

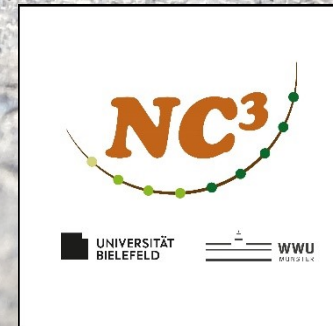
# The bright, the bold and the toxic?

Examining animal personality in fire salamanders



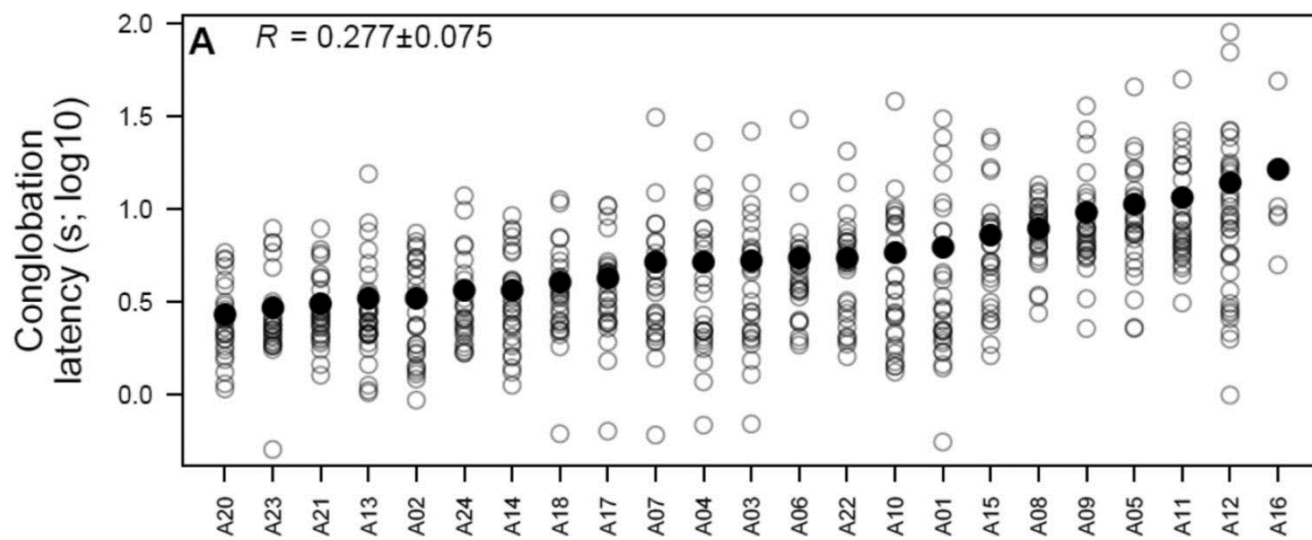
Max Mühlhaupt, *Ph.D.*-student

Behavioural Ecology, Universität Bielefeld



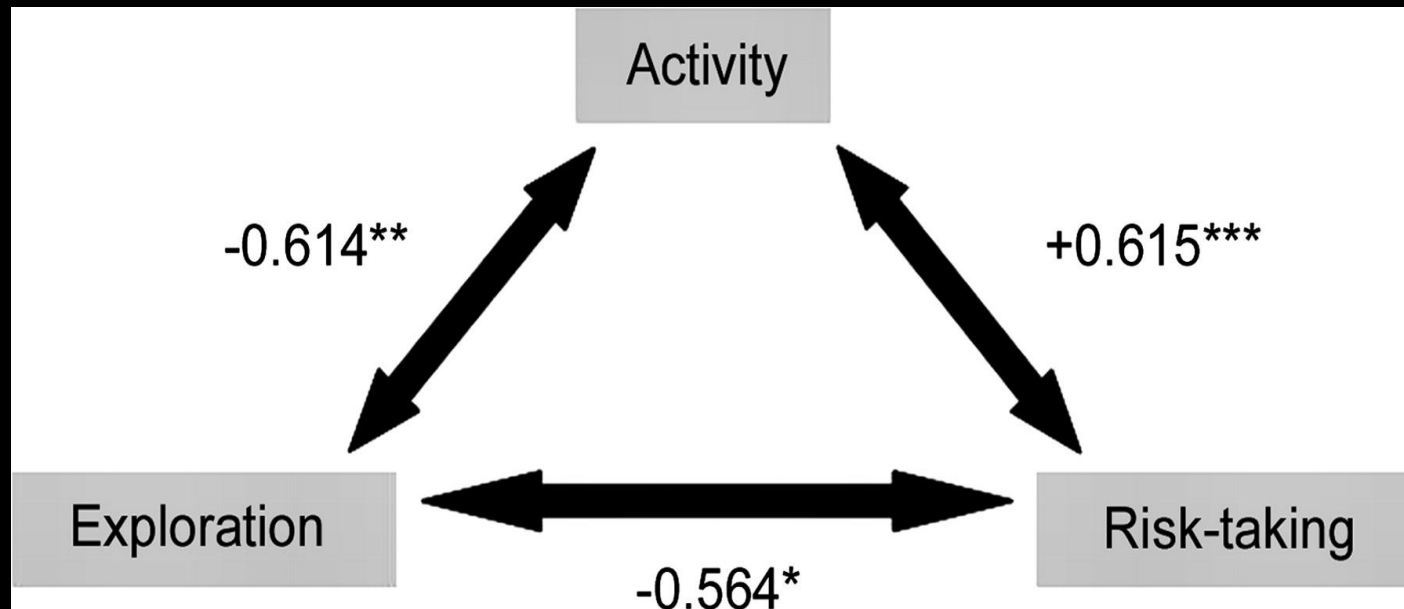


