The Advantages of Numeric Uncertainty Information in Complex Decision-Making Task

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Introduction

- It is now possible to quantify uncertainty information in some domains.
  (weather forecast: 30% chance of 6 inches or more of snow)
- However, experts worry that the lay-person will not understand it.
- Nonetheless, research suggests that people *use* numeric uncertainty to make better decisions for binary choices.

Joslyn & LeClerc, 2013

- However, in many real-world situations there are more options, increasing processing load.
- Will the advantage for numeric uncertainty information hold when more options are considered?

Research Question

Do people make better decision with numeric uncertainty information when 3 as well as 2 options are considered?

Methods

School closure simulation task

- Participants (N = 178) advised schools when to close due to snow
- Based on a weather forecast for snow accumulation (in inches)
- Instructions: advise closing when *snow accumulation* ≤ 6 is expected and advise delaying* when 1 ≤ *snow accumulation* < 6 is expected.
- Goal: Retain as many endowed points as possible
  - Small cost for closing & delaying*
  - Potential larger penalty for not closing or delaying*
  (* indicates that it's only in the 3-option condition)

Weather forecast: (in the 3option + prob. condition)
4 inches of snow. *(single value forecast)*
84% chance of snow 1 inch or more.* *(probabilistic)*
31% chance of snow 6 inches or more.
What is your advice to the school in the area?

Close	Delay*	Open
Cost: 2 points	Cost: 1 point*	Cost: 0 points

61 trials: Forecast → Decision → Outcome

Methods cont.

Point system

- Costs to either close (2 points) or delay (1 point)*
- Possible penalty for not taking protective action

- **2 (2-option vs. 3-option) X 2 (probabilistic vs. single value forecast)**

Complexity	Forecast Format: Single Value	Forecast Format: Probabilistic	Optimal Decision	Outcome: Cost	Outcome: Potential Penalty
2-Option	4" of snow	4" of snow 24% chance of snow 6+"	Close ⬆ ------ 6" Open	2 0	0 8
3-Option	4" of snow	4" of snow 84% chance of snow 1+" 31% chance of snow 6+"	Close ⬆ ------ 6" Delay ⬆ ------ 1" Open	2 1 0	0 4 2 or 8

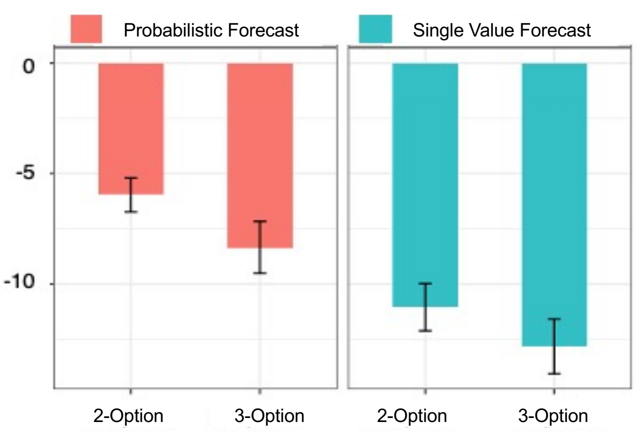
Results

Expected Value

Forecast: 5 inches of snow, 30% chance of 6 or more inches of snow
Close: = -2 points (← optimal choice)
Open: (-8) X (30%) = -2.4 points
Based on the expected value, there is one economically optimal decision for every trial

Expected Value Difference (EVD)

Participants' mean expected value – optimal expected value = EVD



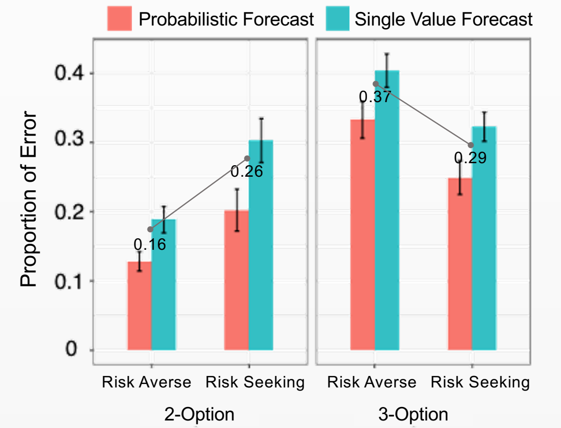
Probabilistic (M = -7.43, SD = 6.43) better (shorter) than **Single Value** (M = -11.88, SD = 7.77), $F(1, 174) = 19.50$, $p < .001$, $\eta_p^2 = .10$;
2-Option (M = -8.70, SD = 6.33) marginally better (shorter) than **3-Option** (M = -10.56, SD = 7.94), $F(1, 174) = 3.65$, $p = .06$, $\eta_p^2 = .02$.
Error bars represent standard errors of the mean.

Results cont.

Decision Error Analysis

Risk averse: a decision safer than optimal option
Risk seeking: a decision riskier than optimal option

Decision Error Analysis



Probabilistic better (less error) than **single value** forecast $F(1, 348) = 19.03$, $p < .001$, $\eta_p^2 = .05$.

2-way interaction: People in **2-option** made more *risk seeking* errors, whereas people in **3-option** condition made more *risk averse* error, $F(1, 348) = 25.43$, $p < .001$, $\eta_p^2 = .07$.
Error bars represent standard errors of the mean.

Kahneman & Tversky, 1979

Conclusion

- Numeric uncertainty information led to better quality decision in a more complex and realistic task
- Addition of an intermediate option changes the tendency from risk seeking to risk averse in loss scenario

References

- Joslyn, S., & LeClerc, J. (2013). Decisions with uncertainty: The glass half full. *Current Directions in Psychological Science*, 22(4), 308-315.
- Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica, 47*, 263-291.

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