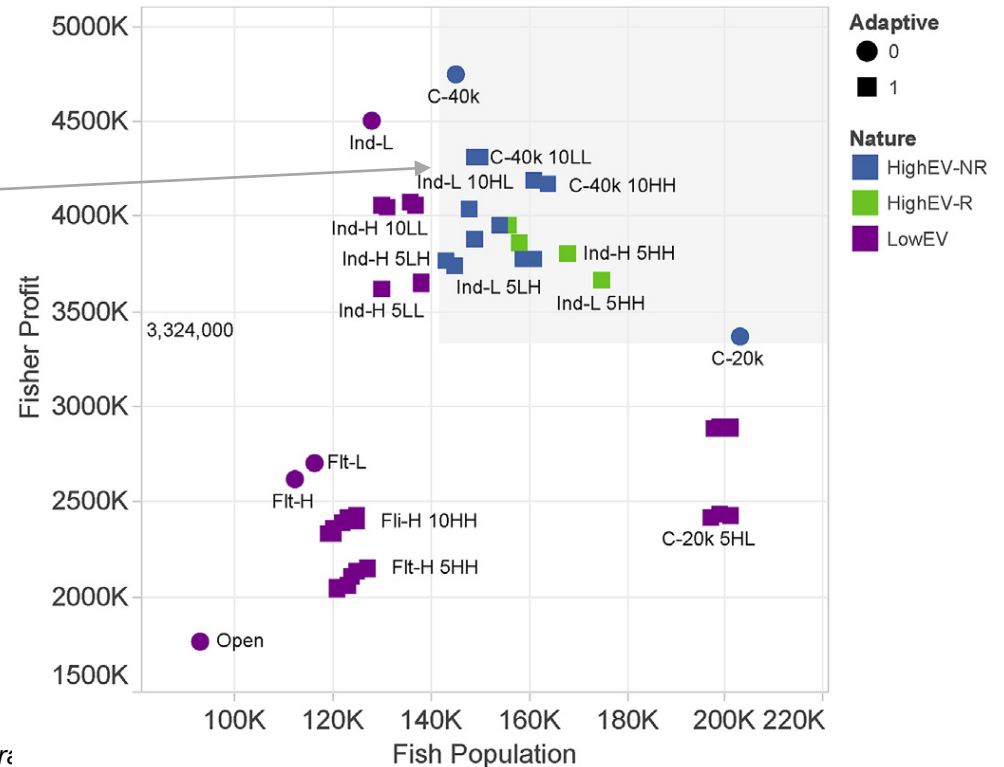
Tradeoffs

Four Strategies Preserve Fishery in Worst-Case Scenario

Options

Instrument	Level	Monitoring frequency	Population trigger	Adaptive response
1. Open	n/a	n/a	n/a	n/a
2. Catch limit 3. Fleet size 4. Individual quota	1. 20 k (L) 2. 40 k (H)	1. No monitoring	n/a	n/a
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Uncertainties

