

Background

Innovation

- Create new behaviors or utilize pre-existing behaviors in a novel context^{1,2}
- May help animals survive in changing anthropogenic landscapes^{1,4}

Human-Elephant Conflict

- Asian elephants (*Elephas maximus*) face habitat loss and agricultural land encroachment^{1,4}.
- Wild elephants innovate to navigate around barriers (e.g., electric fences) and enter crop fields^{1,4}.
- Previous study found individual variation in wild elephants' ability to solve a novel puzzle¹
- Unknown whether individuals are consistent in their innovation capacities
- If individual differences in innovation are consistent across time and contexts, this may represent a **personality trait**².
 - Helpful to understand *why* and *how* elephants enter crop fields to mitigate conflict.



Photo of an elephant stepping over an electric fence in Kanchanaburi, Thailand⁴

Objective: Assess whether innovative problem-solving behaviors are repeatable within individual elephants across two different puzzle boxes

Hypotheses

- Individual variation in problem-solving behaviors within the second puzzle, as previously observed within the first puzzle¹
- Problem-solving behaviors will remain consistently different between elephants across both puzzle boxes.
- Some traits may vary between puzzles:
 - Neophilia: second puzzle lacks novelty
 - Exploratory diversity: different motor actions required to open doors

Repeat visitor 'M038', still captured from camera trap video (cropped, background removed)

Methods

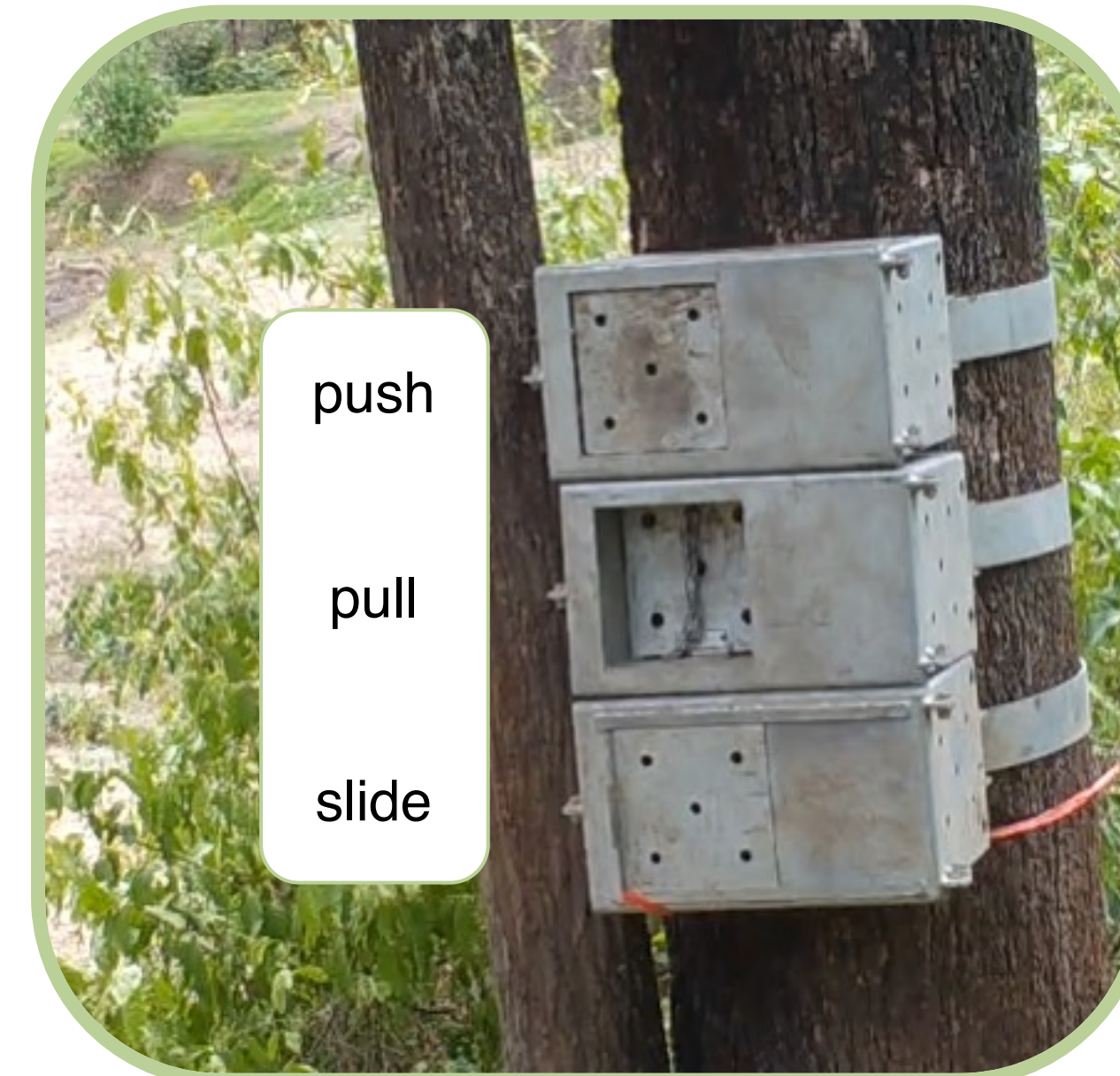
- **Location:** Salakpra Wildlife Sanctuary, Kanchanaburi, Thailand
- **Installed puzzle boxes** following methods of original study¹
- **Recorded videos** using camera traps
- **Coded and scored** problem-solving behaviors

