Characterisation of the impact of nutritional challenge on individual activity patterns in dairy goats.

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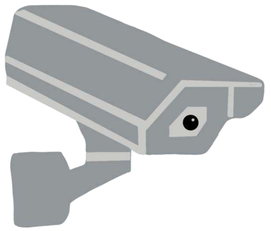
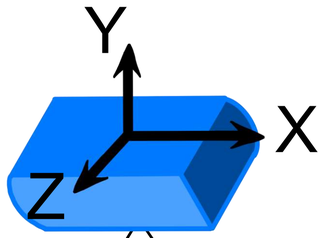
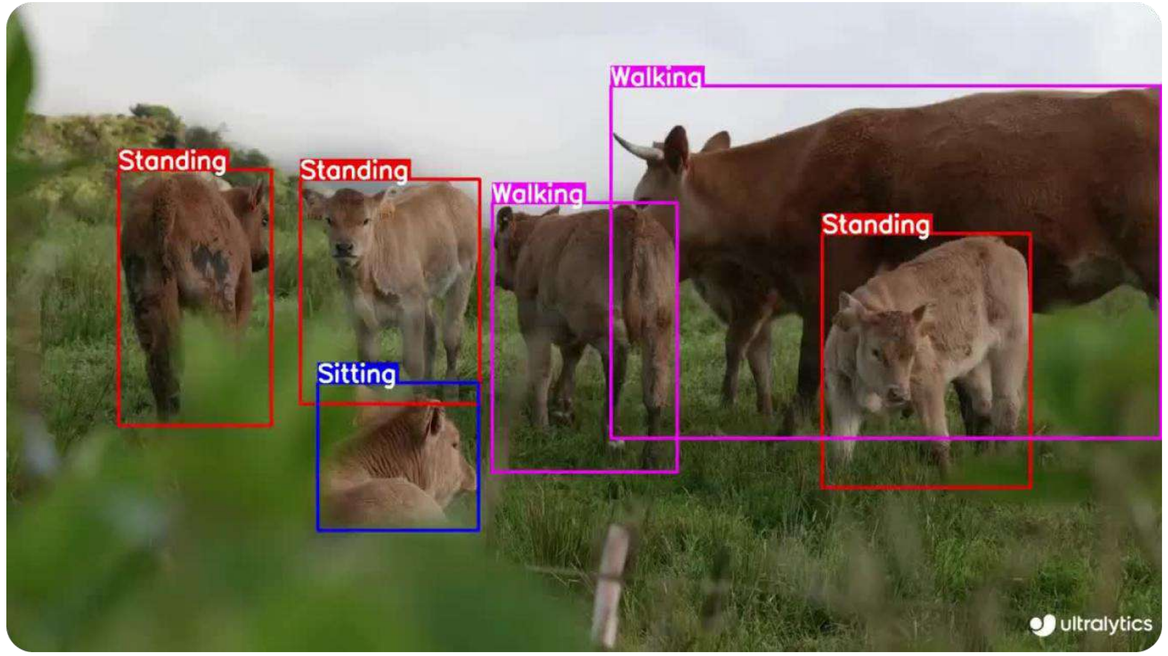


camera

accelerometer



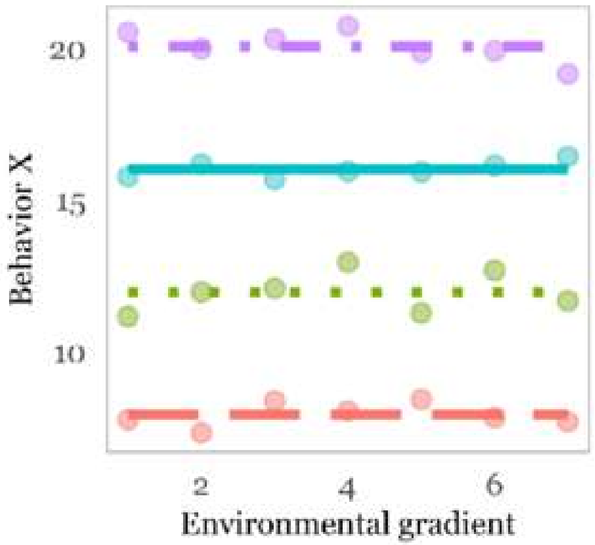


Ultralytics

Mauny et al., 2025

Le Roux et al., 2017

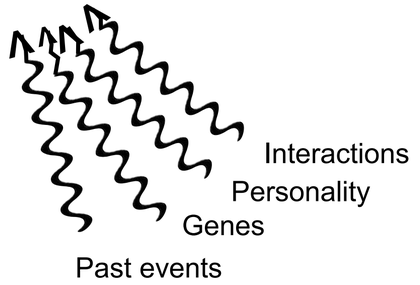
Individual variability



Among-individual differences in mean behavioural expression over repeated measures.

