Motor learning, behavioural flexibility, and colour-associative learning in black-capped chickadees (*Poecile atricapillus*)

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Introduction

"General intelligence hypothesis"

- Predicts that proficiency in one type of learning may indicate proficiency in another type of learning; i.e., individuals differ consistently in cognitive ability
- Supported in mammals (Deary *et al.*, 2010) and is beginning to be tested in birds (Boogert *et al.,* 2010)

Based on the general intelligence hypothesis, we hypothesize that there exists a positive correlation between all 4 of these cognitive abilities:

- **Motor learning**
- **Behavioural flexibility**
- **Colour-associative learning**
- **Reversal learning**

Figure 1. Front-view of operant device

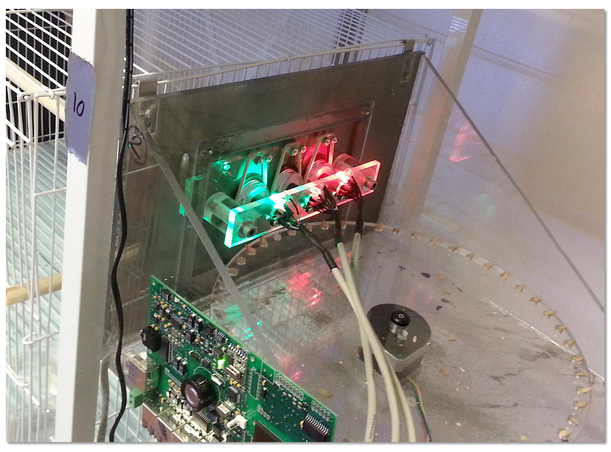

Figure 2. Back-view of operant device

Methodology

An operant device (Skinner box) including a panel with three illuminated, programmable keys was used.

THE TEST →

Stage 1: Motor learning

The bird needed to peck the central key (illuminated **WHITE**) three times.

Stage 2: Behavioural flexibility and colour-associative learning

Both side keys were illuminated: one **RED**, one **GREEN**. Placement of colours was random.

- Pecking the **RED** key resulted in a food reward (positive consequence)
- Pecking the **GREEN** key resulted in a 15-second shut-off of the system (negative consequence)

To pass Stage 2, the bird needed to peck the **RED** key nine times out of ten successive trials.

Stage 3: Reversal learning

Same process as Stage 2 but the reward key changed from **RED** to **GREEN**.

Each bird was exposed to the operant device from 8:00 am to 10:00 am daily for five consecutive days.

In total, 20 wild-caught birds were tested (n=20) and released at site of capture at the end of the experiment.

VARIABLES →

Motor learning = time delay (in minutes) between the first and third center key peck (time required to pass Stage 1)

Behavioural flexibility = time delay (in minutes) between the third center key peck (end of Stage 1) and the first side key peck (beginning of Stage 2)

Colour-associative learning = number of trials before the **RED** key was pecked nine times out of ten successive tries (trials required to pass Stage 2)

Reversal learning = number of trials required to pass Stage 3 (**GREEN** reward key).

Results

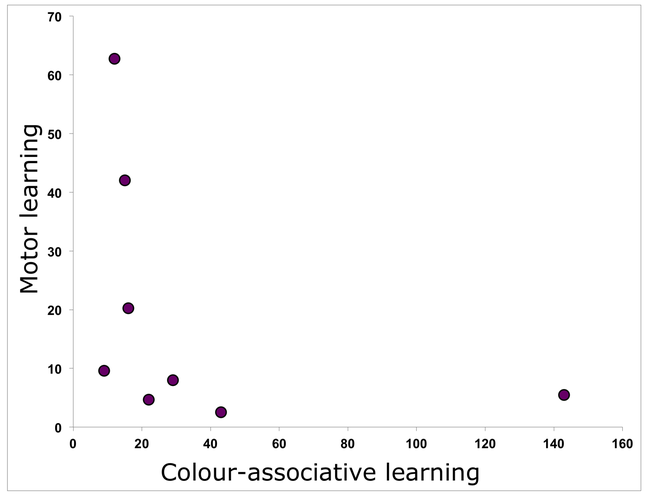

Figure 3. Motor learning vs. colour-associative learning, n=8
Pearson correlation, r = -0.59 , t= -1.79 , d.f. = 6 , p = 0.12

