FACULTY OF VETERINARY MEDICINE
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DEPARTMENT OF VETERINARY AND BIOSCIENCES
RESEARCH GROUP ETHOLOGY AND ANIMAL WELFARE

BEHAVIORAL SYSTEMS

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OVERVIEW

1. Evolution, Selection & Domestication
2. Cognition & Intelligence
3. **Behavioral Systems**
4. Abnormal Behaviour
5. Housing layers
6. Housing broilers
7. Human-Animal Relation
8. Assessing, Monitoring & Labelling Poultry Welfare

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3. BEHAVIOURAL SYSTEMS

a) Agonistic behaviour & social structure

b) (Reproductive behaviour - Prof Antonissen)

c) Absorption & excretion behaviour

d) Grooming & comfort behaviour

e) Exploration, fear, play

f) Sleep & resting behaviour

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A. AGONISTIC BEHAVIOUR & SOCIAL STRUCTURE

Good knowledge of social behaviour becomes increasingly important with emergence of **alternative housing systems** that allow hens to express a **wider range of behaviours** (also importance of **good management ↑**)

Group = safe (isolation = stress)

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SEMI-NATURAL CONDITIONS

Few studies under natural conditions **(shy)**

Bankiva fowl under **semi-natural conditions** (San Diego zoo)

- Groups of **4-30 animals recognising** each other (>100 no longer possible, *D'Eath & Keeling 2003)*

  - competition for resources ↑ , risk of disease & parasites ↑ , general visibility to predators ↑

  ^

  + finding food ↑ , detection & diluted opportunity predation, mates ↑, aggregation against cold, aggression by pecking order ↘, raising chicks, maintenance of plumage (social brushing), social learning & facilitation,

- Roosters and hens share a **'sleeping tree'**

- **Dynamic:** roosters and hens can change groups

- **1 dominant rooster:** - fertilises most eggs
  - defends territory (Φ average 50-75m)
  - tolerates subordinate roosters until young adults (chased to edge of territory)

- **Group behaviour hens:**

  - Soc. facilitation (proximity to other hen facilitates certain behaviour, e.g. feather brushing; maybe because certain behaviours are less risky in company than alone - companion can look out for danger)
  - Allelomimetic / 'contagious' behaviour / 'response ' facilitation (behaviour of some hens is adopted by others; especially dominant rooster and hen are imitated)
  - Synchronisation (simultaneous foraging, dust bathing, egg laying, resting, drinking...): not just response to circadian stimuli (e.g. perching at dark, nesting in the morning). Vulnerable behaviours: individuals are less conspicuous (to predators) if they copy behaviours of conspecifics

Collias & Collias 1996

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SEMI-NATURAL CONDITIONS

- Linear (mostly) dominance hierarchy (**pecking order**) among cocks among themselves and hens among themselves.

- **Social status hens**:
  - stable over consecutive years
  - subtle forms of threatening & yielding usually suffice
  - Individual recognition (colour, size, shape of comb) plays major role

  ↔ **commercial aviaries**: direct signals of weight and comb size instead of recognition (~ people in metro); no ind. recognition but social tolerance instead of hierarchy; social plasticity)

- **Social status roosters**:
  - unstable
  - related to:
    - comb (size, colour, shape) *(Zuk et al 1990)*
    - age, breed, size, colour, weight, health condition
    - freq. of crows/bolt (≈ strength & health) (Koene 1996)
  - also aggressive interactions for the top spot:
    - pecking (aimed at head)
    - attacks with spurs (aimed at head)
    - chase each other

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AGONISTIC BEHAVIOUR

- **Form pecking order** if chance of repeated contact with same individuals is high **:**
  - initial aggression is an investment in more peaceful existence later (↗ spontaneous avoidance of aggression)

- **Formed pecking order:**
  - Aggression is not triggered when chicken enters 'personal space', but rather when an energetic behaviour is directed at another and interpreted as a threat.
  - Most dominant chickens are not necessarily most aggressive.
  - Sometimes persistent aggression towards individual closest in rank (most likely to contest position)
  - More aggression with ↑ group size (up to 10-12 hens)

- **No pecking order (too large group: switch to socially tolerant system):**
  - Often surprisingly little aggression
  - Aggression decreases with group size: too many opponents to defend 'resources'?
  - No individual recognition but direct signals
  - Large group: often a few 'pariah' hens that are excessively pecked and skittishly flee from one shelter to another and hardly dare to approach feed & water lines

- **Modern lines of** cocks are less aggressive towards other cocks than older lines (which were selected for fighting)

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LARGE GROUP: PECKING ORDER → SOCIAL TOLERANCE

Social hierarchy: at high probability of repeated contact with same individuals (small group)

Per hen: - aggressive behaviour (picking & threatening)↘ with group size ↗
- aggression/threats received ↗ with group size ↗ (markings of focal pullets provoked aggression?)

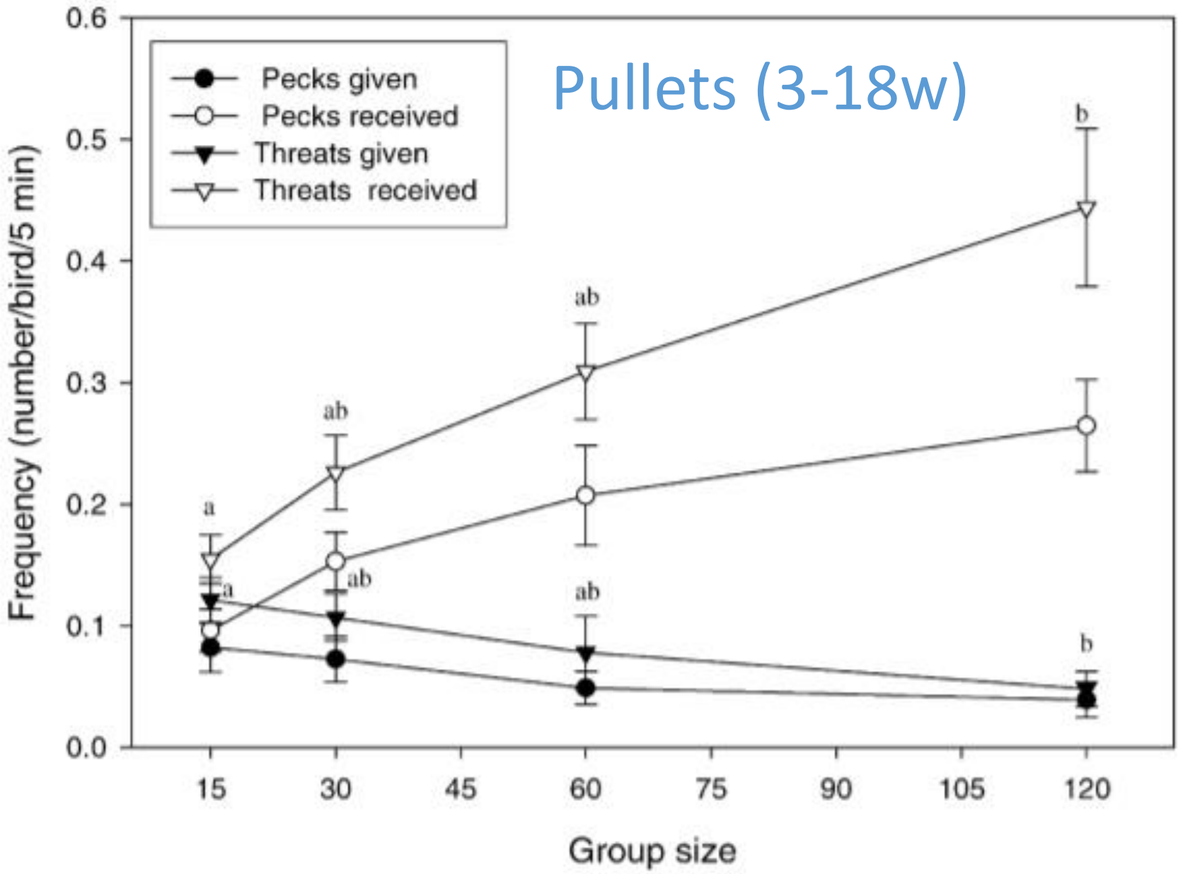

Fig. 1. Mean (±S.E.) frequency of pecks and threats given and received by focal birds in different group sizes. Different letters indicate significant LSD ($P < 0.05$) across group size for threats given and threats received.

Group size ↗: maintaining dominance relationships with all members is too costly.
Switch from hierarchy set up via aggression → tolerant social system with little aggression

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Estevez et al 2003

WHAT PROVOKES AGGRESSION IN AVIARY SYSTEMS?

