Peer Community In Ecology

Exploring exploration and behavioral flexibility in grackles: how to handle issues of ”jingle-jangle” and repeatability

Jeremy Van Cleve *based on peer reviews by 2 anonymous reviewers*

Kelsey B. McCune, Dieter Lukas, Maggie MacPherson, Corina J. Logan (2025) Behavioral flexibility is related to exploration, but not boldness, persistence or motor diversity. EcoEvoRxiv, ver. 2, peer-reviewed and recommended by Peer Community in Ecology. https://doi.org/10.32942/X2H33F

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Animal behavior, like other kinds of phenotypic plasticity, is crucial for survival and reproduction in environments that vary over space and time. Behaviors themselves may need to be flexible when the distributions of environmental conditions themselves change; for example, short-term weather patterns and long-term climate conditions are changing due to human activity, and behavioral flexibility will likely be key to some population persisting during these changes and others going extinct. Thus, measuring this flexibility is key to understanding which species may be resilient to climate change.

Measuring behavioral flexibility is tricky as different studies may define and measure it differently and yet other studies may measure similar kinds of flexibility yet call them different things. This so-called ”jingle-jangle” issue suggests that studies can more robustly measure a behavioral trait when they use multiple behavioral tests. An additional issue is that measuring behavioral traits that vary between individuals due to genetic or development effects, often referred to as ”personality” traits, requires that those trait differences be repeatable across time and between individuals.

With these issues in mind, McCune et al. (2019) presented a preregistration for experiments using a population of great-tailed grackles to investigate how behavioral flexibility relates to other important traits that are known to vary across individuals including exploratory behavior, boldness, and persistence and motor diversity in accessing a new food source. Behavioral flexibility is measured by the rate of learning a color associated with reward after first learning an association with a different color. That preregistration was recommended by PCI Ecology (Van Cleve, 2019). Now, McCune et al. (2025) present results from this study and find that only exploration of a novel environment and persistence were statistically repeatable behaviors. Both

behaviors were not significantly correlated with behavioral flexibility. However, grackles that were trained to perform better in the color reversal learning task were more exploratory. This association between behavioral flexibility and exploratory tendencies may have evolved in grackles to help them survive in new environments, which they have proven very capable of doing as they have expanded their range in North American over the last 140 years (Wehtje, 2003).

There are a few key features of McCune et al. (2025) to merit recommendation. First, the authors are intent on demonstrating careful behavioral research practices including, as evidenced above, preregistering their hypotheses and predictions and making available both the preregistered and final analysis code. Second, the study demonstrates a thorough attempt to address two aspects that bedevil behavioral research, namely the "jingle-jangle" issue and repeatability of traits across individuals. Even after measuring multiple features of boldness, exploratory, persistence, McCune et al. (2025) find that only a subset of the measured behaviors are repeatable and only a subset of those are associated with behavioral flexibility. This suggests that only thorough studies like McCune et al. (2025) can start to probe difficult to measure behavioral associations that may be key to understanding how species will respond to our changing world.

References:

McCune K, Lukas D, MacPherson M, Logan CJ (2025) Behavioral flexibility is related to exploration, but not boldness, persistence or motor diversity. EcoEvoRxiv, ver.2 peer-reviewed and recommended by PCI Ecology https://doi.org/10.32942/X2H33F

Van Cleve, J. (2019) Probing behaviors correlated with behavioral flexibility. PCI Ecology, 100020. https://doi.org/10.24072/pci.ecology.100020

McCune K, Rowney C, Bergeron L, Logan CJ. (2019) Is behavioral flexibility linked with exploration, but not boldness, persistence, or motor diversity? (http://corinalogan.com/Preregistrations/g_exploration.html) In principle acceptance by PCI Ecology of the version on 27 Mar 2019

Wehtje, W. (2003) The range expansion of the great-tailed grackle (Quiscalus mexicanus Gmelin) in North America since 1880. Journal of Biogeography 30:1593–1607 https://doi.org/10.1046/j.1365-2699.2003.00970.x.

