Investigating neophobia as a personality trait across sensory modalities in Asian elephants (*Elephas maximus*)

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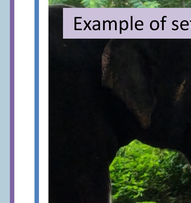
Introduction

- Neophobia, an individual's fear of novelty, can influence how animals forage and avoid threats[1].
- Neophobia is an ecologically relevant personality trait – repeatable inter-individual differences in behaviour[2].
- *It is unknown whether responses to novelty are consistent between sensory modalities.*
- This is relevant for Asian elephants (*Elephas maximus*), as they have highly developed acoustic and olfactory senses[3].



Aim: To determine whether neophobia in Asian elephants is consistent within individuals and across sensory modalities (visual, auditory, and olfactory)

Methods

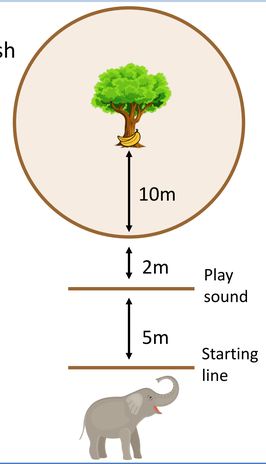
- **Subjects**: captive elephants (*N* = 18; ages 4-66, 3 males and 15 females)
- **Study site:** National Elephant Institute in Lampang, Thailand

Types of novel stimuli

Novel Sounds		Novel Objects		Novel Odors	
					
Dolphin calls	UFO sound	Cattle brush	Woven firehose	Aldehydes	Blue aqua

Trial procedures

- Trials with the food present but without the novel stimuli were conducted first to establish a baseline response.
- Only one stimulus was presented per trial (order counterbalanced across individuals).

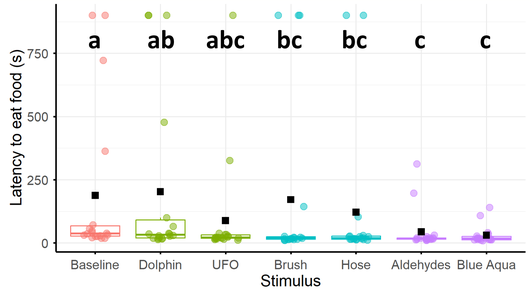


Quantifying Neophobia

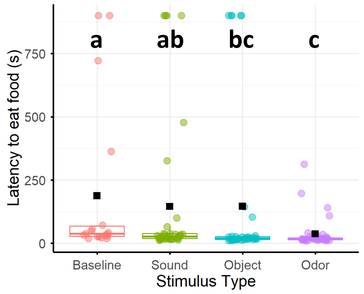
- **Latency to eat food** (banana) after elephant crossed 10 m was calculated.
- **Time within 10 m** of the novel stimulus was recorded, before eating the food and 2 min after eating the food (if eaten).

Overall, neophobia differs across sensory modalities

Latency to eat food

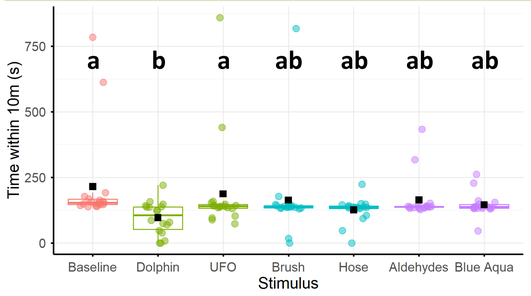


A Cox proportional hazard model with subject included as a frailty term[4] showed a significant effect of stimulus on latency to eat (likelihood ratio test $\chi^2 = 93.38$, df = 19.73, $p < 0.001$).

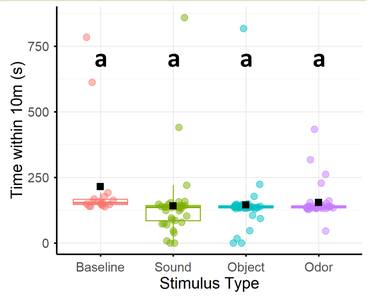


likelihood ratio test for stimulus type: $\chi^2 = 86$, df = 16.52, $p < 0.001$

Time within 10 m



A generalized linear mixed model with a Tweedie distribution and log link with subject included as a random effect showed a significant effect of stimulus on time within 10m (likelihood ratio test: $\chi^2 = 20.56$, df = 6, $p = 0.002$).