# Animals differ consistently in behaviour



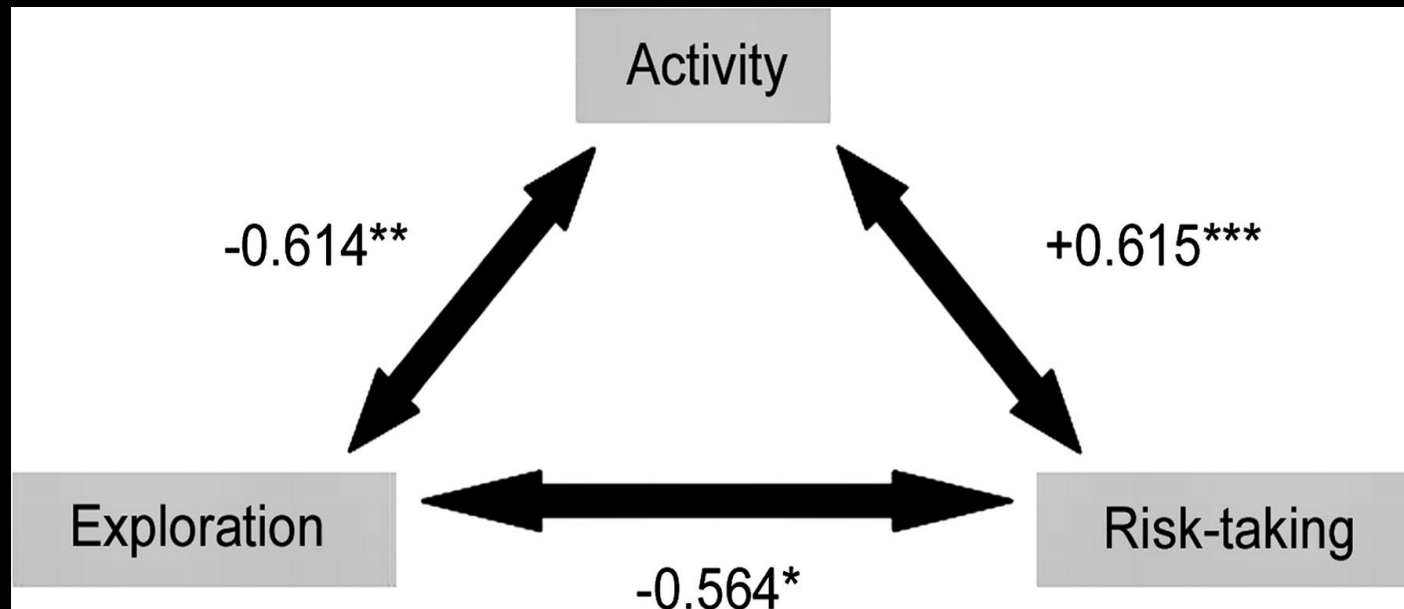
Virginia Museum of Natural History

# Different behaviours can be correlated





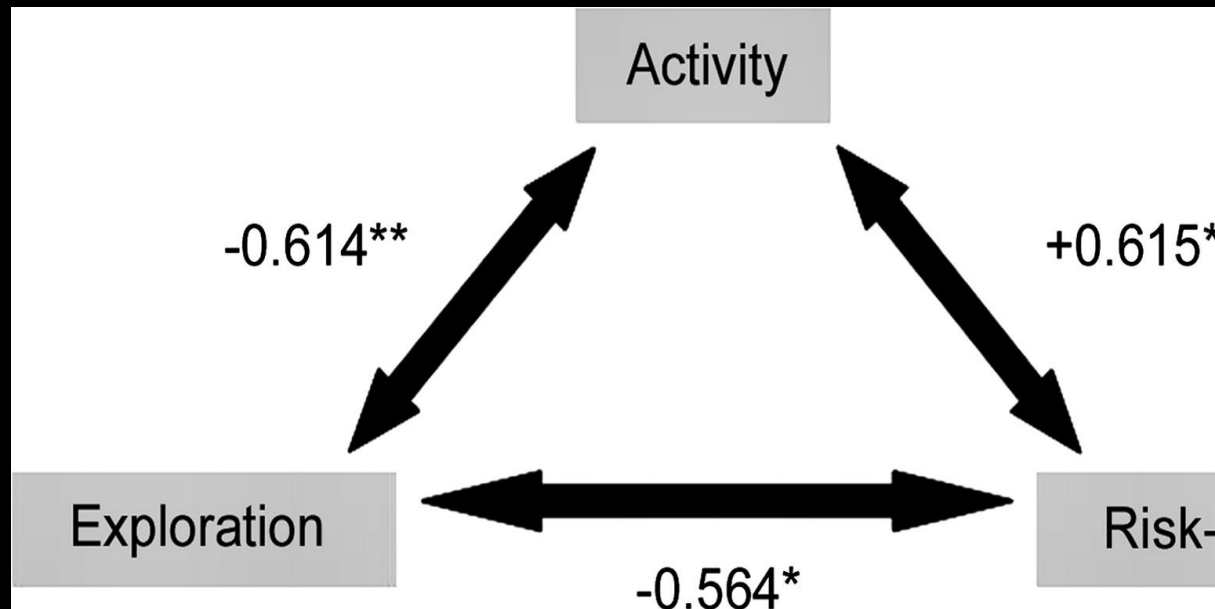
# Different behaviours can be correlated