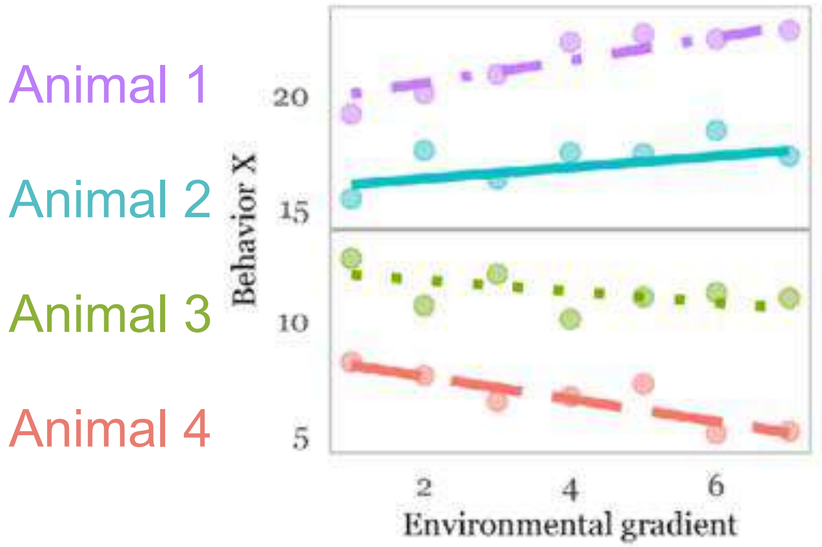
Behaviour plasticity = behavioural adjustments in response to external or internal stimuli

Strier, K.B., 2022



Alvarenga et al., 2023

Stamps., 2015



Linear reaction norm plot: individuals differ in their behavioural plasticity (slope) along an environmental gradient.

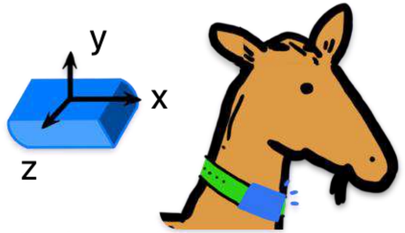
Objective

Limits of group-level analysis → need for individual-level tools.

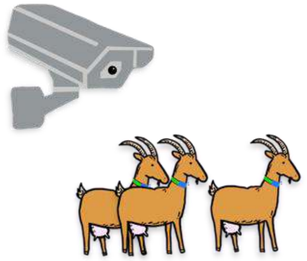
→ to assess how individual dairy goats adjust their behavioural patterns in response to a controlled nutritional challenge, using accelerometer-based data and to characterise the diversity and intensity of the responses.

Methodology

Collection of training data



3-d accelerometer



Behavioural annotation

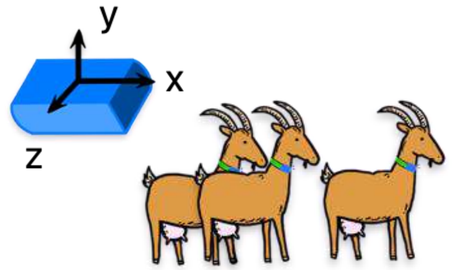
(Mauny et al., 2025)

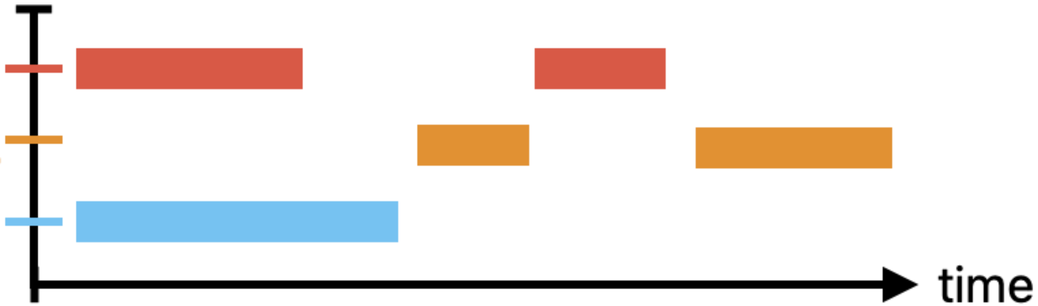
Classification models
-> Ruminating
-> Head in the feeder
-> Lying