Not:

- Proximity/defence of 'resources' (↔ more often in open spaces far from resources)
- Too close (personal space)

Yes: 3 components to be fulfilled simultaneously:

1. Proximity
2. Orientation (directed towards aggressor)
3. Activity: recipient of aggression was walking/stepping (not foraging/standing)

aggression often targeted at most active animal oriented towards aggressor instead of equally close to less active animal

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Rodriguez-Aurrekoetxea & Estevez et al 2014

Crowing: advertising social status

When rooster low-ranking position crows, it is often attacked by rooster with high-ranking position

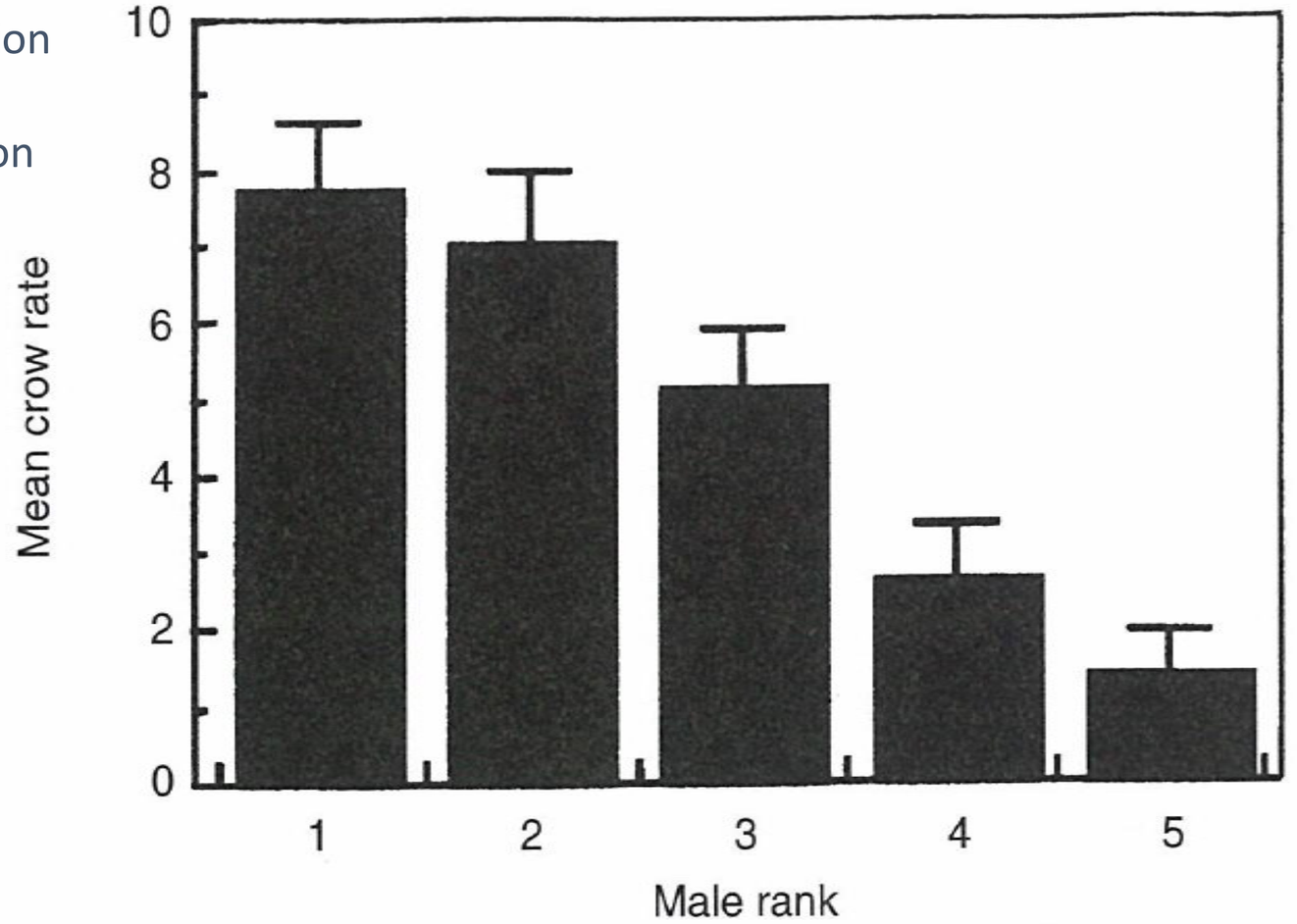

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Fig. 3.1. Crowing by cockerels in groups of five: mean (and standard error) number of crows in a period of 50 min, from 24 groups (from Leonard and Horn, 1995, with permission from Elsevier).

Appleby et al 2004

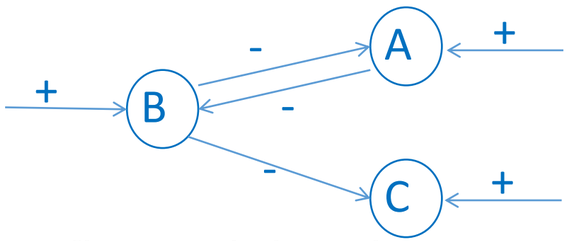
Fights between Bankiva cocks *(Kruijt 1964)*

Displacement behaviour: during a behavioural pattern, a bit of completely different & seemingly irrelevant behaviour is displayed (e.g. sexual urge is temporarily blocked and finds expression in bit of grooming behaviour)

- Winners show predominantly ground pecking & intent pecking & head swaying

- **Losers** show mostly grooming & headshaking & head swaying

Disinhibition hypothesis: 2 strongly activated urges (e.g. A brooding urge and B flight urge) inhibit each other and thus also cancel their inhibition on other motivations C



Function: attempt to divert attention during conflict and thereby create opportunities for oneself to find resolution of the conflict? *(McFarland 1966)*

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C. ABSORPTION & EXCRETION BEHAVIOUR

Semi-natural conditions

- **Omnivores**: seeds, herbs, small invertebrates (worms and insects)
- Also eats **indigestible materials** (sand or pebbles): part remains in gizzard to grind larger pieces of food
- Self-selecting diet that meets needs
- **60-90%** of day (rarely at night): eating & foraging behaviour (extensive livestock: 43%)
- Peak at **beginning and end of light period**
- **Social facilitation** (even behind glass)

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C. ABSORPTION & EXCRETION BEHAVIOUR

Contrafree-loading: preferring to forage for feed rather than consume same feed from a trough *(Duncan & Hughes 1972):*

- additional info (useful for future)
- positive feedback: behaviour has direct impact on outcome (control over situation) (but if behaviour does not have the desired outcome then animal may give up trying to influence its environment → "*learned helplessness*")
- Operant feed trough good for animal welfare even with ad-libitum feed?

↔ **Drinking**: once physiological need met no need to perform drinking-related behaviour.

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Nicol 2015

C. ABSORPTION & EXCRETION BEHAVIOUR

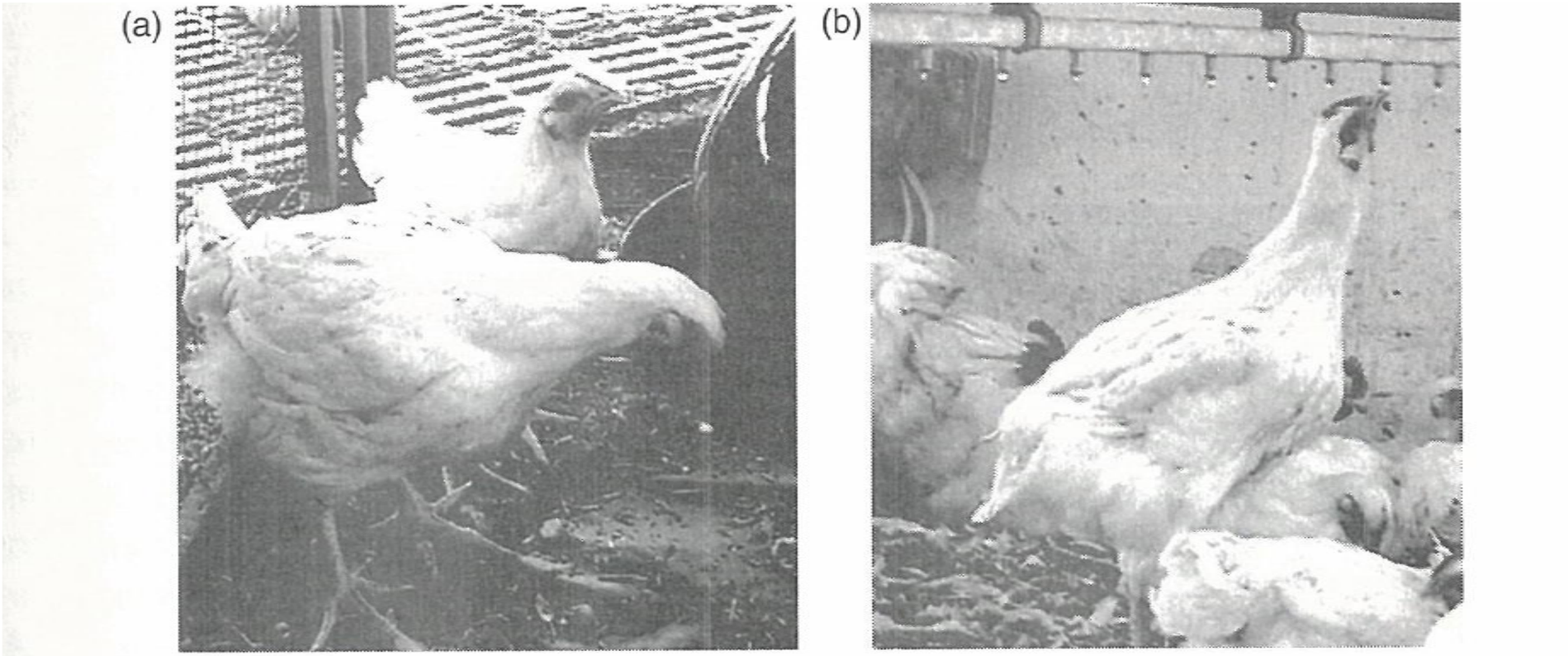

Fig. 9.3. Birds normally drink by scooping up water and then elevating their heads slightly so that the water moves down their oesophagus by gravity (a). Because of concerns about water leaking and making the litter or manure wet, it is common to provide the birds with nipple waterers, which require them to learn to drink in an unnatural position (b) (images courtesy of Houldcroft *et al.*, 2008).