- Vulnerable Fishery and Economy is worst-case scenario

Tradeoffs
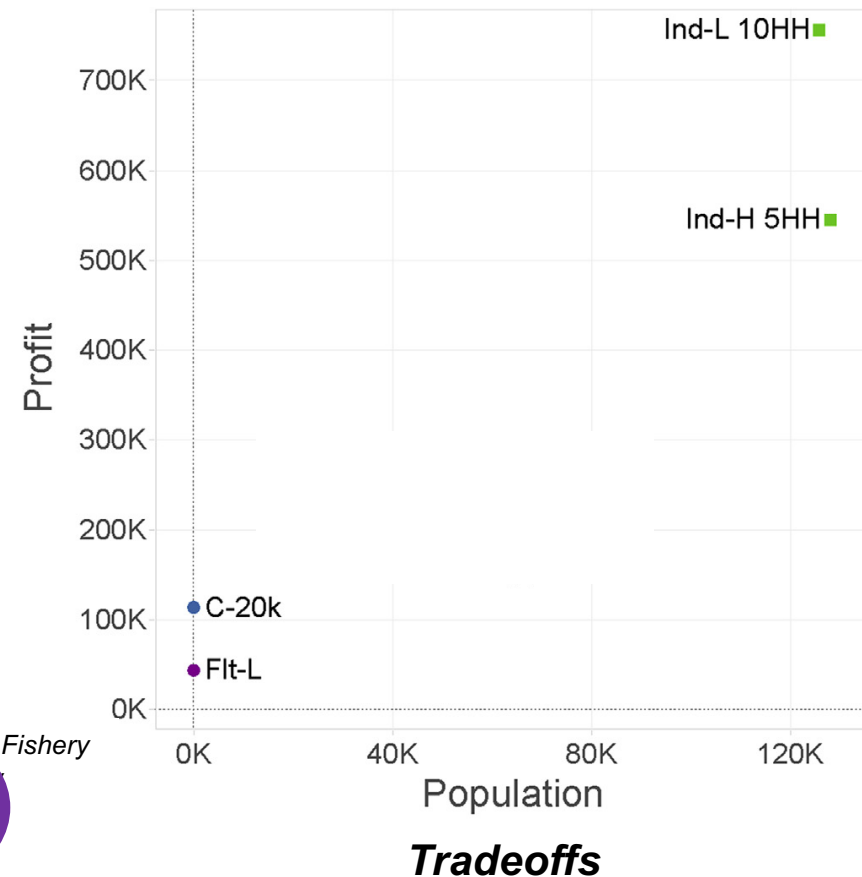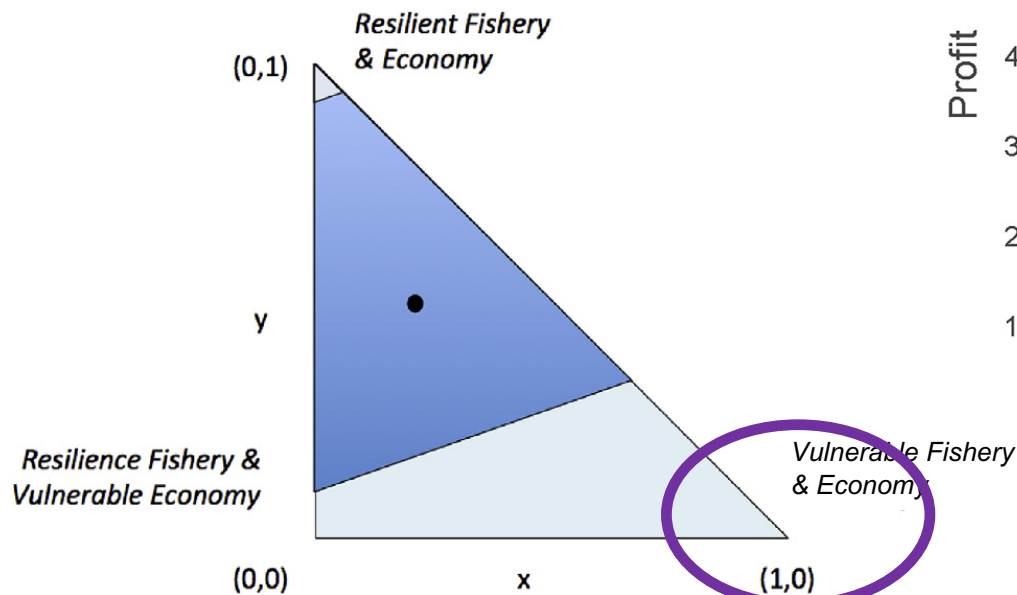