+ Prey  
Mates



# Different behaviours can be correlated

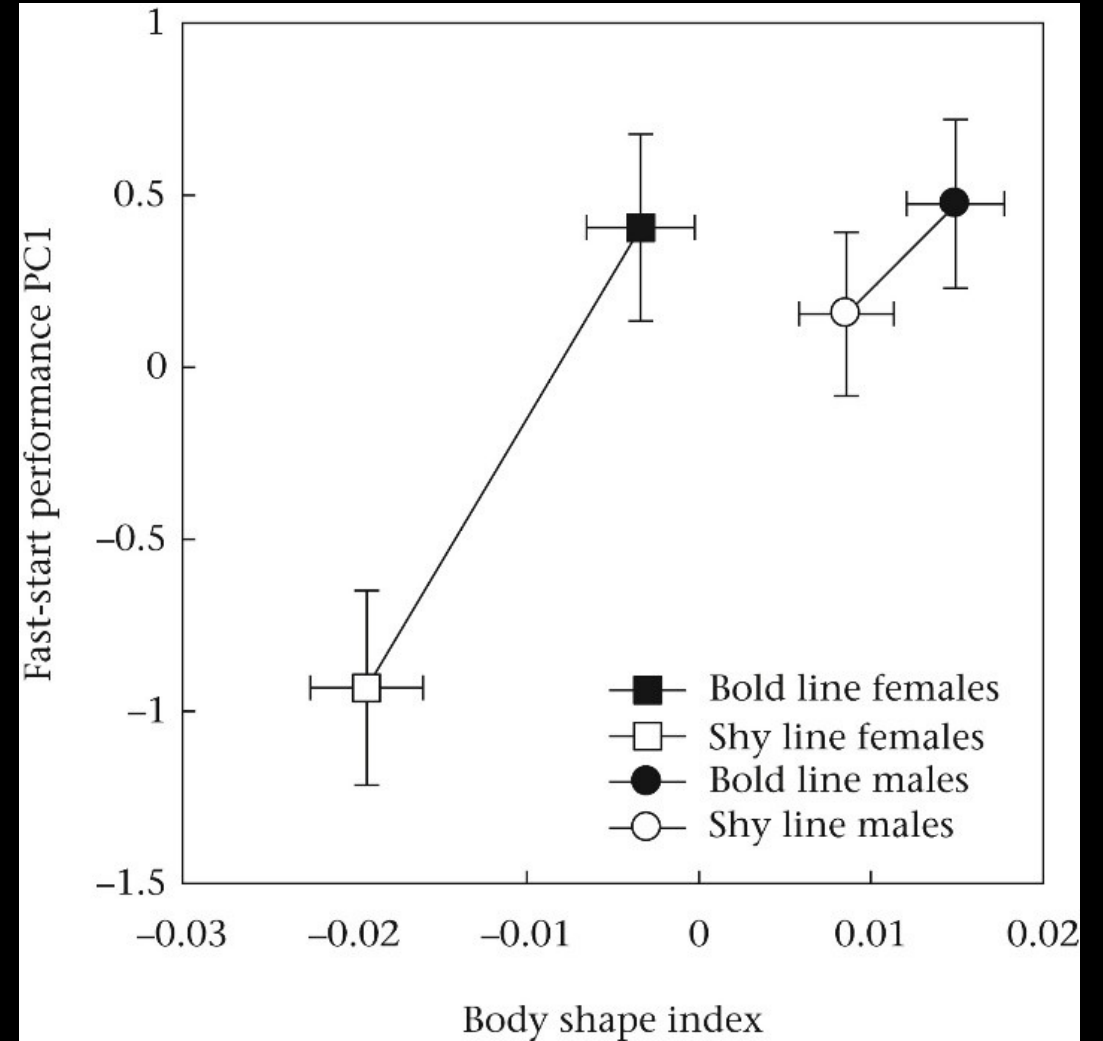
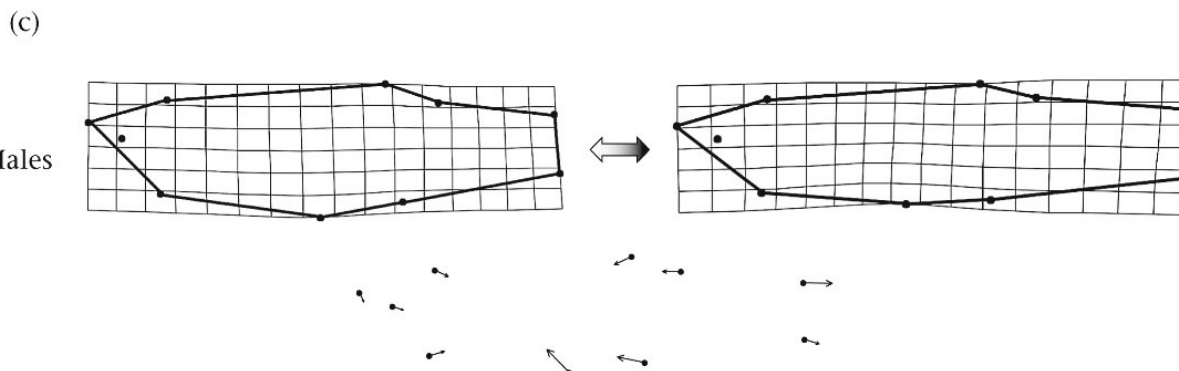
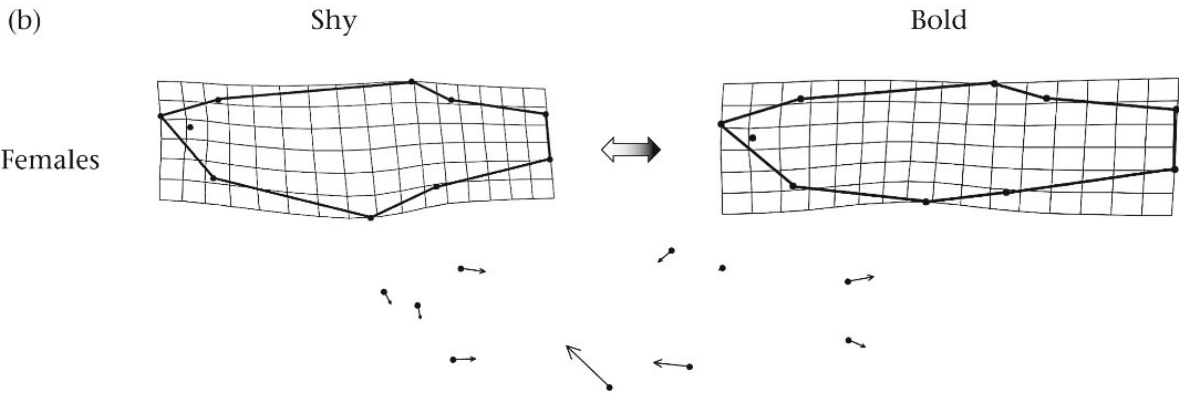
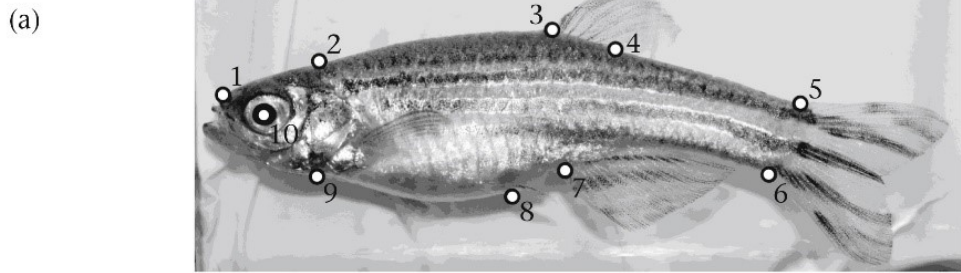


Jonathunder, Wikipedia

+ Prey  
Mates

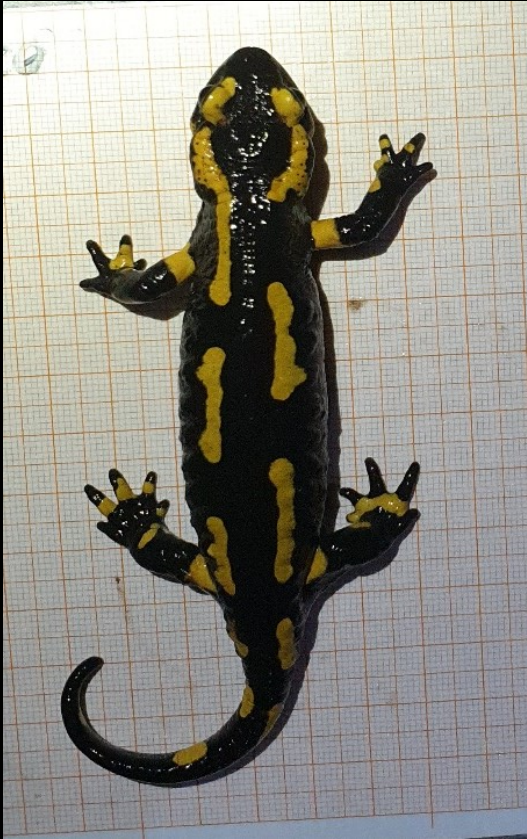
— Predators

# Is animal personality maintained through correlations with other traits?





Are more yellow fire salamanders bolder, more active and more explorative?



