

Personality and behavioral syndromes of wild Atlantic cod

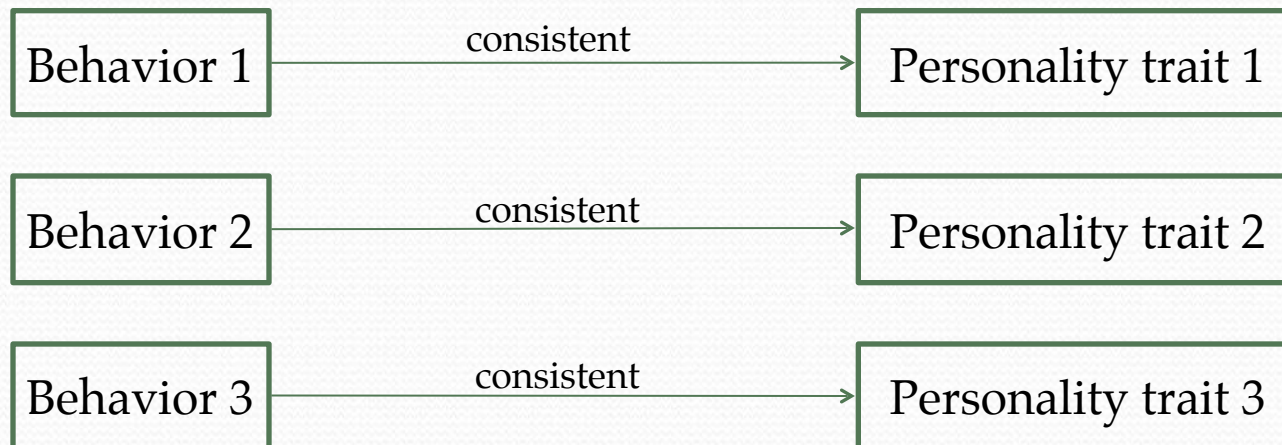
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Flødevigen Research Station, IMR(Norway)

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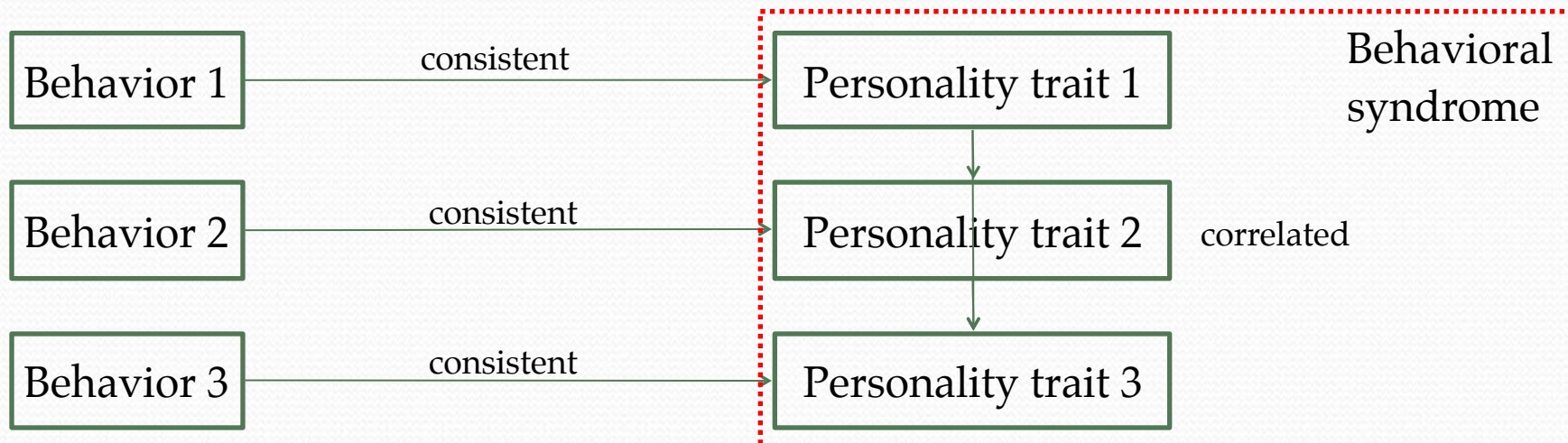
Personality research

- **ANIMAL PERSONALITY:** consistent behavioral differences among individuals over time.



