Feedback Promotes Learning and Knowledge of the Distribution of Values Hinders Exploration in an Optimal Stopping Task

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Summary

In many naturalistic situations such as deciding on an apartment to rent or selecting a life partner, people explore options before making a selection. We investigate the following:

- How do **feedback** and **knowledge of the distribution of option values** affect **learning** in sequential search?
- How do people **deviate from optimal** based on these factors, and can this be modeled with a **cognitive model** of decisions from experience?

Introduction

- Previous work indicates that people are suboptimal at stopping exploration and often stop earlier than optimal [1, 5].
- People may learn to stop at the optimal point with experience [3].
- We investigate factors that may influence learning in stopping decisions and extend our previous modeling work [2] to this task.

Methods

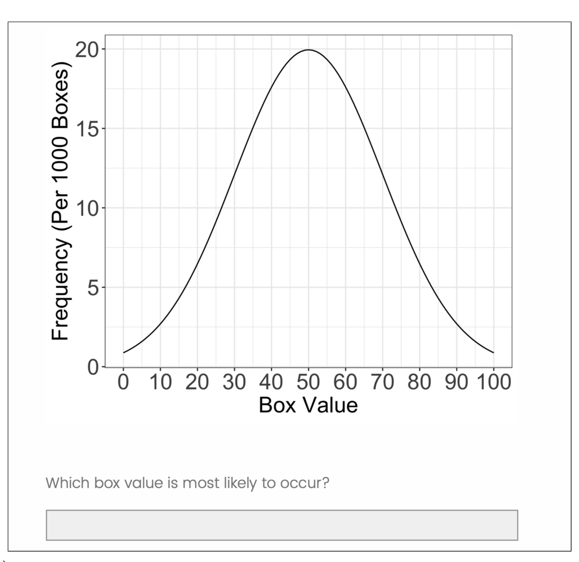
Human Participants

- *Participants*: 256 from Amazon Mechanical Turk
- *Design*: Between-subjects
- *Conditions*: 2 (Knowledge of the Distribution: Known or Unknown) x 3 (Feedback: No Feedback, Outcome, or Detailed)

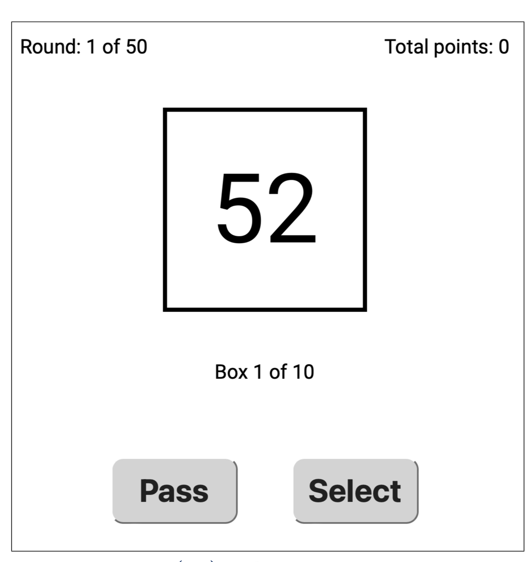
Model Agents

- Simulate 256 IBL model and optimal agents

Optimal Stopping Task



(a) Known Distribution Condition



(b) Choice

Feedback Conditions

- **No Feedback**:
  You chose **Box** [**Number**] with a value of [**Value**].
- **Outcome Feedback**:
  Your choice was [**Correct**/**Wrong**]. You chose **Box** [**Number**] with a value of [**Value**].
- **Detailed Feedback**:
  Your choice was [**Correct**/**Wrong**]. You chose **Box** [**Number**] with a value of [**Value**]. The maximum value box was **Box** [**Number**] with a value of [**Value**].

Cognitive Model: Instance-Based Learning Model

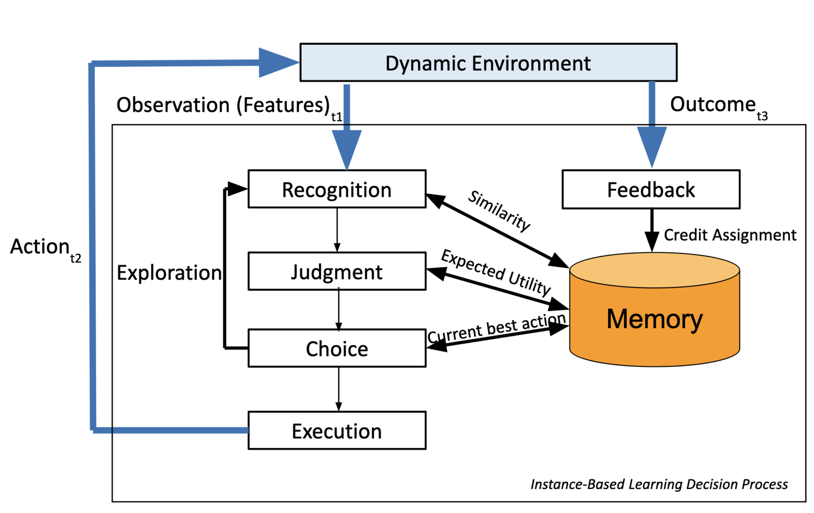


Figure 2: Instance-Based Learning Theory [4]

- Learning occurs through the accumulation of memory units called *instances*.
- Past instances are *retrieved* based on *similarity* to the current situation, frequency, and recency.
- A *blended value* (BV) is calculated based on the *utility* of retrieved instances.
- The agent *chooses* the option with the highest BV.