AUC scores (Area Under the Curve)

0.91
0.93
0.95

Acceleration data of 14 lactating goats for 17 days with a 2-day nutritional challenge





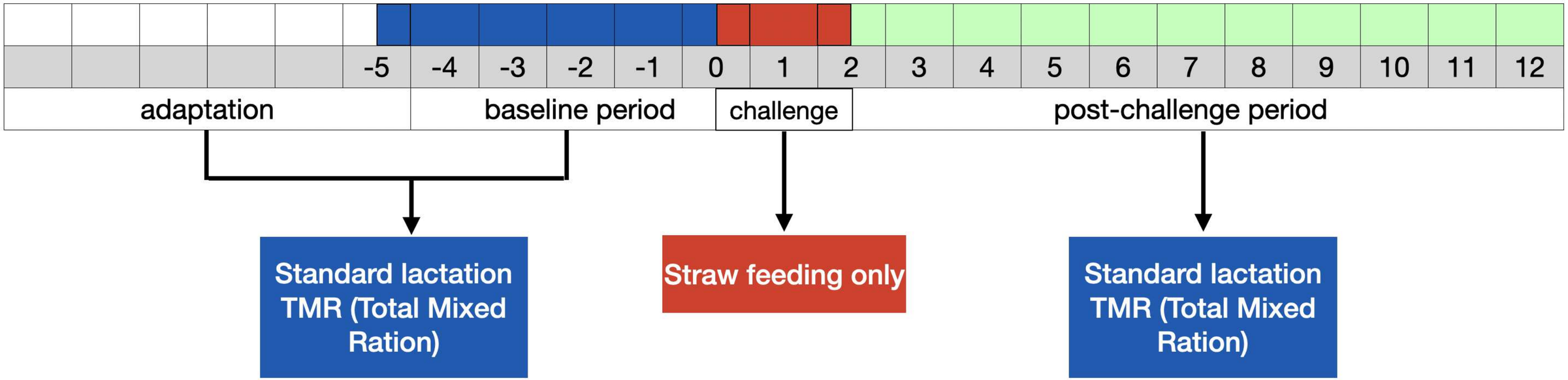
Experimental setup