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C. ABSORPTION & EXCRETION BEHAVIOUR

DEEP LITTER

SLATS

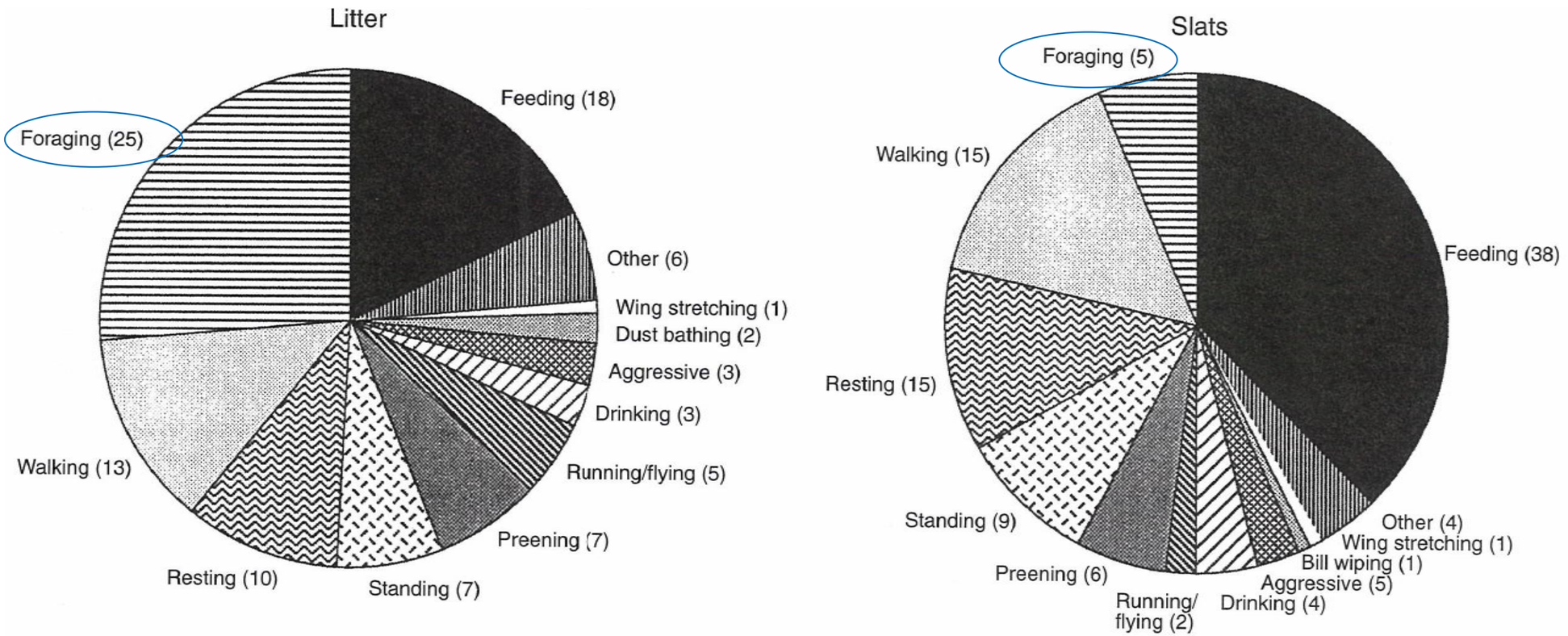

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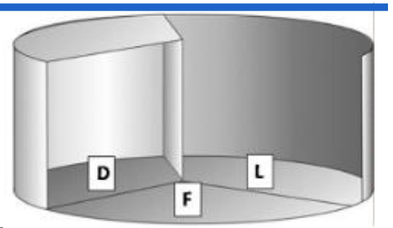
Fig. 4.1. Behaviour of laying hens in a deep litter house: proportion of time spent in different activities on the litter (left) and on a raised, slatted area (right) (from Appleby *et al.*, 1989, with permission from Taylor & Francis Ltd).

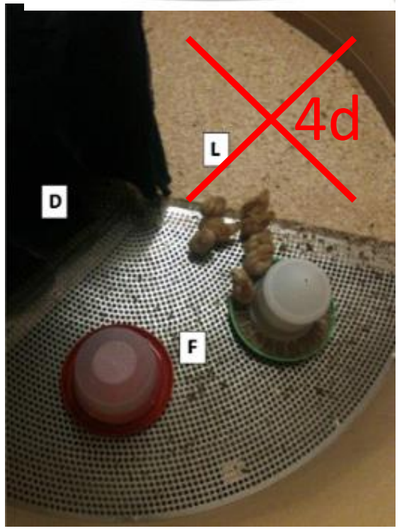
Appleby et al 2004

C. ABSORPTION & EXCRETION BEHAVIOUR

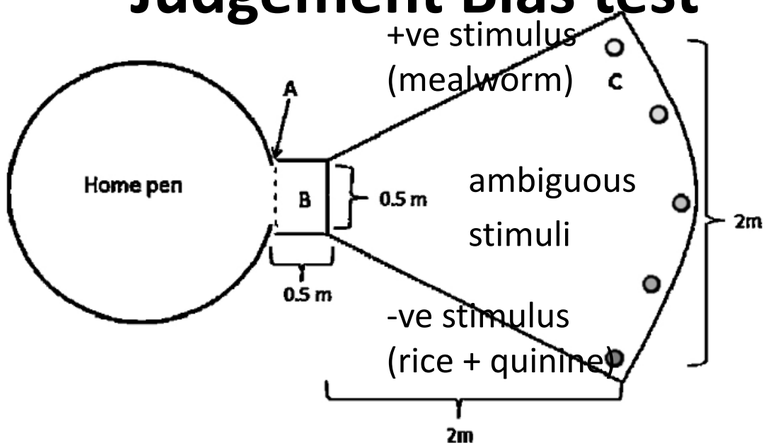
Reward Cycle (Reward Cycle): 3 motivation phases:

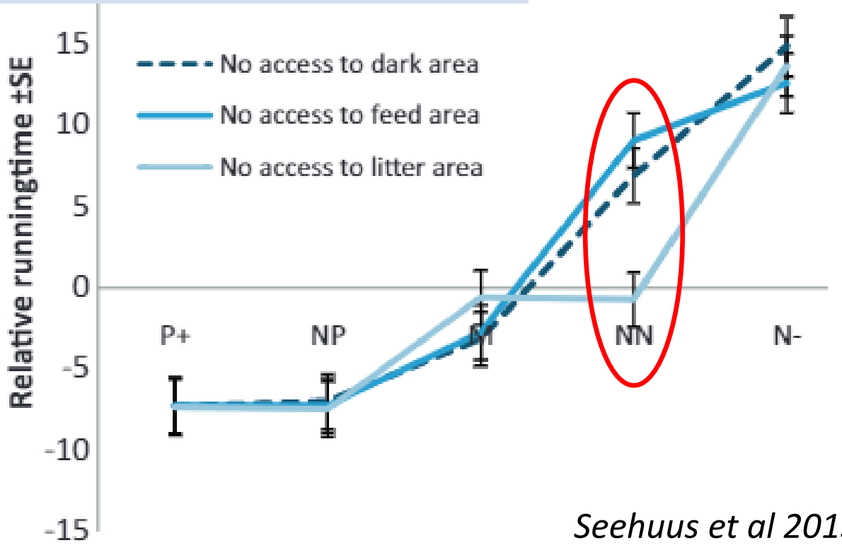
Phase	Affective state	Behaviour	Location (functional area)
1. Appetitive	Desire, excitement, anticipation	Exploration, search	Free-range area, litter (L)
2. Consumption	Prosperity, pleasure	Food	Feed trough (F)
3. Post-consumption	Satiety, satisfaction, relaxation	Maintenance, relaxation	Perch, warm, dark (D)





