

Animal Welfare Science Centre

Scientific Seminar

14 April 2010

“Pain and Slaughter”

Professor David J Mellor

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Areas considered

- **Animal welfare – animals’ subjective experience**
- **The significance of pain – attitudes and attributes**
- **Ideas about humane slaughter**
- **Re-evaluation of neck-cut slaughter**

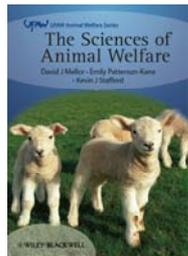
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Published sources used

Mellor, D.J. & Stafford, K.J. (2009). Quality of life: a valuable concept or an unnecessary embellishment when considering animal welfare? In: *The Welfare of Animals – It's everyone's business*. Proceedings of the AAWS International Conference (2008).

http://www.daff.gov.au/_data/assets/pdf_file/0011/1046495/32-david-mellor.pdf



Mellor, D.J., Patterson-Kane, E. & Stafford, K.J. (2009). Chapters 1 Focus of animal welfare. In: *The Sciences of Animal Welfare*, pp 3-12. Wiley-Blackwell, Oxford, UK.

Mellor, D.J. (2010). Galloping colts, fetal feelings and reassuring regulations: putting animal welfare science into practice. *Journal of Veterinary Medical Education* 31 (1), 96-102.

A characterisation of animal welfare

- AW is a state *within* an animal - it is not:
 - A management procedure
 - An environmental feature

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 - A management procedure
 - An environmental feature
- The animal must be *sentient*:
 - Phylogenetically
 - Developmentally
- AW relates to *experienced sensations*:
 - So the animal must be *conscious*
- These experiences can be:
 - Negative
 - Neutral
 - Positive

A characterisation of animal welfare

- These experiences result from *integrated outcomes* of *sensory and other neural inputs*:
 - From within the *animal's body*
 - From the animal's *environment*

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 - Its *species-specific and individual* nature
 - Its *past experience*

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 - From within the *animal's body*
 - From the animal's *environment*
- These inputs are *processed and interpreted* by the *animal's brain* according to:
 - Its *species-specific and individual* nature
 - Its *past experience*
- **The integrated outcomes represent:**
 - **The animal's *current experience* (i.e. its *AW status*)**
 - **This *changes* as the *balance of inputs* changes**

A characterisation of animal welfare

- The animal's experiences are *subjective states*:
 - They are *inferred* from *human experience*
 - They are likely to include:
 - *Negatives* - thirst, hunger, nausea, pain, breathlessness
 - *Positives* - satiety, contentment, exploration, play
- *As subjective states they cannot be measured directly*

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 - *Positives* - satiety, contentment, exploration, play
- *As subjective states they cannot be measured directly*
- **Informative *indirect indices* rely on:**
 - **Physiological, pathophysiological and behavioural knowledge, *critically evaluated* regarding the animal's specific context**

A characterisation of animal welfare

- *AW status at any one time varies on a continuum from extremely bad to very good*

A characterisation of animal welfare

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- This characterisation clearly emphasised *affective state*
- This accords with our '*five domains concept*':

A characterisation of animal welfare

- *The Five Domains concept* – Mellor & Reid (1994); modified [Mellor & Stafford, 2001; Mellor et al., 2009]

– Domain 1:	<i>Nutrition</i>	<u>Physical/functional</u>
– Domain 2:	<i>Environment</i>	
– Domain 3:	<i>Health</i>	
– Domain 4:	<i>Behaviour</i>	
– Domain 5:	<i>Mental state</i>	<u>Affect/‘feelings’</u>

Domains of animal welfare compromise

- *The Five Domains concept* – Mellor & Reid (1994); modified [Mellor & Stafford, 2001; Mellor et al., 2009]

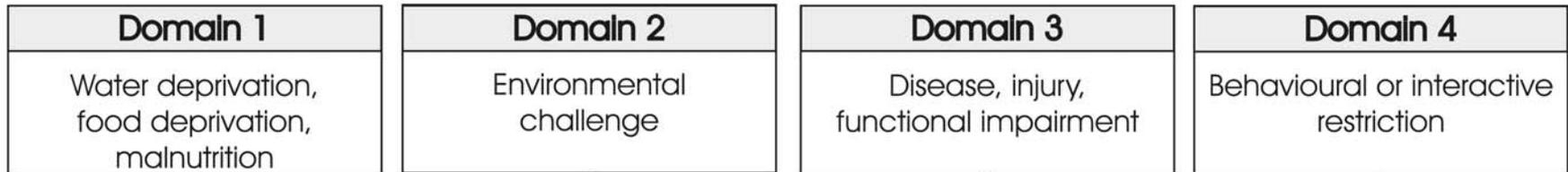
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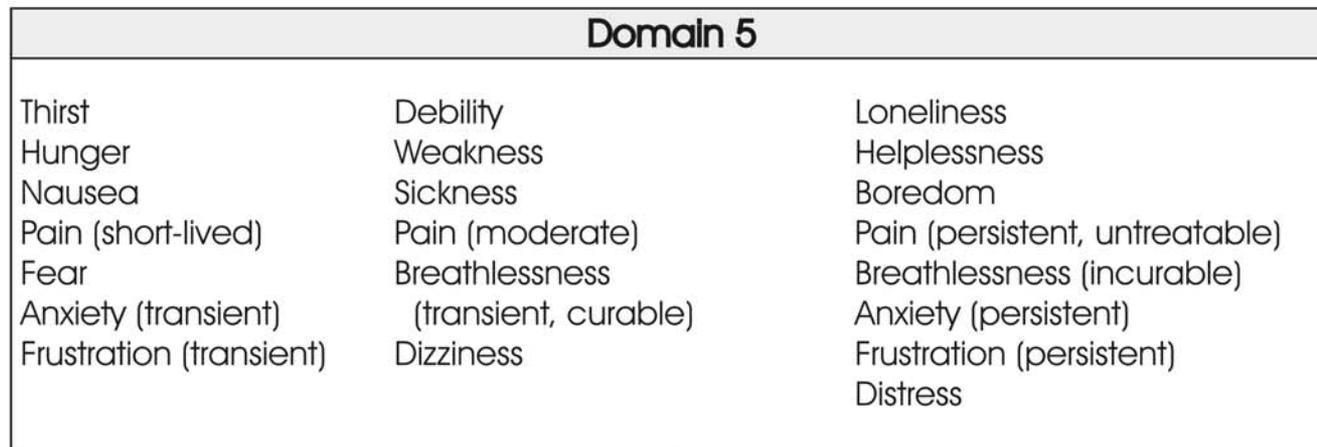
- Five domains give *comprehensive coverage*