- Yellow colouration is costly but acts as warning towards predators

Toxin glands bolder, more



- Toxins are produced and stored within toxin glands (e.g., parotoid gland)
- Amount of toxin is correlated to parotoid gland size



# Experimental Design

14 salamanders in Spring

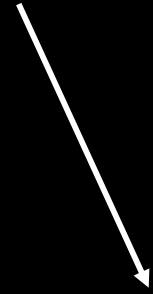


15 salamanders in Autumn

60 days

# Experimental Design

14 salamanders in Spring



Behavioural test  
(Field)



60 days



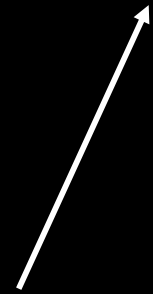
Behavioural test  
(Lab1)

3 days



Behavioural test  
(Lab2)

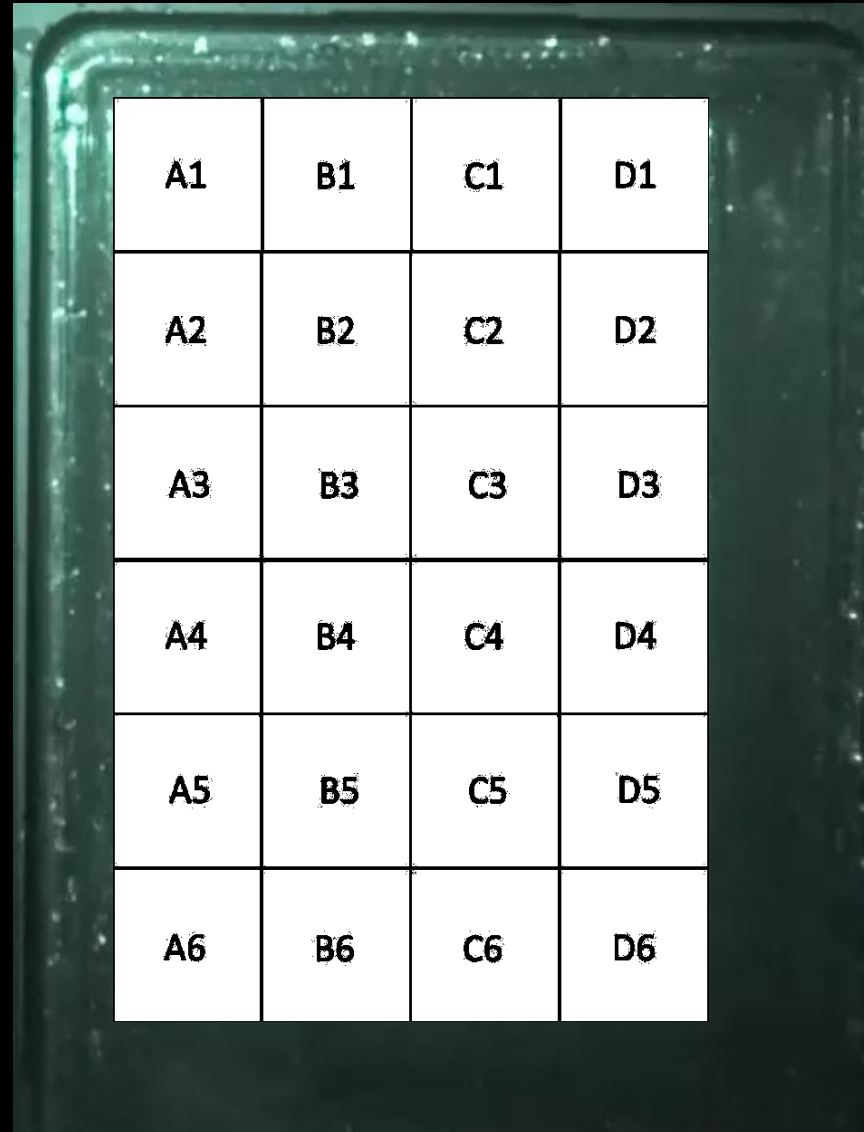
15 salamanders in Autumn





# Behavioural Trial: Part I – Activity and Exploration

- Time spent moving (Activity)
- Number of squares explored (Exploration)



# Behavioural Trial: Part 2 – Boldness

- Left “hide”: yes/no
- Latency to leave the hide





# Morphological measurements

- Proportion of yellow on the back
- Relative parotoid gland length



# Questions

1. Are behaviours repeatable?



# Questions

1. Are behaviours repeatable?
2. Are personality traits correlated?

# Questions

1. Are behaviours repeatable?
2. Are personality traits correlated?
3. Are colouration and relative parotoid gland length correlated with personality traits?

# Questions

1. Are behaviours repeatable?
2. Are personality traits correlated?
3. Are colouration and relative parotoid gland length correlated with personality traits?
4. What other factors affect personality traits?