Personality research

- **ANIMAL PERSONALITY:** consistent behavioral differences among individuals over time.
- When several personality traits are correlated, they are said to form a **BEHAVIORAL SYNDROME**. They have the potential to dramatically affect and constrain evolutionary responses.



Fish personality and fisheries

1. Personality-dependent catchability and selection
2. Personality correlated with other traits
3. Fisheries induced evolution (FIE) on behavioral traits can entail FIE in other correlated traits

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Life-history and activity shape catchability in a sedentary fish

David Villegas-Ríos^{1,6,*}, Josep Alós², Miquel Palmer³, Susan K. Lowerre-Barbieri⁴, Rafael Bañón⁵, Alexandre Alonso-Fernández¹, Fran Saborido-Rey¹

Opinion

Cell
PRESS

Are animal personality traits linked to life-history productivity?

Peter A. Biro¹ and Judy A. Stamps²

Rapid depletion of genotypes with fast growth and bold personality traits from harvested fish populations

Peter A. Biro** and John R. Post†

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Fish personality in captivity

- Replicated measurements
- Controlled conditions
- Limitations:
 - Stress associated with capture
 - Relaxed natural selection
 - Variability in coping with captivity / isolation
 - Captive behavior may not represent wild behavior and can have accumulated non-adaptative genotypic variation



www.jollejolle.com



www.befishproject.wordpress.com

Personality in the wild

- Wild traits are those subject to selection. The role of personality in the local adaptation and evolution of populations can only be fully elucidated in the context of their natural ecology
- Limitations:
 - Selective trapping
 - Non-standard conditions
 - Logistical limitations
 - Ability to track focal animals. **Aquatic telemetry!**

Our objectives

Investigate behavior in wild realistic conditions and apply methods in behavioral ecology and personality research to answer...

