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

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

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References


Images: (above) http://meetyourneighbours.net/wp-content/uploads/2013/11/chickadee.jpg (left)