Judgement Bias test





Seehuus et al 2013

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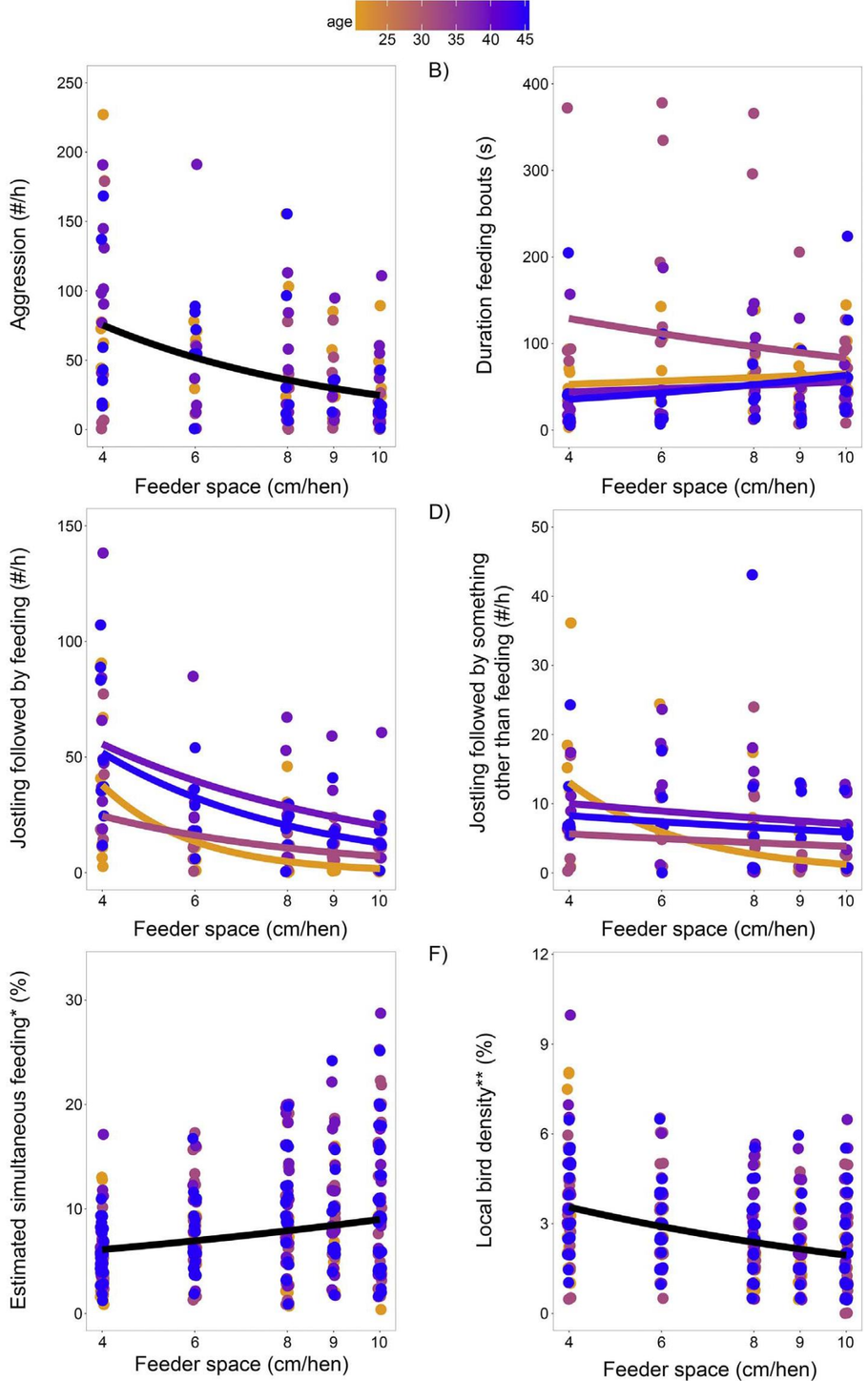
C. ABSORPTION & EXCRETION BEHAVIOUR



Feeder space (cm/ hen)	Feed disappearance (kg)	Feed conversion (kg feed/kg eggs)
3.8	21.2 (0.3)	1.8 (0.02)
6.0	23.1 (0.3)	1.9 (0.03)
8.0	23.0 (0.4)	1.9 (0.03)
9.0	23.1 (0.4)	1.9 (0.03)
10.0	22.5 (0.3)	1.9 (0.03)

↗ cm feed trough per hen (aviary):

- ↘ aggression
- ↘ displacement
- ↗simultaneous eating
- ↗duration of eating
- hardly any effect on feed conversion

Sirovnik et al 2018

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D. GROOMING (COMFORT BEHAVIOUR)

Body* / tail shaking*, beak rubbing, paw stretching,...

Keep plumage in good condition:

- Preening* (waterproofing and insulating, parasite removal); hardly any "allo-preening"
- Wing flapping *
- Setting up feathers
- Wing stretching**
- Dust baths* (removing excess fat and ecto-parasites)

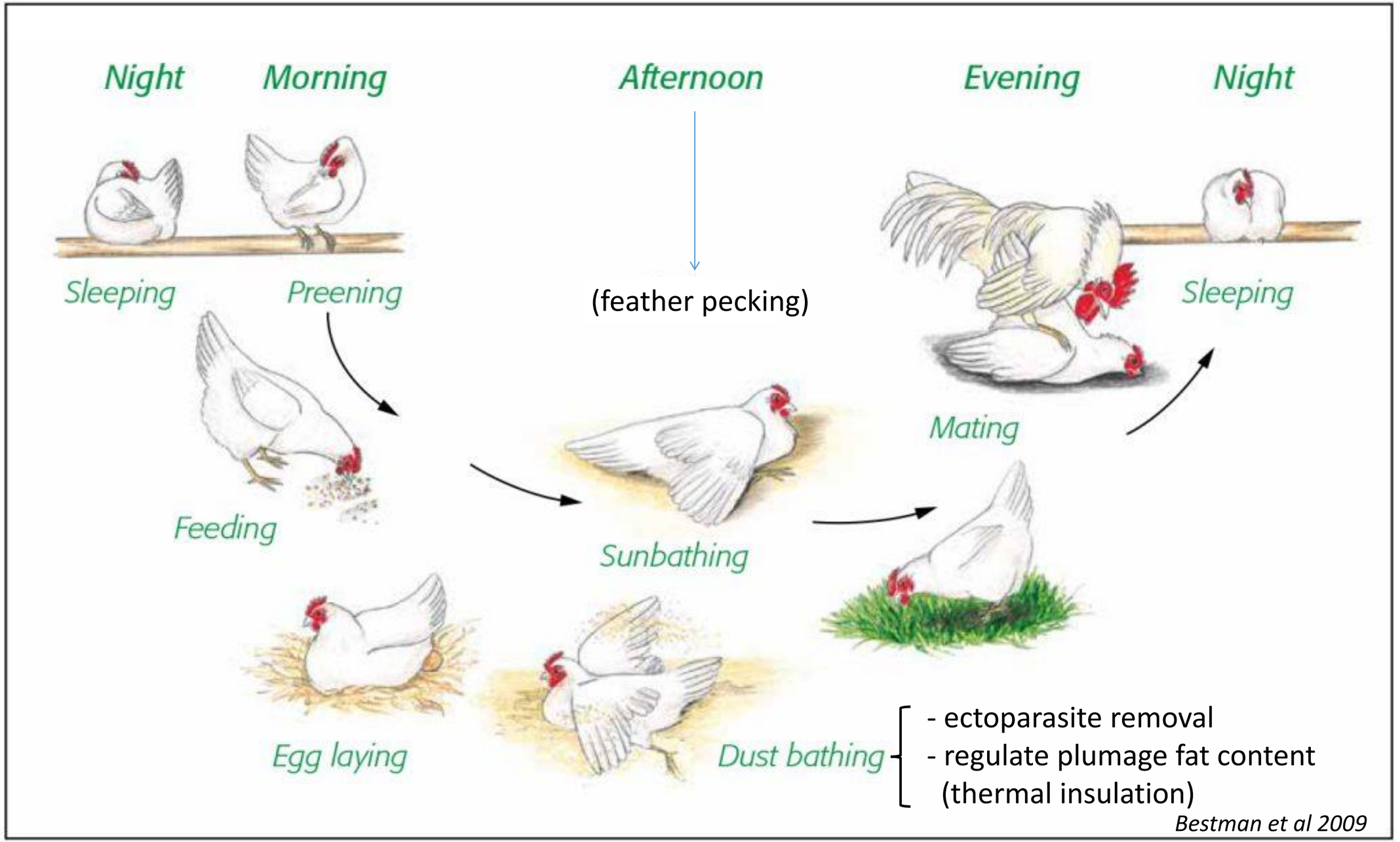
* Insufficient space in **battery cage** to exhibit these behaviours unhindered (hence less frequent)

Nevertheless high motivation (**rebound effect** after deprivation due to lack of space)

* Occur more frequently when conspecific is visible/close by *(Nicol 1989)*

https://www.youtube.com/watch?v=pbTxJKqLvVM (dust baths)