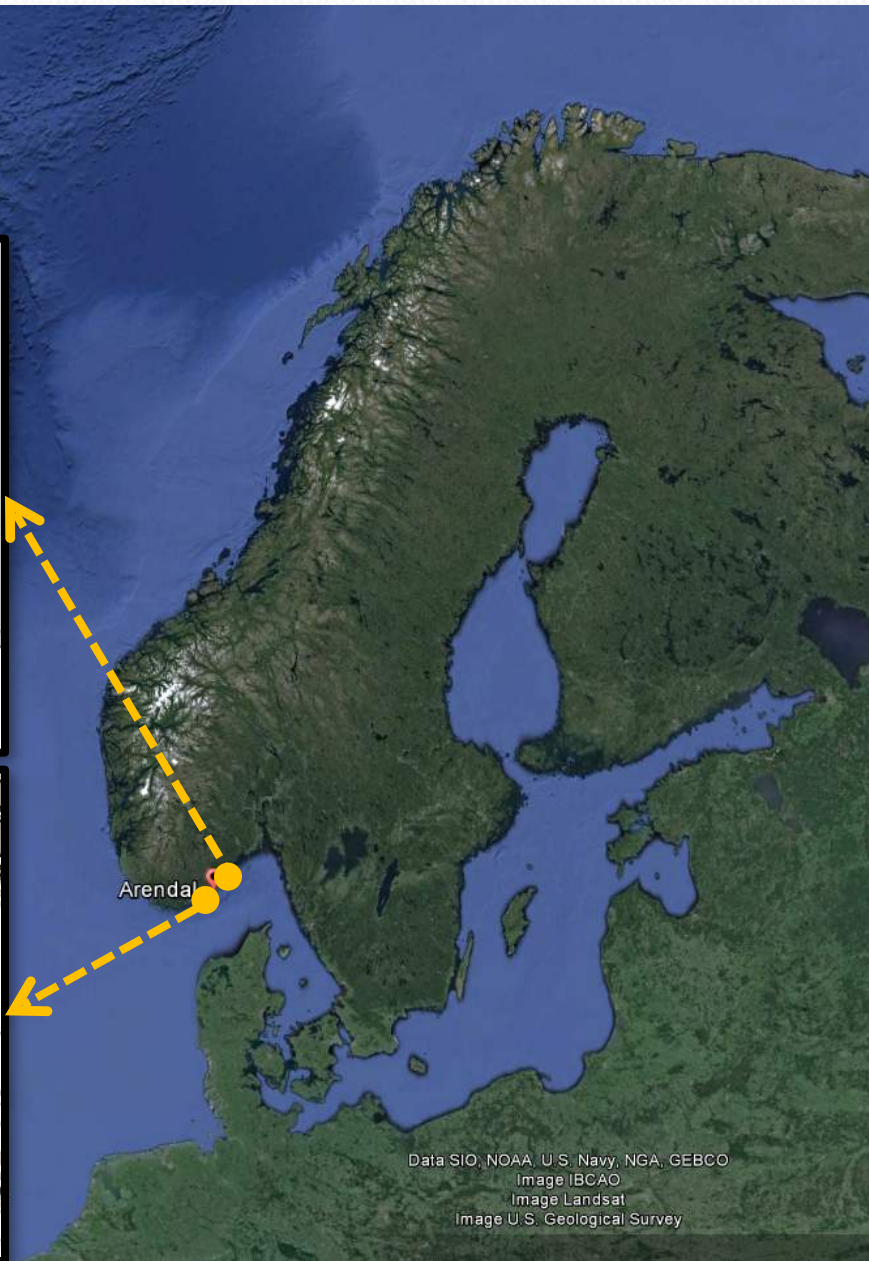
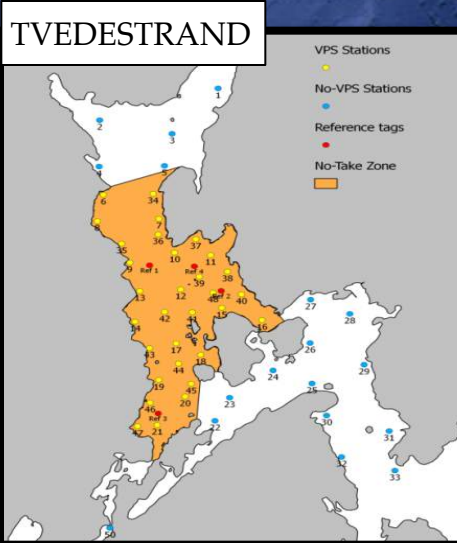
Do individuals wild cod behave consistently?

Are personality traits correlated?

Can these correlations constrain evolution?

Telemetry set-

up



- ~100 receivers VR2W
- 274 cods
- V9P Vemco Tags

Behavioral traits

- **Vertical activity:** standard deviation in depth for every 1-h period averaged for each given day.
- **Home range:** 95% kernel utilization distribution
- **Horizontal activity:** distance moved per time bin (30 min) averaged per day.
- **Dispersal from release:** distance between a particular position and the release site.

All of them potentially subject to selection by fisheries

Personality: methods

- Personality trait \rightarrow Repeatability $\neq 0$

$$R^2 = \frac{\text{Between-subject variance}}{\text{Between-subject variance} + \text{Within-subject variance}}$$

Personality: methods

- Personality trait \rightarrow Repeatability $\neq 0$

$$R = \frac{R + 5 \text{ (small boxes)}}{R + 10 \text{ (small boxes)}} + R + 5 \text{ (small boxes)}$$

