Noisy inference in information seeking without prospective reward trade-offs

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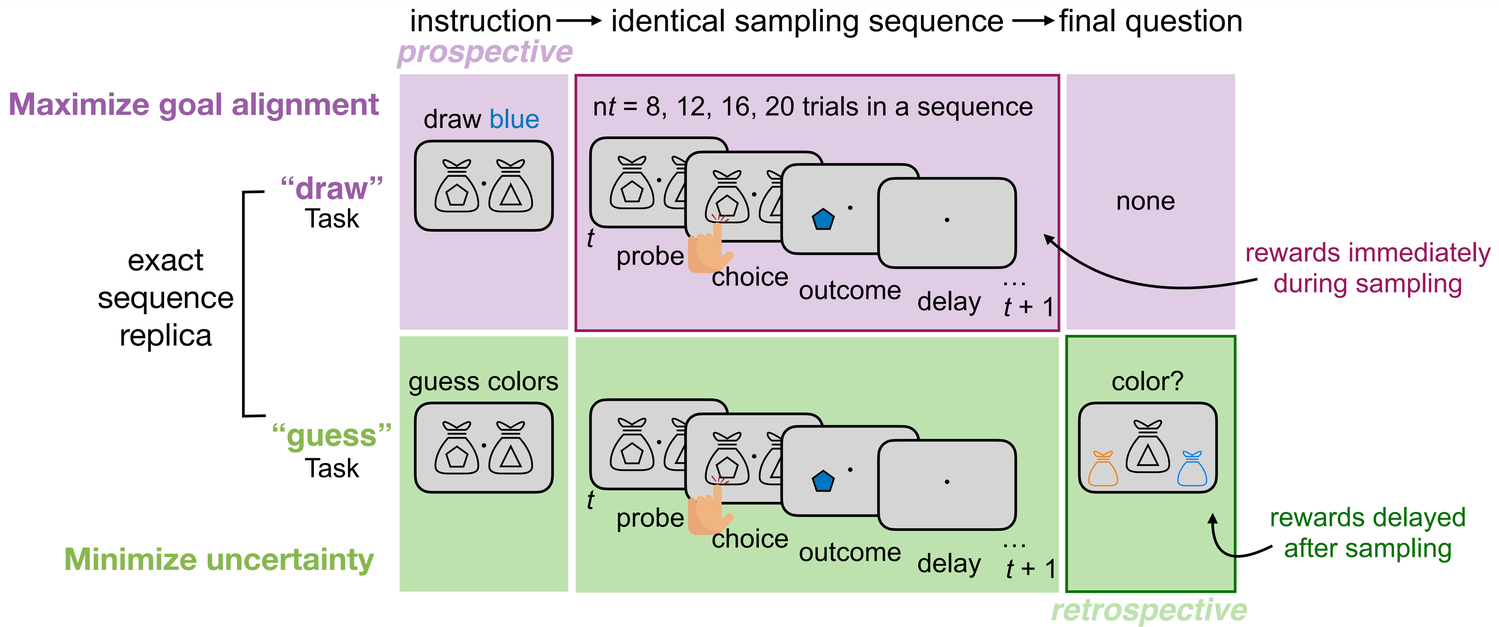
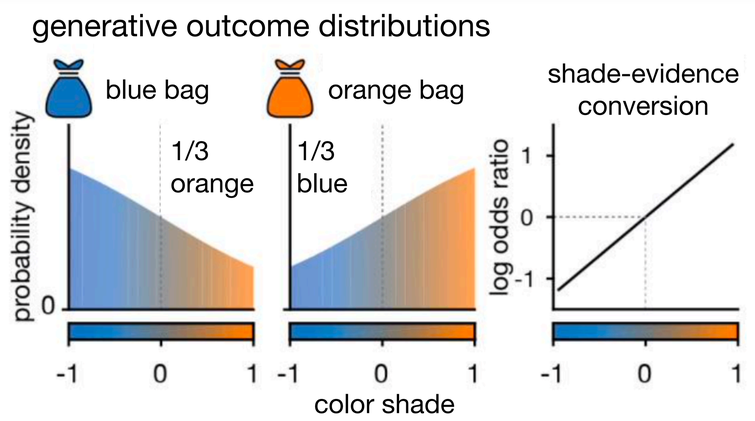
1 *Introduction*

