The Forgetful Finch: Does developmental stress affect learning in zebra finches?

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Background

- Developmental stress decreases song learning and associative learning in many passerines.
- Most studies have focused on the effects of nutritional stress.
- Few studies have examined the direct effects of glucocorticoids on learning.
- We examined how high and low levels of stress during development affects cognitive function in adult zebra finches (*Taeniopygia guttata)*.

Hypothesis

- Developmental stress decreases cognitive function in zebra finches.

Methods

- We fed nestlings either high or low doses of corticosterone (CORT) dissolved in peanut oil twice a day from 12 to 28 days post-hatch. Control nestlings were fed peanut oil.
- High and low CORT doses were estimated to bring circulating CORT levels to intermediate and maximal stress levels previously measured in zebra finches.
- We measured cognitive function in adult finches using an established foraging paradigm (as per Boogert et. al. 2008).
- The foraging paradigm consisted of four stages of escalating difficulty (Fig. 1). To pass a stage, birds had to eat 4 of the 20 seeds located in wells on the learning apparatus (2 in each well).
- Birds that solve the stages in the fewest trials are superior learners.
- To account for nest effects, we statistically compared finches to nestmates (Fig. 2).

Results

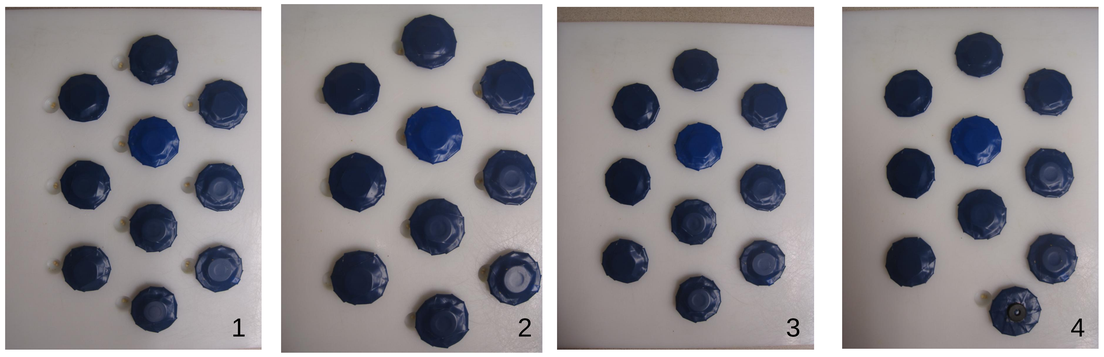

Figure 1. The four stages of the learning paradigm. The stages are as follows: 1) lids placed next to wells, 2) lids covered half of the wells, 3) wells were completely covered by lids, 4) rubber bumpers beneath the lids were pushed into the wells. To pass stage 4 birds had to pry the lids off the well.

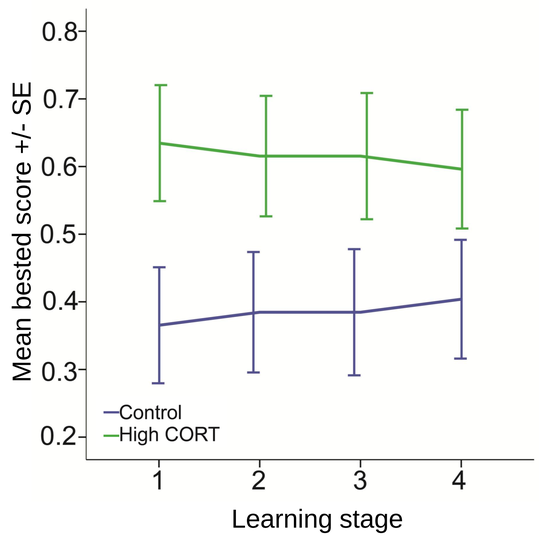

Figure 2. There was a strong nest effect on learning. To account for family effects, we paired a stressed finch with a control sibling and compared which finch bested the other (i.e. solving the stage in the fewest trials). Finches that bested their sibling received a 1, losses received a zero, and ties received a 0.5. Finches exposed to developmental stress bested their siblings in stages 1 and 4 ($P<0.05$, $n=26$) and non-significantly bested their siblings in stages 2 and 3 ($P<0.065$, $n=26$).

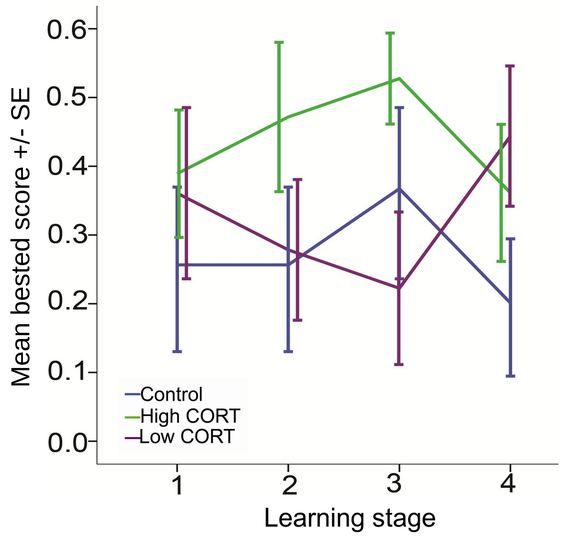

Figure 3. There was a significant difference between high and low CORT treatments in stage 3 ($P=0.03$, $n=6$). There were no other significant differences between high and low CORT or between control finches and CORT finches.

Results (cont.)

- Males passed stages in fewer trials compared to females ($P<0.042$)
- Accounting for sex effects, finches exposed to 'high CORT' developmental stress passed all stages in fewer trials than control nestmates (Fig. 2).
- Overall there was no difference between high and low CORT treatment groups.

Conclusions

- Developmental stress has sustained positive effects on cognitive function into adulthood in zebra finches.
- Developmental stress may increase investment in neural structures associated with spatial and associative learning.

Future Directions

- Increase sample size for low versus high CORT comparison.
- Explore mechanisms that explain why CORT-exposed birds learn faster than control birds.
  - Hippocampal size
  - Response to novelty

References

Boogert, N. J., L.A. Giraldeau, and L. Lefebvre. 2008. Song complexity correlates with learning ability in zebra finch males. *Animal Behaviour* 76: 1735-1741.

Acknowledgments

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