Temperament traits and stress responsiveness in livestock: a developmental perspective

Marie Haskell, Simon Turner and Kenny Rutherford
Potentially stressful events

• Potentially stressful events occur routinely in the lives of farm livestock
• Increased stress responses have been shown for:
  – Regrouping with unfamiliar animals
  – Poor handling, veterinary procedures
  – Separation from groupmates
  – Transport
  – Others…
The stress response: 3 elements

- **the stressor**

- **perception of stressor** - innate experience

- **Stress response**
  - **Behaviour:**
    - flight/approach
  - **Physiology:**
    - changes in cortisol
    - changes in heart rate

source of variation
What determines the response?

• The level or degree of response depends on:
  – Genetic background
    • Some genotypes or breeds show greater stress response than others
    • QTL’s identified for stress responsiveness traits
What determines the response?

- The level or degree of response depends on:
  - Genetic background
  - Prenatal and neonatal experience/stressors
    - During gestation maternal cortisol can cross the placenta and influence fetal development
    - Positive and negative events in neonatal life can also permanently alter biology
What determines the response?

• The level or degree of response depends on:
  – Genetic background
  – Prenatal and neonatal experience/stressors
  – Experience with that situation/stressor over time
    • Learning theory suggests that an innate response to a frightening event will decline with repeated experience if that experience is neutral
    • Repeated negative experience will increase stress response
Timeline of response

So we can think of this as a ‘timeline’:

- Embryo with certain genetic attributes
- Prenatal/post-natal influences
- Learning/experience
- Response as an adult

This presentation will look at two examples to illustrate this:
- Handling temperament in cattle
- Aggression at mixing in pigs
1. Cattle handling

- There is variation in individual response to handling: often known as ‘temperament’
  - Crush score: response to confinement in a crush; scored from calm to agitated
  - Flight time: time to move over a set distance from the crush
  - Docility: measure of ease of handling in a yard
  - Dairy milking temperament: response to milking procedure
Cattle handling

- Individuals are consistent in their response over time and there is variation between animals.

![Graph showing frequency distribution of crush scores and flight times.]

Highly stressed

[Image of a cattle handling setup with a calf inside.]
Cattle handling: genetics

Meanheritabilities for different measures:
- Crush score: 0.24 (0.03-0.67)
- Flight speed: 0.36 (0.05-0.7)
- Docility score: 0.26 (0.0-0.61)
- Milking temperament: 0.19 (0.07-0.53)  
  Haskell et al., 2014

QTLs detected for handling traits  
Guitierrez-Gil et al., 2008

GWAS and fine mapping found relationship between temperament and systems regulating sympathetic/parasympathetic nervous system  
Hulsman Hanna et al., 2014
Handling: pre-natal

- No studies relating pre-natal stress to these specific handling measures but:
  - Lay et al (1997) found that transporting pregnant cows altered the physiological response to restraint in their calves. Higher cortisol and higher heart rates.
Handling: learning

- Previous experience of gentle handling:
  - Reduces cortisol (Breuer et al., 2003)
  - Reduces heart rate in a veterinary procedure (Waiblinger et al., 2004)
Cattle handling: conclusions

• Genetic influences and experience affect behavioural response to handling
• More research needed for pre-natal effects, but likely that behavioural response will be affected by pre-natal conditions
2. Pig aggression during mixing

- Pigs are routinely mixed into new groups with unfamiliar animals and will fight to determine dominance rank.
- Considerable variation between animals

Desire et al., 2015
Pig aggression: genetics

Reciprocal fighting:
$h^2 = 0.43$ (se 0.04)

Delivery of bullying:
$h^2 = 0.31$ (se 0.04)

(Turner et al., 2009)

Genetic influences

Prenatal/post-natal influences

Learning/experience

Response as an adult
Pig aggression

- Pigs **will** fight on mixing
- Two individual strategies are evident from studies:
  - Intense fights directly after mixing; less fighting thereafter
  - Less fighting immediately; fights occur over many days
Pig aggression: prenatal stress

Pre-natally stressed (PNS) offspring are less aggressive during the first 30mins post-mixing. Other studies have shown more agonistic interactions in stable groups after weaning (Jarvis et al 2006).
Levels of cortisol are increased in response to mixing into a new social group at ~10wks old (Jarvis et al 2006).
Pig aggression: experience

- Piglets ‘socialised’ days 10-30 of life and mixed at day 50.
- Socialised piglets started fighting sooner, had more intense fights. Fights completed and formed a stable hierarchy more rapidly. Fewer fights overall.

Genetic influences

Prenatal/post-natal influences

Learning/experience

Response as an adult

D’Eath, 2005
Pig aggression: conclusions

- Genetic effects on aggression
- Fight pattern strategy affected by pre-natal stress
- Modified (ameliorated?) by experience
Overall conclusions

- Selective breeding, prenatal effects and experience all affect the stress responsiveness of the individual
- There are welfare consequences
- Impact on productivity through reduced growth
Overall conclusions

• Good breeding choices: use a breed or strain that shows appropriate behaviour

• ‘Mothers matter’: good care of pregnant livestock (at the individual level) will reduce stress responsiveness of offspring

• Good handling and management: reducing frequency of mixing, good handling will reduce stress response
Aspect Ratio Check
Should look circular