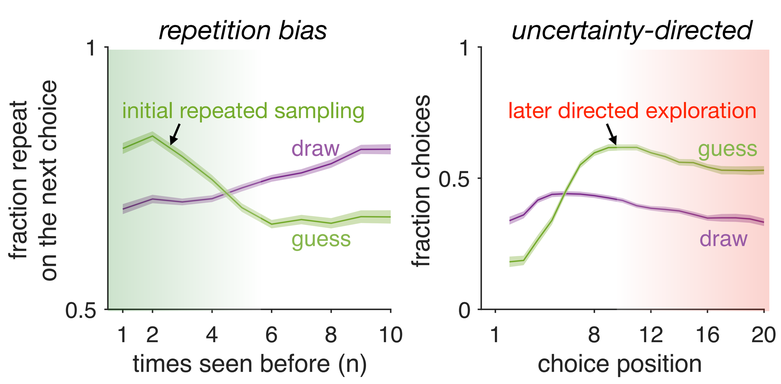
- **Exploration studied in laboratory settings:** Goal-directed actions to maximize rewards;
- **Not all choices yield immediate rewards:** e.g., browsing restaurant reviews online;
- **Key question:** How does information seeking contribute to learning the environment's structure versus maximizing rewards?

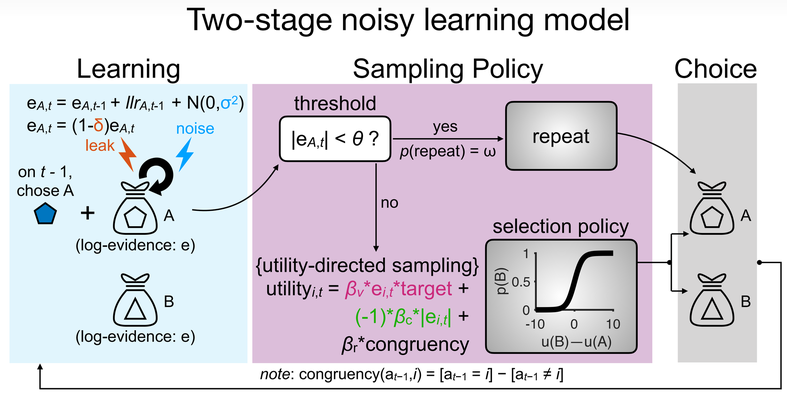
2 *Information-seeking task[1] (N = 420 human participants)*

