Can context changes improve behavioral flexibility? Towards a better understanding of species adaptability to environmental changes

Aurélie Coulon ⓘ *based on peer reviews by **Andrea Griffin** and **Maxime Dahirel** ⓘ*

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Behavioral flexibility is a key for species adaptation to new environments. Predicting species responses to new contexts hence requires knowledge on the amount to and conditions in which behavior can be flexible. This is what Logan and collaborators propose to assess in a series of experiments on the great-tailed grackles, in a context of rapid range expansion. This pre-registration is integrated into this large research project and concerns more specifically the manipulability of the cognitive aspects of behavioral flexibility. Logan and collaborators will use reversal learning tests to test whether (i) behavioral flexibility is manipulatable, (ii) manipulating flexibility improves flexibility and problem solving in a new context, (iii) flexibility is repeatable within individuals, (iv) individuals are faster at problem solving as they progress through serial reversals. The pre-registration carefully details the hypotheses, their associated predictions and alternatives, and the plan of statistical analyses, including power tests. The ambitious program presented in this pre-registration has the potential to provide important pieces to better understand the mechanisms of species adaptability to new environments.

Reviews

Evaluation round #1

Authors' reply, 22 February 2019

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Decision by **Aurélie Coulon** ⬤, posted 13 September 2018

Decision on pre-registration "Is behavioral flexibility manipulatable and, if so, does it improve flexibility and problem solving in a new context?"

Dear authors,

I have now received two reviews of your pre-registration. It took longer time than we wished to get reviews, because of the (summer) timing and also because of the novelty of the pre-registration process. I apologize about this.

Both reviewers have interesting comments and suggestions about your hypotheses/predictions and protocol. I suggest revising your pre-registration accordingly, alongside writing a detailed response to each reviewer's comment.

I look forward to receiving a revised version of your pre-registration.

Yours sincerely,

Aurélie Coulon.

Reviewed by **Maxime Dahirel** ⬤, 29 July 2018

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Reviewed by **Andrea Griffin**, 13 September 2018

The overall aim of this project is stated to be to "determine how behavioural flexibility works and how we can make predictions about a species' ability to adapt their behavior to new environments". Its aims are "to manipulate grackle behavioral flexibility ... to determine whether their flexibility is generalizable across contexts, whether it is repeatable within individuals and across contexts, and what learning strategies they employ. Although I find these specific questions divorced from the background of invasive spread, and hence, do not particularly buy into the advantage of using an invasive species undergoing a current range expansion (in fact, I explain below how I find some predictions inherently contradictory with this background), the questions are worthwhile asking. Detailed comments are as follows: Please clarify: "they generally get faster rather than getting faster with each reversal" and how the learning criterion was altered to accommodate this

P1: Although I find it interesting to compare the extent to which rule-learning generalizes across contexts as a function of experience with rule learning, the question seems to contradict the notion that behavioural flexibility (measured here as rule learning) can be a target of selection during a range expansion, meaning that individuals would need to differ in some inherent way in their capacity to rule learn. Hence, for behavioural flexibility to be a target of selection, behavioural flexibility should not be flexible, if that makes sense. Put differently, invasive birds should not become broader-context rule-learners as a consequence of experience with rule learning. In fact, learning this capacity would be predicted to delay selection on the trait. Hence, H3a seems the more logical prediction and test, given the larger context of the project.

P1 alternative: "If the number of trials to reverse a preference does not correlate with or positively correlates with reversal number"; this contradicts the general pattern of finding of an SDR (number of trials to criterion decreases with increased reversal number) and also the authors' own statement under P1: "Individuals improve their flexibility on a serial reversal learning task using colored tubes by generally requiring fewer trials to reverse a preference as the number of reversals increases". Is this a typo?

Methods:

Learning criterion: is the sequence re-started at each testing session? Ie what is planned if a bird is willing to do 10 choices on one day and then satiates. Is the trial number started again at each testing session? Or do the, for example, correct trials yesterday count towards today's? ie does the sliding window for scoring carry across testing sessions?

IVs: What is 'batch'? test cohort? How many birds are tested simultaneously?

"we should expect due to the lack of data on this species for these experiments": ok, but there are several published comparative data sets on SDR that you could use (e.g. Tebbich et al.).

"Analysis": N=32: does that mean 16 experimental and 16 controls?

In measuring the latencies to switch to new options on the multi-access box: how can 'work-time' be disentangled from 'non-work time' in a latency? I.e. a bird that tries lots of options and interacts with the box might have the same latency as a bird that does mostly other things but then tries once and by chance solves the box immediately. How can these two seemingly very different birds be differentiated in a latency? I guess this is equivalent to asking whether multi-access box testing yields any motivation variables, similar to number of beak-to-task contacts one can obtain from an innovative problem-solving task. I would predict that motivation variables, which end up providing some measure of persistence, will be associated with exploitation vs. exploration strategies. I could not find an answer to this question in the protocol.

"Learning strategies": The authors might find the following research and analysis strategy useful as it disentangles exploration from exploitation phases within each reversal. Federspiel, I. G., Garland, A., Guez, D., Bugnyar, T., Healy, S. D., Güntürkün, O., & Griffin, A. S. (2017). Adjusting foraging strategies: a comparison of rural and urban common mynas (Acridotheres tristis). Animal Cognition, 20, 65–74. Protocol_flexibility:

Why will birds only undergo 5 reversals on the touch screen? Is this enough to establish a significant slope in learning speed that can be compared across tasks?

I am also confused by not testing the control group. Was the suggestion not to train birds on the tube task (experimental and control) and then to compare the transfer of both these groups to each of the two additional tasks (multi-access and touch screen)? Why would the controls not participate in the reversals?

Reviewed by Andrea S. Griffin