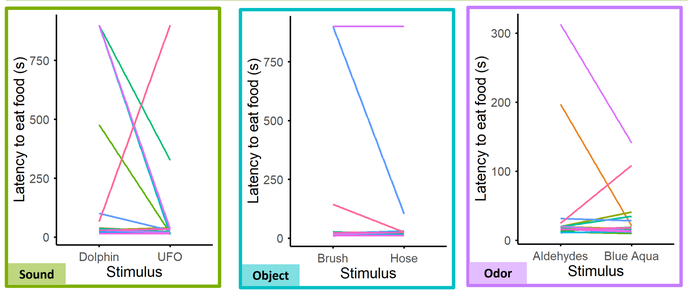


likelihood ratio test for stimulus type: $\chi^2 = 7.81$, df = 3, $p = 0.05$

Letters denote significant differences in estimated marginal means (p<0.05), shared letter = no significant difference. Colours represent stimulus types.

Consistent individual differences in neophobia *within* sensory modalities

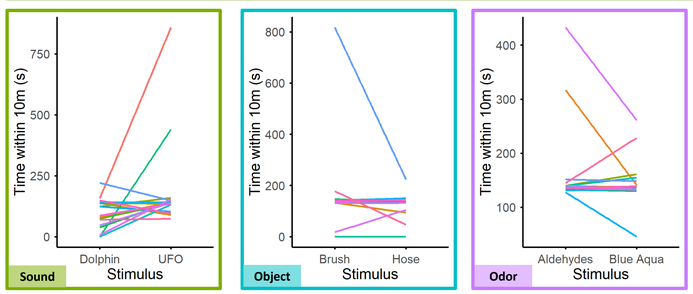
Latency to eat food



The Cox proportional hazard models including subject identity fit the data better than models without subject identity for the sound ($\chi^2 = 14.96$, $p = 0.017$), odor ($\chi^2 = 42.14$, $p < 0.001$) and object ($\chi^2 = 55.97$, $p < 0.001$) stimuli.

Sound	Object	Odor
ICC = 0.12	ICC = 0.39	ICC = 0.29

Time within 10 m



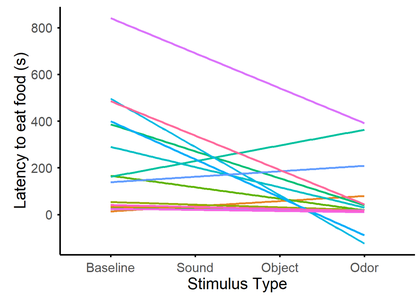
The generalized linear mixed models including subject identity fit the data better than models without subject identity for the odor ($\chi^2 = 7.97$, $p = 0.005$) and object ($\chi^2 = 17.85$, $p < 0.001$) stimuli, but not the sound stimuli ($\chi^2 = 2.06$, $p = 0.15$).

Sound	Object	Odor
ICC = 0.25	ICC = 0.57	ICC = 0.49

Line colours represent individuals (*N*=18).

Consistent individual differences in neophobia *across* sensory modalities

Latency to eat food

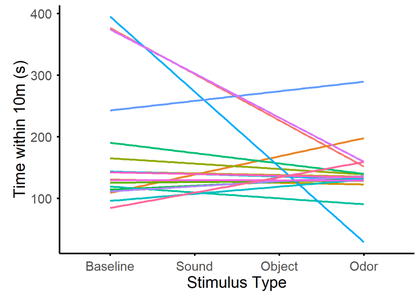


The Cox proportional hazard models including subject identity fit the data better than models without subject identity.

stimulus: $\chi^2 = 77.242$, p **<0.001**;
ICC = 0.21 (adjusted for stimulus)

stimulus type: $\chi^2 = 72.229$, p **<0.001;**
ICC = 0.19 (adjusted for stimulus type)

Time within 10 m



The generalized linear mixed models including subject identity did not fit the data better than the models without subject identity.

stimulus: $\chi^2 = 3.64$, $p = 0.06$;
ICC = 0.12 (adjusted for stimulus)

stimulus type: $\chi^2 = 3.15$, $p = 0.08$;
ICC = 0.11 (adjusted for stimulus type)

Line colours represent individuals (*N*=18).

Conclusions & Significance

- We found differences in neophobia across sensory modalities in Asian elephants, with auditory stimuli eliciting the highest neophobic response.
- Consistent individual differences in neophobia were found across and within sensory modalities.

To our knowledge, this is the first evidence of consistency in personality *across* sensory modalities in any species.

- This work highlights the need to consider the relevance of multi-modal sensory information in animal personality research, especially when studying primarily non-visual species.
- Elephants in the wild often engage in crop foraging behaviour in anthropogenic landscapes, resulting in negative interactions with farmers. Understanding how elephants respond to different stimuli across sensory modalities can help in the development of conflict mitigation methods that target individual personality types[5].

References & Acknowledgements

1. Greggor et al. (2015). *Curr. Opin. Behav. Sci.* 6, 82–89. **2.** Roche et al (2016). *J Exp Biol* 219, 3832–3843 (2016). **3.** Jacobson et al. (2020). *CCBR* 15, 131–148. **4.** McCune et al. (2025). *Anim. Behav.* 222, 123102. **5.** Mumby & Plotnik (2018). *Front. Ecol. Evol.* 6, 122.

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