

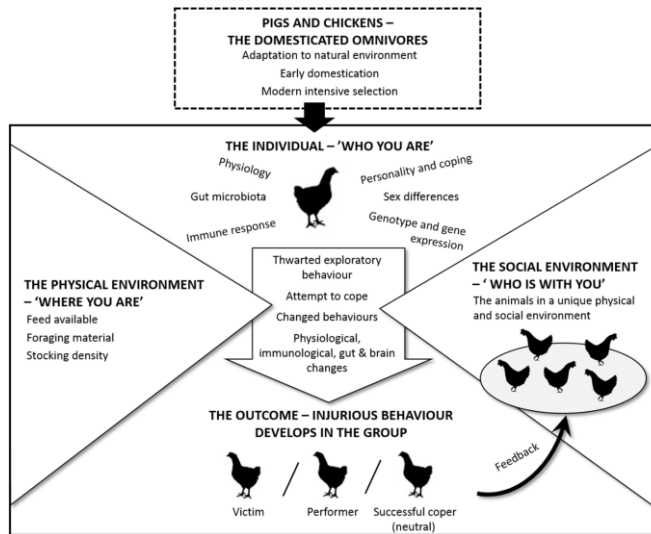
Relationships between health and damaging behaviours in laying hens

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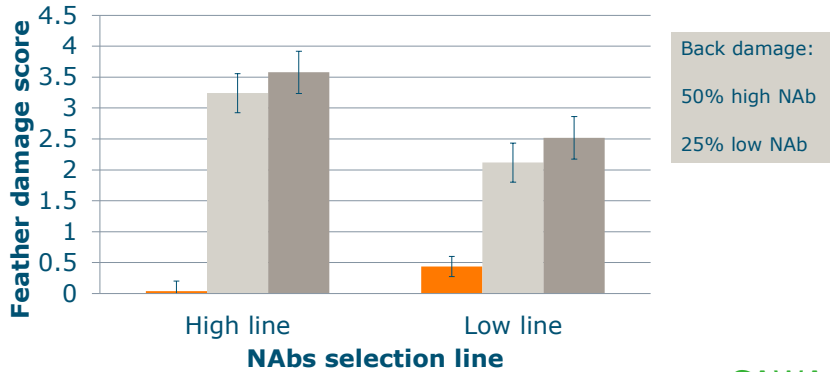
Damaging behaviours (Brunberg et al., 2016)



Link immune system & FP – NAb lines

Lines selected on high and low total natural antibody levels (Berghof et al., 2015)

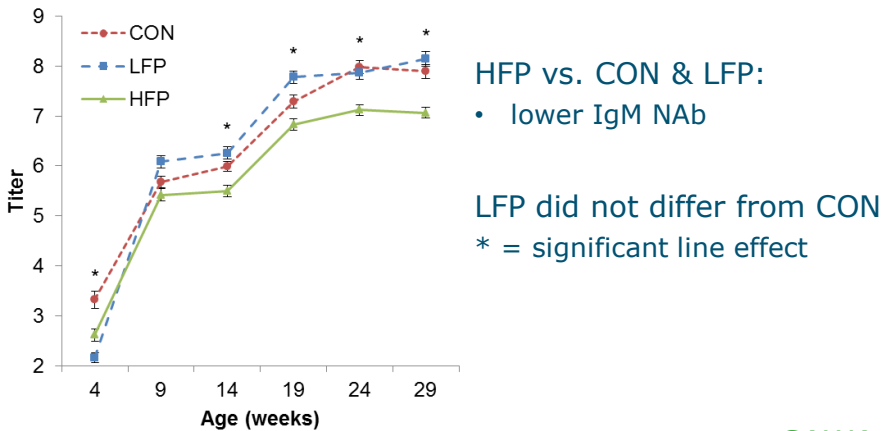
■ Week 20 (P=0.0094) ■ Week 24 (P=0.0269) ■ Week 26 (P=0.1004)



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Link immune system & FP – FP lines