Feeding system of the experimental setup

Accelerometer fixed to the collar tag of the goat

A: accelerometer, B: weight, C: collar

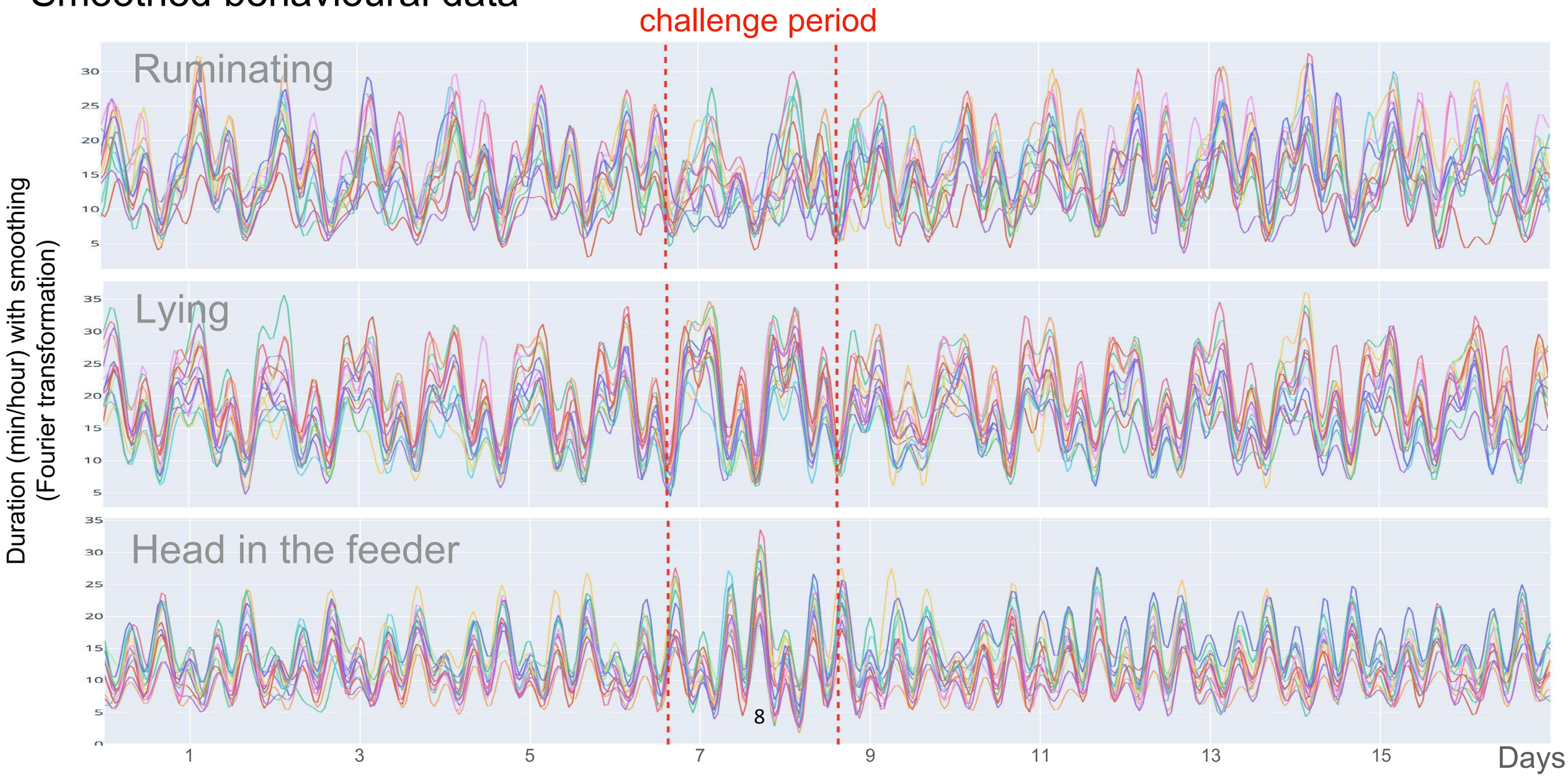
Nutritional challenge