D. GROOMING (COMFORT BEHAVIOUR)



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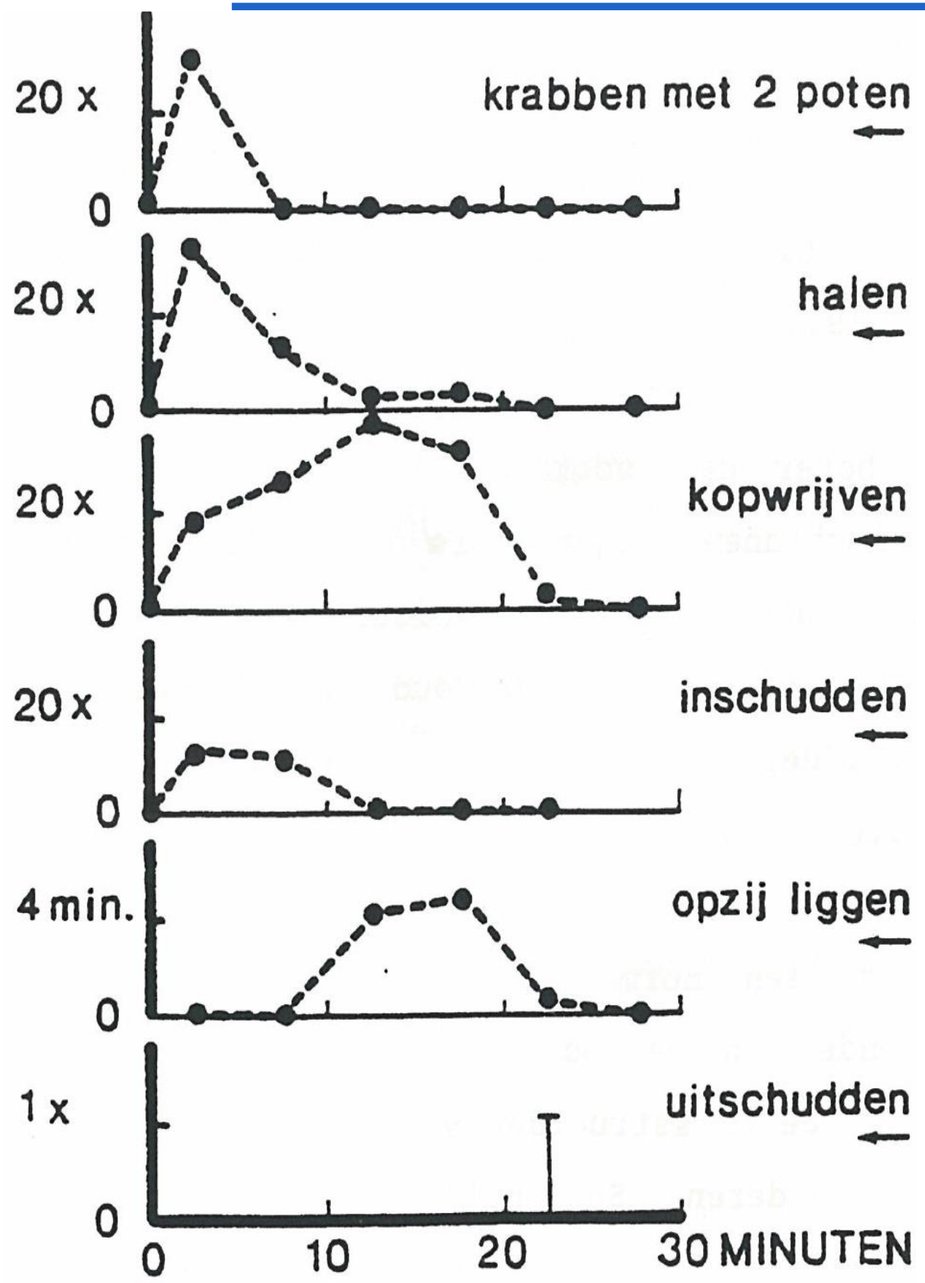


Dust baths: 4 phases

1. Preparation: hen puts up feathers and sits down.
2. Shaking in: chicken repeatedly scratches sand upwards behind itself, so it falls between the fluffed feathers.
3. Rubbing: chicken lies on its side and turns a little around its longitudinal axis. Sometimes it is shaken in between.
4. Shaking out: chicken stands up, opens its feathers and shakes body and wings vigorously

D. GROOMING (COMFORT BEHAVIOUR)

Dust baths:

- Preferred **sunny** and **sheltered** site where **pitting** is possible
- Preference for **fine** substrates (sand, peat,...) possibly because they penetrate deeper into feathers *(Scholz et al 2011)*
- Preference for **low-fat** substrates (enriched cages: astroturf mat sprinkled with feed relatively containing relatively high fat content: unsuitable for lipid removal; often shorter dust bathing behaviour indicative of some frustration) *(Scholz et al 2014)*
- **Long & complete dust bathing behaviour** is good indicator of positive wellbeing
- **Apparent dust baths**: no suitable substrate (e.g. mesh bottom) not all sequences of dust bath behaviour, less satisfactory

E. EXPLORATION, FEAR, PLAY

- Chick explores from once out of egg by pecking at small visual stimuli (≈ cereal grains) or moving objects (≈ small insects)

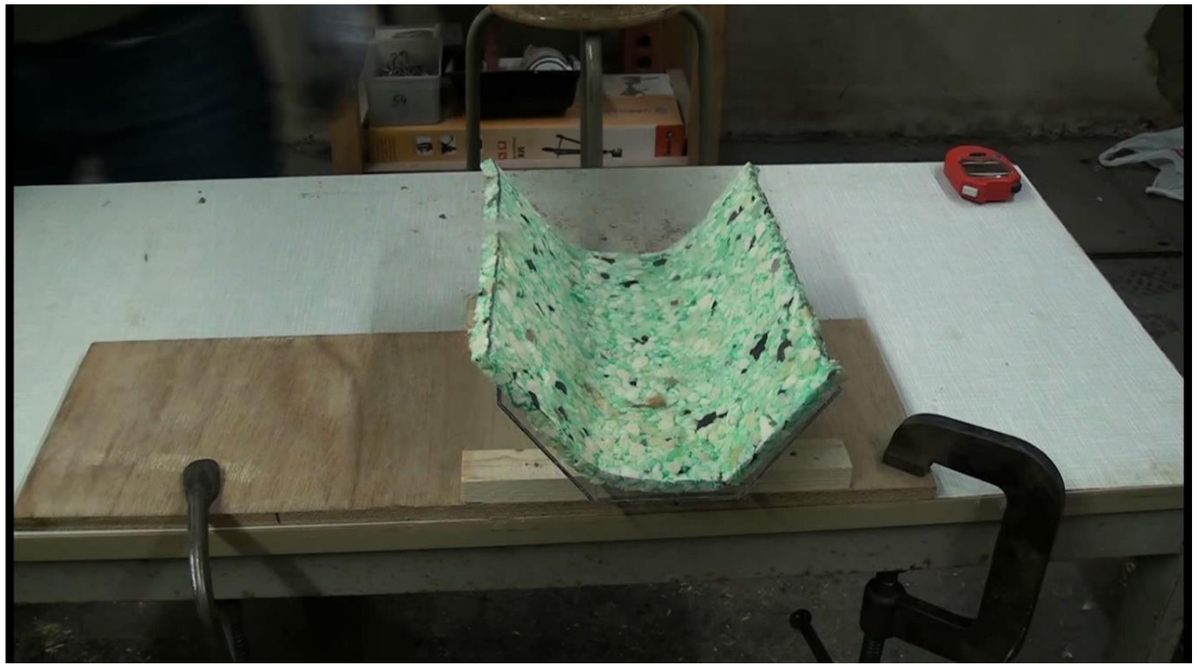
- Much of this pecking is done with closed mouth (important sense!) and especially immediately after hatching, much pecking is purely exploratory

E. EXPLORATION, FEAR, PLAY

Tonic Immobility:

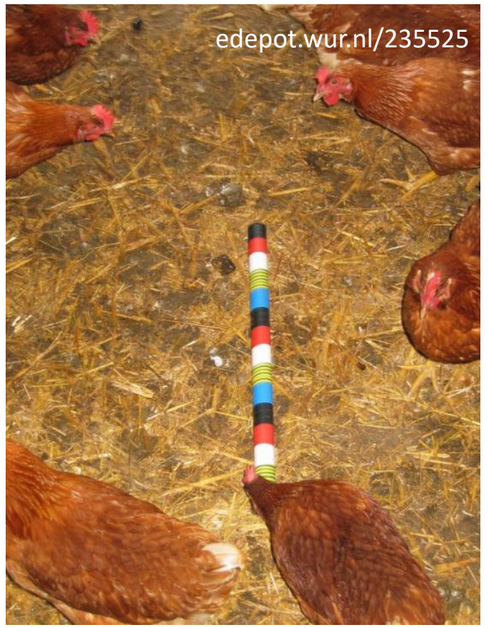
- Inductions
- Latency to stand up
- Vocalisations

Housing and human-animal relationships influence anxiety



Novel object test:

- Latency to approach (zones)



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E. EXPLORATION, FEAR, PLAY

- **Elastic behaviour**: displayed more when other needs are met
- **Object**, **locomotor** (walking with feathers open) and **social** play (mock/play fighting ; 'sparring' - not as complex and variable as in mammals):
  www.nature.com/articles/s41598-022-17617-x#Sec14
- Not well known in chickens; **difficult to** distinguish from other behaviour
- **5 conditions** *(Burghardt 2005)*
  1. Includes elements that do not contribute to immediate survivability
  2. It is spontaneous or rewarding in itself
  3. Structure or temporal organisation differs from the functional variant of behaviour
  4. It is repeated in various forms throughout at least parts of the ontogeny
  5. It occurs mostly when the animal is in good health and stress-free
- **Enrichment** has no (Vasdal et al 2019) or reducing (Liu et al 2020) effect on play behaviour in broilers