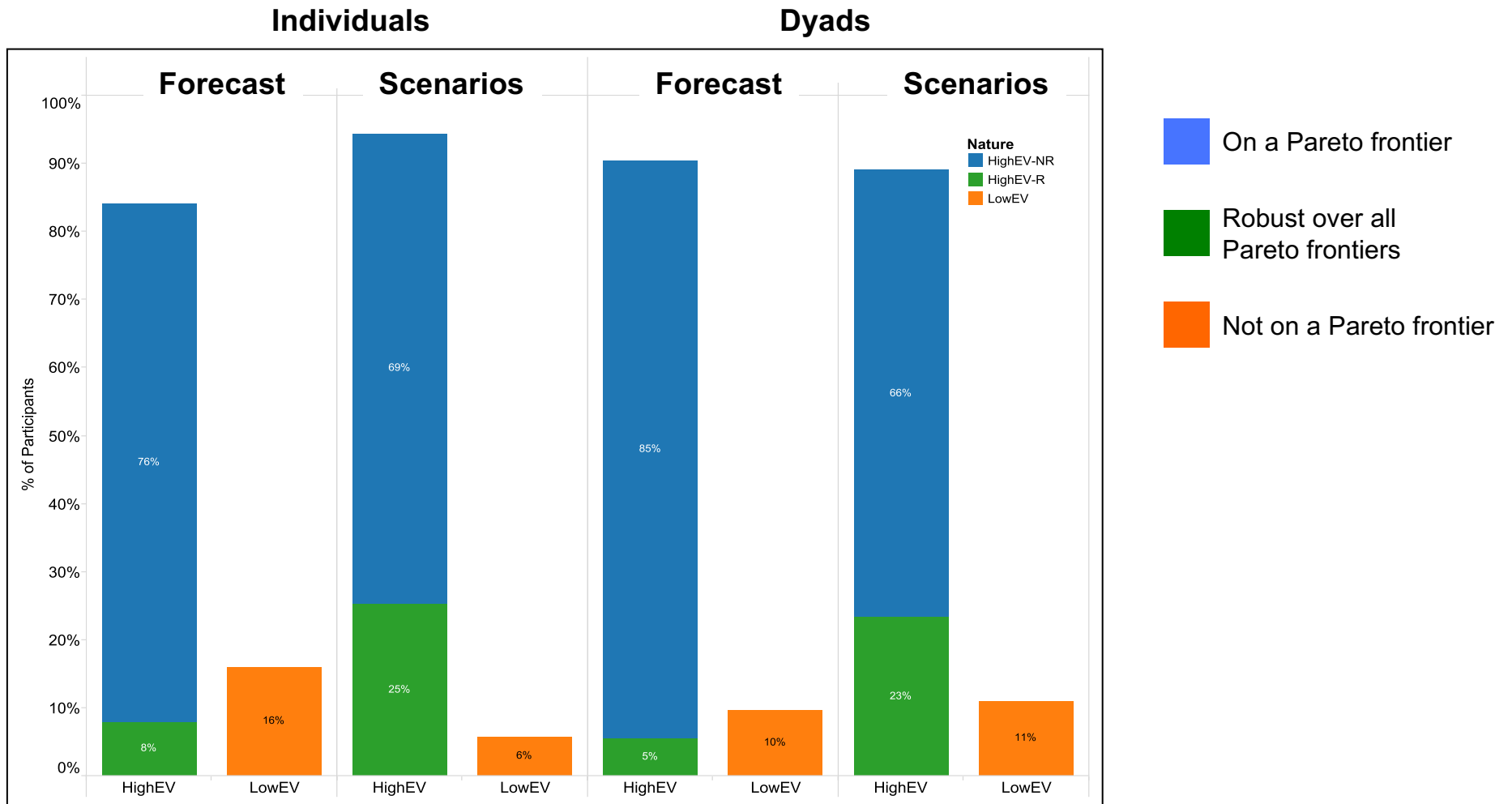# Decision Support Tool Helped Participants Explore Options in Either Scenario or Forecast Condition