Focus on affect or 'feelings'

PHYSICAL COMPONENTS



MENTAL COMPONENTS



Animal Welfare Status

A characterisation of animal welfare

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- **Now, *positive experiences* are increasingly recognised:**
 - **Vitality, companionship, contentment, satiety, happiness, curiosity, exploration, foraging and play**
 - **Thus, good AW may also include the presence of positive experiences, and not merely the absence of negative ones**

A characterisation of animal welfare

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 - Thus, good AW is may also include the presence of positive experiences, and not merely the absence of negative ones
- Today, however, we are focusing on *PAIN*

Areas considered

- Animal welfare – animals' subjective experience
- **The significance of pain – attitudes and attributes**
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- Re-evaluation of neck-cut slaughter

Published sources used



Mellor, D.J., Thornber, P.M., Bayvel, A.C.D. & Kahn, S. (Eds.) (2008). *Scientific assessment and management of animal pain. OIE Technical Series Volume 10, 1-218.*

Mellor, D.J. (2010). *Animal pain and OIE guidelines. Proceedings of the OIE Conference on Evolving Veterinary Education for a Safer World, Paris 2009 (in press).*

Significance of pain – Attitudes

- Progression in dominant ideas about pain:
 - Animals do not feel pain: until about 30 years ago
 - Animals might feel pain, but we are not sure: last 25-30 years
 - Animals do feel pain: increasing during the last 10-15 years
- Globally, all three still exist among animal users/owners, but the '*might*' and '*do*' ideas are much more common.

Significance of pain – Attitudes

- *Vary* in different contexts – e.g. on-farm, in the clinic
- *Commitment* to pain management could be improved in each country and worldwide
- *Increasing knowledge* of animal pain and its management will help
- *Increasing the attention* given in *veterinary education* to animal pain, its management and how it compromises animal welfare will also help
- In terms of *raising global animal welfare awareness*, focusing on pain is a good place to start
- The source publications deal with this idea directly.

Significance of pain – Attributes

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Significance of pain – Attributes

- It can be a most *unpleasant* experience in humans
- Depending on its *intensity, duration* and *character* it can cause *great suffering*
- **Most veterinarians now accepted that *animals can feel pain* and may suffer as a result**
- ***Pain has many causes* – injuries and pathological states**
- **So it has *many manifestations*; for example**

Manifestations of pain

<i>Aching</i>	<i>Burning</i>	<i>Beating</i>
<i>Throbbing</i>	<i>Shooting</i>	<i>Bursting</i>
<i>Boring</i>	<i>Sharp</i>	<i>Smarting</i>
<i>Drawing</i>	<i>Hot iron</i>	<i>Electricity</i>
<i>Pulling</i>	<i>Soreness</i>	<i>Stinging</i>
<i>Gripping</i>	<i>Knife-like</i>	<i>Pricking</i>
<i>Cramping</i>	<i>Stabbing</i>	<i>Needle-like</i>
<i>Nagging</i>	<i>Toothache</i>	<i>Tingling</i>
<i>Sense of pressure</i>	<i>Tearing</i>	<i>Itching</i>
<i>Gnawing</i>	<i>Hot cords</i>	

*Neville Gregory (2004). Physiology & Behaviour of Animal Suffering.
UFAW / Wiley-Blackwell*

Significance of pain – Attributes

- **Pain may also be:**
 - Acute
 - Chronic
 - Localized
 - Generalized
 - Physical
 - Emotional
 - Adaptive
 - Maladaptive
- *More than one type can be present at the same time*

Significance of pain – Attributes

Global Context:

- **Focusing on *pain avoidance* and *pain management* therefore covers *many causes of welfare compromise***

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- This contrasts with the *far fewer individual causes of thirst, hunger, nausea, breathlessness and sickness*
- Of course, *these ‘feelings’ are important* and do merit attention, but, *as a strategy, initially focusing on pain may be more effective in promoting good animal welfare practices*

Significance of pain – Attributes

Global Context:

- Focusing on *pain avoidance* and *pain management* therefore covers *many causes of welfare compromise*
- This contrasts with the *far fewer individual causes* of *thirst, hunger, nausea, breathlessness and sickness*
- Of course, *these 'feelings' are important* and do merit attention, but, *as a strategy, initially* focusing on pain may be *more effective in promoting good animal welfare practices*
- Moreover, pain is *easily understood* by most people as having the potential to be *extremely unpleasant*
- But making a strong link between *human experience* and *animal pain experience* will be important.

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Mellor, D.J. & Littin, K.E. (2004). Using science to support ethical decisions promoting humane livestock slaughter and vertebrate pest control. *Animal Welfare* 13 Supplement, S127-S132.