List and definitions of problem-solving traits scored for each elephant in both puzzle box studies¹

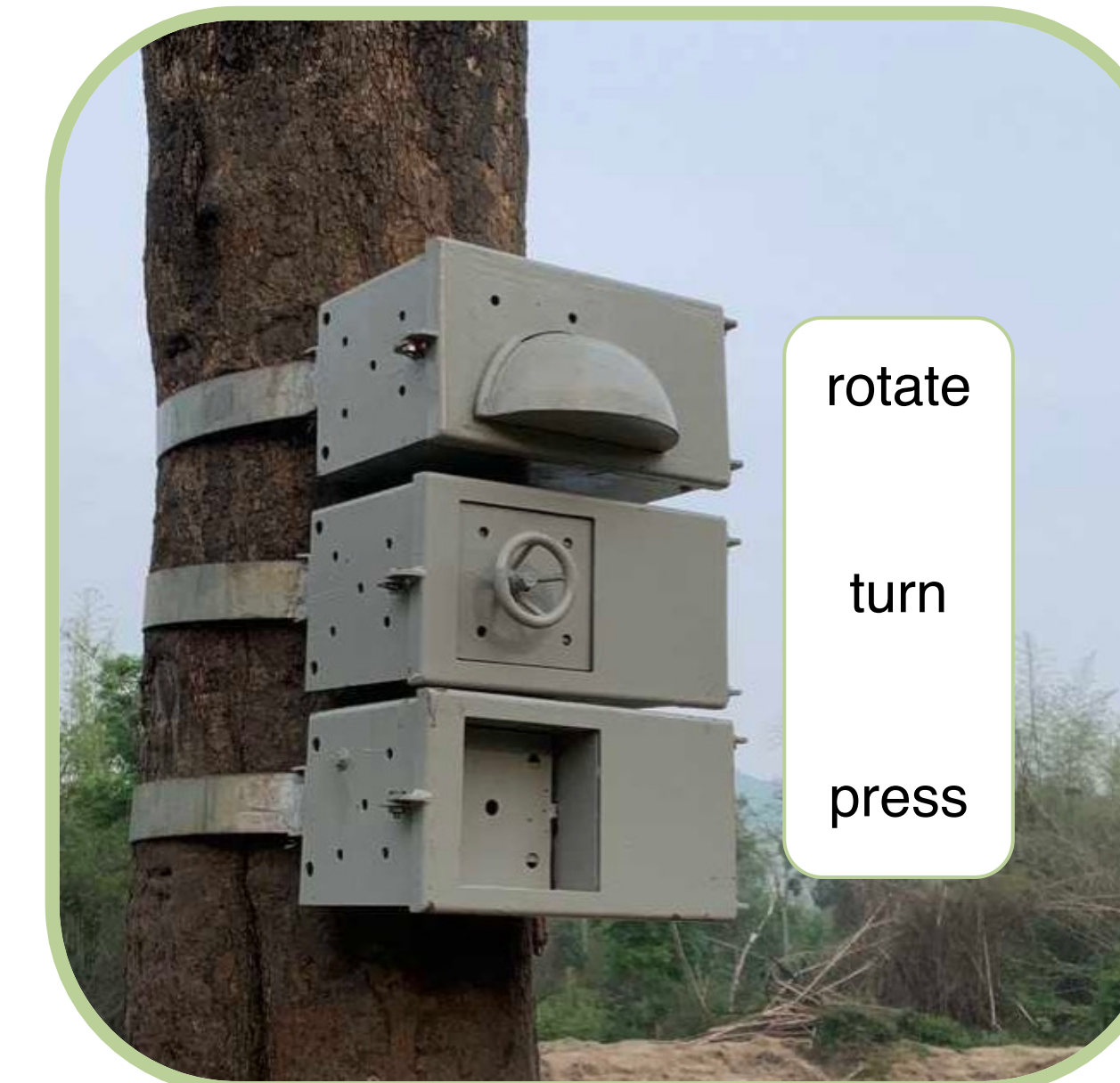
Trait Scored	Description
Innovation	Maximum number of types of doors opened across all visits. Scored from 0 to 3.
Success	Proportion of doors opened out of available doors each visit.
Neophilia	Latency (s) to contact after first step within a 5m perimeter on first visit. A lower score indicates a greater degree of neophilia.
Exploratory Diversity	Count of unique motor actions based on different body parts used to interact with the box each visit.
Solving Latency	Duration of interaction prior to door solved for each visit.
Persistence	Proportion of time interacting with the puzzle box out of the total time observed within 5m of the box each visit.

