HORSE BEHAVIOURAL GENETICS: A REVIEW

Haifa Benhajali

Université de Rennes 1/CNRS
Ethologie animale et humaine

INTRODUCTION

Horse's behaviour

Very important for its use (Visser et al., 2010)

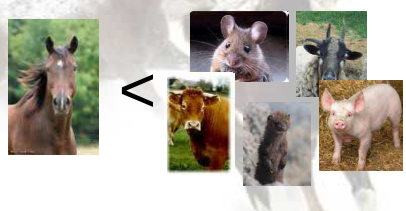
Temperament is the most important characteristic of a Pony Club horse.

Buckley et al. (2004)

However

Behavioural Genetics

Less studied than in many other species.



Mostly comparisons, between breeds, strains, bloodlines.

Hausberger & Richard 2005

INTRODUCTION

Behavioural Genetics

- Which horse for which use?
- Which horse for which environment?
- To eliminate extremes
- To improve welfare of horses and humans

MATERNAL BEHAVIOUR

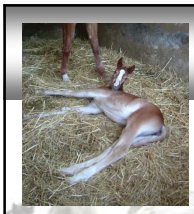
pigs
Grandinson et al., 2003

sheep
Everett-Hincks et al., 2002

Cattle
LeNeindre et al., 2002

Heritability estimates vary between 0.05±0.03 and 0.32±0.23.

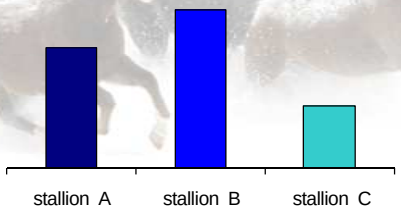
- No breed effect. *Shaw & Houpt, 1985*.
- Individual differences, persist from foal to foal *Crowell-Davis, 1986*.



FOAL BEHAVIOUR

Sire effect

Time spent resting, playing and within 10 m of their dams (13 suckling French Saddlebred foals, 5 stallions).
Wolff & Hausberger, 1994; Hausberger et al., 1996.



Time (in %) spent by foals from different sires 1-5m from mares
Wolff & Hausberger, 1994

LEARNING

Sire effect

- Chest opening task
- Solve detour problem task.

Wolff & Hausberger, 1996

Breed differences

- Visual discrimination. *Mader & Price, 1980*
- Spatial learning (*Budzynski et al., 1992; Hausberger et al., 1996; Hausberger et al., 2004; Lesimple, subm*.)
- Instrumental learning (*Lindberg, 1999, Hausberger et al., 1996; Hausberger et al., 2004)*

ABNORMAL BEHAVIOUR

Abnormal maternal behaviour

Sheep

Dwyer and Lawrence, 1998

Pigs (h^2 = 0.1–0.3)

Van der Steen et al.,1988

Sire and breed differences

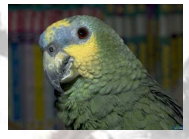
- Certain sires were more likely to be present in pedigrees of rejecting vs. nonrejecting mares. *Juarbe-Diaz et al., 1998*
- Foal rejection: Arab mares (5%) > Paint horses (2%). *Juarbe-Diaz et al., 1998*
- Arab mares > Quarter horses. *Houpt & Kusunose, 2001*

ABNORMAL BEHAVIOUR

Stereotypic behaviour

Bank voles

Schoenecker & Heller, 2000



Amazon parrots

Garner et al., 2006

Farm mink

Jeppesen et al., 2004

Humans

Muthugovindan & Singer. 2009

Sire effect

Hosodo, 1950; Vechioti & Galanti, 1986; Luescher et al., 1998

Breed differences

More in Thouroughbreds.

Redbo et al., 1998

Angloarabs > French Saddlebreds.

Hausberger et al., 1996.

Self mutilation: Breed and family differences (Dodman et al., 1994)

TEMPERAMENT

Methods of assessment

1. Observer ratings (e.g. Visser et al., 2010)
2. Physiological measures (e.g. HR and HRV: *Visser et al., 2008*; cortisol: *Mills et al., 1997*)
3. Behavioural tests

Arena test

Novel object test

Bridge test

Hausberger et al., 1992

TEMPERAMENT

Behavioural tests

Consistency over time

- Arena test, novel object test, reaction to human: 3 times, 9 days between trials.
  Only arena test was repeatable
  Seaman et al., 2002
- Novel object test, reaction to human at 8 months; 1,5; 2,5 years: consistent over time.
- No consistency between 3 weeks and 6 months.
  Lansade et al., 2007,2008

Consistency across situations

Novel object are not always correlated with reactions to social isolation *(e.g. Wolff et al., 1997)*; or reactions to human *(Lansade et al., 2007, Seaman et al., 2002)*

↓

Temperament
A multifaceted concept?