acceleration recordings

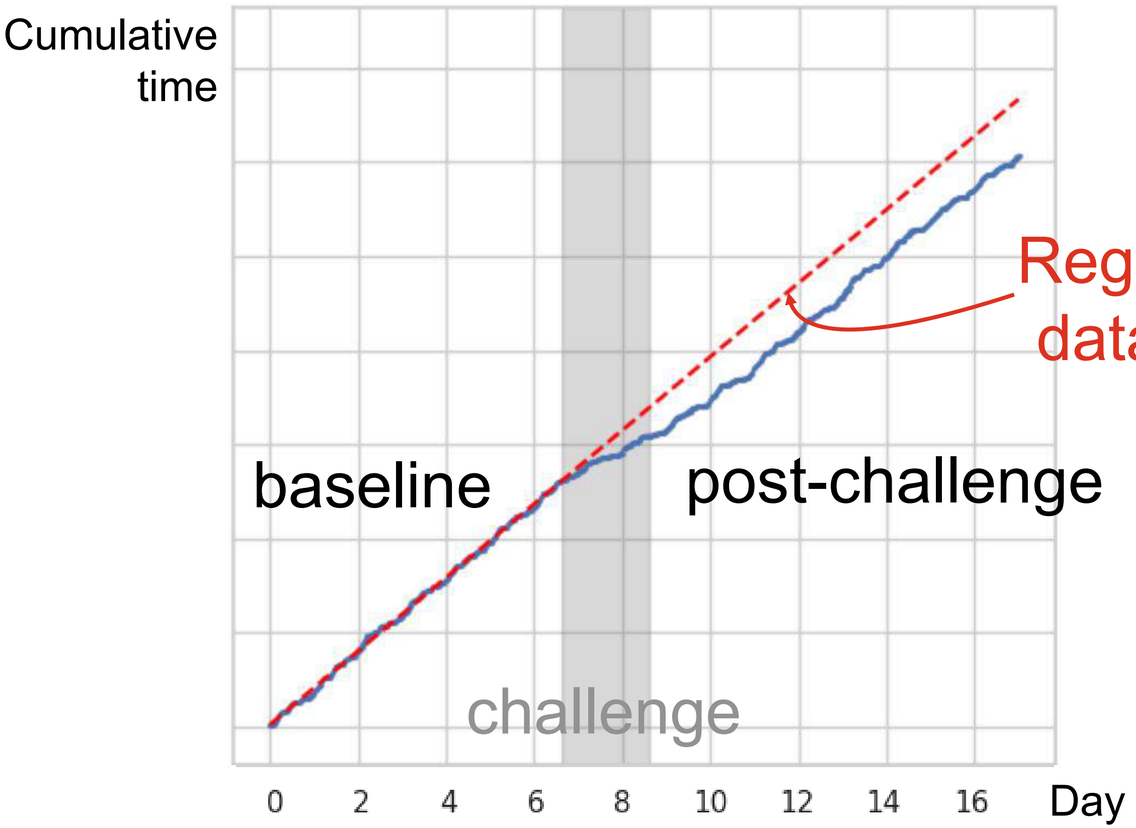
Smoothed behavioural data

Smoothed behavioural data



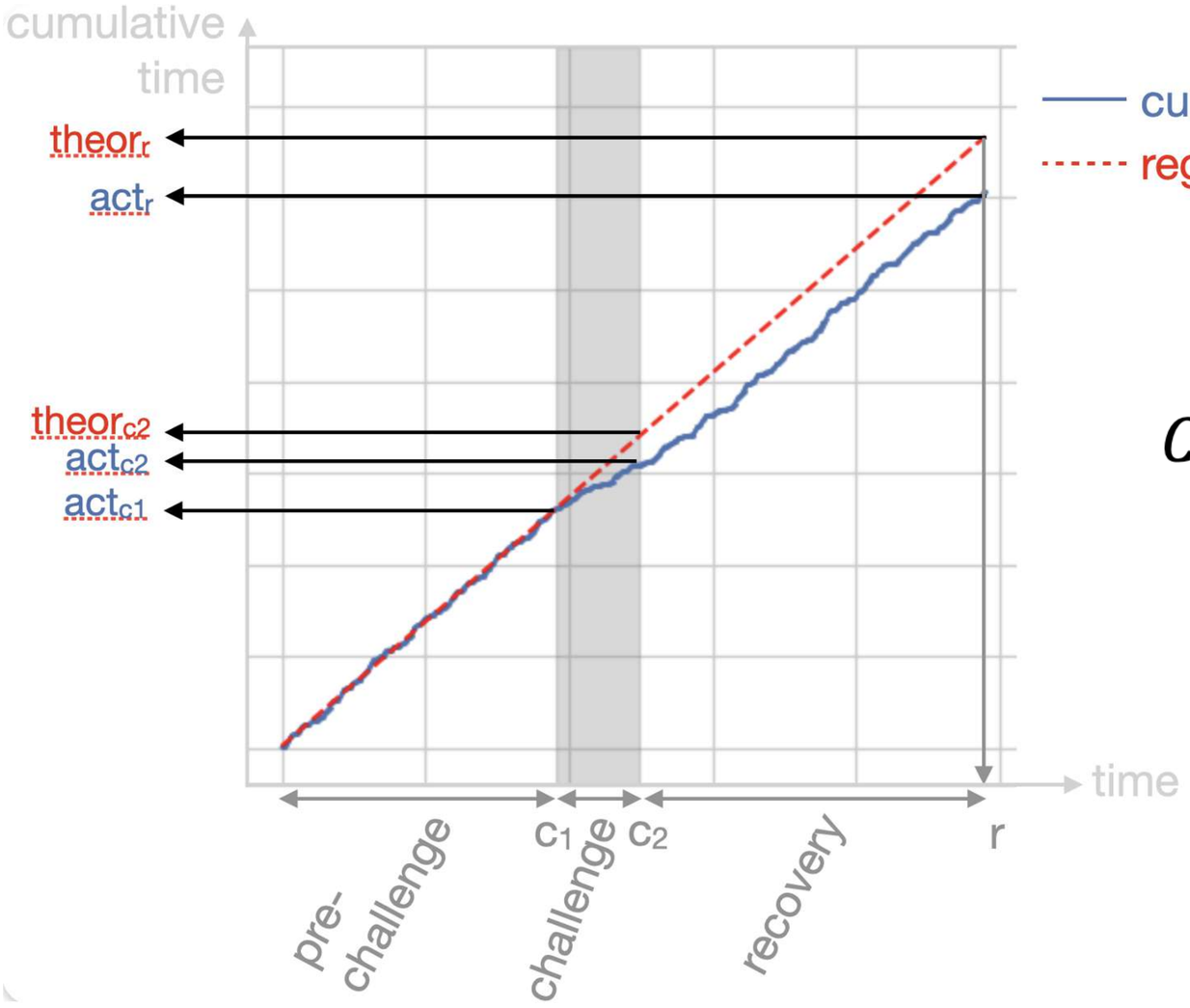
Duration of each behaviour (min/hour)