Personality: results & discussion

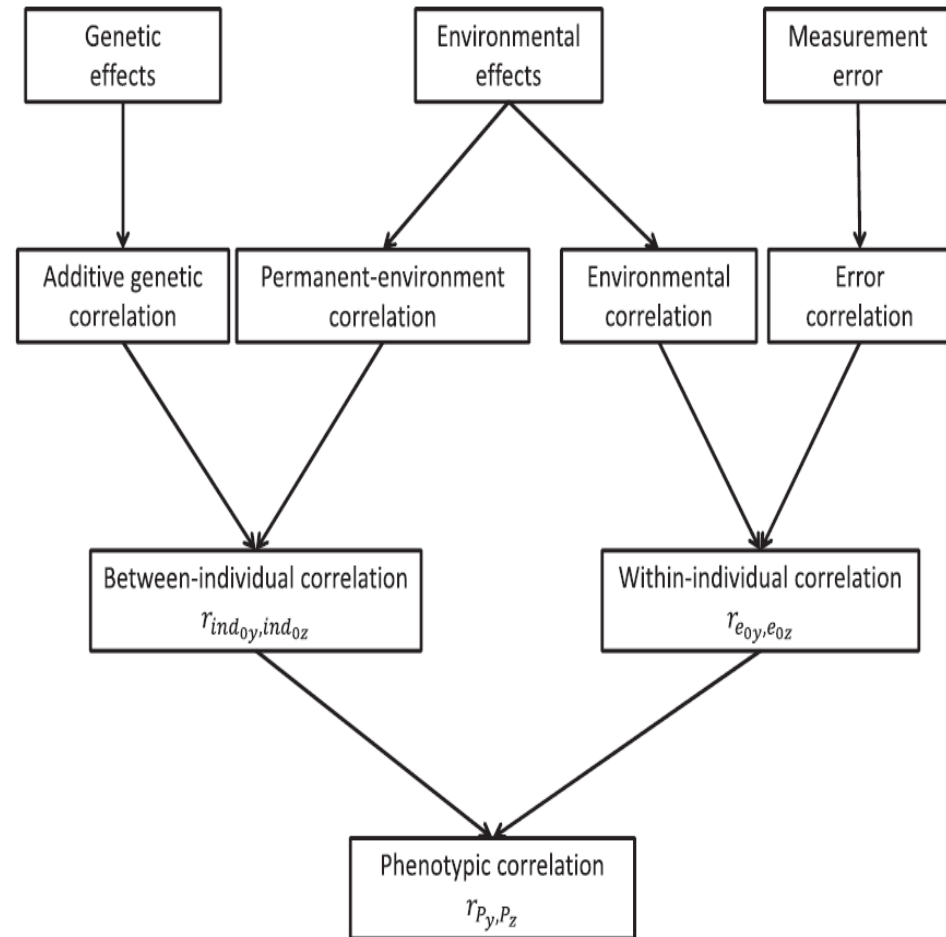
TRAIT	TEMPORAL SCALE	*REPEATABILITY	
		Raw (uncorrected)	Adjusted (autocorrelation and covariates)
Vertical activity	Monthly	0,37	0,18
	Weekly	0,32	0,31
Home range	Monthly	0,47	0,35
	Weekly	0,46	0,44
Horizontal activity	Monthly	0,44	0,33
	Weekly	0,41	0,42
Dispersal from release	Monthly	0,66	0,61
	Weekly	0,65	0,69

- All traits can be considered personality traits
- Accounting for temporal autocorrelation is important
- Higher values with weekly replicates
- Mean R: 0,42

