Strategy Selection in Sequential Advice Taking

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judge	1-st advisor	judge		k-th advisor	judge		K-th advisor	experimenter	judge
make initial estimate E_0 state initial confidence C_0	provide advice A_1	stopping decision s_1	…	provide advice A_k	stopping decision s_k	…	provide advice A_K	forced stopping (e.g., at $K = 20$)	make final estimate E_K state final confidence C_K

Abstract

In sampling approaches to advice taking, participants have the opportunity to **sequentially sample** multiple pieces of advice per judgment (see flowchart at the top). Typically, **no intermediate judgments** are recorded in the judge-advisor system (JAS) with active sampling (e.g., Hütter & Ache, 2016). Therefore, a cognitive model of sequential advice taking was formulated that allows to investigate step-wise belief updating by means of Bayes' rule. To contribute to the understanding of active advice seeking, the Bayesian model was compared to cumulative versions of the established **choosing and compromising strategies** from the traditional paradigm (Soll & Larrick, 2009). In a re-analysis of empirical data from Experiment 5 of Ache (2017), we found that compromising between one's own initial beliefs and the distribution of multiple pieces of advice sampled from others was **more predictive** than choosing one of the two. However, cumulative compromising was more popular than sequential compromising. Moreover, **egocentrism** was as pronounced for (not) taking multiple pieces of advice as in the traditional paradigm. Also participants' willingness to integrate external opinions was relatively lower for multiple pieces of **closer** as compared to **more distant** advice. Essentially, however, there are large **inter- and intra-individual differences** in strategy selection for sequential advice taking. In summary, people's utilization of multiple, sequentially sampled external opinions resembles their single advice taking strategies.

1. Sequential advice assessment

The **distance** between a (new) piece of advice and one's current beliefs is often assumed to be processed **fast** (and automatically; Kahneman, 2003). Hence participants' assessment of advice trustworthiness is specified as **first-stage** belief updating in the sequential model.

Model specification

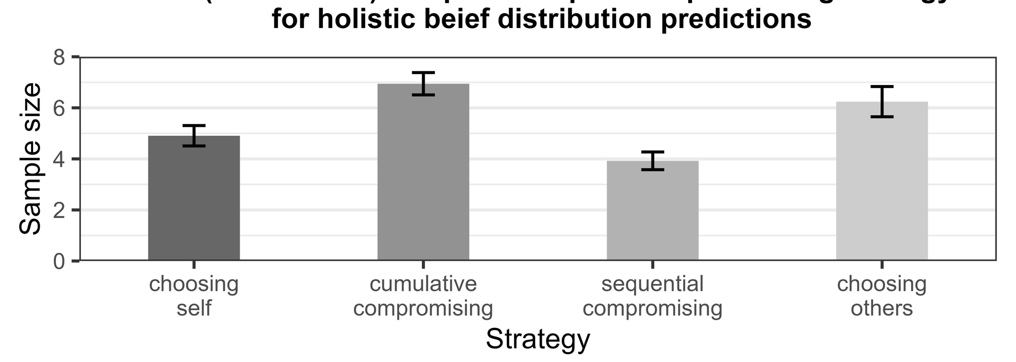
Prior beliefs about advice precision	Likelihood of advice
$\tau^2 \sim \text{Inv}-\chi^2(L_0, T_0^2)$	$A_k \sim N(\hat{E}_{k-1}, \tau^2)$

– **Sequential belief updating:** $L_k = L_{k-1} + 1$ and $\hat{T}_k^2 = \frac{L_{k-1}}{L_k}\hat{T}_{k-1}^2 + \frac{1}{L_k}(A_k - \hat{E}_{k-1})^2$

3. Sequential stopping

Free sampling requires stopping decisions at the **third stage** of a sampling trial. Indeed, we found significant differences in the amount of external evidence considered across the four advice taking strategies.

Mean (incl. 95% CI) sample sizes per best performing strategy for holistic beief distribution predictions



Close advice typically induces confidence boosts rather than judgment shifts and is sampled less frequently than distant advice (e.g., Hütter & Ache, 2016). Therefore, informative stopping rules (or a Bayesian stopping model) may be derived from **posterior confidence thresholds** to predict sampling decisions in future research (cf. Hausmann & Läge, 2008).

2. Sequential belief updating

Participants' **initial** judgments are supposed to be the result of an **internal** (i.e., Thurstonian) sampling process whereas their **final** judgments integrate **external** (i.e., Brunswikian) evidence (Sniezek & Buckley, 1995). Judgment and confidence updating are specified to account for this dissociation on the **second stage** of a sequential advice sampling chain.