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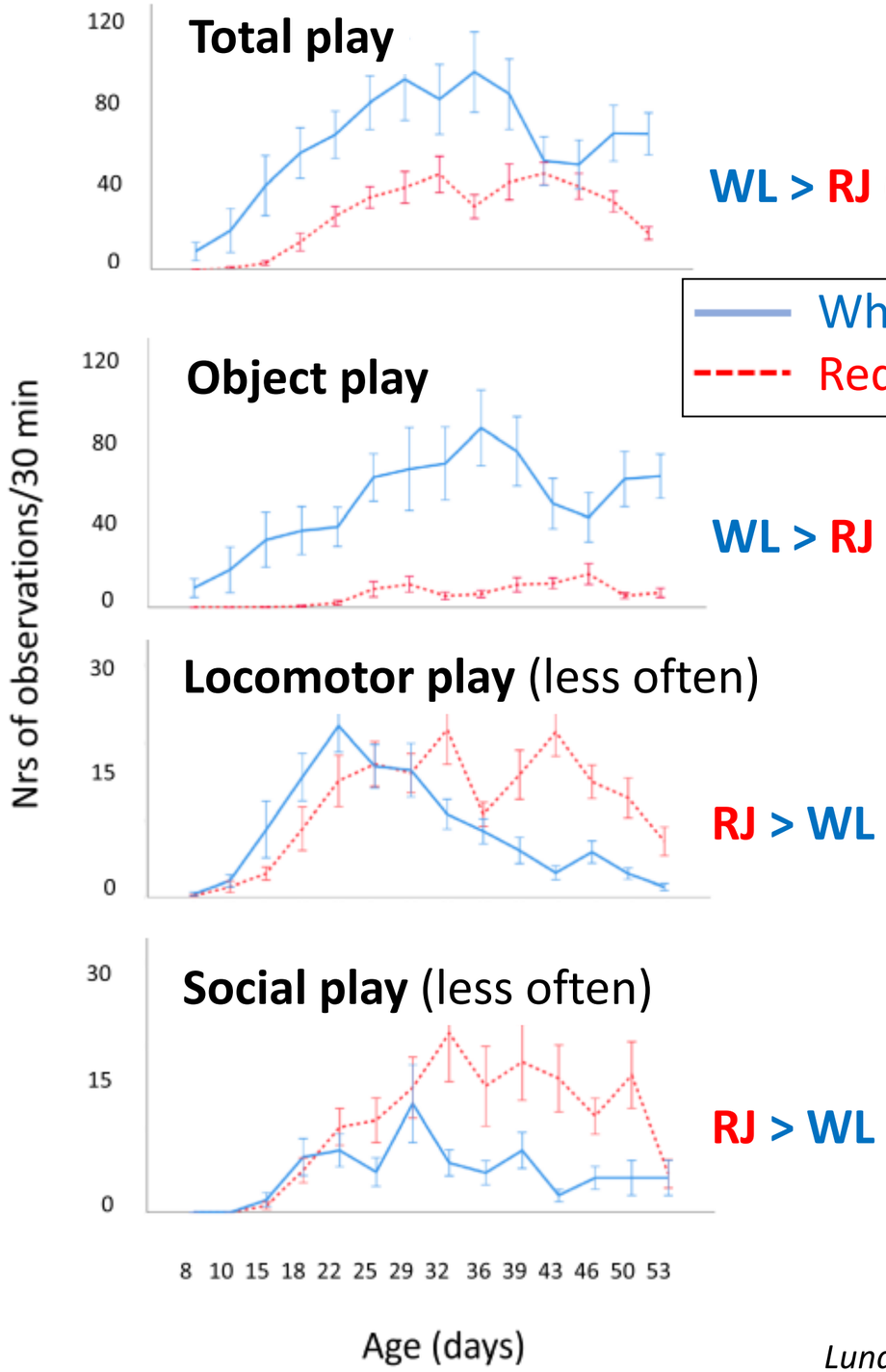

Domestication:

↗ object-oriented play behaviour
Early development of play behaviour

No qualitative breed differences in form or type of play behaviour

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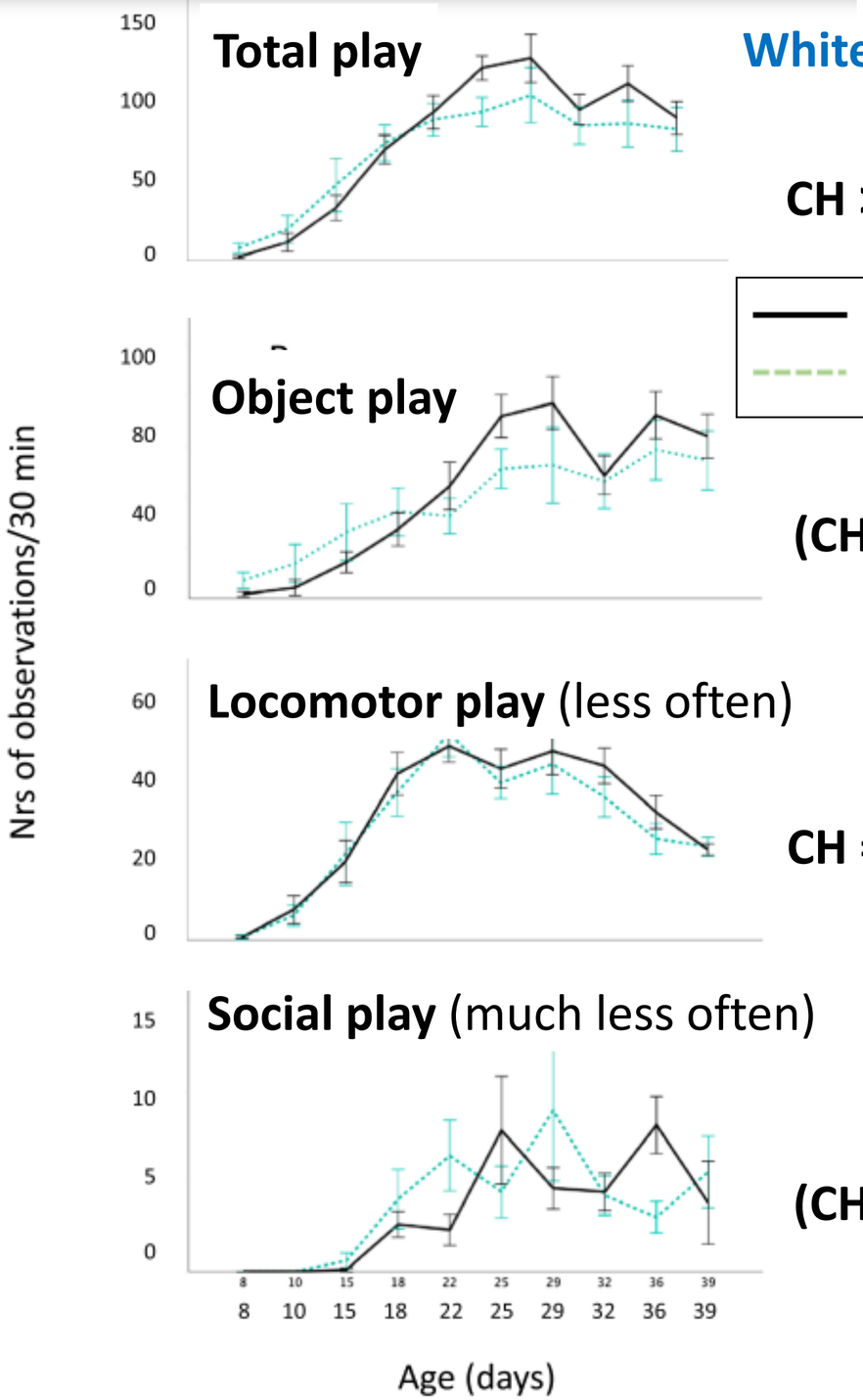
Lundèn et al 2022



White Leghorn: effect stress during hatching on play

CH > CC !!! (small difference but against expectations)

Commercial hatching (stress) **CH**

Calm conditions (CC)

(CH > CC)

CH = CC

(CH > CC)

Early stress:

↗ play behaviour when moving to play arena with many stimuli

(Did early stress make chickens more tolerant to stress from displacement?)