**All estimates significant at 95%*

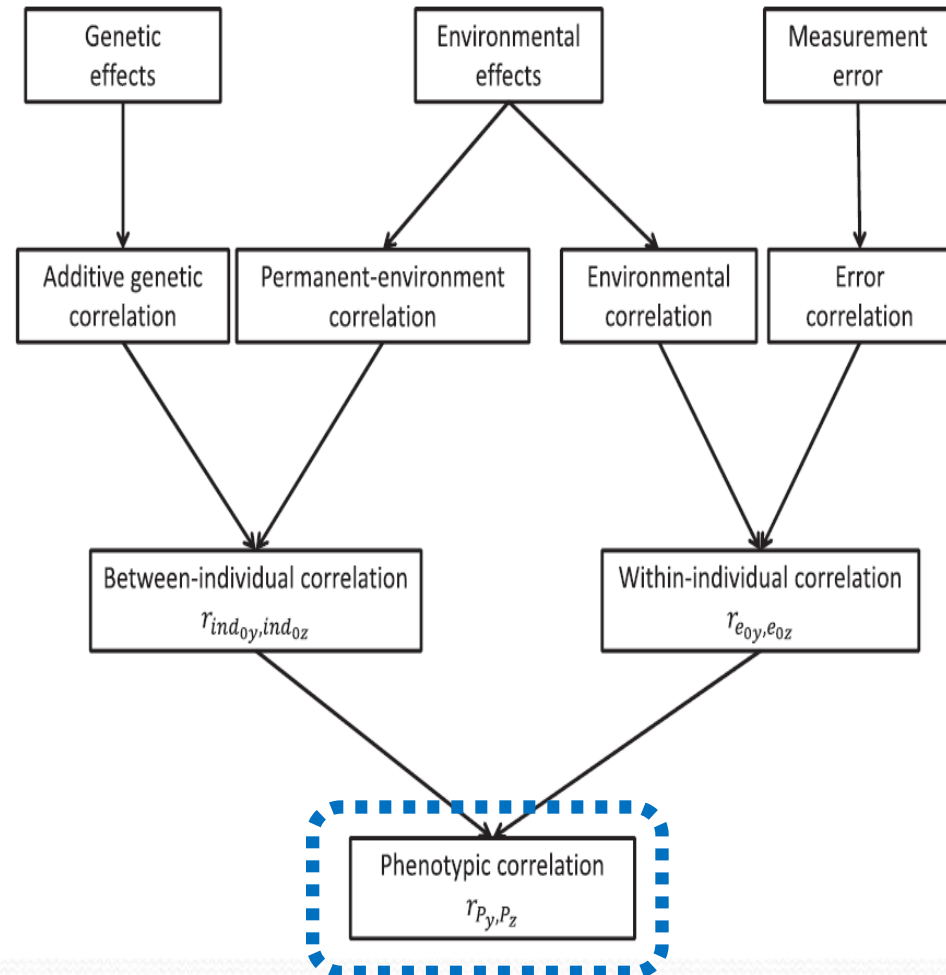
Behavioral syndromes: methods

- **Behavioral syndrome:**
between-individual
correlations



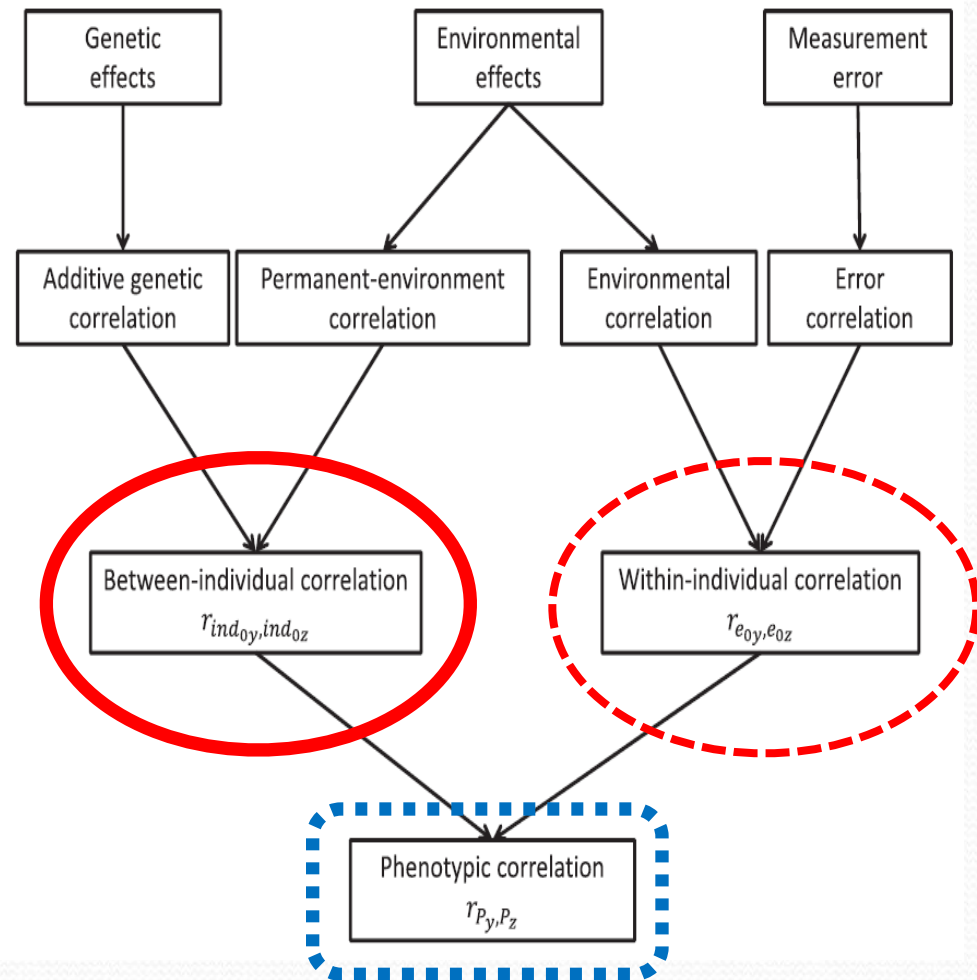