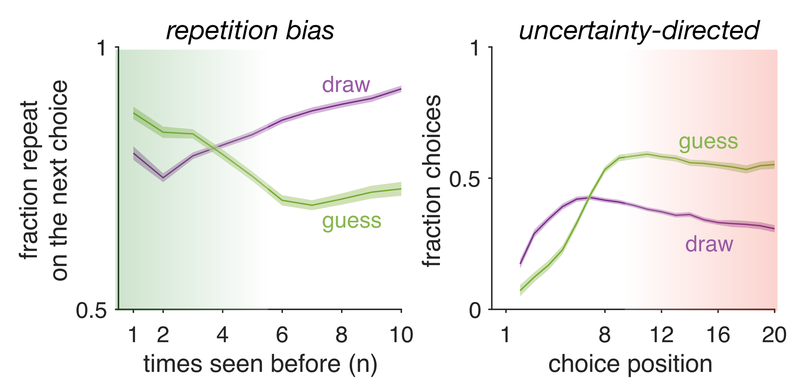




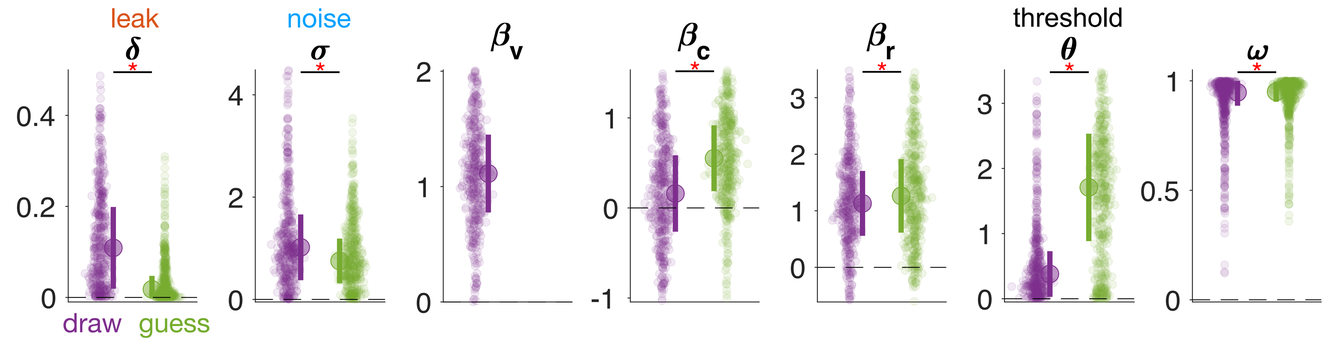
3 *Human & model sampling behavior*

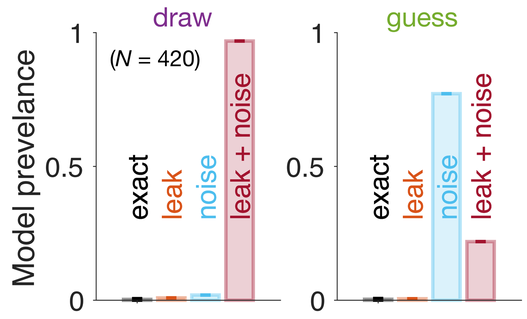




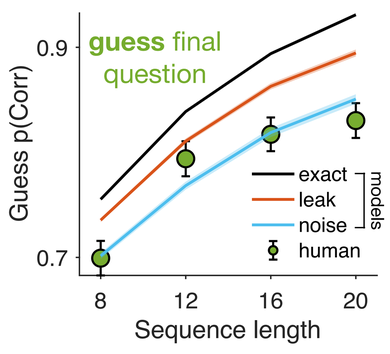


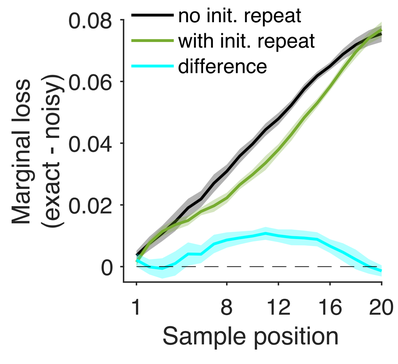
4 *Model parameters & analysis*



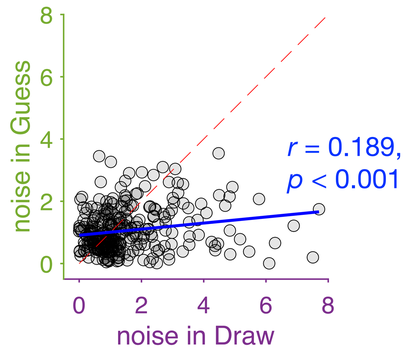


- Noisy model > exact model



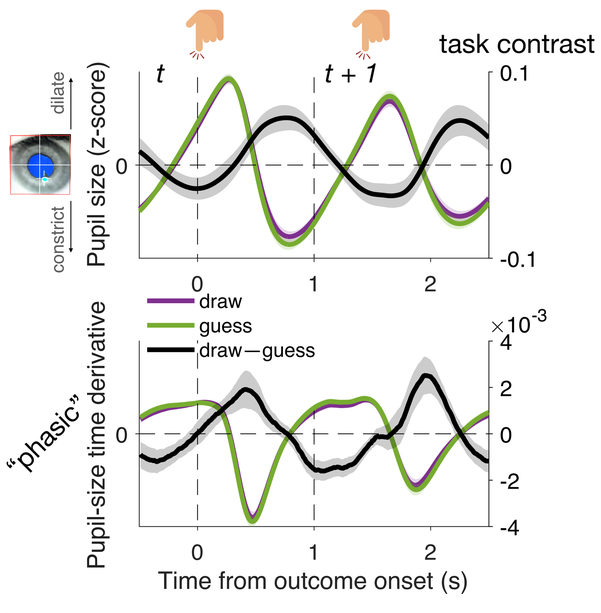


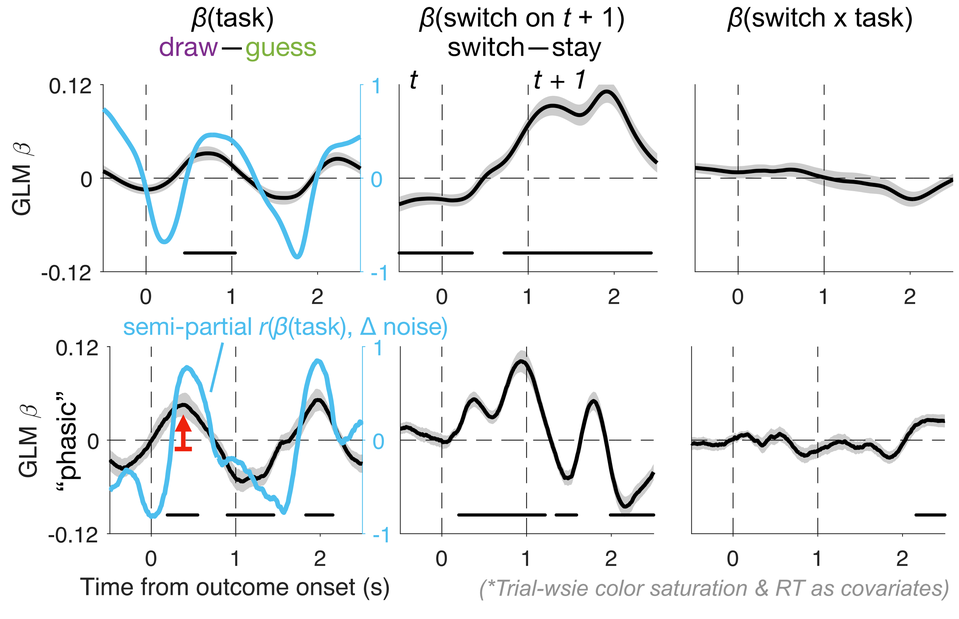
- *Marginal loss*: The final guess (p(correct)) that would have been obtained if there were no noise during learning, i.e., the difference between the exact and noisy model predictions.
- Initial repeated sampling helps protect simulated agents from marginal loss in accuracy.

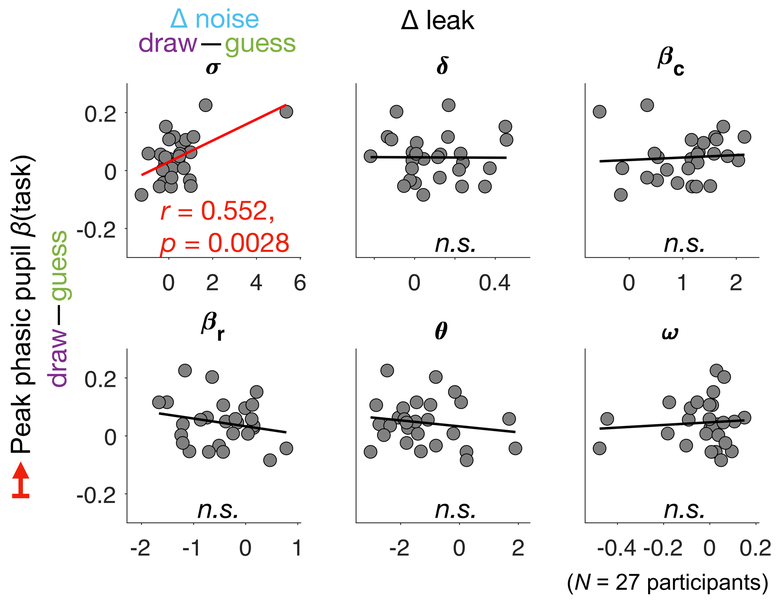


- Noise & leak: Draw > Guess
- Sig. correlation: Draw vs. Guess noise magnitude

5 *Pupillometry*







6 *Conclusions*

- In "guess" task (structure learning), participants use a two-stage sampling policy: an initial phase of repeated sampling in temporal "chunks" to generate and test hypotheses about each novel single option, followed by a directed-sampling phase focusing on the more uncertain option.
- This initial phase of repeated sampling reduces the marginal loss in accuracy due to learning noise.
- Task-induced changes in phasic pupil-dilation dynamics[2] correlate with changes in the magnitude of learning noise (but not with other parameters).

1. Almeras, C., Chambon, V., & Wyart, V. (2022). Competing cognitive pressures on human exploration in the absence of trade-off with exploitation. *PsyArxiv.*
2. Reimer et al. (2016). Pupil fluctuations track rapid changes in adrenergic and cholinergic activity in cortex. *Nat. comm., 7*(1), 13289.

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