Reactions to human in restrained or unrestrained conditions are not genetically correlated in calves. *Benhajali et al., 2009*

TEMPERAMENT

Sire effect

- Arena test, Novel object test, Bridge test

  Half-sibling showed similar proportions of various behaviours performed during tests in contrast to unrelated horses (42 FS horses)

  Wolff et al., 1997, Wolff & Hausberger, 1996

- Reactions to checking eyes, auscultation and blood sampling in a large sample of horses (9644 horses, 62 stallions, two training centers).

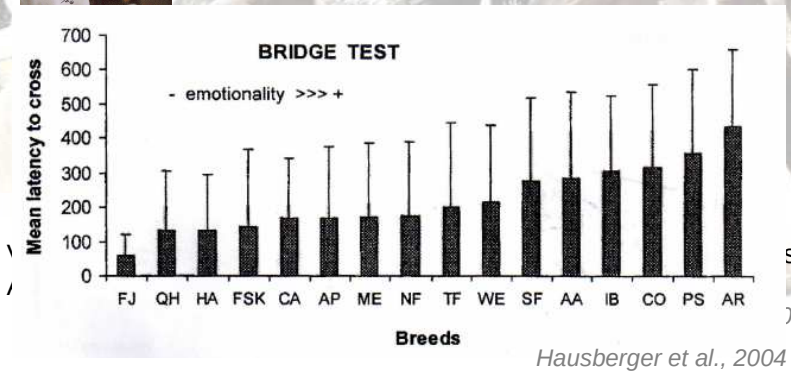
  Houpt & Kusunose, 2001

TEMPERAMENT

Breed differences

Purebred Arab horses are more reactive than several other breeds.

Hausberger et al., 2004, Lloyd et al., 2008



Hausberger et al., 2004

TEMPERAMENT

Heritability estimates

Species	Trait	h^2	References
Dairy cattle	Fear of humans	0.09-0.53	Reviewed by Boissy et al., 2005a
Beef cattle	Reaction to handling	0.12-0.54	Burrow et al., 1988, Le Neindre et al., 1995, Benhajali et al., 2010
Sheep	Reaction to novelty, human contact and social isolation	0.14-0.48	Boissy et al., 2005b

	h^2	Genetic correlation
Behavioural reactions to the inspections of conjunctiva, auscultation and blood sampling	0.23 -0.28	0.9

Oki et al., 2007

MOLECULAR GENETICS

QTL associated with behaviour

- Reaction to humans in cattle. *Schmutz et al., 2001*
- Response to a novel environment in pigs. *Desautes et al., 2002*
- Novel environment behaviour and tonic immobility in quails. *Beaumont et al., 2005*

Genes polymorphisms

The dopamine receptor D4 gene (Drd4) variants

Ebstein 2006

Bailey et al. 2007

Ito et al., 2004

Fidler et al., 2005

MOLECULAR GENETICS

Drd4 associated with curiosity and vigilance.
Momozawa et al., 2007

HORSE GENOME PROJECT

- The genome of the horse has been decoded. *Wade et al., 2009*.
- Behaviour is currently under study

SELECTION

Selection experiments on behavioural traits

Species	Trait	h^2	References
Silverfox	Tameness		Belyaev, 1979
bluefox	Tameness	0.16-0.20	Kenttamies and Smeds (2002)
Mink	Fear	0.20-0.25	Hansen (1996), Berg et al. (2002)
Quail	Tonic immobility	0.12-0.28	Mills and Faure (1991)
	Dustbathing	0.18-0.38	Gerken and Petersen (1985)
Domestic foal	Feather pecking	0.14-0.18	Su et al. (2005)
	Male mating behaviour	0.14-0.36	Siegel (1965)

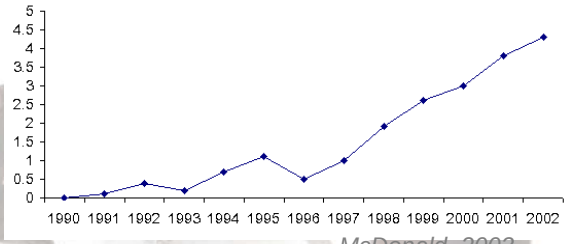
Reviewed by Jensen et al., 2008

SELECTION

Selection on docility in beef cattle

Australia, New Zealand and America

chute score from 1(docile) to 5 or 6 (aggressive)



McDonald, 2003

France: on-farm test (number of mvts during weighing)

Benhajali et al., 2010

SELECTION

No selection

GENETICISTS

Selection criterion:

- ❑Simple
- ❑Repeatable
- ❑Heritable
- ❑Valid to improve temperament

ETHOLOGISTS

Temperament is complex

- ❑Which trait?
  - Flightiness (Visser et al., 2001)
  - Anxiety (Momozawa et al., 2003)
  - Excitability (Llyod et al., 2008)
- ❑Which test?
  What are we measuring?
- ❑Users request is complicated in horses
- ❑What is acceptable temperament?

CONCLUSION

- Selection on behaviour in horses should be possible
- Objectives must be clearly defined
- Tests need to be refined: repeatability and heritability?
- Genetic correlations with other traits
- Selection is not the magical solution: importance of the environment