The Puzzle Boxes

First iteration

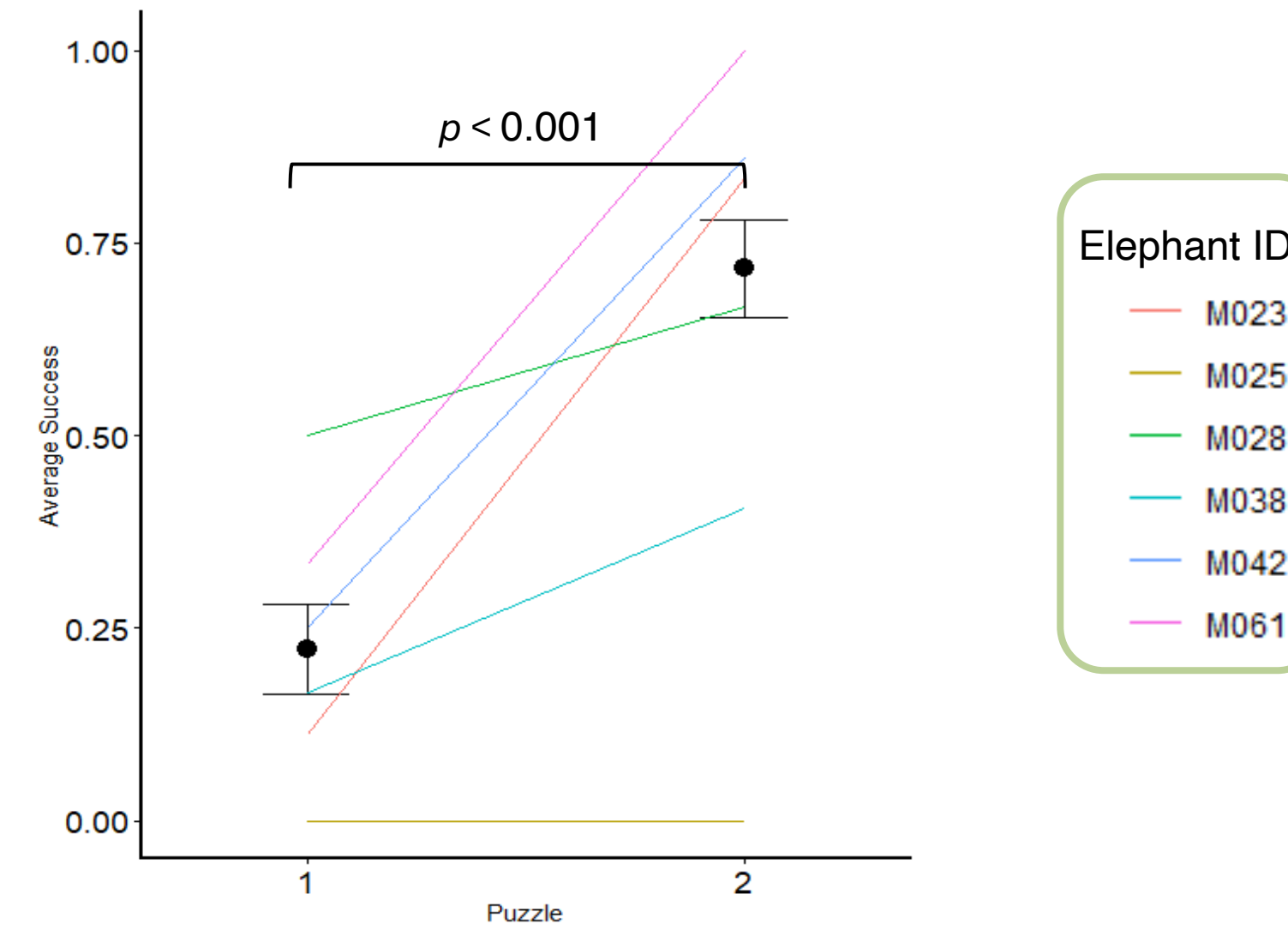


Second iteration



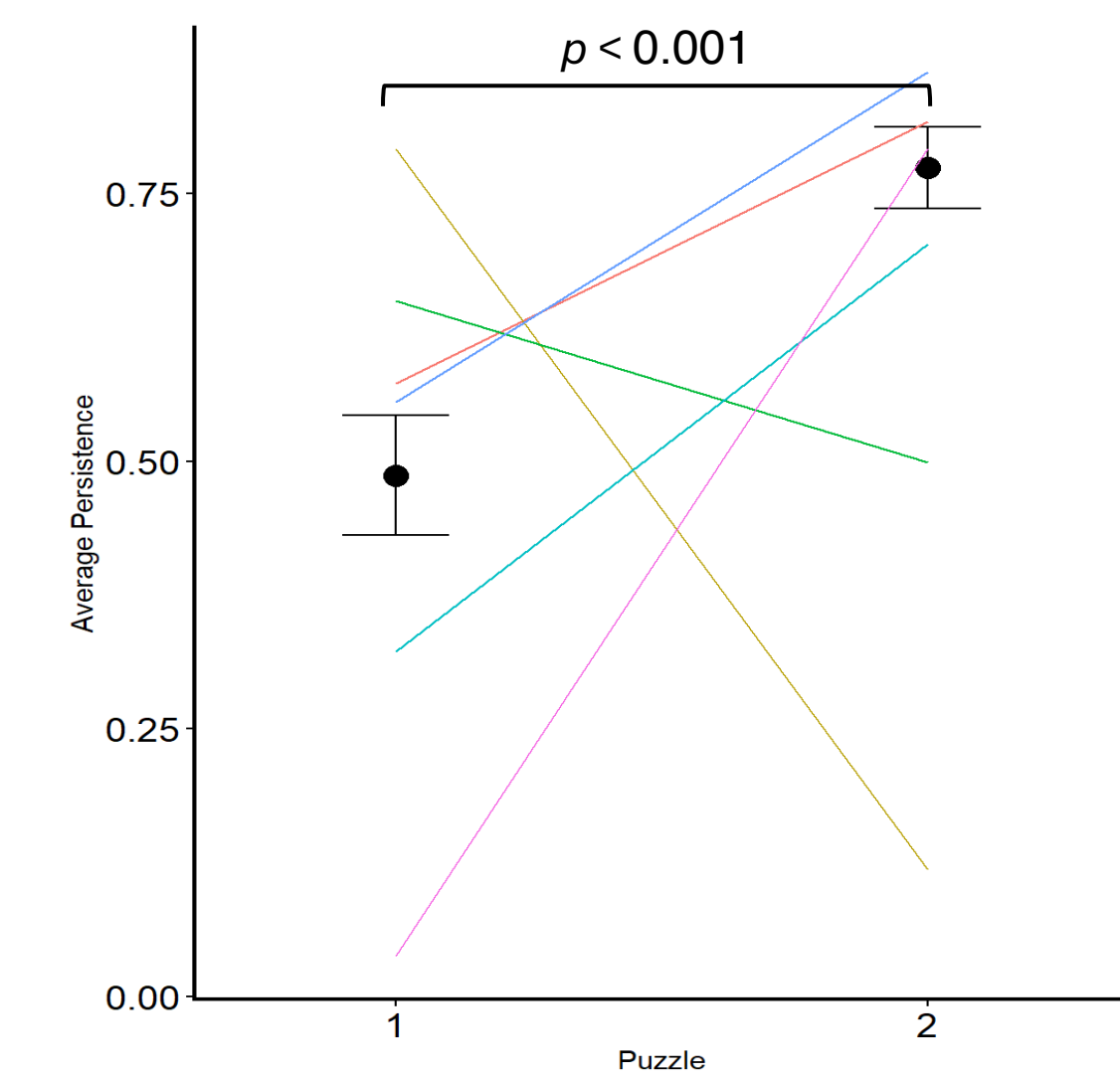
Preliminary Analyses

Mean Success Between Puzzles