Cumulative time (min)



represents the hypothetical scenario of a regular expression of the behaviour over time

Regression line fitted on the data of the baseline period



CEI (*Challenge Effect Index*)

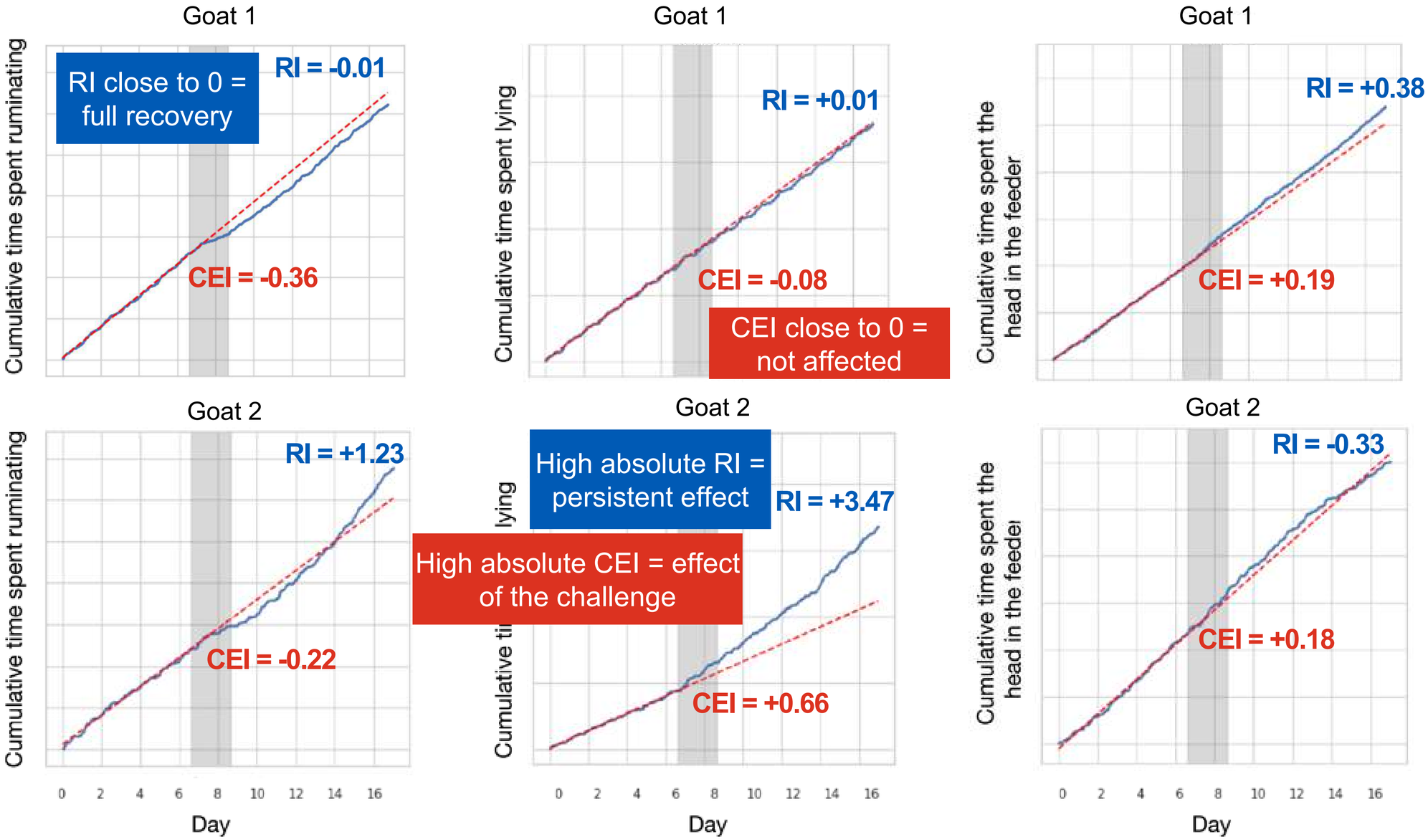
$$CEI = \frac{act_{c2} - theor_{c2}}{theor_{c2} - act_{c1}}$$

effect of the challenge on the time spent expressing the behaviour compared to the theoretical value (regression line)

