

➤ Laying hens tweet. They also lead and follow! Implications for genetic selection against gregarious nesting

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➤ The gregarious nesting in laying hens

- Gregarious nesting occurs when a hen chooses a nest already occupied while other nests are vacant
- Causes:
 - Anti-predator response (Riber, 2012)
 - Lack of experience for young hens (Riber, 2010)
 - Limited number of (attractive) nest-site (Clausen and Riber, 2012; Ringgenberg et al., 2015)
- Breeding issues:
 - Welfare: aggressive behavior and mortality with suffocation in the nest
 - Production: eggs broken in the nests or laid outside the nest (floor eggs)

> Question

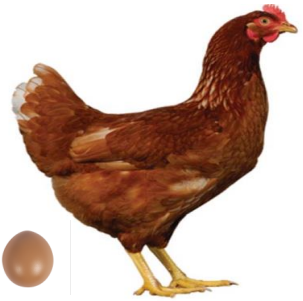
- Genetic background? (van den Oever et al., 2021)
 - Difficult to record at the individual scale for large population
 - Opportunities lies in technologies like electronic nests

Can we find heritable predictors of gregarious nesting?

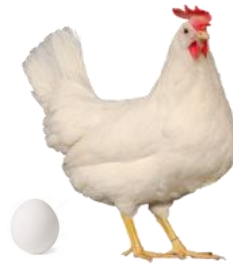
- Social network traits
- Genetic correlations with individual nesting behavior traits

➤ Hens

➤ 2 pure lines



- 1,268 Rhode Island Red
- 144 sires and 506 dams
- 3 flocks

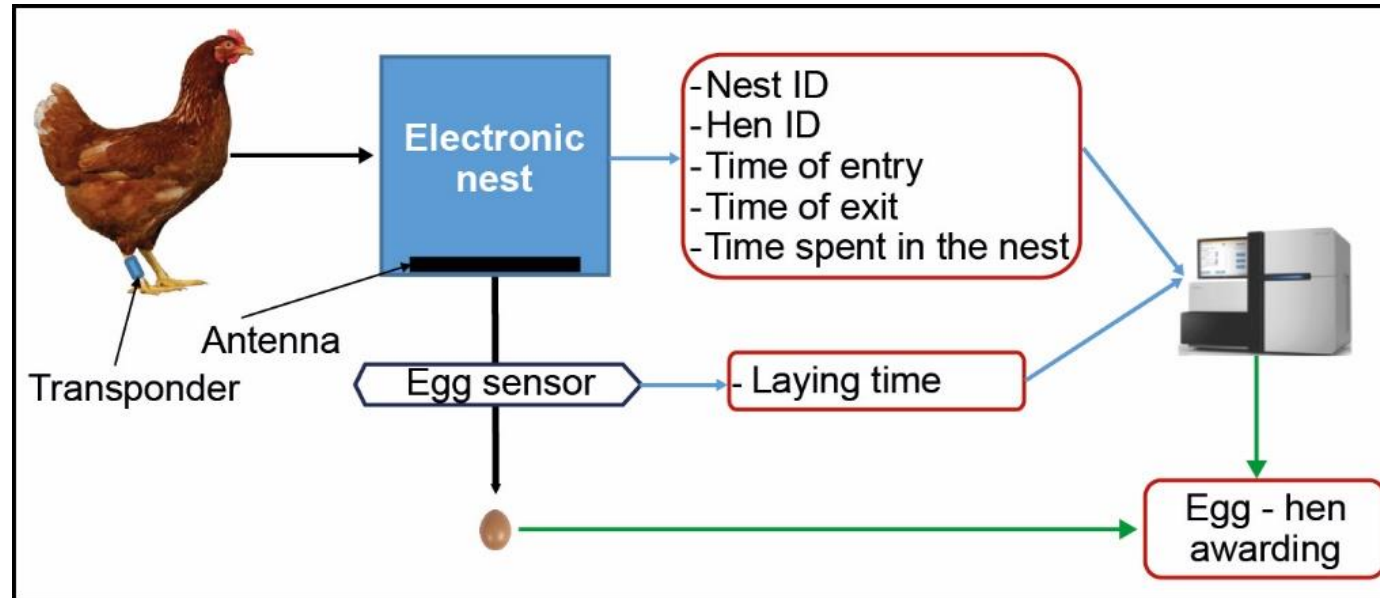


- 1,080 White Leghorn
- 100 sires and 372 dams
- 2 flocks

➤ Hens raised on the floor with roosters

➤ Data

- Individual electronic nests overlaid on two rows (≈ 1 nest for 5 hens)