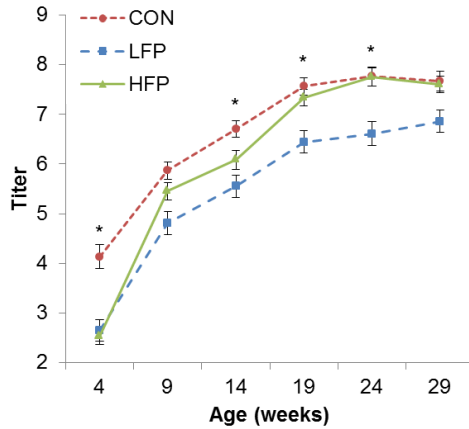
Lines selected on high and low FP (11 generations) + unselected control line (van der Eijk et al., 2016)



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Link immune system & FP – FP lines

Lines selected on high and low FP (11 generations) + unselected control line (van der Eijk et al., 2016)



LFP vs. CON & HFP:

- lower IgG NAb

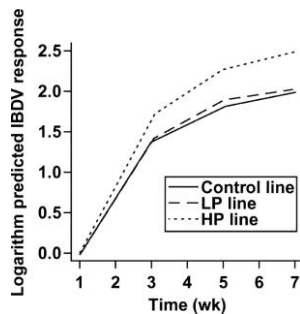
HFP vs. CON:

- lower IgG Nab

* = significant line effect

Link immune system & FP – FP lines

Lines selected on high and low FP (5 generations) + unselected control line (Buitenhuis et al., 2006)



HFP vs. CON and LFP:

- Stronger response to IBDV vaccination

Genetic correlations between severe FP and specific antibody response in FP selection lines (Buitenhuis et al., 2003)

Link immune system & FP – Group survival lines

Lines selected on high and low group productivity & survival (8 generations)

(Cheng et al., 2001)



■ LGPS line:

- lower CD4⁺:CD8⁺ ratios T-cells – less efficient cell mediated immune competence
- higher IgG NAb

Link immune system & FP

Intratracheal challenges with HuSA (human serum albumin) or LPS (lipopolysaccharide) at young age

(Parmentier et al., 2009)

- HuSA: activates specific immune components
- LPS: activates nonspecific immune components

HuSA challenge led to increased feather damage at adult age

- Stimulation of specific immune responses may predispose layers for FP

Underlying mechanisms? (Dantzer et al., 2008)



Cytokines – signalling molecules of immune system

- Neuroendocrine effects
- Sickness behaviour
 - ↓ Activity
 - ↓ Exploratory behaviour
 - ↓ Social interaction
 - ↓ Eating & drinking

Serotonergic system (5-HT)

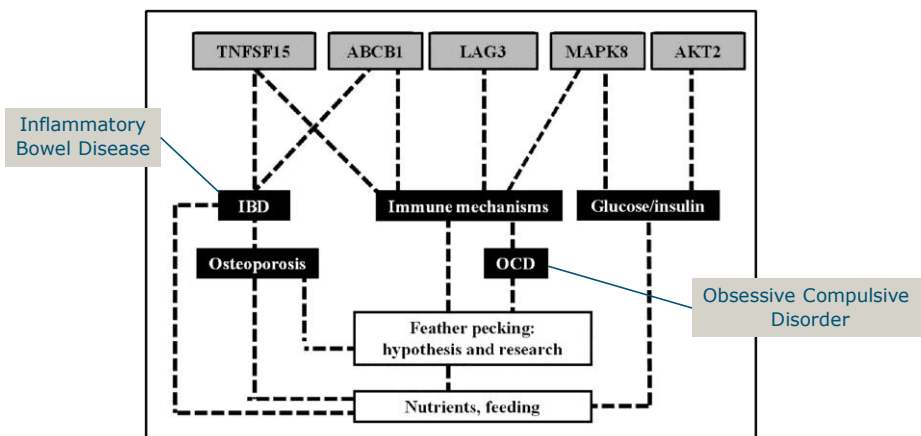
- Cytokines activate enzymes that degrade tryptophan, 5-HT precursor
- Decrease central serotonergic signalling
- Related with increased feather pecking behaviour
 - HP and LP lines (van Hierden et al., 2004)
 - HFP and LFP lines (Kops et al., 2017)
- Selection on low mortality: higher whole-blood 5-HT levels, lower 5-HT uptake (Bolhuis et al., 2009)

Link immune system, FP, serotonergic system

Feather damage associated with polymorphisms in immune related and serotonergic related genes (Biscarini et al., 2010)