State		Action	Utility
Value	Boxes Remaining	{Select, Pass}	{0, 1}

Table 1: Instance Structure

Results

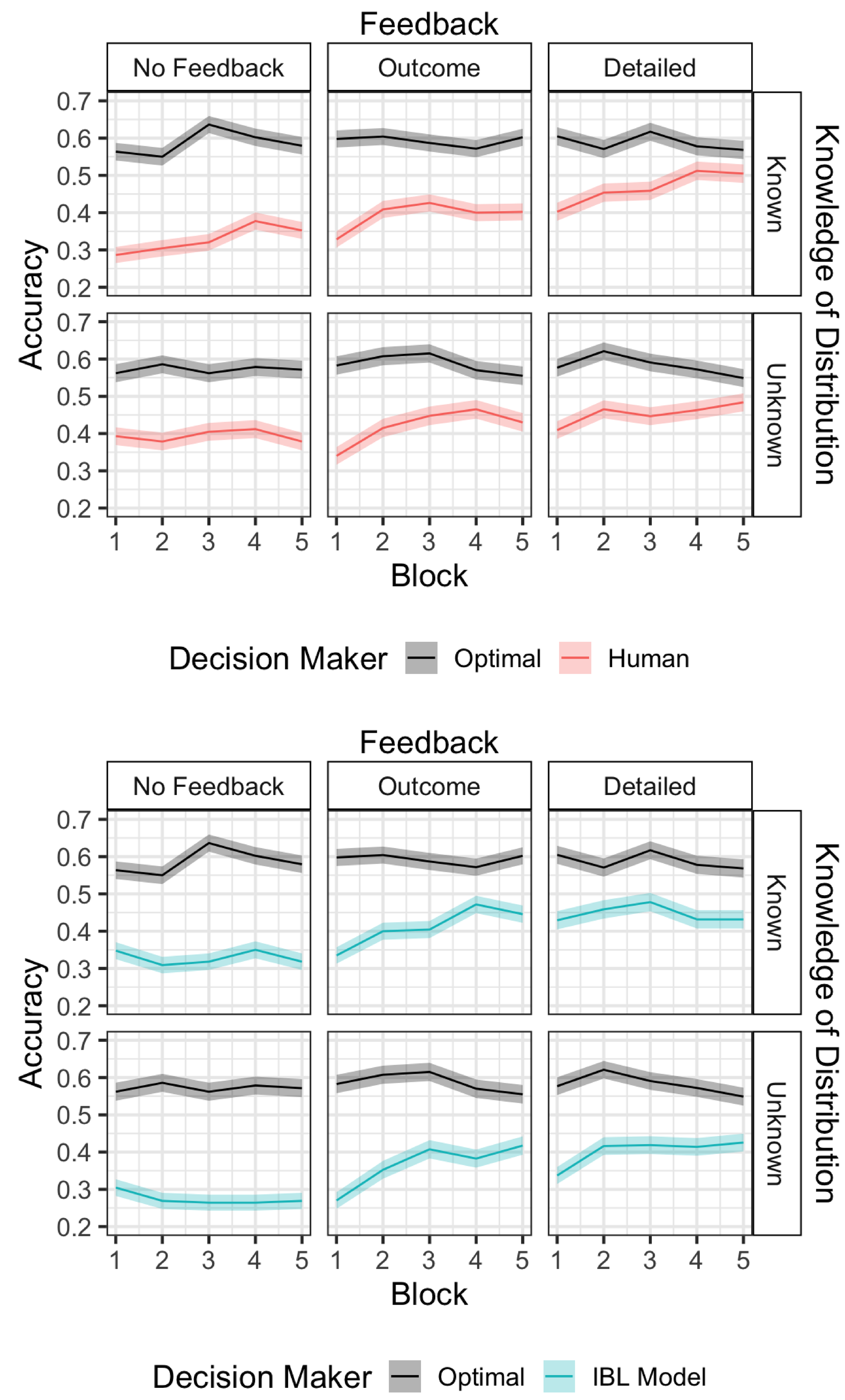


Figure 3: Accuracy for Human Participants (top, red), IBL Agents (bottom, blue), and Optimal Agents (both, black) over Blocks of 10 Problems

Conclusion

Key Findings:

- **Feedback Promotes Learning**: Participants in the feedback conditions stopped closer to the optimal position and achieved higher accuracy.
- **Knowledge of the Distribution Hinders Exploration**: Participants with distribution knowledge explored less by stopping earlier than those without this knowledge.
- **Model Predictive Accuracy**: The IBL model accurately predicted human stopping behavior across conditions.

Future Work:

- Investigate additional factors (variability of sequence length, crowd decisions)

References

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[4] Cleotilde Gonzalez, Javier F. Lerch, and Christian Lebiere. Instance-based learning in dynamic decision making. *Cognitive Science*, 27, 2003.

[5] Maime Guan, Ryan Stokes, Joachim Vandekerckhove, and Michael D. Lee. A cognitive modeling analysis of risk in sequential choice tasks. *Judgment and Decision Making*, 15(5):823–850, September 2020.

Additional Information

- **Lab Website:** cmu.edu/ddmlab
- **Personal Website:** erinbugbee.com
- **For Materials, Paper, Poster:** Scan QR code