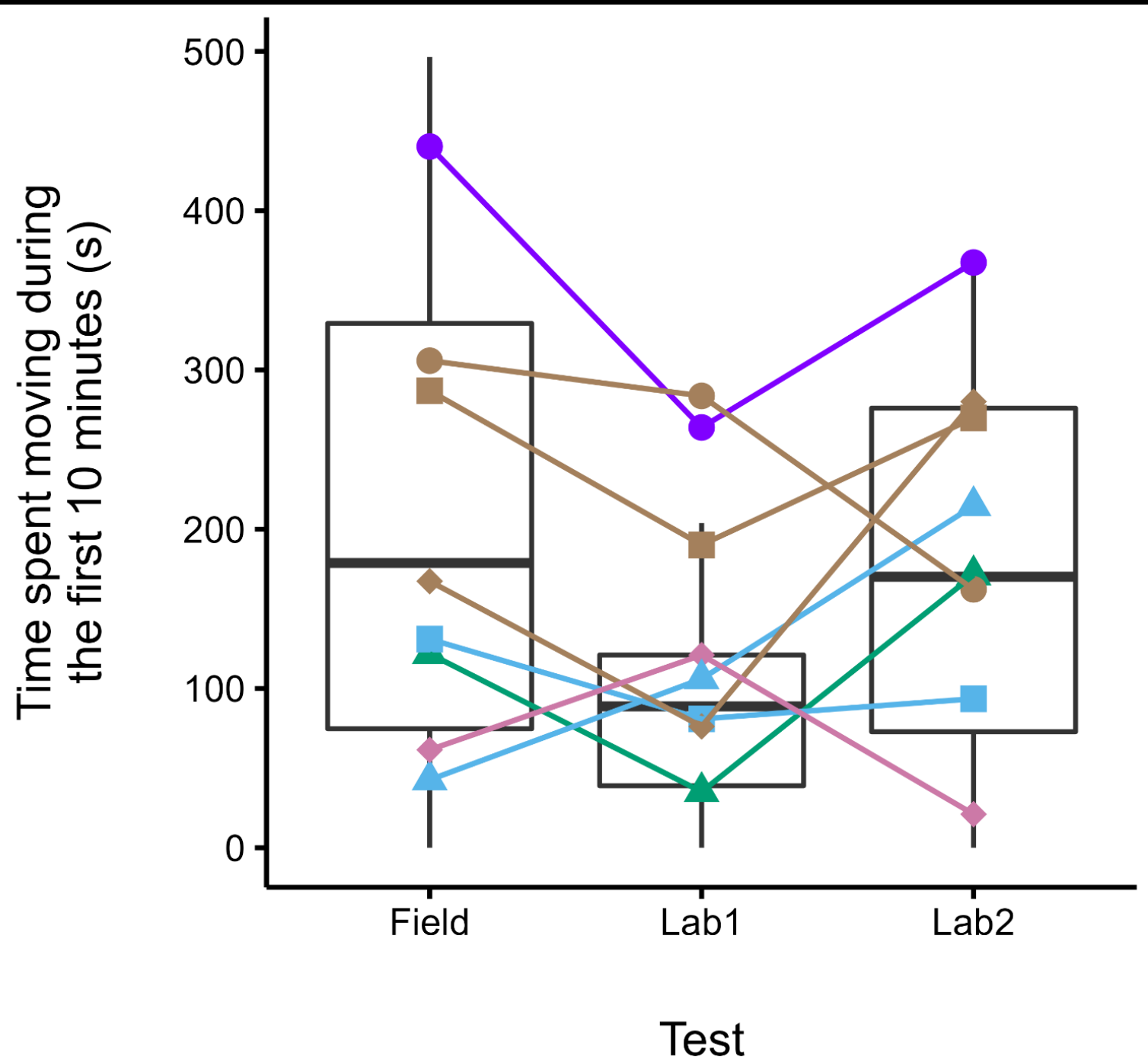


# Activity is repeatable

**Repeatability\*\*:**  $R = 0.348 \pm 0.121$

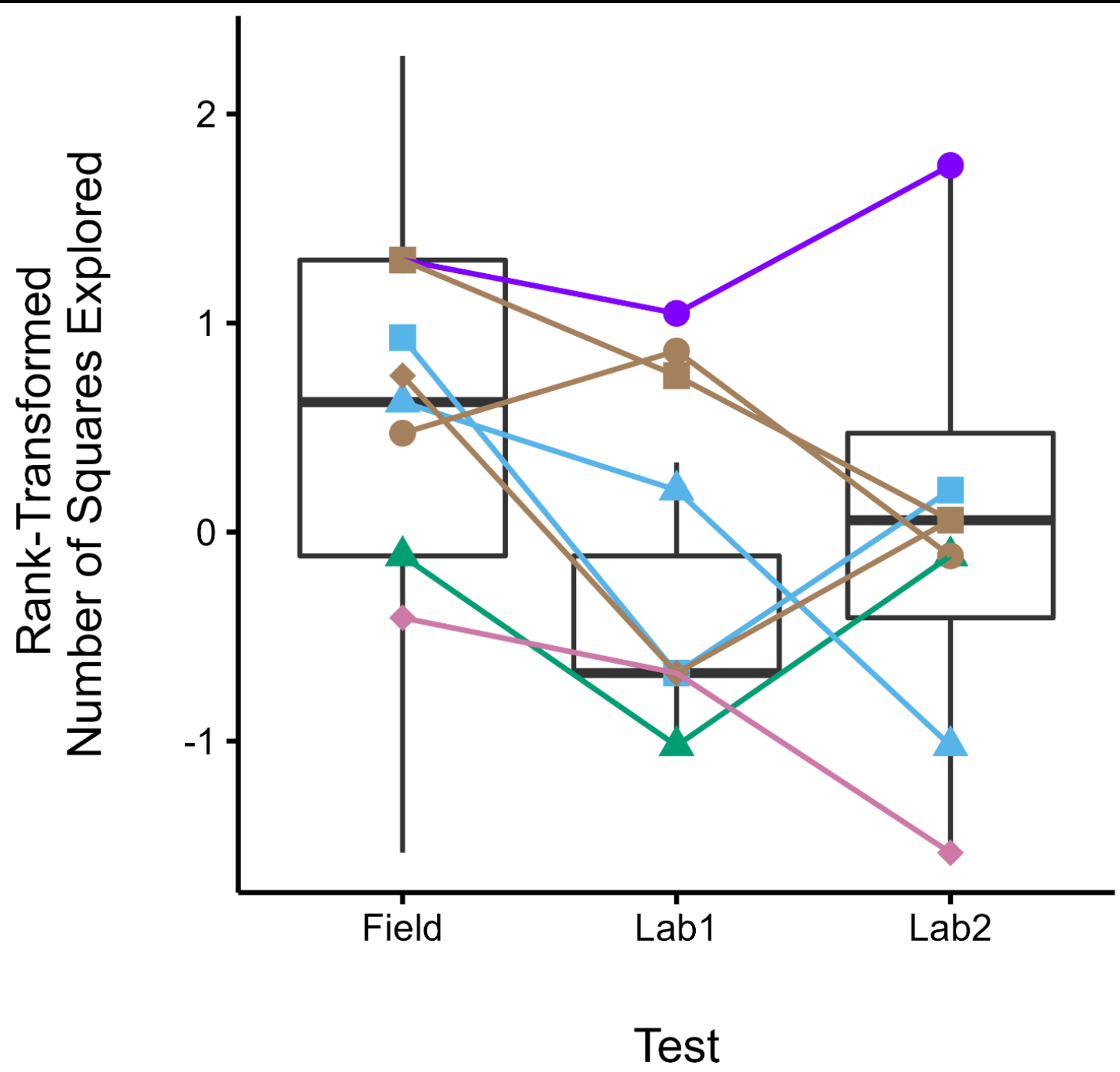
**Test\*\*\*:** Chisq. = 18.96

**Temp:** Chisq. = 0.218



# Exploration is repeatable

**Repeatability\*\*:**  $R = 0.302 \pm 0.121$   
**Test\*\*\*:** Chisq. = 19.469  
**Temp:** Chisq. = 0.411



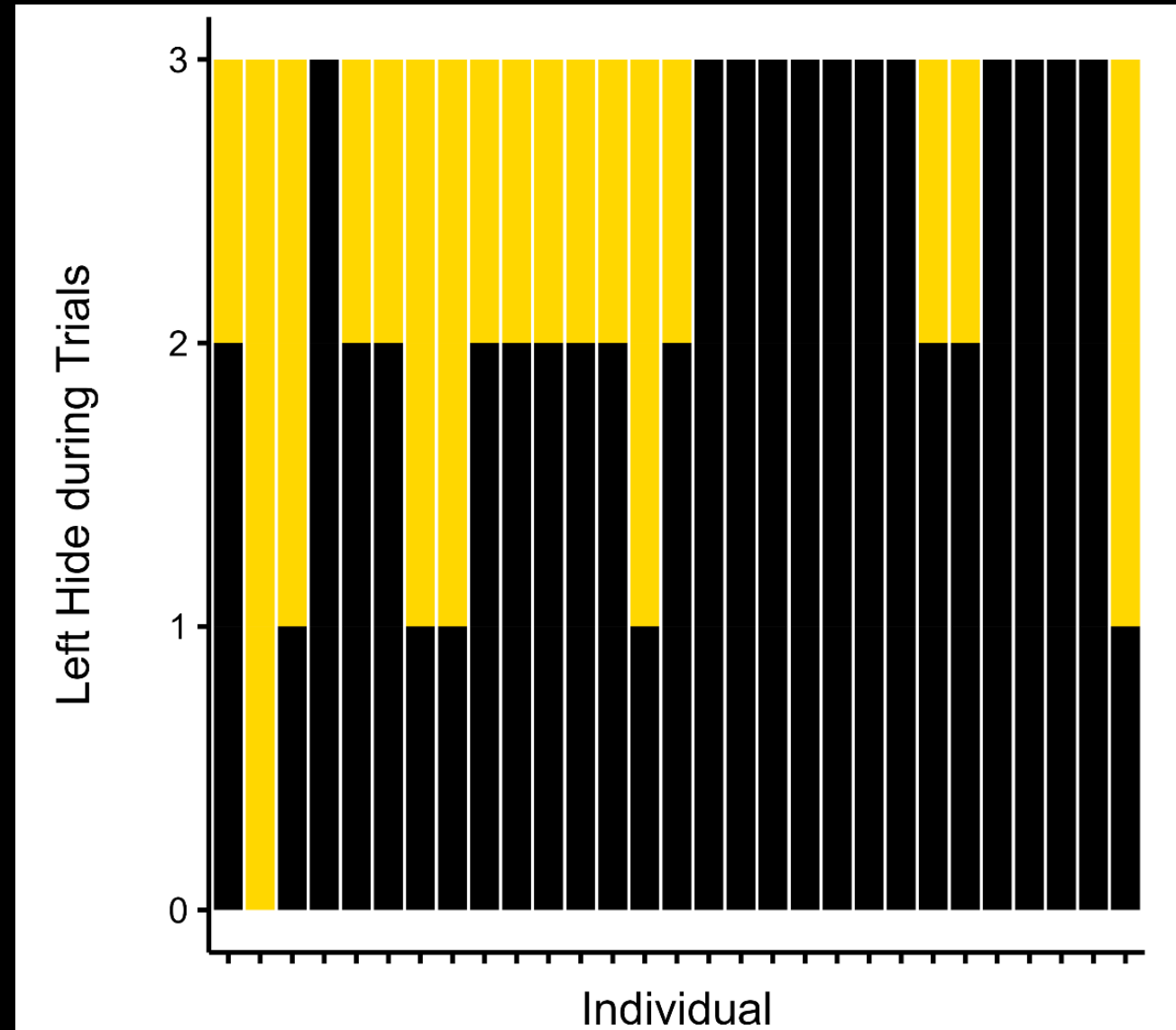