Mellor, D.J., Gibson, T.J. & Johnson, C.B. (2009). A re-evaluation of the need to stun calves prior to slaughter by ventral-neck incision: an introductory review. *New Zealand Veterinary Journal* 57, 74-76.

Maximising the humaneness of livestock slaughter

- Slaughter can cause extreme suffering



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animal welfare science and bioethics centre

Maximising the humaneness of livestock slaughter

- Slaughter can cause extreme suffering
- Consider execution in human beings:
Beheading, throat-cut, gun-shot, hanging, electrocution, poisoning (gas chamber), lethal injection, etc.
 - Which causes the least suffering?
 - If no escape, we would want that one!



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- **Livestock:**
 - **Given the choice, they would presumably prefer NO suffering**
 - **We are ethically obliged to minimise any suffering**
 - **Abattoirs offer the practical opportunity to minimise it with each and every animal that is killed**



Maximising the humaneness of livestock slaughter

- **Questions raised by slaughter methods:**



Maximising the humaneness of livestock slaughter

- **Questions raised by slaughter methods:**

- Throat or neck cut -**

- Is the cut painful?*
 - How much pain is generated in the cut tissues?*
 - Does the sudden drop in blood flow to the brain cause distress?*
 - How long does sensibility last after the cut?*



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- *How long does the severed head remain conscious?*



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Beheading

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Minimising the harm

- *How can we minimise any pain and distress and reduce the duration of sensibility after the cut?*



Maximising the humaneness of livestock slaughter

- **Harms and their magnitude:**



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- *Extent:* it transects skin, muscle, trachea, oesophagus, carotid arteries, jugular veins, other blood vessels, sensory nerves (incl. pain nerves), other nerves, connective tissue.



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- *Extent:* it transects skin, muscle, trachea, oesophagus, carotid arteries, jugular veins, other blood vessels, sensory nerves (incl. pain nerves), other nerves, connective tissue.
- *Cutting these tissues* and their *pain nerves* will cause barrages of impulses in pain pathways to the brain
- *Massive trauma* caused by the cut *severing all sensory nerves* may also cause *psychological shock*



Maximising the humaneness of livestock slaughter

- Harms and their magnitude:

Consciousness (sensibility) is not lost immediately.



Maximising the humaneness of livestock slaughter

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Parameters used to assess this include:

Particular behaviours

EEG, ECoG

Evoked responses using light, sound and electrical stimuli

Cranial nerve reflex activity

Neurotransmitter release

Breathing characteristics

Heart rate, blood flow, blood pressure, bruise formation

Blood O₂, CO₂ and metabolite levels



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Maximising the humaneness of livestock slaughter

- Harms and their magnitude:

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Maximising the humaneness of livestock slaughter

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<u>Current estimates:</u>	goats	3 to < 7 sec
	sheep	3 to 7 sec (most), range 3 to 22 sec
	cattle	5 to > 60 sec
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Before insensibility, animals have potential to experience:
intense suffering as pain, distress,
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Although short-lived, we are still ethically obliged to mitigate such suffering

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- **Minimising the harms (suffering):**



Maximising the humaneness of livestock slaughter

- **Minimising the harms (suffering):**
 - **Shechita, the Jewish method, was probably the first means of mitigation**
 - **Halal, the Muslim method, followed**



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Both use:

- an exquisitely sharp knife
- no blemishes on the blade
- a swift, clean cut
- attempt to achieve a rapid bleed-out



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Animals are conscious at the time of the cut, so they may suffer before becoming insensible



Maximising the humaneness of livestock slaughter

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To repeat: *Animals are conscious at the time of the cut, so they may suffer before becoming insensible*

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- This is disputed by some scientists (e.g. Levinger)
- This is asserted by others (e.g. Blackmore, Gregory, Devine)

The overwhelming weight of international scientific opinion supports the latter view

**Yet, until recently,
there was no direct evidence**



Maximising the humaneness of livestock slaughter

- *Pre-cut stunning* is the main method of mitigation today:
 - It induces *disordered brain function* and *unconsciousness*
 - Unconscious animals *cannot suffer* (pain, distress, fear)



Maximising the humaneness of livestock slaughter

- Pre-cut stunning is the main method of mitigation today:
 - It induces disordered brain function and unconsciousness
 - Unconscious animals cannot suffer (pain, distress, fear)
- Three main stunning methods:
 - Head concussion (captive bolt, percussive bolt, gun shot)
 - Electrical (head only, head-to-back)
 - CO₂-induced unconsciousness



Maximising the humaneness of livestock slaughter

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- Three main stunning methods:
 - Head concussion (captive bolt, percussive bolt, gun shot)
 - Electrical (head only, head-to-back)
 - CO₂-induced unconsciousness
- Percussive head stunning used for centuries:
 - China 15th Century (since at least 1420)
 - Europe 18th Century
 - USA 18th Century

 - Initially, for controlling large animals



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Programme led by Associate Professor Craig Johnson

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Gibson, T.J., Johnson, C.B., Murrell, J.C., Chambers, P.J., Stafford, K.J. and Mellor D.J. (2009b). Components of EEG responses to slaughter: effects of cutting neck tissues compared to major blood vessels in calves. *New Zealand Veterinary Journal* 57, 84-89.

Gibson, T.J., Johnson, C.B., Murrell, J.C., Mitchinson, S.L., Stafford, K.J. and Mellor D.J. (2009c). Electroencephalographic response to concussive non-penetrative captive bolt stunning in calves. *New Zealand Veterinary Journal* 57, 90-95.