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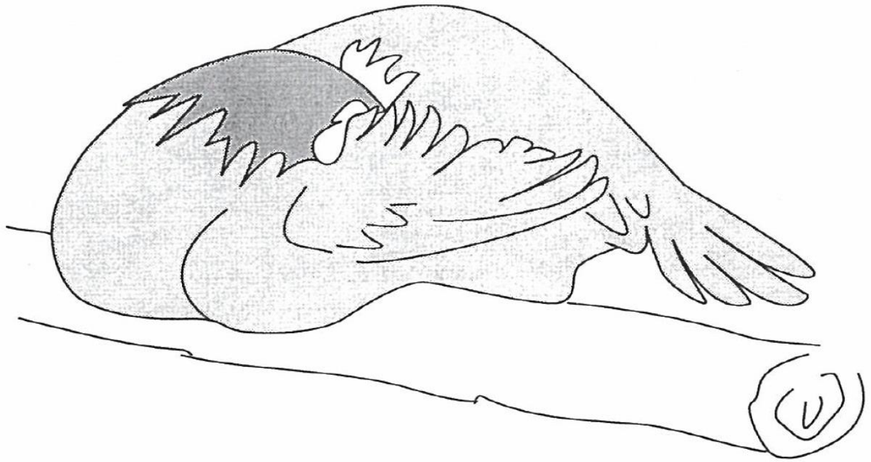
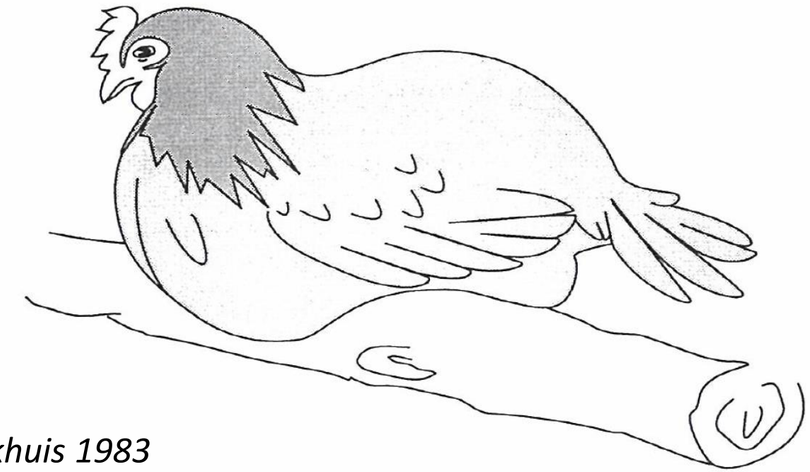
Lundèn et al 2022

F. SLEEP AND RESTING BEHAVIOUR



Sleeping (beak between feathers - counteracts cooling by heat loss through comb and wattles. Cold: this sleeping position becomes more frequent)



Dozing (beak not between feathers)

Blokhuis 1983

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F. SLEEP AND RESTING BEHAVIOUR

- **Night**: - 75% 'really asleep' (eyelids closed)
  - 19% passive (motionless but with at least 1 eye open)
  - 6-7% active
- Also **REM** sleep (both eyelids closed), but without full muscle relaxation as in mammals
- It seems that **eyelids are** not necessarily closed when chickens sleep (≈ rats)
- **Hemispheric dissociation**: 1 eye open and 1 eye closed
  - EEG: brain hemisphere contralateral to closed eye is asleep while brain hemisphere on side of closed eye is awake
  - Strategy to rest brain and still be vigilant for danger?
    (Ducks: one-eyed sleep when there is predator danger)
  - Sleep deprivation (14h): sleeping with both eyes closed & ↘ one-eyed sleep
- **lighting regimes**:
  - EU (broiler chicken): max 18h per day, except first 7d (food stimulation) and last 3d: 24L allowed
    → sleep deprivation/fragmentation/disturbance
    → behavioural disruption & frustration &↘ well-being

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Boerema et al 2003; Rattenborg et al 2009; Forslind et al 2021

F. SLEEP AND RESTING BEHAVIOUR

- **Evening:** seek familiar resting place (preference for higher places ↔ predators)

- **Bankiva fowl:** dozing less during the night and sleeping more:
  - Get deeper and deeper into sleep?
  - thermoregulation: animals get colder during the night
  → head with temperature-sensitive comb is inserted deeper between feathers?

- Resting behaviour is preceded & followed by lots of **pecking behaviour** (higher-ranking animals claim best places?)

- **Broiler chickens** prefer to rest near **walls**, especially at high stocking densities: to avoid disturbance by others? *(Buijs et al 2010)*

Wiepkema 2001

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F. SLEEP AND RESTING BEHAVIOUR

Perch

- **By day:**
  - favourable position to survey surroundings
  - fleeing disturbance/aggression from other hens

- **Sleep** (day & night): protection from **predators**
  - perch use bankiva fowl > commercial laying hen (and more synchronised)
  - perching small > large group
  - large majority seeks perch when darkening (need for sufficient perches)

- **High motivation/importance:**
  - motivation tests and high usage
  - indications of frustration if access to (known) perches is denied
  - need for height rather than clamping stick (lesser motivation if they already have elevated platforms?)
  - large tolerance for different shapes and thicknesses of perch
  - less aggression, fear and pecking if perches present

- **But: ↗** sternum fractures & deformities

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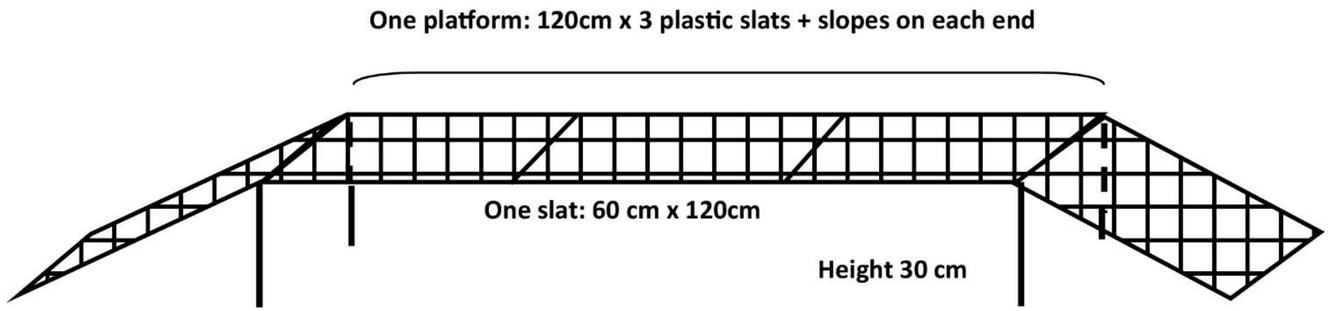
Nicol 2015

F. SLEEP AND RESTING BEHAVIOUR

Perch use: broiler chicken << laying hen

- **Age:**
  - perching behaviour is learned between 2-6wk
  - perch use 2w < 4w, but decreases thereafter especially in the heaviest broiler chickens
  - fleeing disturbance/aggression from other hens

- **Rapid growth & weight**
  - elevated platforms: - are used much more *(Norring et al 2016)*
    - longer rest periods & ↘ disturbance *(Forslind et al 2021)*



- **Cooled perches against heat stress:**
  - usage ↗ with age broiler chicken
  - improved foot health and production

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Nicol 2015

PERCHING - BROILER WELFARE

- Perching = a natural chicken behaviour
- Perches / **Elevated platforms**
- Benefits
  - ↘ fearfulness (Baxter et al., 2019)
  - ↗ activity (Malchow et al., 2019)
  - ↘ contact with wet litter (Kaukonen et al., 2017)
  - ↗foot health (Kiyma et al., 2016)
  - Cleaner plumage (Tahamtani et al., 2020)

- WISH project
  - Elevated platforms + Additional Functionalities

↓

Increase the welfare benefits

Improve litter quality

Reduce ammonia emissions

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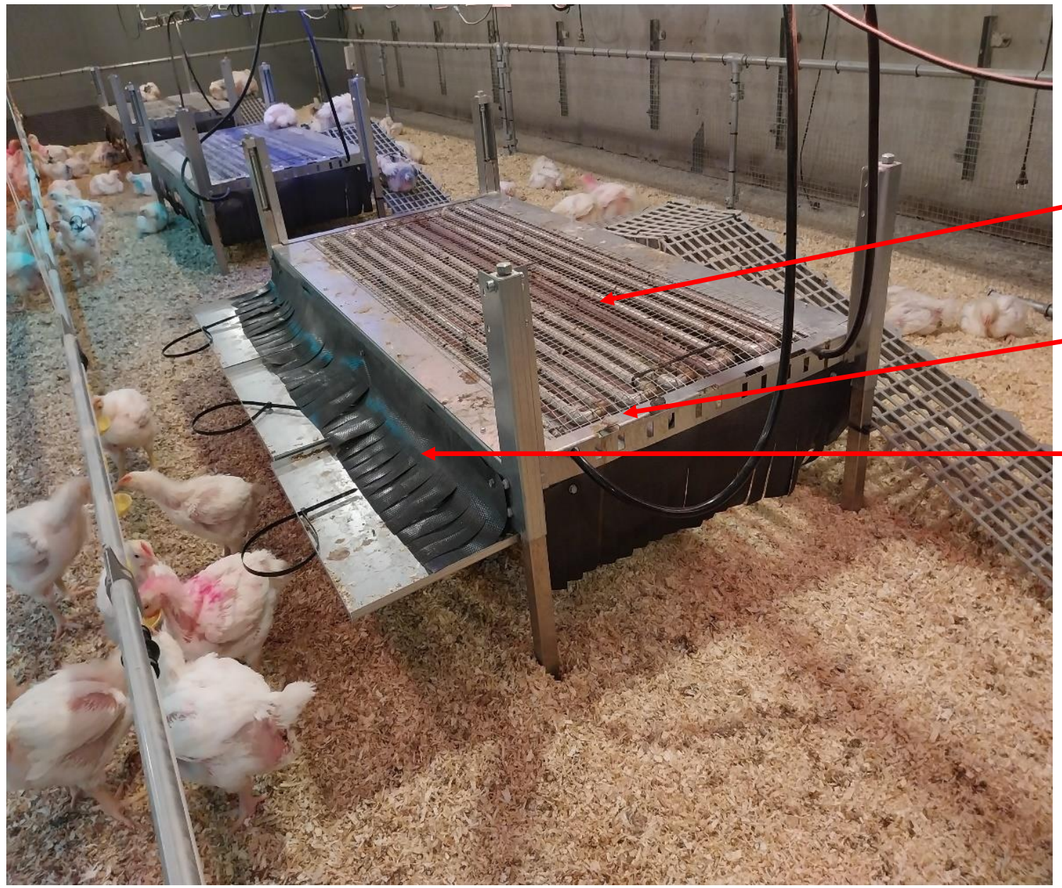
WISH MULTIFUNCTIONAL PLATFORMS

THE PLATFORM FUNCTIONALITIES



Cooling system: Thermoregulation via footpads

Dark brooder underneath the platform

Manure collection trays: Preventing manure from falling on the litter

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F. SLEEP AND RESTING BEHAVIOUR

Ethogram of sleep behaviour assessment criteria and corresponding electroencephalograph (EEG) patterns.

