Models of predecisional information distortion

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Abstract

Information distortion, the tendency for people to interpret incoming information according to their pre-existing beliefs, is a prevalent phenomenon in preferential and inferential tasks. However, most current models of the decision-making process do not account for this tendency. We present a new model which represents preference change as a random walk over preference states, where the probability of transiting to stronger or weaker preferences depends on the current state. We show that the model captures distortion in preference ratings and choice proportions using a dataset from Dekay, Stone, & Miller (2011).

The Phenomenon

Before making a decision, participants receive a series of pieces of information. Each piece favors option A (up) or B (down). The order of presentation of the options affects a person's preferences such that information favoring a preferred option is weighted more heavily, and information against a preferred option is weighted more lightly.

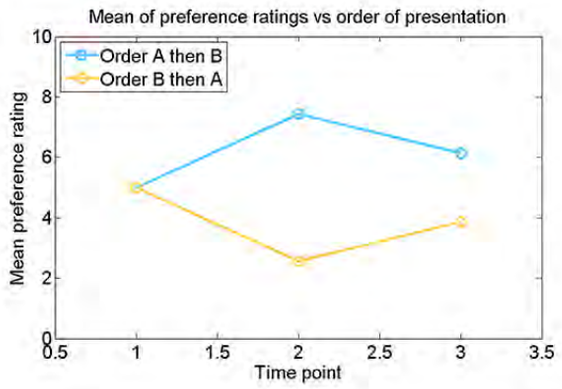

Figure 1: General pattern of mean preference strength over different orders of information presentation. Final choice proportions also reflect the difference in preference shown in the rightmost preference ratings.

Task structure

Participants made a series of preference judgments about a pair of gambles. They received a series of 5 pieces of information, the order of which was manipulated:

1 = Strongly favored A 2 = Weakly favored A

3 = Weakly favored B 4 = Strongly favored B

5 = Provided no new information (in principle)

After each piece, they rated their confidence that they would choose option A or B. At the end, they chose between the gambles. This was repeated for 4 sets of alternatives.

Model structure

The model used a random walk process to describe changes in distributions of preference over time as well as predict choice proportions. Each piece of information had a mean strength (drift) and variability (diffusion).

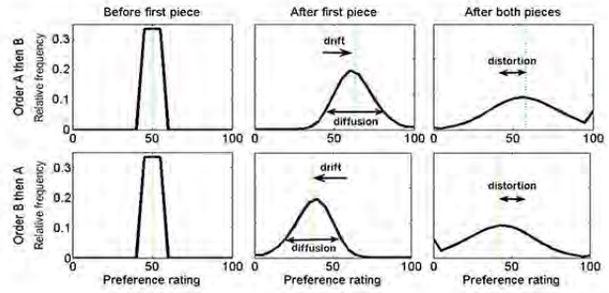

Figure 2: Pattern of model predictions for two orders or information presentation

Information distortion arose from a single free parameter that makes it more likely to step toward the favored alternative. It is similar to a discrete-state, reversed Ornstein-Uhlenbeck process on a finite state space (see e.g. Busemeyer & Diedrich, 2002), and used 11 total free parameters.

Results

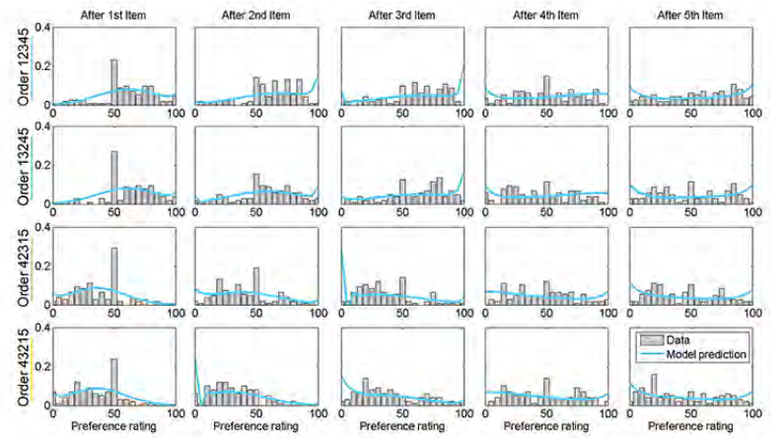

Figure 3: Plots of the distribution of preference data (bars) along with maximum likelihood model predictions (line plots) across the 4 order manipulations (rows) after participants received each piece of information (columns).

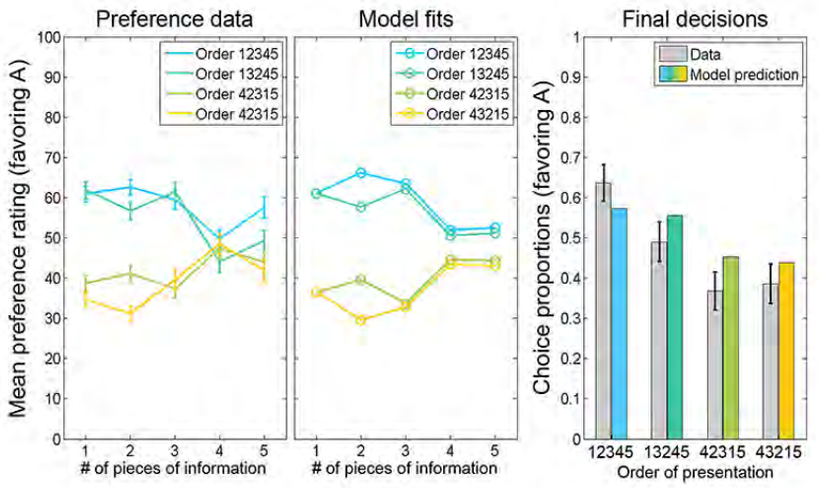

Figure 4: Plot of mean preference across order manipulations (left), along with model predictions (middle). Also shown are the choice proportions between alternatives, taken after all 5 preference responses, alongside model predictions for these values (right).

Discussion

The model provided a good account of the qualitative pattern of information distortion, distributions of preference ratings, and mean preference change within and across conditions. However, it struggled somewhat to reproduce the final choice proportions. This is primarily due to a larger effect size in choice proportions than in preference.

We gain a number of benefits from applying the random walk approach to modeling information distortion:

1. The model predicts entire distributions of preference ratings where other models of information distortion (e.g. connectionist models) could or would not.

2. The model recovered the strength of pieces of information presented (i.e. 1 was the strongest in favor of A, 4 was similar strength for B) and could predict effects across any order of presentation.

3. Information distortion in both preference ratings and choice proportions arose out of a single mechanism.

4. It provides new predictions, namely:

- More ambiguous (high variance) information should be more heavily distorted.
- Information distortion should lead to faster decisions in optional stopping decision tasks.
- Distributions of preference should be asymmetric when information is distorted

These predictions invite new directions for future research, and the model itself provides a process-level, computational explanation of information distortion.

References

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Busemeyer, J. R., & Diederich, A. (2002). Survey of decision field theory. *Mathematical Social Sciences, 43*(3), 345-370.

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