- Data recorded continuously in seven 30-days periods between 200-409 days of age (middle of egg production)
- $\approx 200,000$ nest visits with oviposition by line

➤ Social network traits

➤ Pairs of hens using a close nests (dist = 1 nest) at the same time (≈2,600 pairs each day)

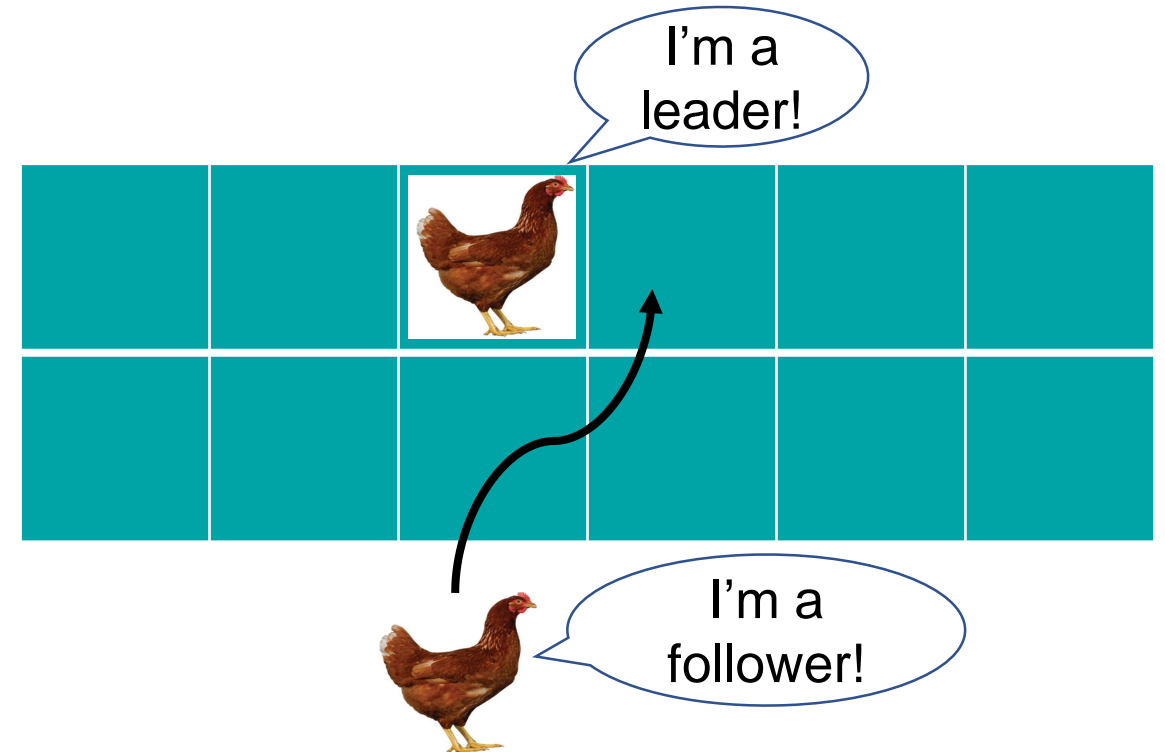
➤ **Weighted indegree (WID)**

Number of times the hen entered in first
= « leader »

➤ **Weighted outdegree (WOD)**

Number of times a hen entered in second
= « follower »

→ Each hen have a value for WID and WOD



➤ Nesting behavior traits and model

➤ Laying traits

- Laying rate in the nests = (egg number laid in the nest / number of days)*100
- Mean and variance of oviposition time