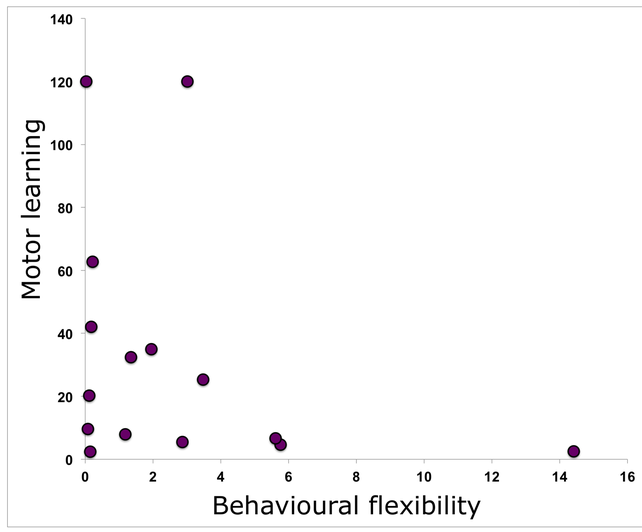

Figure 4. Motor learning vs. behavioural flexibility, n=15
Pearson correlation, r = -0.37 , t= -1.43, d.f. = 13 , p = 0.18

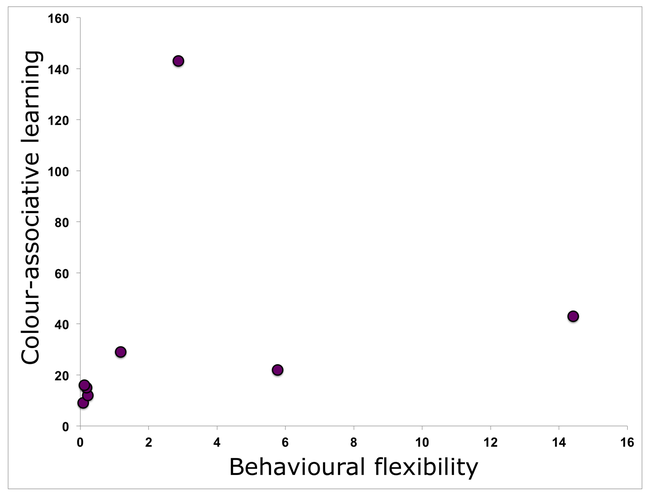

Figure 5. Colour-associative learning vs. behavioural flexibility, n=8
Pearson correlation, r = 0.70 , t= 2.43 , d.f. = 6 , p = 0.051

Conclusion

Only 1 bird passed Stage 3, indicating that reversing a colour association (**GREEN**, instead of **RED**) was more difficult than anticipated.

The general intelligence hypothesis was **not supported**: proficiency in one type of learning does not appear to correlate with proficiency in a different type of learning in *Poecile atricapillus.*

This data contributes to existing limited knowledge regarding "general intelligence hypothesis" tests in birds.

Further research

- Increase sample size
- Increase daily time allotted to operant task
- Limit or eliminate additional cognitive tasks to avoid confusion

Acknowledgements

- Dr. Morand-Ferron and Dr. Maxime Cauchoix, from the Avian Cognitive Ecology lab
- The University of Ottawa, for supporting undergraduate research

References

Boogert, N. J., Monceau, K., Lefebvre, L. (2010). *Behavioural Processes*, 85, 135-141.

Deary, I. J., Penke, L., Johnson, W. (2010). *Nature Reviews: Neuroscience,* 11, 201-211.

Images: (above) http://meetyourneighbours.net/wp-content/uploads/2013/11/chickadee.jpg, (left) http://dnr.wi.gov/org/caer/ce/eek/critter/bird/images/chickadee.gif

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