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- **Behavioral syndrome:**
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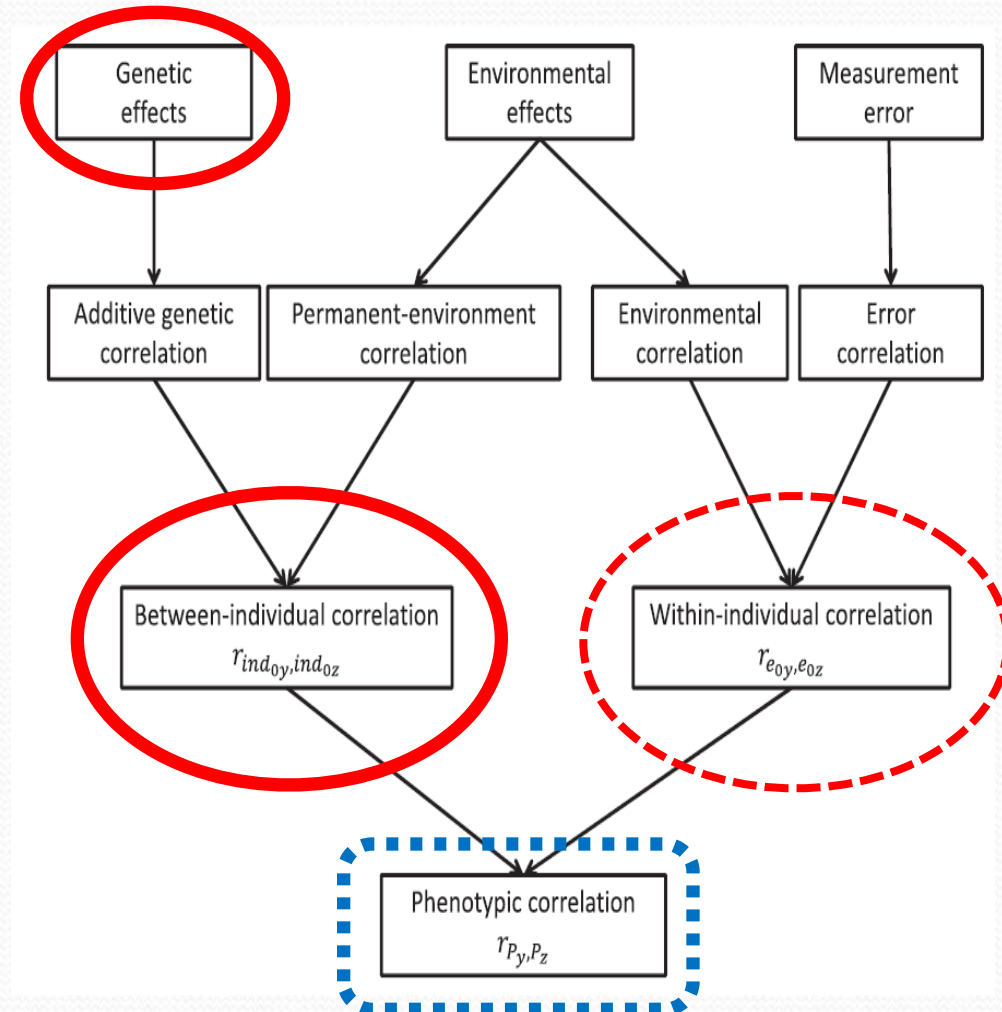
Behavioral syndromes: methods