Model specification

Prior beliefs about the truth	Likelihood of advice
$\theta \sim N(E_0, C_0)$	$A_k \sim N(\theta, \hat{T}_k^{-2})$

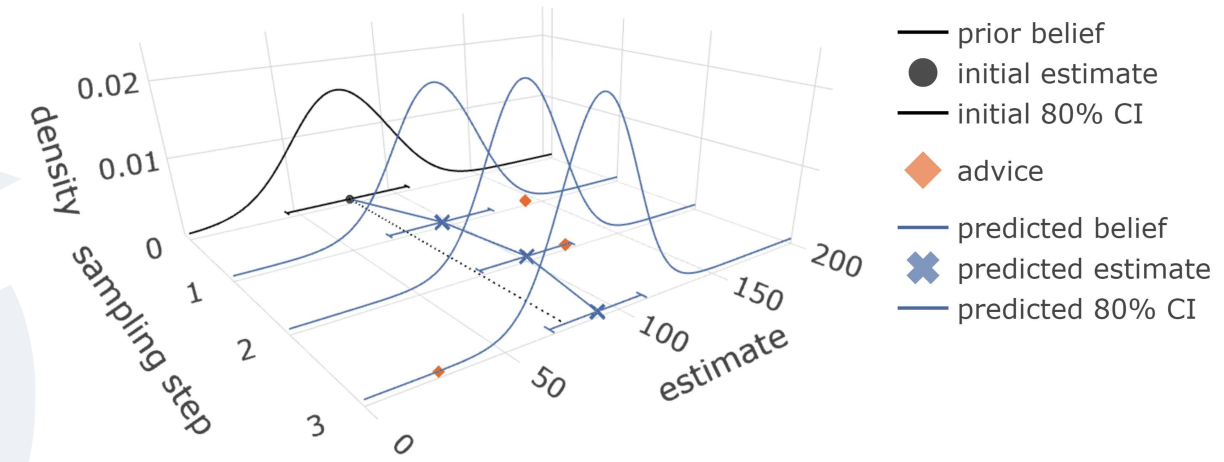
– **Sequential belief updating:** $\hat{E}_k = \widehat{W}_{A_k} A_k + (1 - \widehat{W}_{A_k})\hat{E}_{k-1}$ and $\hat{C}_k = \hat{C}_{k-1} + \hat{T}_k^{-2}$

– **Bayesian weight of advice (WOA):** $\widehat{W}_{A_k} = \frac{\hat{T}_k^{-2}}{\hat{C}_{k-1} + \hat{T}_k^{-2}} \in (0,1)$

Confidence	Advice distance: Close	Advice distance: Distant	Marginal effect
Low	$\hat{C}_{k-1} \ll \hat{T}_k^{-2}$ $\Rightarrow \widehat{W}_{A_k} \to 1$	$\hat{C}_{k-1} \approx \hat{T}_k^{-2}$ $\Rightarrow \widehat{W}_{A_k} \approx 0.5$	$\widehat{W}_{A_k} \gtrsim 0.5$
High	$\hat{C}_{k-1} \approx \hat{T}_k^{-2}$ $\Rightarrow \widehat{W}_{A_k} \approx 0.5$	$\hat{C}_{k-1} \gg \hat{T}_k^{-2}$ $\Rightarrow \widehat{W}_{A_k} \to 0$	$\widehat{W}_{A_k} \lesssim 0.5$
Marginal effect	$\widehat{W}_{A_k} \gtrsim 0.5$	$\widehat{W}_{A_k} \lesssim 0.5$	Internal \ external inconsistency discounting

– Inconsistency discounting: **Uncertainty-dependent** updating implies relatively lower weighting of more variable (imprecise) internal (external) evidence (Anderson, 1971)