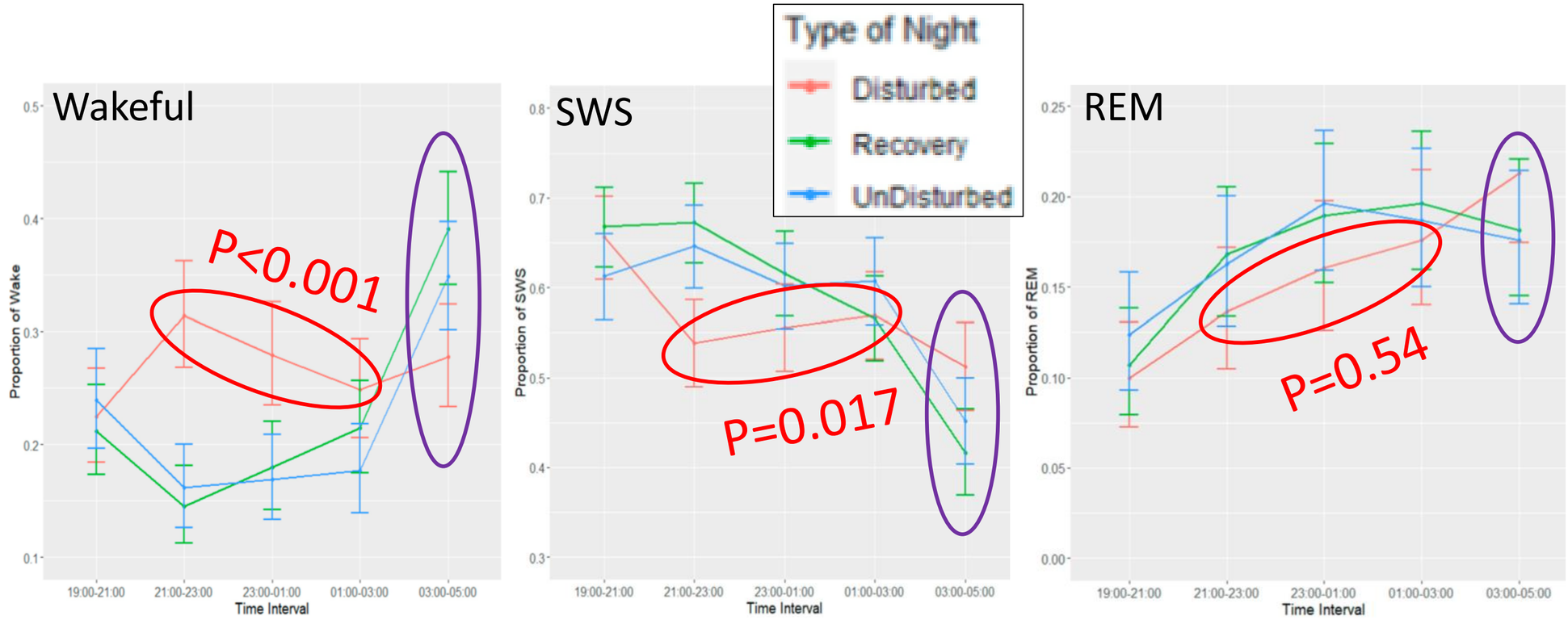
Video	EEG	Definition
Awake	Waking EEG (low-amplitude high-frequency waves)	Bird is clearly awake and engaged in activity, including walking, preening, nest building, laying, feeding, drinking or foraging
Resting	Waking EEG (low-amplitude high-frequency waves)	Bird appears to be awake as evidenced by minor and infrequent head movements and may be in a stereotypic sleep posture (sitting with wings folded or head retracted into the breast) and not engaged in any active activity. One or both eyes may be closed with occasional opening. No corresponding EEG activity to suggest it is asleep
Sleep	Slow-wave sleep (SWS) EEG (high-amplitude low-frequency waves)	Bird is in a stereotypic sleep posture (sitting or perching with wings folded and head retracted) with one or both eyes closed. EEG has transitioned from waking to SWS
Sleep	Rapid eye movement (REM) sleep EEG (low-amplitude high-frequency waves - must be preceded by SWS)	Bird is in a stereotypic sleep posture (sitting or perching with wings relaxed and head hanging downwards) with both eyes closed. EEG has transitioned from SWS to REM sleep

Putyora 2023

F. SLEEP AND RESTING BEHAVIOUR

Repeated short sleep disturbance: layers

(21-03h: wind / 90dB noise / 20 lux light for 5' every 30')



- No carry-over effects the following day or night
- Layers seem **resilient to short-term sleep disruption** by **compensating** for this in the same night

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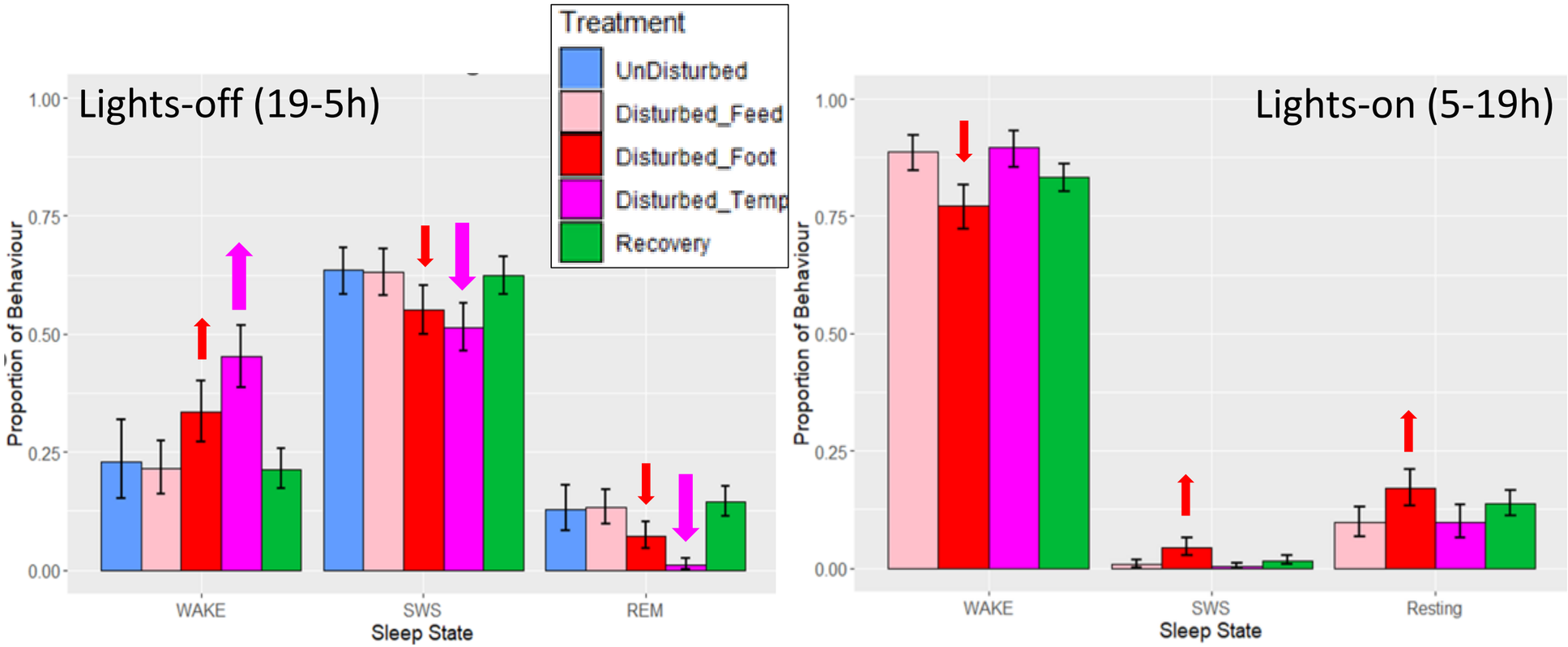
F. SLEEP AND RESTING BEHAVIOUR

24h stressors → Sleep disturbance: layers
(feed deprivation / heat stress (28°C) / simulated footpad pain)



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➢ **Pain** and especially **heat stress** (global warming) affect sleep

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