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between-individual
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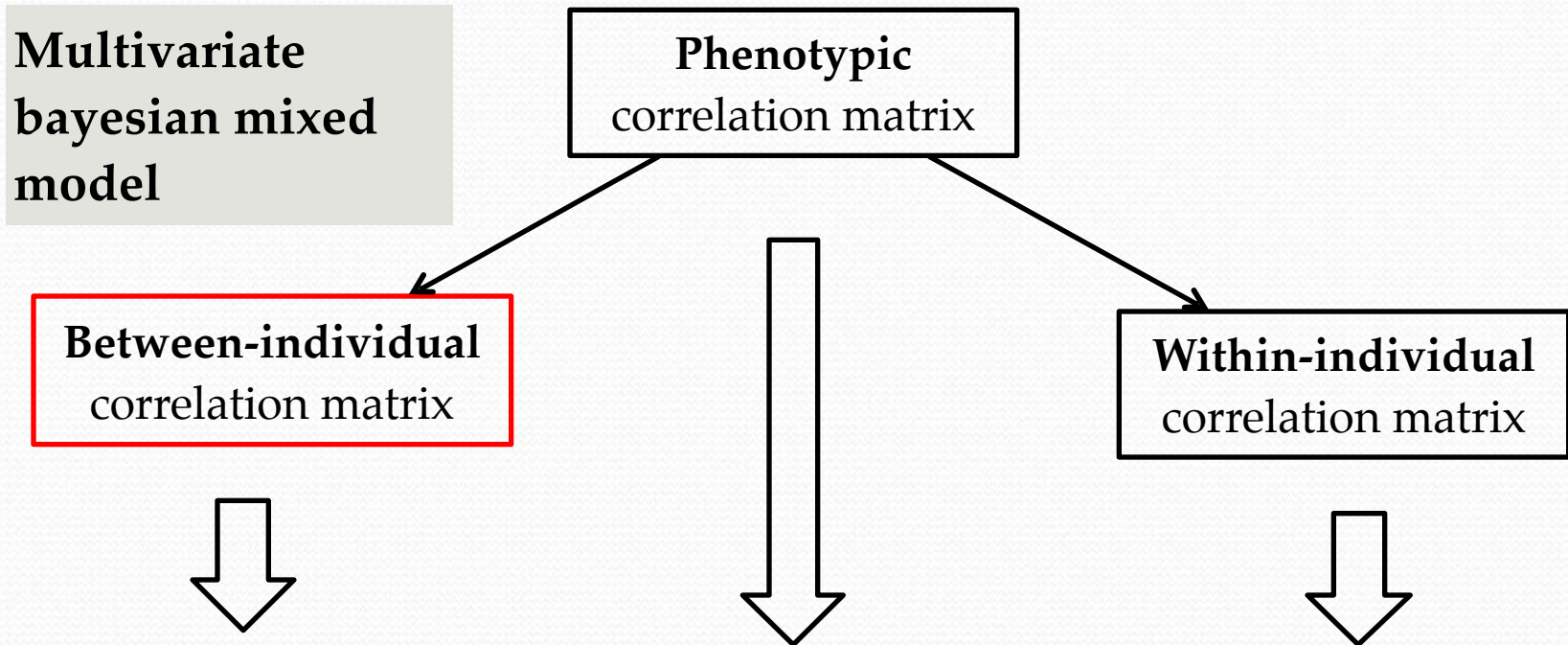


Behavioral syndromes: methods

- **Behavioral syndrome:**
between-individual
correlations



Behavioral syndromes: methods



Structural equation modelling: confirmatory factor analysis. Allow to test how well hypothesized syndrome structures fit the data. Ability to compare statistically the fit of alternative hypothesis

Behavioral syndromes: methods

Structural equation modelling: syndrome structures

Vertical activity

Home range

Horizontal activity

Dispersal from release

Full model

Vertical activity

Home range

Horizontal activity

Dispersal from release

One trait out

(x4)