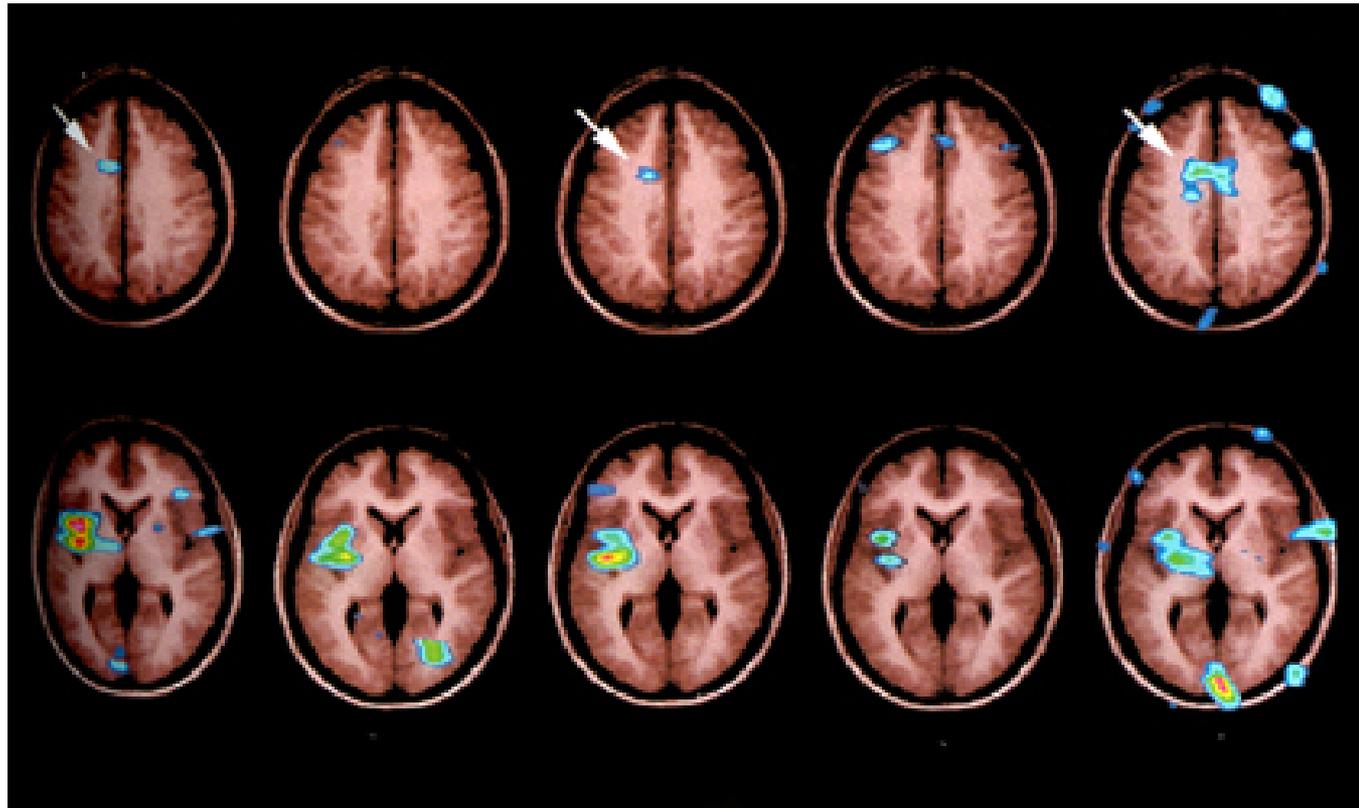
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Imaging Studies