# Boldness (Left hide) is not repeatable

In 28% of trials, individuals did not leave "hide"

Repeatability:  $R = 0.028$

Test:  $\text{Chisq.} = 1.91$

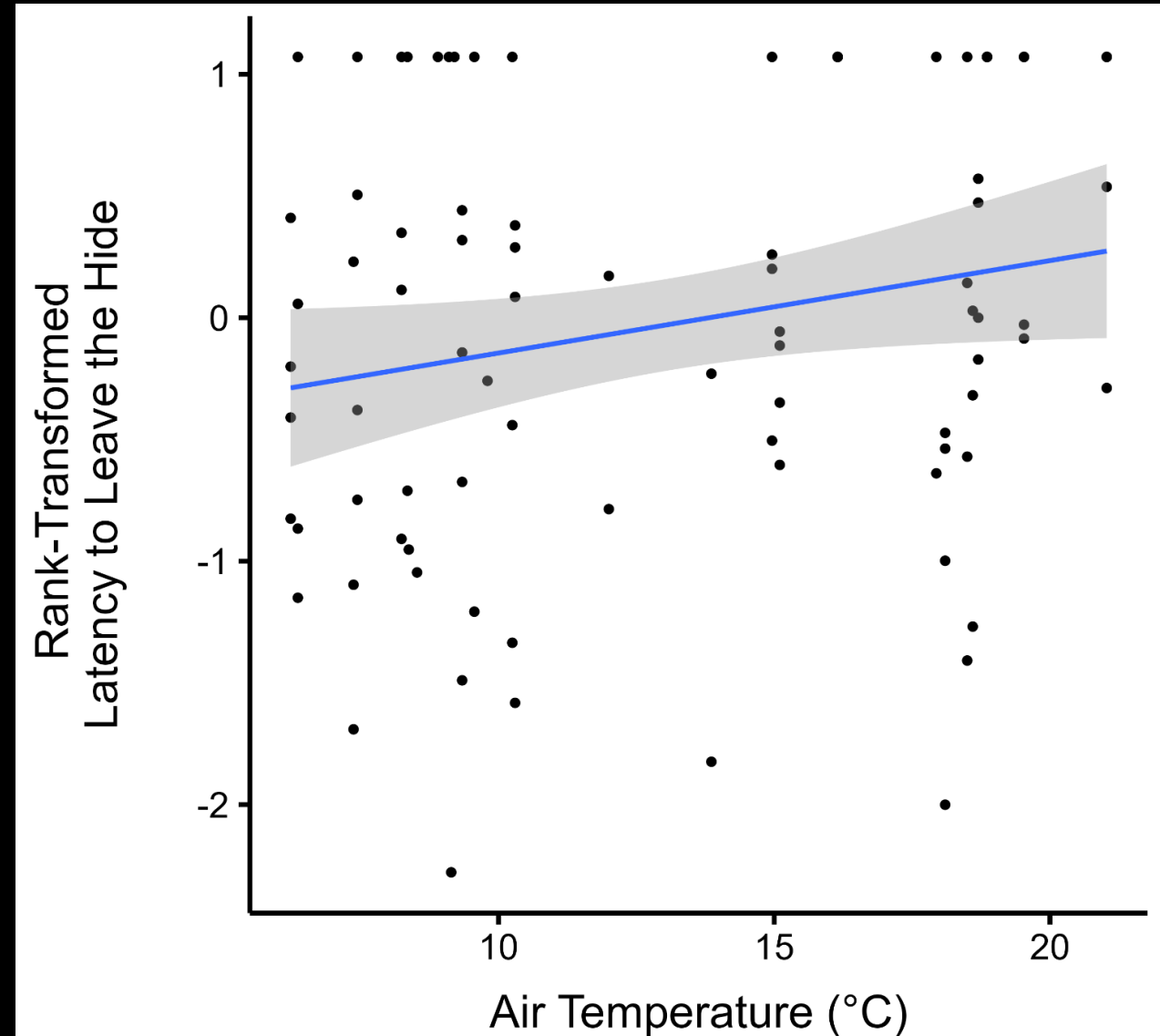
Temp:  $\text{Chisq.} = 3.188$





# Boldness (Latency to leave the hide) as well

Repeatability:  $R = 0.025 \pm 0.079$   
Test: Chisq. = 3.98  
Temp\*: Chisq. = 5.054