Reviews

Evaluation round #1

DOI or URL of the preprint: https://doi.org/10.32942/X2H33F
Version of the preprint: 1

Authors' reply, 01 April 2025

See the attached document for the reviewer comments and our responses. Please let us know if more changes are requested or if anything is unclear.

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Decision by Jeremy Van Cleve, posted 31 December 2024, validated 03 January 2025

The authors use wild caught great-tailed grackles to study how behavioral flexibility is connected to behavioral traits related to boldness, exploration, motor diversity, and persistence. The authors restrict their analysis to traits that are repeatable and find that exploration and persistence were repeatable and both of these had some relationship with flexibility. The study has a registered and peer-reviewed preregistration manuscript and the authors detail how their analyses matched or deviated from the preregistration.

Two reviewers have assessed the manuscript and both have a number of suggestions for improvement. The biggest issue the reviewers note is how the manuscript connects to the preregistration manuscript. Both reviewers have some difficulty reading the manuscript without explicitly referring back to the preregistration. In so far as the authors would like the manuscript to readable on its own without necessarily reading the preregistration first, they should consider the reviewers comments on this issue. I agree that the overall readability was impaired a bit from referring back to the preregistration manuscript and describing differences with the preregistration. I think the readability would be improved by having the main body describe the methods and results in whole and then leaving differences with the preregistration to supplementary material. One reviewer mentions dropping the wild vs captivity comparison; this may help with the readability though the authors may find a place for these results in the revision.

The other suggestions by the reviewers are mostly related to adding clarification about the conceptual relationships between the behavioral traits and clarifying some points in the analyses and discussion. A revision can easily accommodate or address these suggestions.

Reviewed by anonymous reviewer 1, 04 December 2024

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Reviewed by anonymous reviewer 2, 28 November 2024

This study tested:

1- if exploration/boldness/persistence/motor diversity are repeatable traits in their study system.

2- if behavioural flexibility, measured as reversal learning, was related to exploration/boldness/persistence/motor diversity in wild caught great-tailed grackles.

3- (not introduced in the introduction but can be found in the methods and results sections) if exploration and boldness are repeatable in the wild vs in captivity

I would have a few main comments that would need to be addressed before publication, in my opinion:

- I would suggest to keep points 1/2 in this paper and remove point 3. The goals are different and do not really fit in the same paper. Goal 3 is actually not present in the introduction of the present paper, but we can find the methods and results in the present paper. Moreover, goal 3 does not really have results as the sample size is too small.

- Is this study using the same data as Logan et al. 2016b? Because the question - if reversal learning is linked to behavioural traits like exploration persistence and motor diversity - seemed to be explored in both this paper and the present study? The differences would need to be emphasized to better understand the aim of the present study.

- It is not clear to me, the purpose of training grackles for higher behavioural flexibility in the case of this study (L217-218)? These are potentially correlated traits that can be linked to behavioural flexibility, but there is no causation hypothesis between them. What it the goal? And the hypotheses? I do not understand how increasing behavioural flexibility on a task will have something to do with the ability to detect a relationship with other traits measured using other tasks? This might need more explanation here.

Title and abstract

- Does the title clearly reflect the content of the article? [x] Yes

but only if the paper only presents results about hypothesis 1

Hypothesis 2 would need another title

- Does the abstract present the main findings of the study? [x] Yes

Introduction

- Are the research questions/hypotheses/predictions clearly presented? [x] Yes
- Does the introduction build on relevant research in the field? [x] Yes,

I have a few minor comments here:

L53: Behavioural flexibility, measured as reversal learning performance, is not rarely tested at the individual level. What is rarely tested is its link with actual individual traits that would indicate greater flexibility (e.g., novel food type, habitat range, exploration etc.).

L57-60: I would not cite a preprint not yet reviewed as evidence (Logan et al. 2024) – or maybe it has been reviewed ??

Add 1-2 examples – maybe from other species – to this section to describe a little bit more what has been found on this question (L 60-61).

L67-74: I would add definition to the behavioural traits cited and add hypotheses- what link is expected -for boldness persistence and motor diversity too. So that we understand why those traits are cited here.

I just read that it has been done in the next paragraph, maybe both paragraphs should be joined.