Craig *et al.* 1996

Anterior
cingulate

Insula



Noxious
Cold

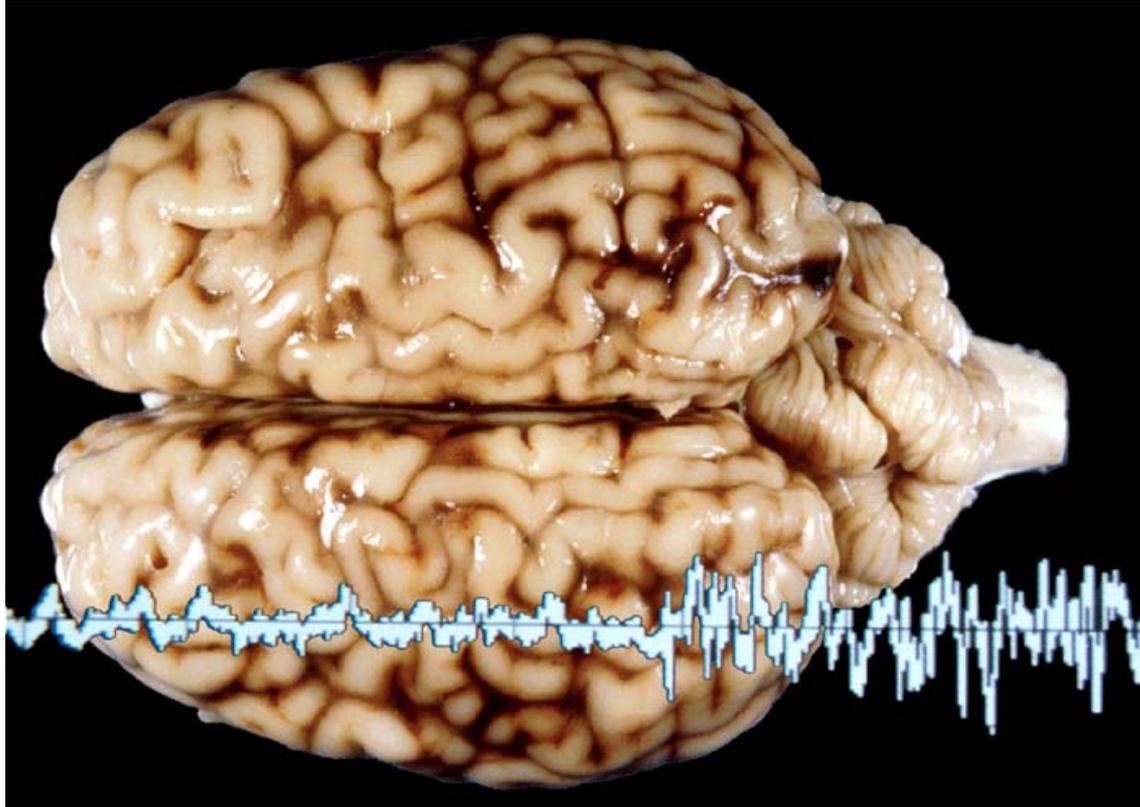
Cool

Warm

Noxious
Heat

Functional MRI

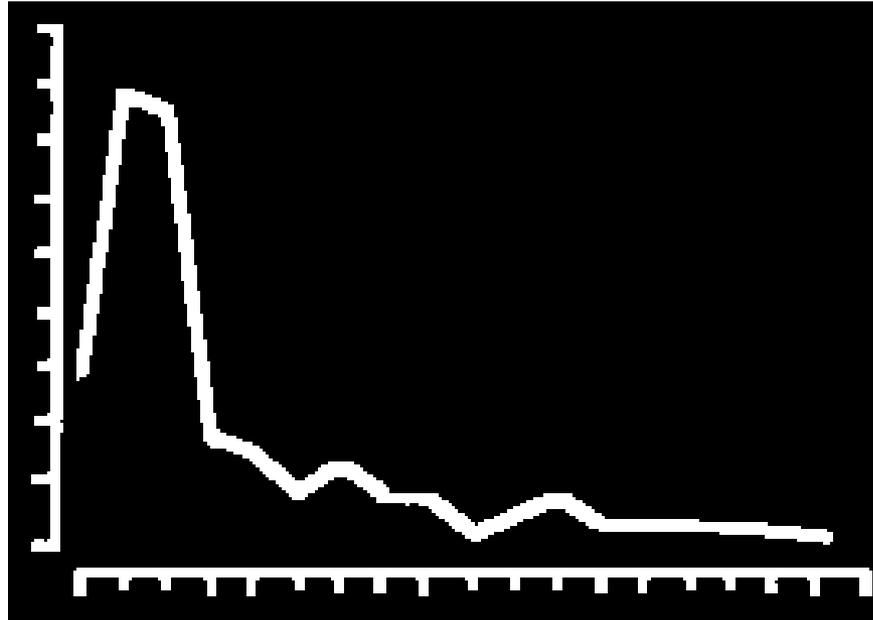
Electrophysiology



**Equine EEG under halothane –
response to iv thiopentone**

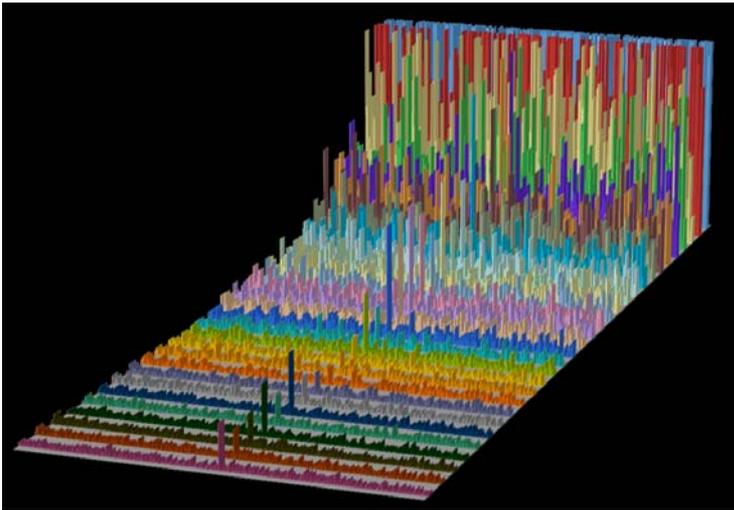
Power Spectrum

Power (μV^2)



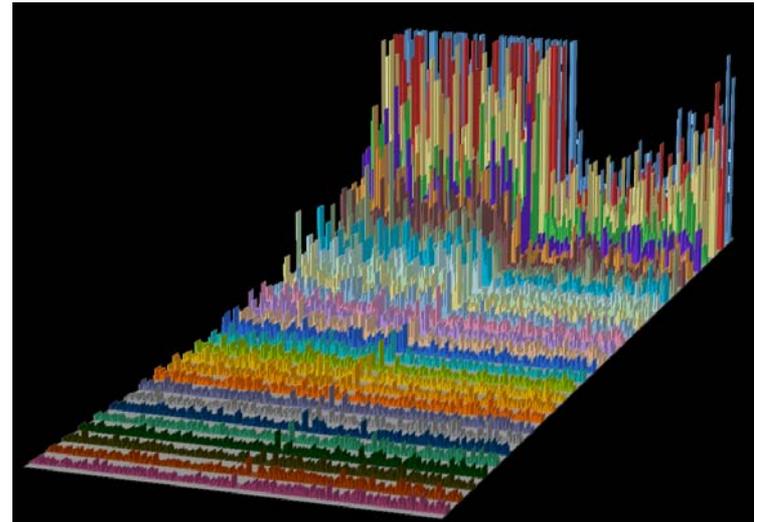
Frequency (Hz)