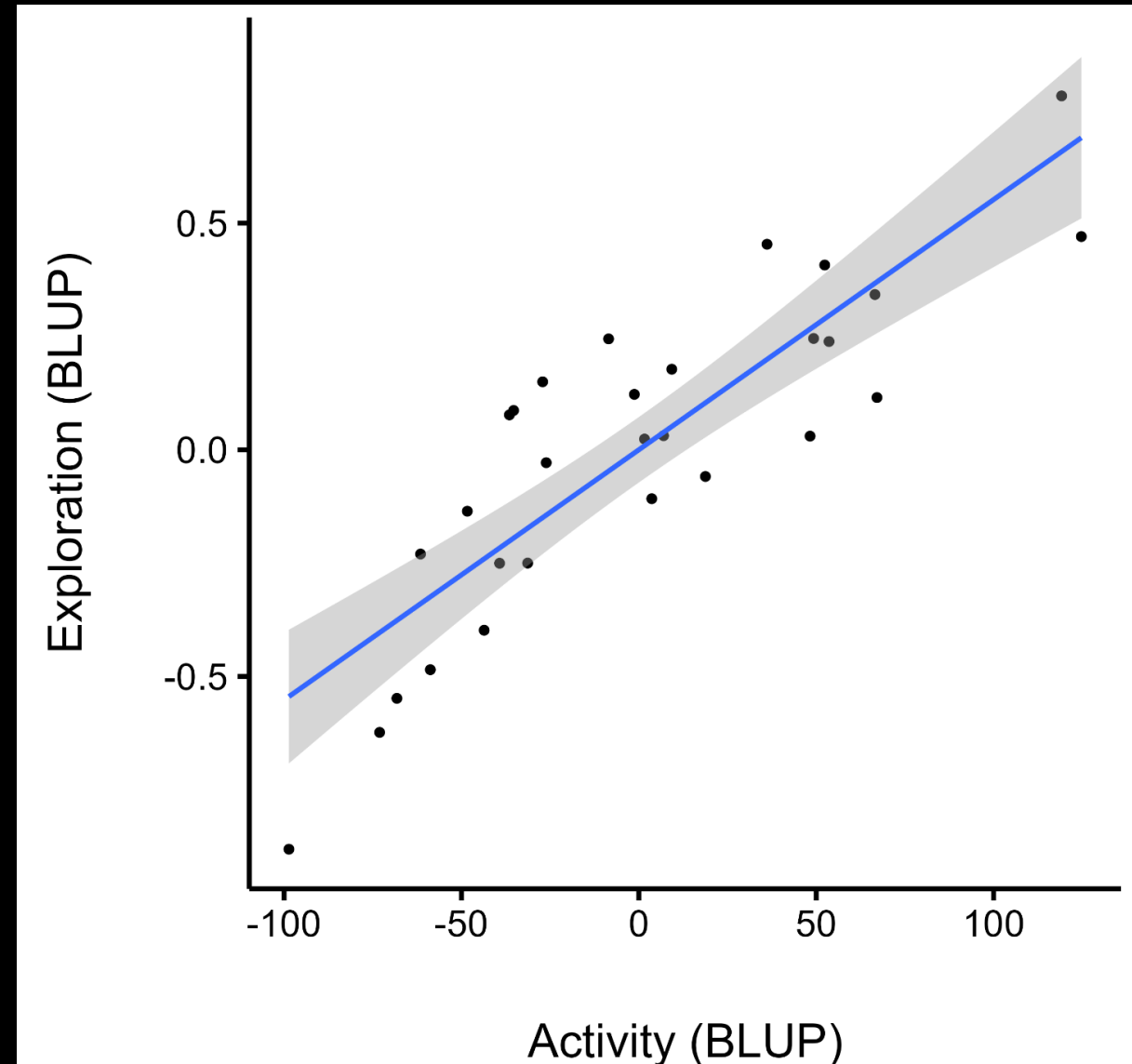
# Personality in fire salamanders

- Both activity and exploration are repeatable (= personality)
- Boldness is not repeatable

# Active individuals are also more explorative

Best Linear Unbiased Predictor – Predicted behaviour of an individual given the repeatability of that behaviour

Spearman's Rank Correlation:  
 $p < 0.001$   
 $\rho = 0.837$



Does colouration and/or toxin gland size influence personality?

- Dependent: Activity (BLUP) or Exploration (BLUP)



# Does colouration and/or toxin gland size influence personality?

- Dependent: Activity (BLUP) or Exploration (BLUP)
- Independent:
  - Percent of yellow colouration
  - Relative parotoid gland size
  - Sex
  - Season

# Does colouration and/or toxin gland size influence personality?

- Dependent: Activity (BLUP) or Exploration (BLUP)

- Independent:

- Percent of yellow colouration
- Relative parotoid gland size
- Sex
- Season

➤ Step-wise model reduction (based on AIC)