Vertical activity

Home range

Horizontal activity

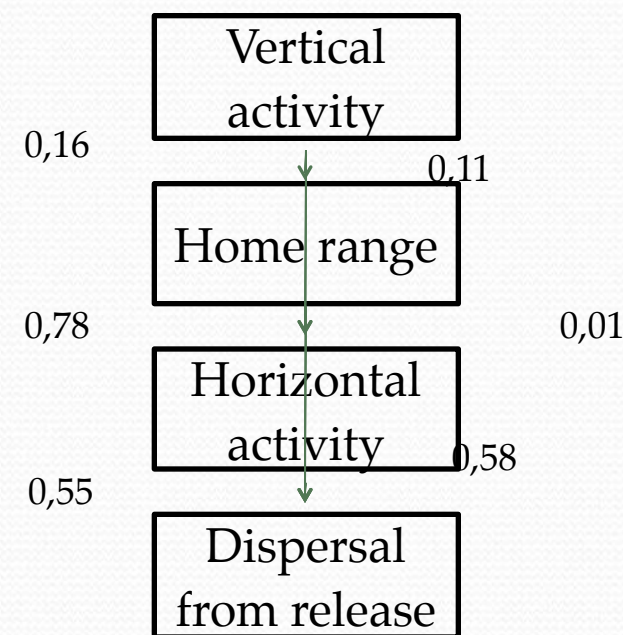
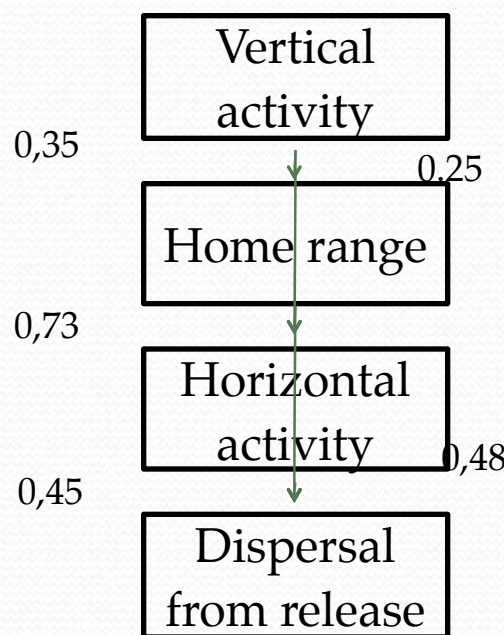
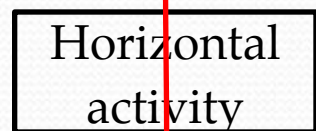
Dispersal from release

Null model

Model selection based on AIC

Beh. syndromes: results & disc

Structural equation modelling: syndrome structures



0,83

0,62

0,35

0,25

0,16

0,11

0,73

0,12

0,78

0,01

0,45

0,48

0,55

0,58

Between-individual correlations

Within-individual correlations

Phenotypic correlations

BEHAVIORAL SYNDROME

Average autonomy

- Quantifies the extent in which estimated genetic covariance constrain the rate of evolutionary change of behavioral traits forming a syndrome when these traits are under selections in all possible directions of multivariate trait-space.

\bar{a} $\left\{ \begin{array}{l} =1 \text{ no constrains} \\ =0 \text{ complete constrain in at least one direction of the phenotypic space} \end{array} \right.$

Average autonomy

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Estimated (co)variance matrix

	Vertical	Home range	Horizontal activity	Dispersal
Vertical activity	0,09	-0,02	-0,06	-0,05
Home range	-0,02	0,25	0,75	0,40
Horizontal activity	-0,06	0,75	3,79	1,42
Dispersal	-0,05	0,40	1,42	1,28

$\bar{a}=0,56$ (0,52-0,60)

Null (co)variance matrix

	Vertical	Home range	Horizontal activity	Dispersal
Vertical activity	0,09	0	0	0
Home range	0	0,25	0	0
Horizontal activity	0	0	3,79	0
Dispersal	0	0	0	1,28

$\bar{a}_0=0,97$ (0,96-0,98)

Evolutionary constrain: reduction of 42% in the ability to respond in the multivariate space

Summing up!

1. Telemetry as a appropriate tool for **personality research** in wild aquatic animals
2. **Personality-dependent spatial ecology**
 1. Behavioral traits are **repeatable** in wild cod and can be considered personality traits
 2. Behavioral traits are **correlated** at the among-individual level, but variance decomposition is needed. The correlations found represent a **constraint to evolution**

Future challenges

- Investigate links with life-history and physiological traits
- Combine personality data with fitness information (survival, reproductive success, time at risk) to estimate the actual multivariate selection gradients of these behavioral syndromes

Thanks



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<https://>

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SEVENTH FRAMEWORK
PROGRAMME



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