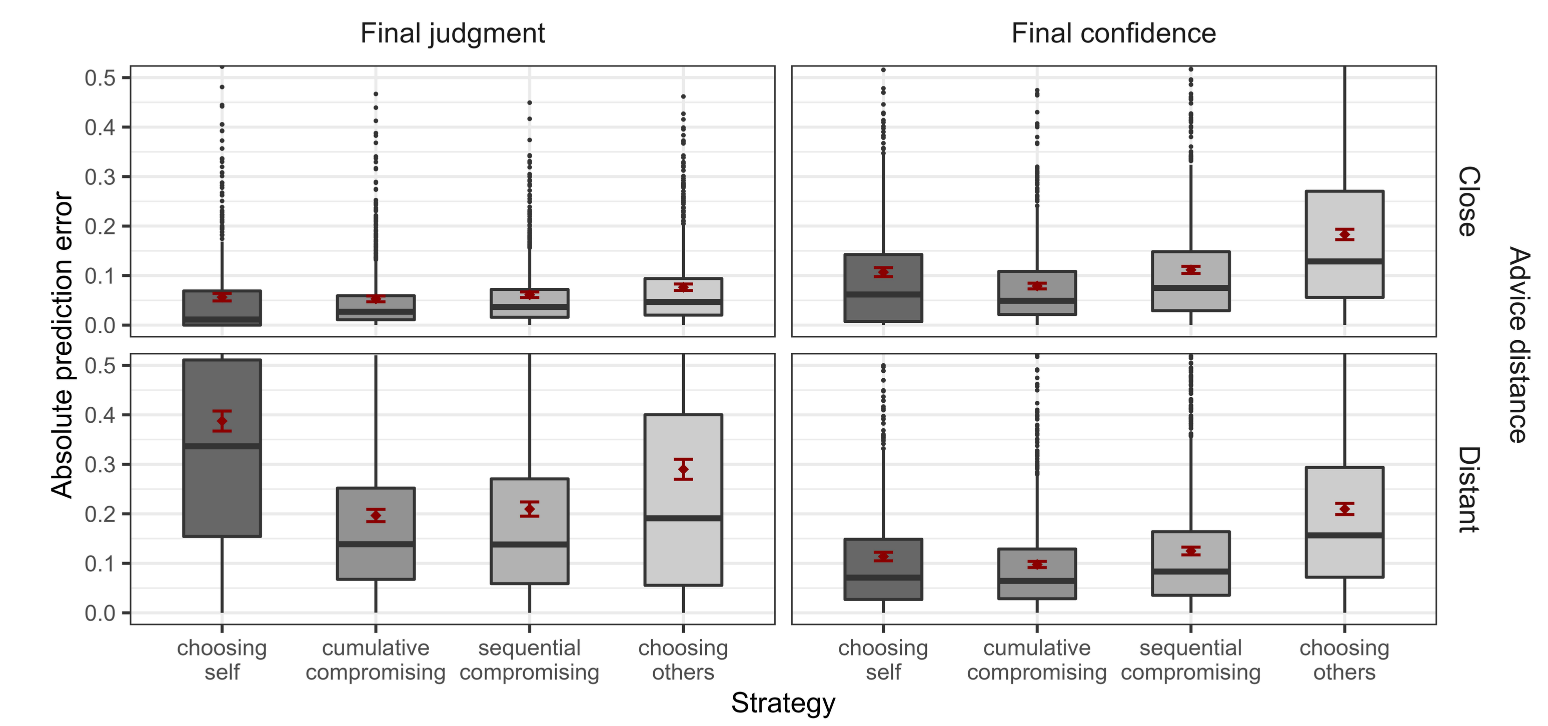
– **Example:**



Model comparisons: Empirical results

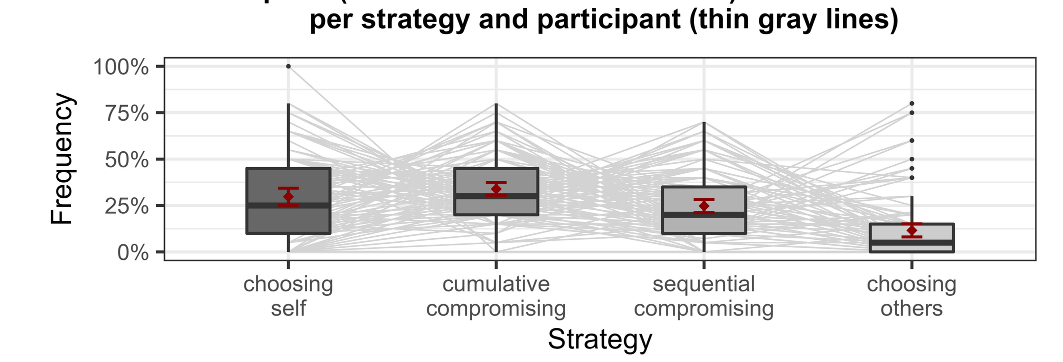
Cumulative compromising **best predicted** final judgments and confidence, followed by sequential Bayesian updating, choosing the self, and finally choosing (all) others. Whereas the prediction performances for final **confidence** were approximately the same across **distance conditions**, all models performed much better in predicting final **judgments** in response to close as compared to more distant advice.

Boxplots (incl. mean and 95% CI in red) of prediction performance per strategy and belief distribution parameter



The best fitting model **varies** between items and trials for all but one participant who is perfectly described as no advice taker and did not sample any advice. That is, there are large **inter- and intra-individual differences** in strategy selection for sequential advice taking.

Boxplots (incl. mean and 95% CI in red) of share of best fit per strategy and participant (thin gray lines)



Discussion

The two compromising strategies are comparable in terms of average prediction performance for Experiment 5 of Ache (2017). Divergent mathematical properties (e.g., inconsistency discounting vs. harmonically decaying influence of advice) are one reason for (partly striking) **ranking reversals** between the two for most participants. In fact, the Bayesian account **dynamically** dissociates all three established strategies (choosing the self/advisor or compromising; Soll and Larrick, 2009) into **uncertainty-dependent** outcomes of sequential updating (see Bayesian WOA).

Order effects

Sequential updating entails both **primacy** effects due to strictly growing posterior confidence (i.e., from a **sequential** perspective) and **recency** effects due to updating the Bayesian WOAs by a factor strictly smaller than one in each sampling step (i.e., in terms of **total** weighting). However, a more flexible version of this model would allow to account for empirically observed **serial patterns**.

Multi-stage processing

Advice (re-)assessment prior to judgment and confidence updating in the Bayesian account as well as stopping versus sampling decision-making are strong temporal assumptions about the **processing sequence** of information that require **empirical testing** in future research.

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