# Factors influencing activity

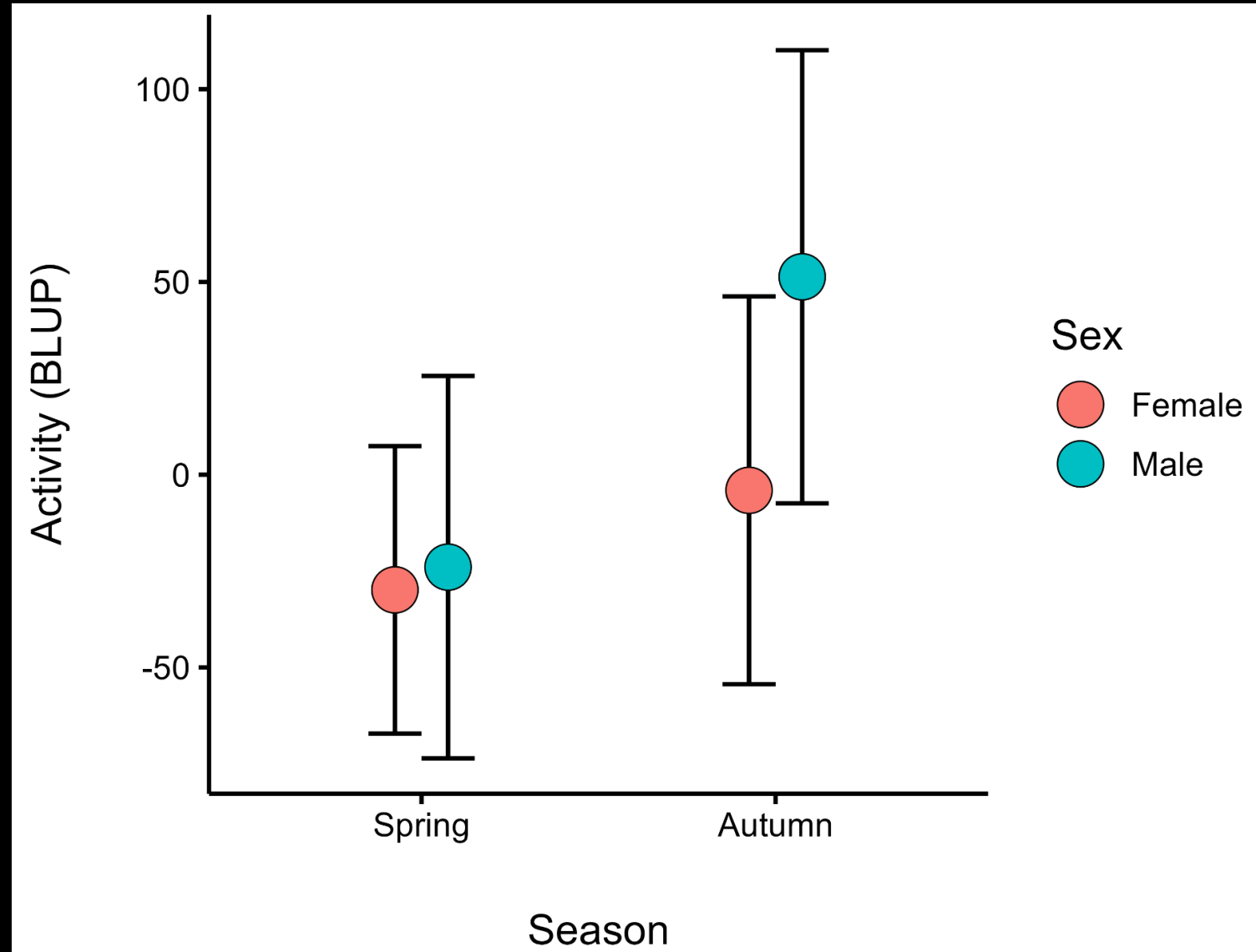
- × Colouration

- × Parotoid gland size

# Factors influencing activity

× Colouration

× Parotoid gland size



Sex: s.s. = 6735

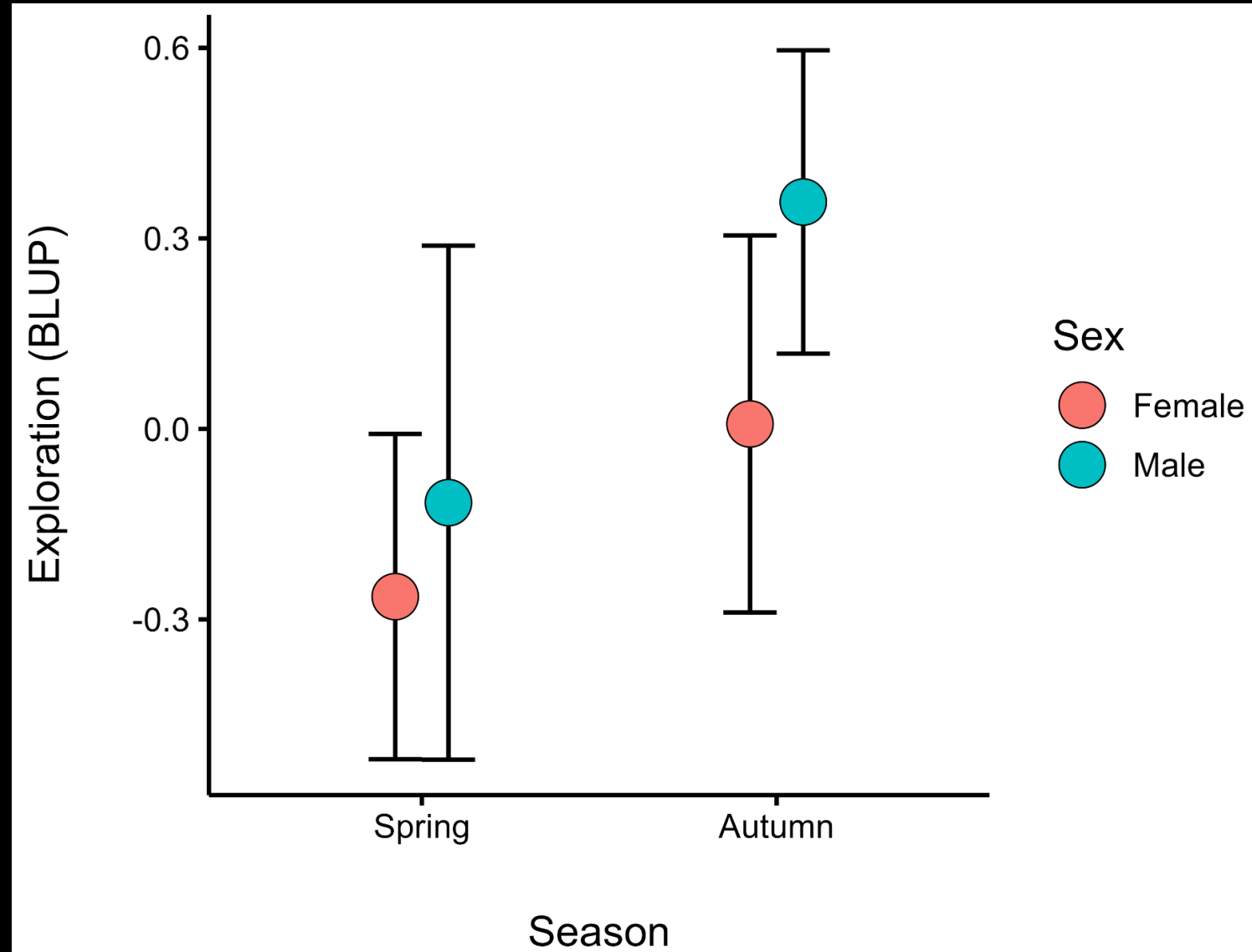
Season\*: s.s. = 16543



# Factors influencing exploration

× Colouration

× Parotoid gland size



Sex\*: s.s. = 0.43

Season\*\*: s.s. = 0.915

# The influence of colouration and toxicity on animal behaviour



Wikimedia Commons



Virginia Museum of Natural History

# The influence of season on fire salamander personality

- “short-term – personality” or sampling bias?



# The influence of sex on fire salamander exploration

A male fire salamander in the typical “look-out”-position:



# Outlook

- Pilot study to inform future larger-scale behavioural experiments

# Thank you!

## Co-authors

Manuela Schmidt

Henry Bony

Laura Schulte

Philipp Wagner

Barbara Caspers



Isabel Damas Moreira

Barbara Fuchs

Jonas Tebbe

Marc Gilles

Saskia Ebert

...

## Other cool people

Giorgos Drosopoulos

Stephen Salazar

Ane Liv Berthelsen

...



# Correlation between yellow colouration and gland size