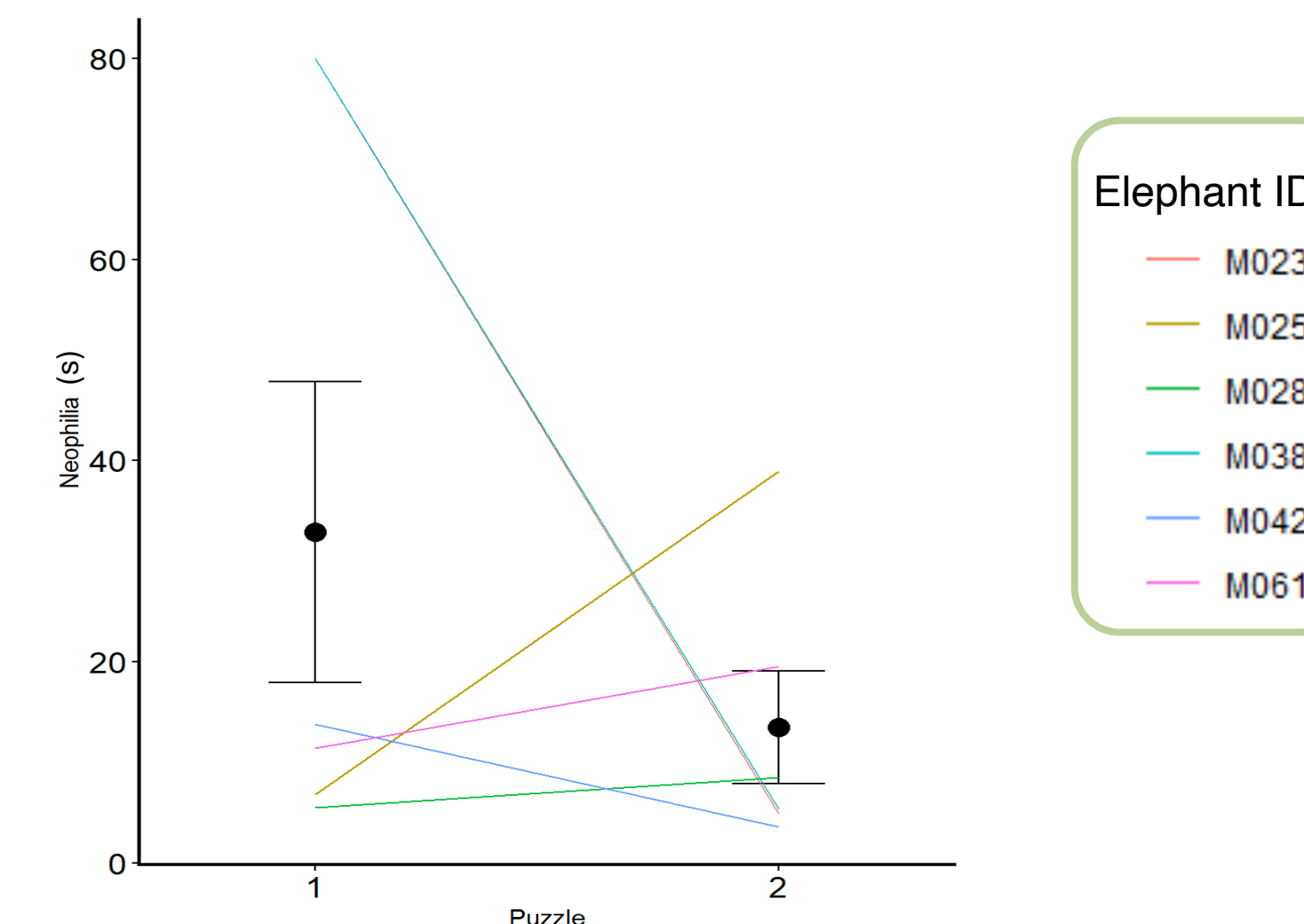
Elephants were significantly more successful with puzzle two compared to puzzle one ($X^2 = 27.96$, $df = 1$, $p < 0.001$). Estimation of repeatability using a linear mixed-effects model showed that average success scores were significantly repeatable within individuals ($R = 0.26$, $SE = 0.17$, $p = 0.029$).