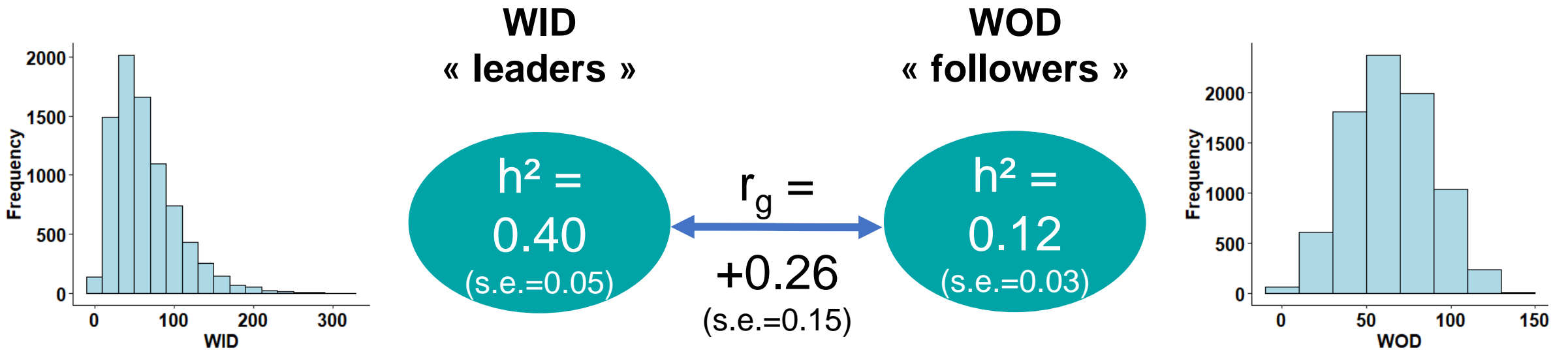
➤ Behavior traits

- Mean distance between nests of laying (exploratory behavior)
- Mean laying duration (= time spent in the nests for laying)

➤ Model

- Multivariate animal
- Environmental effects: fixed effect of the flock and random effect of the common environment of the hen (seven 30-days periods by hen)

➤ Results



- WID and WOD are variable and heritable traits
- WID and WOD are not genetically opposite!

➤ Results

Genetic correlations		WID « leaders »	WOD « followers »
Laying	Laying rate in the nests	+0.02*	+0.69*
	Mean of oviposition time	-0.61	-0.13
	Variance of oviposition time	-0.51	-0.36

s.e. = 0.07-0.15 except for* (0.28-0.42)

➤ Genetically:

- « leaders » would have an oviposition time earlier and more stable
- « followers » would lay better in the nests and have a more stable oviposition time

➤ Results

Genetic correlations		WID « leaders »	WOD « followers »
Behavior	Mean dist. between nests of laying	+0.14	+0.20
	Mean laying duration	+0.78	+0.02

s.e. = 0.05-0.19

- Low genetic correlations ($\leq +0.20$) with dist. between nests of laying
- Genetically, « leaders » would spend more time in the nests

➤ Additional results

- Effects of mean oviposition time and laying duration on genetic variance of WID ?

Estimates of genetic parameters for WID (« leaders »; univariate models)

Covariate(s)	σ^2_a	σ^2_c	σ^2_e	h^2
-	0.38 (0.06)	0.28 (0.05)	0.32 (0.01)	0.39 (0.06)
Mean oviposition time	0.24 (0.04)	0.24 (0.03)	0.20 (0.003)	0.35 (0.05)
Mean laying duration	0.38 (0.06)	0.28 (0.05)	0.32 (0.01)	0.39 (0.06)
Both	0.24 (0.04)	0.24 (0.03)	0.20 (0.003)	0.35 (0.05)

- Genetic variance of WID is not explain only by mean oviposition time or laying duration, there is other thing!

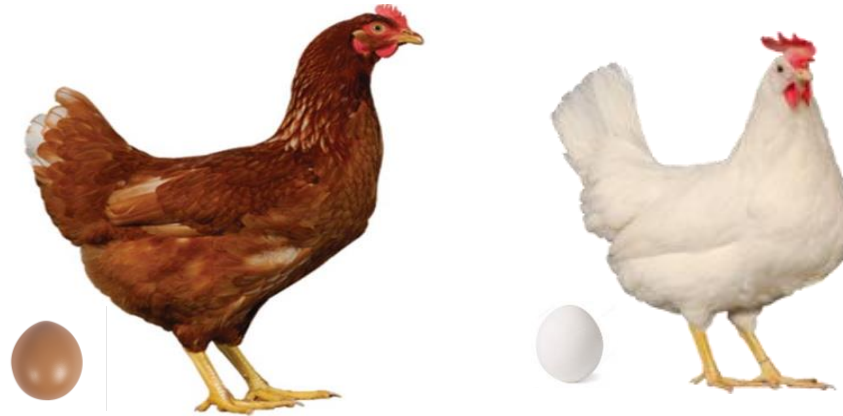
➤ Discussion

- WID and WOD are heritable traits and would provide both a different information linked to gregarious nesting
- Similar results for two different lines (Rhode Island Red and White Leghorn)
- Applications:
 - Selecting « leaders » (high WID) and « not followers » (low WOD) hens could help reduce gregarious nesting
 - Consider the negative impact on mean laying duration (WID) and laying rate in the nests (WOD)
 - Will not replace a good environmental management

➤ Perspectives

- WID and WOD are calculated with the same information, it takes a « leader » to have a « follower » and vice versa: what real effects can we expect?
- Relationships with egg qualities?
- The beginning of lay?
- Validate (or not) results with collective nests

Thank you for your attention



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