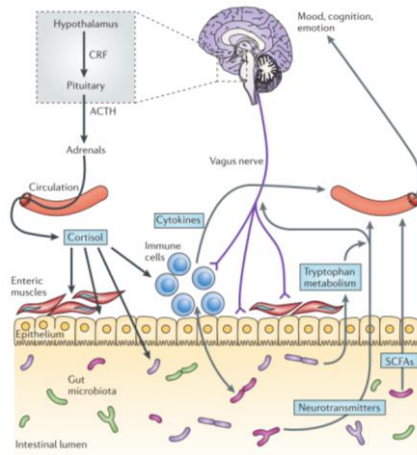
- IL4, IL9, NFKB, CCL4 -> cytokines
- HTR2C, MAO-A -> serotonin receptor & serotonin metabolizer

Differences in gene expression peckers, victims and neutrals (Brunberg et al., 2011)



Microbiota-gut-brain axis: connecting piece?

(Brunberg et al., 2016; Dinan and Cryan, 2012)



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Microbiota colonization:

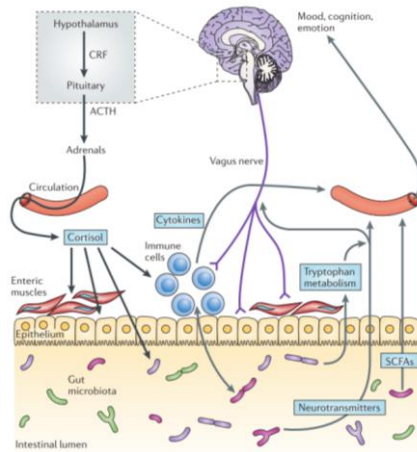
- Programming of HPA-axis
- Activation and development of immune system
- Influence on behaviour..

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Microbiota-gut-brain axis: connecting piece?

(Brunberg et al., 2016; Dinan and Cryan, 2012)



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Anxiety, activity, stress

response and sociality

(Heijtj et al., 2011; Neufeld et al., 2011; Gareau et al., 2011; Sudo et al. 2004)

Via neural, immunological

(cytokines) and metabolic

routes (tryptophan)

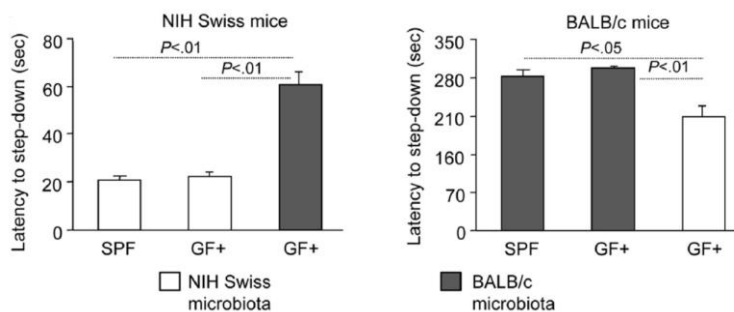
(Cryan and Dinan, 2012; Collins et al., 2012)

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Microbiota transplantation

Behavioural profile similar to donor strain (Bercik et al., 2011)



Gut microbiota and FP

Behaviours influenced by microbiota linked to FP – activity, fearfulness, stress sensitivity (Kjaer, 2009; Rodenburg et al., 2013)

First indications that HFP and LFP selection lines differ in gut microbiota (metabolites) (Meyer et al., 2012)

Feather eating led to different microbiota composition: more keratinolytic bacteria (Meyer et al., 2013)



Gut microbiota and FP

PhD project Jerine van der Eijk:

- HFP and LFP selection lines
- Characterisation: behaviour, microbiota, immunology
- Could microbiota composition be a driver of FP?
- Transplantations HFP to LFP and vice versa directly after hatch



Summing up

- Genes simultaneously involved in immune system and feather pecking (NAb lines, FP lines, genetic studies)
 - HFP line and LGPS line: higher IgG NAb levels
 - High total Nab line: increased feather damage
- Immune challenge: increased feather damage
- Microbiota-gut-brain axis: links FP, immune system, serotonergic system?
- Feather peckers vs victims, neutrals

Conclusion

Many relationships found between damaging behaviour and health in laying hens

We are just starting to place these in a common and coherent framework



Promising approaches:

- Selection experiments (FP, survival, NABs)
- Work on microbiota-gut-brain axis



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Thank you!

Questions?



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