Memory Effects in the Clark's Nutcracker: A Cognitive Model for Corvids

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❶ Introduction & Objectives

Like most corvids - or crow relatives - Clark's nutcrackers bury food under ground, saving it for later.

Laboratory work shows that this process of caching and recovery depends on memory for individual sites.

Clark's nutcracker

credit: Russell Balda

our aim:

- to build a computational, cognitive model of corvid caching and recovery

in order to:

- integrate the available data
- provide new insights
- demonstrate the technique for other species

❷ Empirical Experiments (Kamil & Balda)

We model three experiments[2,3], all with the same basic structure:

- one caching session, where each bird can cache seeds in an experimental room
- one or more recovery sessions, where each bird can recover its seeds

experimental room

biosci.unl.edu/avcog/

example setup

❸ Model

Memories of caching and recovery events are stored in chunks. Chunks' activation B_i depends on their frequency and recency of use[1].

With these activation values and noise, we create two mechanisms:

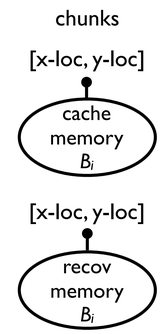
- successful recovery:

  higher cache chunk activation → higher odds of recovering there

- inhibition of return:

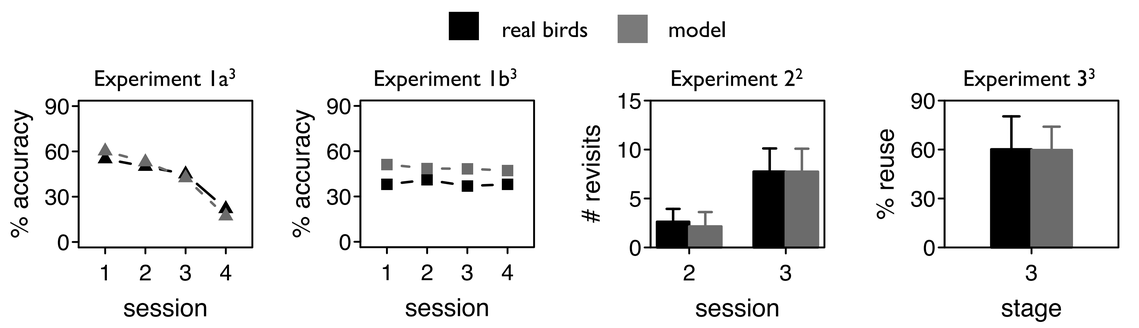
  higher cache chunk activation → lower odds of caching there

  higher recov chunk activation → lower odds of recovering there



❹ Results

With one set of three parameters, our model fits four different patterns, from three different experiments[2,3]:



- When the birds can recover in any order, their accuracy falls across sessions.
- When the birds must recover by room quarter, their accuracy stays constant.
- When the birds must recover across multiple sessions, they revisit emptied sites.
- When the birds must cache in new or previously used sites, they prefer used ones.

❺ Contribution & Conclusion

Our model's major contribution is that it provides a new explanation.

In the lab, accuracy declines significantly across sessions just a few days apart (Experiment 1a).

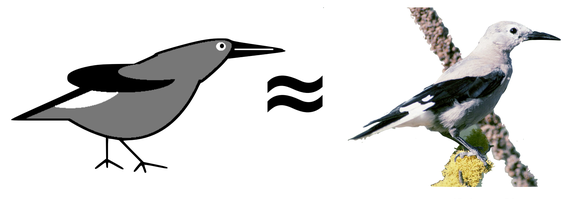
Why?

- in the original hypothesis [3], it's because the best-remembered sites are recovered first
- in our model, the same effect arises as a byproduct of chance and noise

This seems to be a useful alternative explanation, because attempts to discover *why* certain sites might be memorable have not been successful[4].

So, we conclude that our model meets our objectives:

- it integrates data from three experiments, covering four different patterns
- it provides new insight into why Clark's nutcrackers become less accurate
- and thus, it demonstrates that cognitive modeling can be useful for other species



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[4]Kamil, A. C., Balda, R. P., & Good, S. (1999). Patterns of movement and orientation during caching and recovery by Clark's nutcrackers, *Nucifraga columbiana*. *Animal Behaviour*, 57, 1327-1335.