Compressed Spectral Array

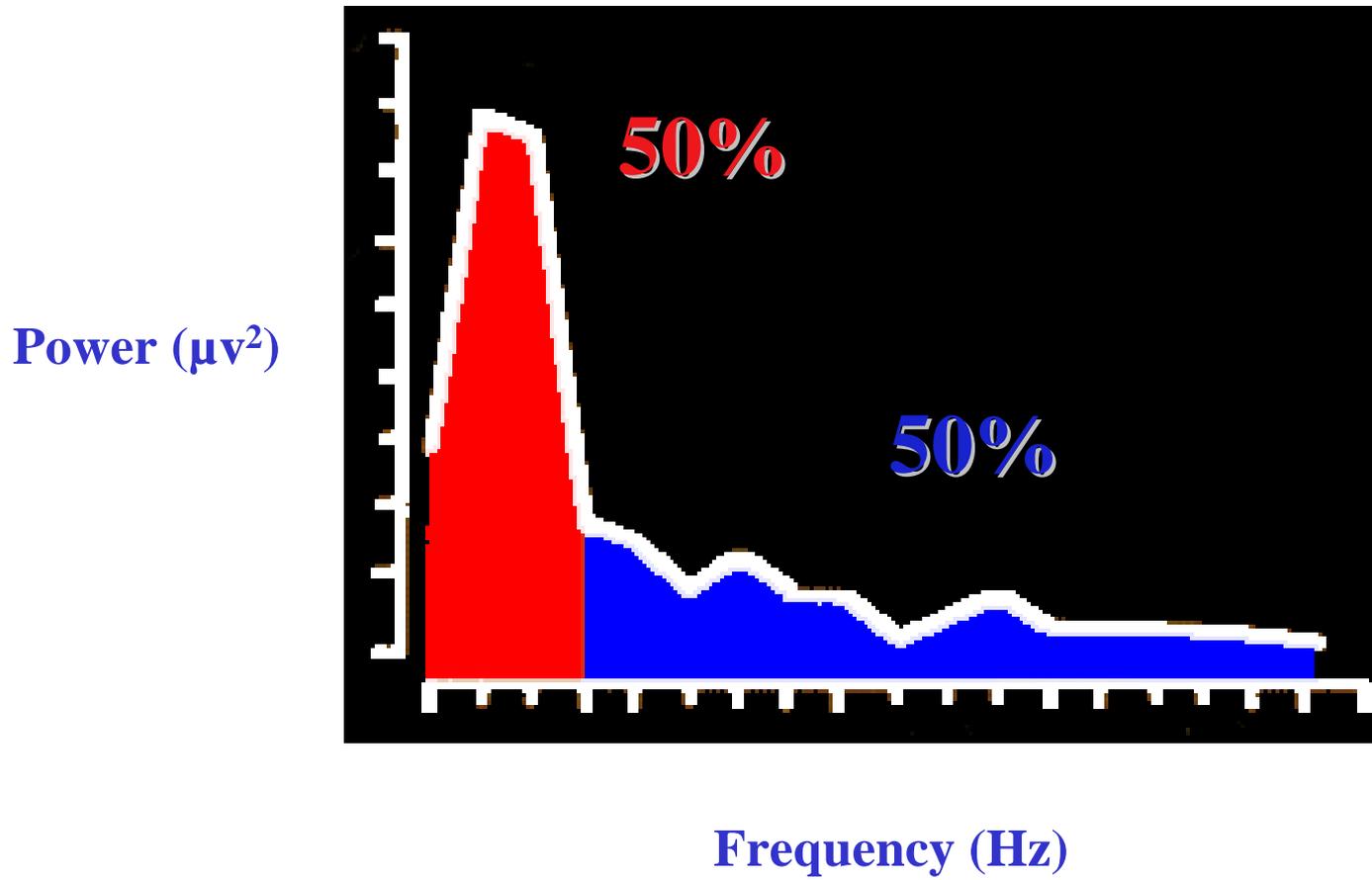


GA then LA+DH

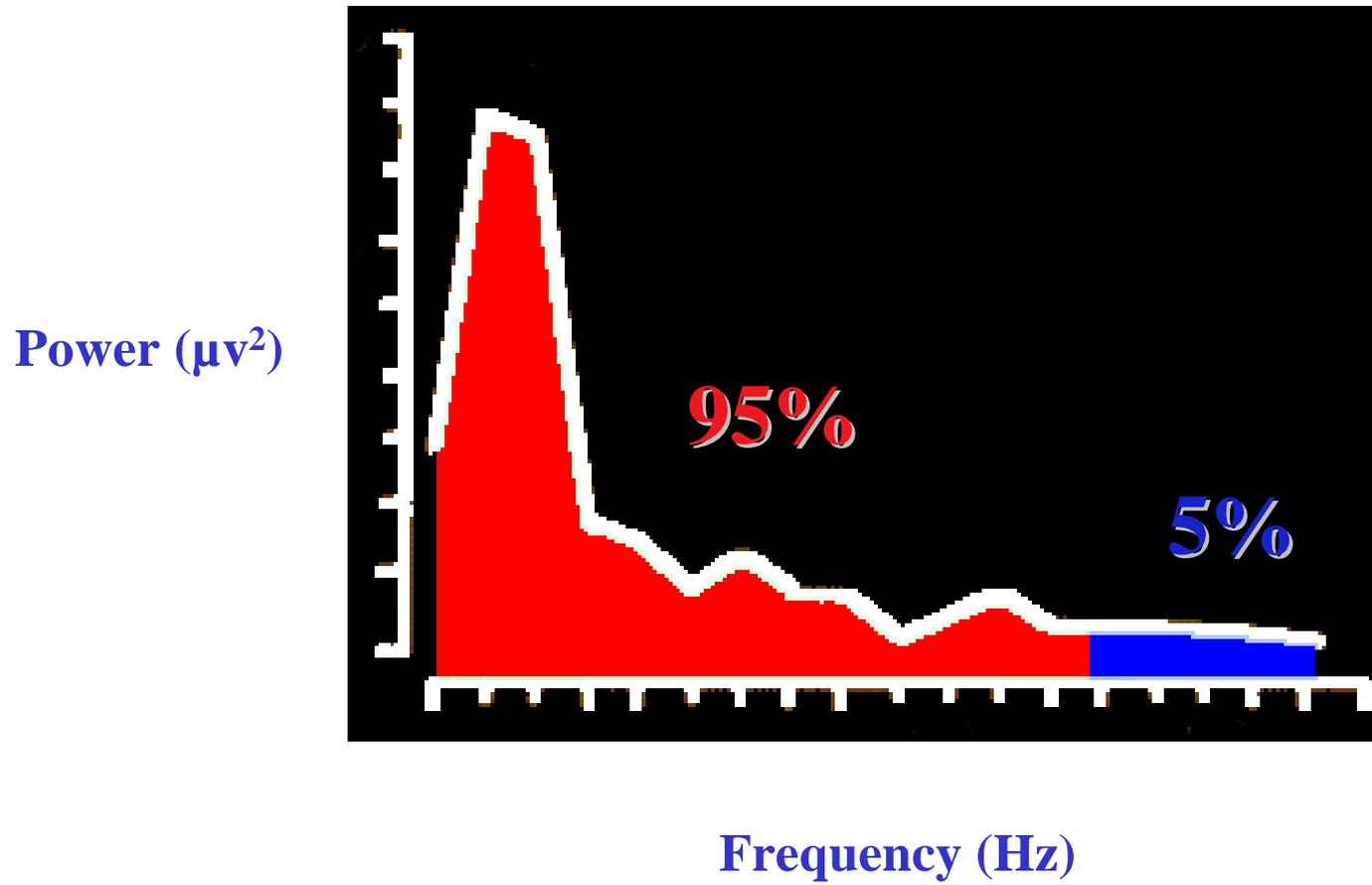