Mean Persistence Between Puzzles



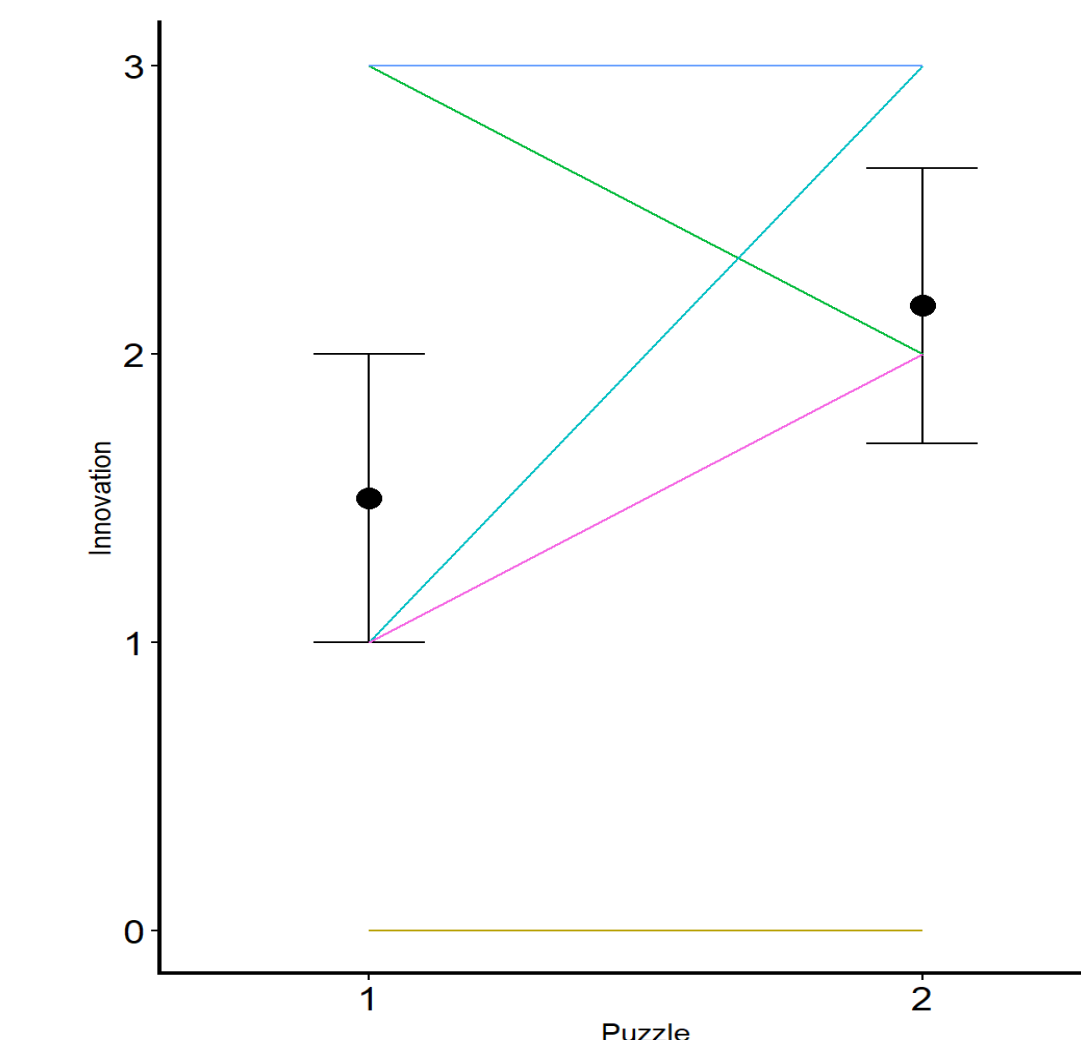
Elephants showed significantly greater average persistence with puzzle two than with puzzle one ($X^2 = 17.57$, $df = 1$, $p < 0.001$). Individual differences in persistence were not repeatable within individuals ($R = 0.13$, $SE = 0.13$, $p = 0.1$).