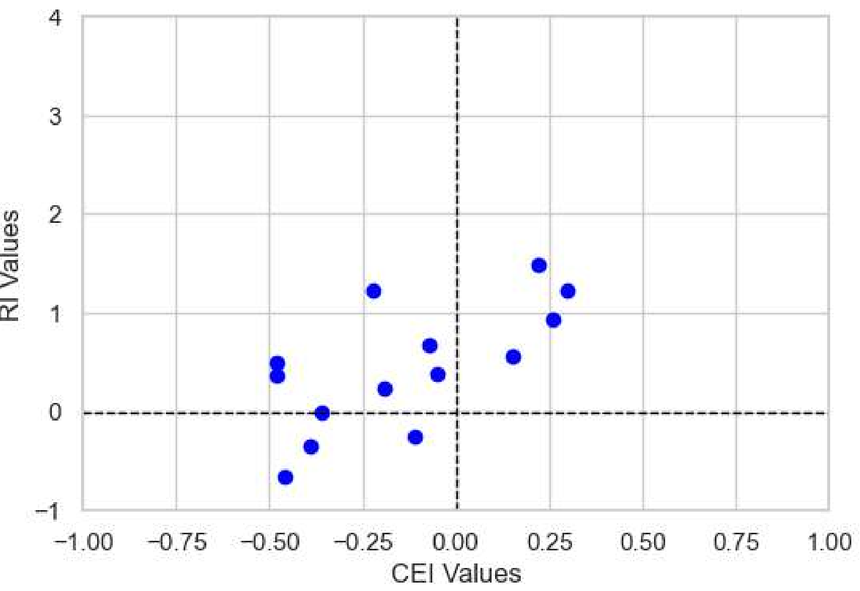
RI (*Recovery Index*)

$$RI_r = \frac{act_r - theor_r - (act_{c2} - theor_{c2})}{theor_{c2} - act_{c1}}$$

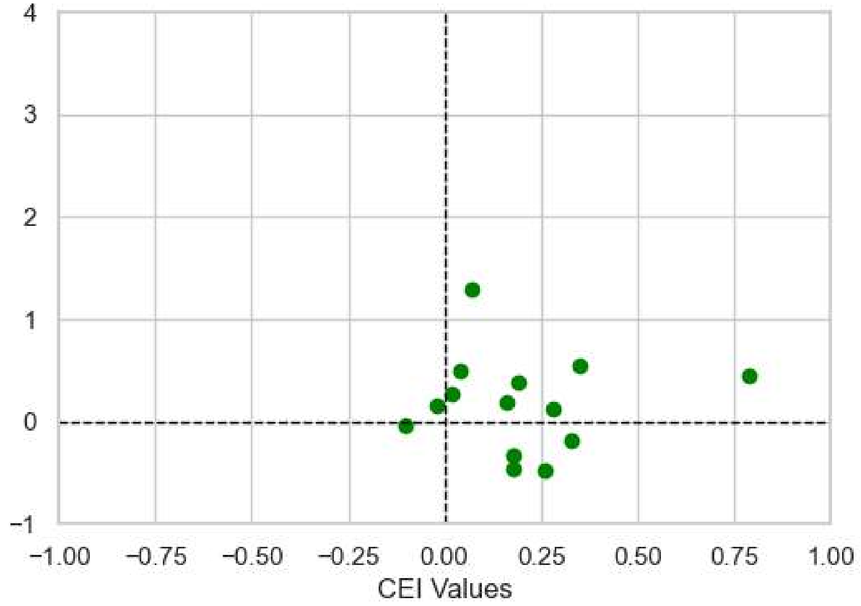
deviation from the theoretical value r days after the challenge


Goat 1
Cumulative time spent ruminating
RI close to 0 = full recovery
RI = -0.01
CEI = -0.36
Goat 1
Cumulative time spent lying
RI = +0.01
CEI = -0.08
CEI close to 0 = not affected
Goat 1
Cumulative time spent the head in the feeder
RI = +0.38
CEI = +0.19
Goat 2
Cumulative time spent ruminating
RI = +1.23
CEI = -0.22
High absolute CEI = effect of the challenge
Goat 2
High absolute RI = persistent effect
RI = +3.47
CEI = +0.66
Goat 2
Cumulative time spent the head in the feeder
RI = -0.33
CEI = +0.18
0 2 4 6 8 10 12 14 16
Day