GA then DH



Median Frequency (F50)

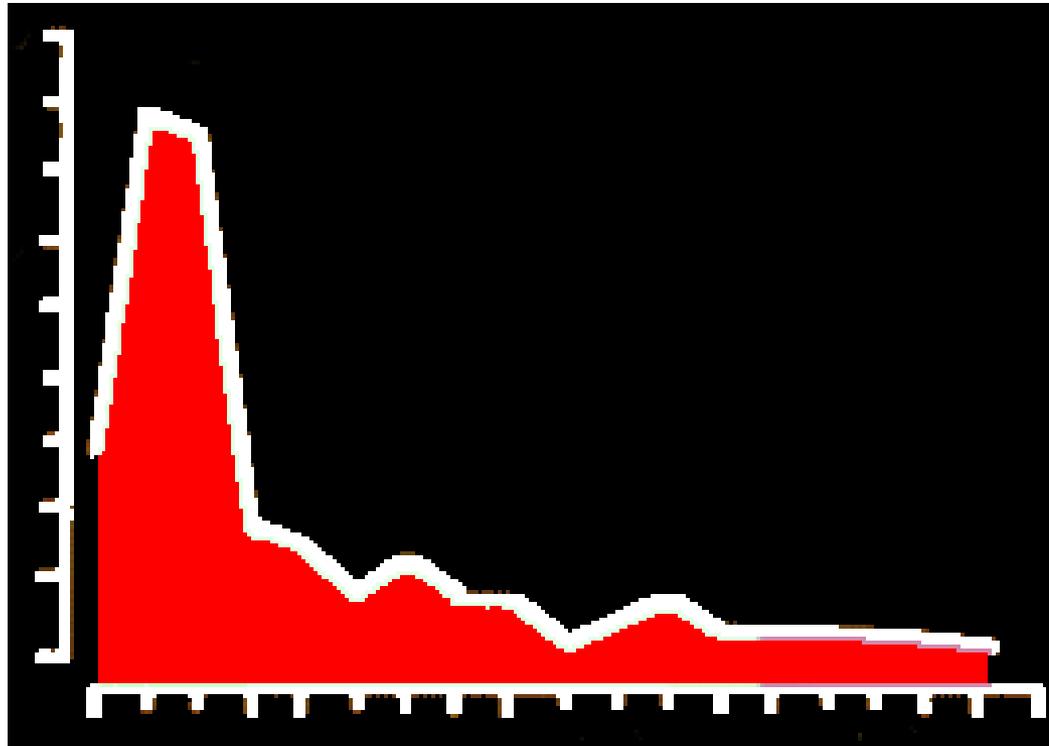


Spectral Edge Frequency (F95)