Neophilia Between Puzzles



No significant differences were found in neophilia scores between the two puzzles ($X^2 = 1.48$, $df = 1$, $p = 0.22$). Single score intraclass correlation showed no repeatability of neophilia within individuals ($ICC = -0.328$, $F(5,5) = 0.506$, $p = 0.76$).

Innovation Scores Between Puzzles



There were no significant differences in elephants' innovation (types of doors opened) between puzzles ($X^2 = 1.82$, $df = 1$, $p = 0.18$). Single score intraclass correlation showed no repeatability of innovation within individuals ($ICC = 0.488$, $F(5,5) = 2.91$, $p = 0.13$).

Discussion

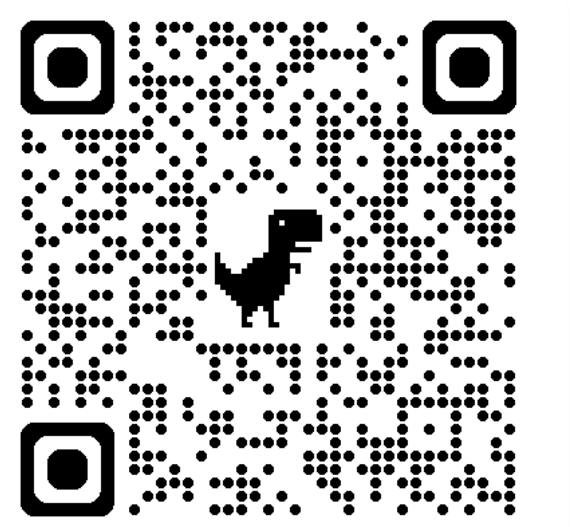
- Increase in both mean **persistence** and **success** between puzzles
 - May be more persistent and successful due to previous experience with first puzzle box
 - May also spend more time interacting with the box (i.e., persistence) if trying to use previous techniques to open new door types
- **Success may be repeatable.**
 - Though success increased in the second puzzle, elephants' success also remained *consistently different* between individuals.
 - Evidence that problem-solving success may be a personality trait in elephants
- No differences in **innovation** or **neophilia** between puzzles; no consistent differences between individuals
 - May be limited by small sample
 - Some elephants had only single interactions with either one or both boxes.



Still captured from camera trap video (cropped) showing adult male elephant 'M042' after opening all three doors ('press', 'turn', and 'rotate' from top to bottom)

Future directions

- Continue data collection to increase repeat visitor sample size and assess repeatability
- Assess common personality traits across crop-foraging elephants
- Development of **personality-based human-elephant conflict mitigation strategies**
 - Targeted deterrents of elephants likely to crop forage



Scan the QR code to see ongoing research at ccconservation.org

Acknowledgements

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References

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