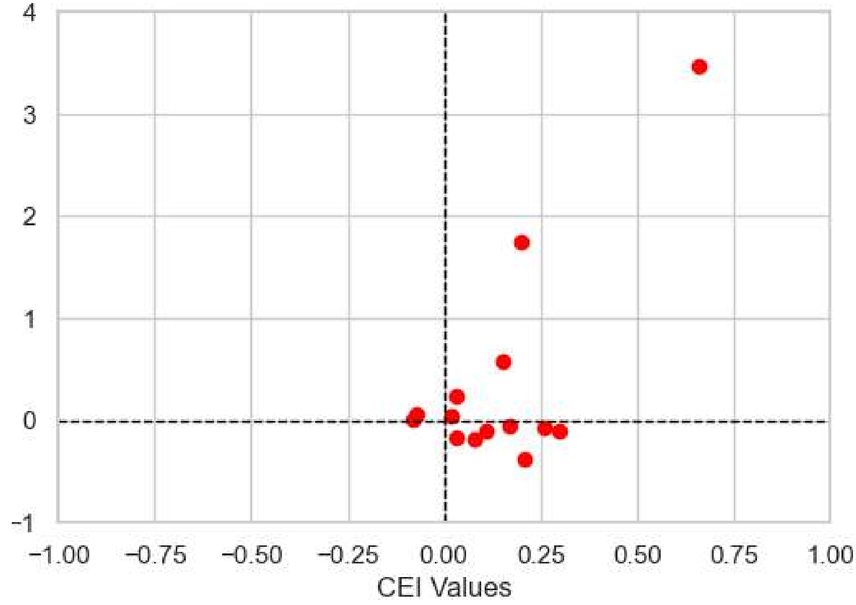
● Ruminating

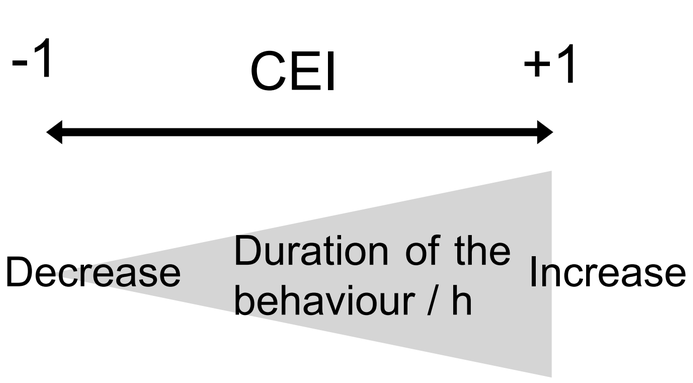


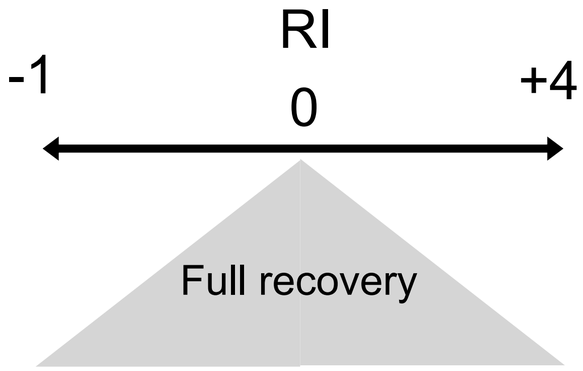
● Head in the feeder



● Lying



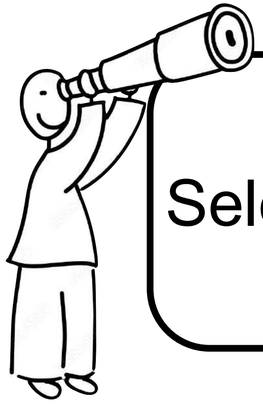




- individual goats responded differently despite the same challenge : **behavioural plasticity**

- CEI and RI allow quantifying individual trajectories in response to perturbations

- This methodology complements group-scale analysis and contributes to the development of individual behaviour monitoring



Selection of the appropriate response to climate change?

Thank you for your attention

We sincerely thank the staff of the experimental goat unit of MoSAR (INRAE-AgroParisTech-Université Paris-Saclay) for their contribution to this work.

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