L75: I don't think the examples cited are 'experimental' evaluation, an experimental test would need a manipulation of a trait to test its effect on another. I think the authors cited correlative studies.

L77-78: this ref refers to one species and thus does not illustrate inconsistencies, maybe it should be more described (like for exploration L80-83).

L78-79: same comment as above. I don't think this sentence is needed as concrete examples are provided after.

L107-108: I do not understand this sentence.

Materials and methods

- Are the methods and analyses sufficiently detailed to allow replication by other researchers? [x] No
- Are the methods and statistical analyses appropriate and well described? [x] No

It is written that methods have been already reviewed elsewhere, so I guess they are relevant, but if this paper is to be published by itself, I would re work this part to be more clear. It was hard to follow, especially the behavioural flexibility section: I did not understand what test was done and why, how variables were measured etc.

I would add more details, such as:

L176: when where and how were the birds caught? Catching methods can have impacts on the personality profiles of the individuals caught.

L184-185: when and where?

L187: remove "as part of a different investigation", we need anyway this information here.

L188-190: I think it is important to add here the full description of the methods even if it has been described elsewhere. Some details, such as a validation test or a figure, can be cited from another paper but I think it is important to report the full methods for the study itself. For example, what is the training protocol?

L192-193: "to switch their preference in the first reversal and search primarily in the second color container" the measure is not clear to me, is it the number of trials it took to 17/20 correct trials during the reversal?

L194-198: I am sorry, I do not see the point of this for this study?

L196: why 50 is fast? What are the numbers that support this choice?

L199-215: I do not understand this part, this was not in the aims of this study or I missed something? A MAB is mentioned for motor diversity assays, not for behavioural flexibility. This is really not clear. I would just describe the variable used to measure behavioural flexibility in this study (without referring to another).

L228-229/2039-240: I would move here the info about the variable chosen.

L242-251: it is not clear how motor diversity and persistence are measured from the results of various tests?? Means are used? Or number of trials are added?

L281-288: I have to say that I have no clue about what has been done here, but maybe a ref or two would be useful to show that this is the usual way to do it?

L290: so which measure, the first one or the second one or a mean?

L293-295: sex should be included too.

L370-372: but then the number of models run will increase? I would keep Behavioural flebility as a response variable, and all behavioural measures as independent variables, but separate in two analyses, one for the group with high flexibility, and on for the control group. That way you will see by comparing the results and the estimates if the relationships are stronger?

L381-386: I guess a good way to test that it is ok to do so is to compare the results with and without the 2 juveniles and see if they are qualitatively the same? I would do the same for sex.

Results

· In the case of negative results, is there a statistical power analysis (or an adequate Bayesian analysis or equivalence testing)? [x] No

· Are the results described and interpreted correctly? [x] Yes

L420: data should enable to confirm this: did more grackles participated/stayed longer on the ground in the second test than in the first time, on average (not clear from Fig2)? One possibility is also that the objects were too scary, leading to a floor effect.

L462-463: is it possible that the repeatability effect is found because lots of results were just 0 peck? I think persistence measured during boldness or exploration tests would not indicate the same 'persistence' as during problem-solving tests (this is partly confirmed with the figure 4 where nearly all results from bolness and exploration tests are around 0), I would only use persistence during problem-solving.

L482-484: the repeatability test has been done only on latencies, so I would use only this measure (if I remember well, it was written earlier in the MS that analyses with flexibility would be done only on repeatable measures). And then, which measure has been used for this analysis, the first the second or a mean?

L492: 'in contrast' with what?

L493: as above, the repeatability test has been done only on the total number of pecks. And here only persistence measures with MAB are used?

Discussion

· Have the authors appropriately emphasized the strengths and limitations of their study/theory/methods/argument? [ ] Yes, [ ] No (please explain), [x] I don't know

· Are the conclusions adequately supported by the results (without overstating the implications of the findings)? [ ] Yes, [ ] No (please explain), [x] I don't know

I think the discussion will have to change a bit. Negative results are discussed like real negative results but it should be emphasized a little bit more that they could also just reflect a problem with the methods or a lack of statistical power.