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Independent Testimonies are no better than Sequential Testimonies in Judgments under Uncertainty

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Background

Independent testimonies provide novel information

Dependent testimonies involve redundant information

Two conflicting accounts:

1) Dependent evidence influences reasoning more than it normatively should.

- Participants were as confident in a true consensus (many primary sources) as a false consensus (a single primary source) (Yousif, Aboody, & Keil, 2018)
- Participants either did not attend to dependence, or did not know how to incorporate dependencies when combining forecasts (Maines, 1996)
- Participants conformed more to opinions consistent with their own information, regardless of that opinion's level of redundancy to their own information (Gonzalez, 1994)

2) People are sensitive to dependency, consistent with a Bayesian model of updating.

- Whalen, Griffiths, and Buchsbaum (2017) developed a Bayesian model of social learning
  - Then used a balls-and-urns task with social testimony (Anderson and Holt, 1997)
  - Participants used dependent testimony less than independent testimony

Aims:

1) Re-examine participants' sensitivity to dependency, using the Whalen et al., (2017) task
2) Identify how participants update after each piece of evidence
3) Compare this updating with Whalen et al., (2017)'s Bayesian model of social learning

Experiment 1

Method

Participants: $N = 223$ US residents, recruited from MTurk

Procedure: Participants guess which of 2 jars was randomly selected

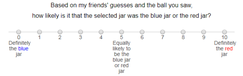
1) Blue jar contains 100 blue, 20 red balls ($5/6^{ths}$ blue)
p(blue jar) = p(red jar) = .5

2) Several friends help:
1. Each receives a ball from the jar
2. Gives their best guess on which jar was selected
   - Always guessed the same jar

We manipulated:
- Dependency of testimony:
  - Guesses are **independent** (top)
  - Or made **sequentially** after hearing previous guesses (bottom)
- Number of informants:
  - 3 or 7

3) Participant makes likelihood rating after each guess

4) Participant receives own ball
- Colour conflicts with all guesses



5) Participant makes final likelihood rating

Bayesian Model of Social Learning (Whalen et al., 2017)

Independent

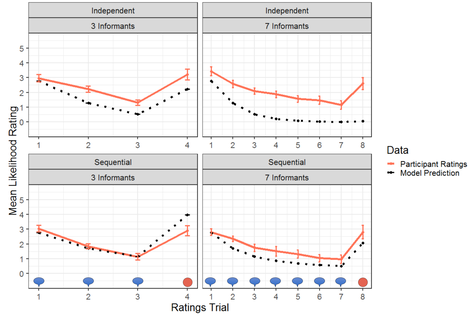
- Posterior probability of $jar_{red} \propto$ probability of each testimony, given possible balls

$$p(jar_{red} \mid ball_{own}, t_1, t_2, t_3) = 1 - p(jar_{blue} \mid ball_{own}, t_1, t_2, t_3)$$
$$\propto p(t_1, t_2, t_3 \mid jar_{red}) \times p(ball_{own} \mid jar_{red}) \times p(jar_{red})$$
$$= p(t_1 \mid ball_{i1}) \times p(t_2 \mid ball_{i2}) \times p(t_3 \mid ball_{i3}) \times p(ball_{i1}, ball_{i2}, ball_{i3}) \times 1/6 \times 1/2$$
$$= .78$$

Sequential

- Posterior probability of $jar_{red} \propto$ probability of each testimony, given possible balls AND previous testimonies
- Therefore, every informant undergoes the above inference for any previous informant(s)
  - Model assumes participants take this into account

Results



Mean ratings of the likelihood that the selected jar was of the colour implied by the participants' ball (the 'red jar' in this example). Ratings are shown for each trial where the participant received evidence - either testimony or their own ball. Error bars represent ±1 SEM.

Independent vs. Sequential

1. Downward slope - ratings after (3 or 7) testimonies
   - Likelihood ratings decreased with more testimonies ($BF_{10} > 1000$)
     - Decrease not affected by number of informants (3 vs. 7; $BF_{01} = 2.46$)
     - Nor by dependency (independent vs. sequential; $BF_{10} = 1.05$)
2. Uptick - rating after own ball
   - Rating increased from penultimate to final rating ($BF_{10} > 1000$)
     - Increase not affected by number of informants ($BF_{01} = 5.96$)
     - Nor by dependency ($BF_{01} = 6.58$)

Participant ratings vs. Model predictions

- Closer model fit in sequential conditions ($R^2 = .81$),
  - Compared to independent conditions ($R^2 = .71$)
- Independent ratings are conservative (closer towards midline than predicted)

Summary

1. In all conditions, participants updated in the predicted directions.
2. This updating was unaffected by 1) dependency, or 2) number of informants.
3. Sequential ratings fit the Whalen et al., (2017) model better than independent ratings.

Conclusions

We found no evidence that participants are sensitive to the dependency of testimony.

- In other experiments, we have shown that this lack of sensitivity is NOT due to;
  - Using a between-subjects design ($N = 150$)
  - Recency effects (swapped evidence order; $N = 450$)
  - Belief that sources are unreliable ($N = 167$; e.g., Collins, Hahn, von Gerber, & Olsson, 2018)
- Dependency-insensitive reasoning is often thought to be caused by participants giving too much weight to dependent information
  - E.g., Fiedler, Hütter, Schott, and Kutzner (2019) argue that we experience 'metacognitive myopia' in failing to discount repeated information

We show that reasoning from sequential evidence conforms more to a Bayesian model than reasoning from independent evidence.

- This is somewhat unexpected - the computational task of inferring probabilities from sequential testimonies is more complex than that from independent testimonies
- Independent ratings resemble classic demonstrations of conservatism (Phillips, Hays, & Edwards, 1966)
  - This conservatism may be caused by participants assuming some conditional dependence (Navon, 1978; Winkler & Murphy, 1973)

Future work:

- What is the influence of dependent testimonies in other domains (e.g., medical diagnosis)?
- What other models of belief updating could better account for these results?

Key References

Anderson, L. R., & Holt, C. A. (1997). Information Cascades in the Laboratory. *The American Economic Review, 87*(5), 847–862.
Whalen, A., Griffiths, T. L., & Buchsbaum, D. (2017). Sensitivity to Shared Information in Social Learning. *Cognitive Science*. doi: 10.1111/cogs.12485

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