1. Chose strategy with pull down menus
2. Examine results
3. Compare selected options

Participants in Scenario Conditions Chose Robust Strategies More Often

Some Implications

- Participants in scenario condition

  - Chose high expected value strategies at least as often as participants in forecast condition

  - Chose robust strategies more often

  - Reported planing with more than one future in mind

- But, surprisingly,

  - Participants in both conditions considered robust and adaptive strategies with equal frequency

  - We found no differences between individuals and groups

Overall, experiment suggests that well-chosen scenarios can help overcome cognitive load imposed by extreme cases

But decision context did not activate some expected differences between forecasts and scenarios

Outline

- **Testing the Scenario Hypothesis**

- **From scenarios to world views**

Many Policy Challenges Confront Multiple Worldviews Among Stakeholders

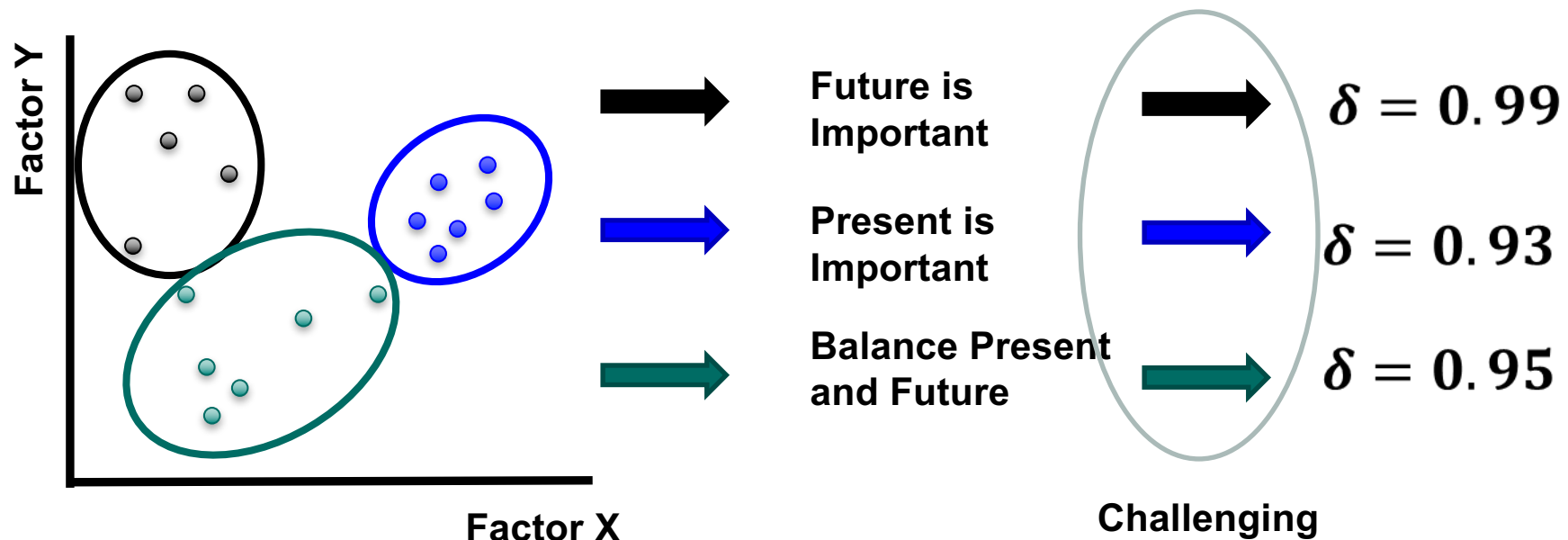- People filter information based on worldviews

By worldviews, we mean a cluster of objectives, mental models of causality, ethical values, and non-consequentialist judgments about legitimacy of alternative policy options

- These may affect

  – Epistemic interpretation of the nature of the world

  – Ethical analysis of the objectives to be sought

  – Willingness to compromise on means to achieve goals

Anthropological Approaches Can Help Identify and Organize Information on Worldviews

- Goal is to specify clearly enough to incorporate into quantitative modelling and ultimately improve stakeholder engagement

- Multiple data sources: interviews, surveys, pre-existing texts

- Multiple methods: cultural consensus analysis, text analysis

Factor Y

Factor X

Future is Important

Present is Important

Balance Present and Future

$\delta = 0.99$

$\delta = 0.93$

$\delta = 0.95$

Challenging

Next Steps

- Values Informed Mental Models (VIMM) work focuses on understanding the clusters of values that underlie stakeholders' mental models*

- Multiple worldviews concept focuses on a heterogeneity of values – both epistemological and ethical

- Maturing multi-objective RDM approaches (MORDM) provide a vehicle to incorporate these ideas into quantitative decision support

* Bessette et. al. (2017). "Building a Values-Informed Mental Model for New Orleans Climate Risk Management." Risk Analysis and

Mayer et. al. (2017) "Understanding scientists' computational modeling decisions about climate risk management strategies using values-informed mental models." Global Environmental Change 42: 107-116.

Thank you!

http://www.rand.org/pardee.html

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