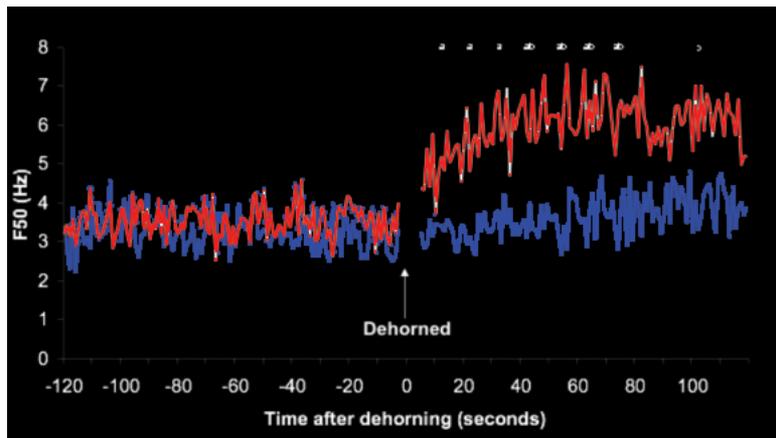
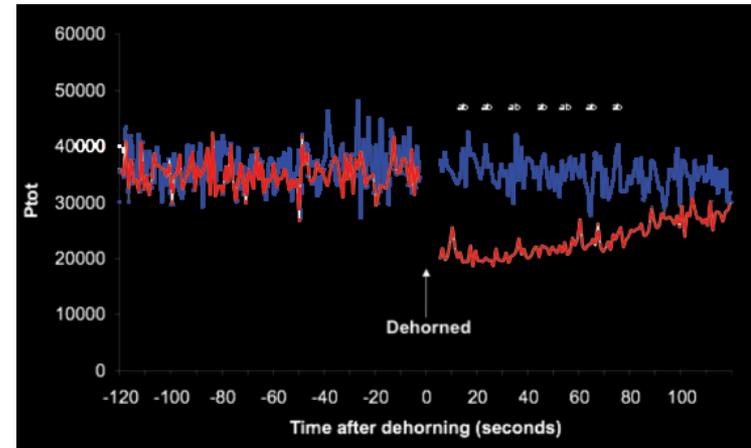
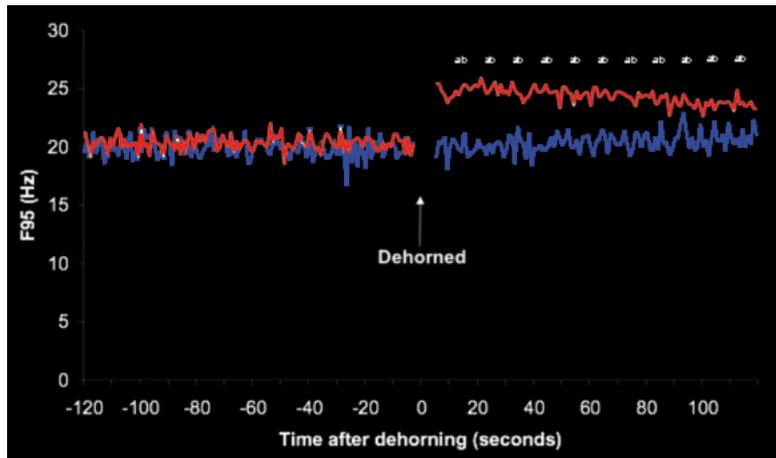
Total Power (P_{tot})

Power (μv^2)



Frequency (Hz)

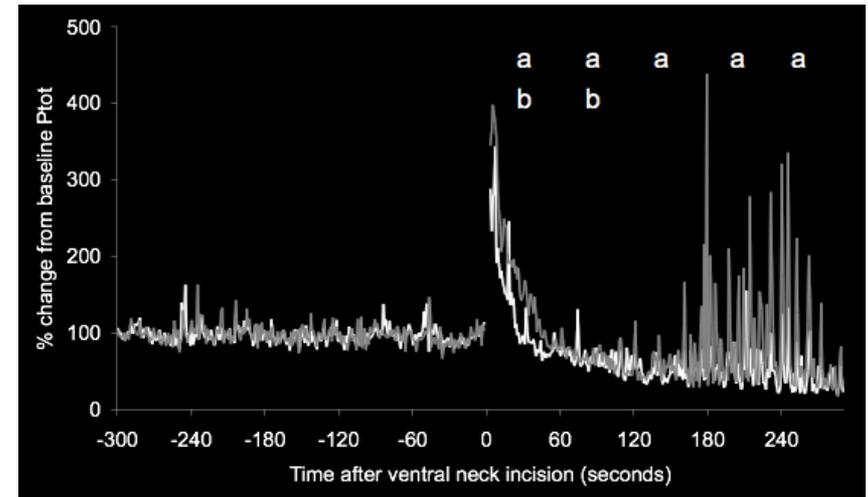
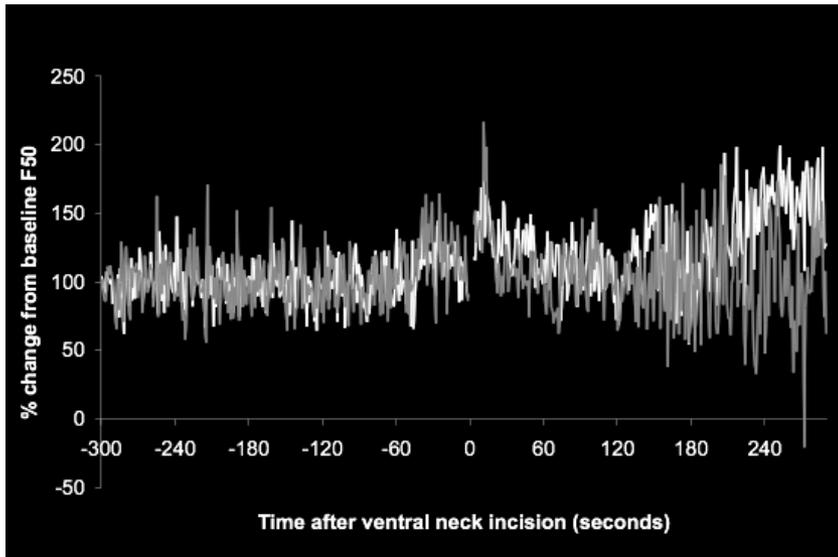
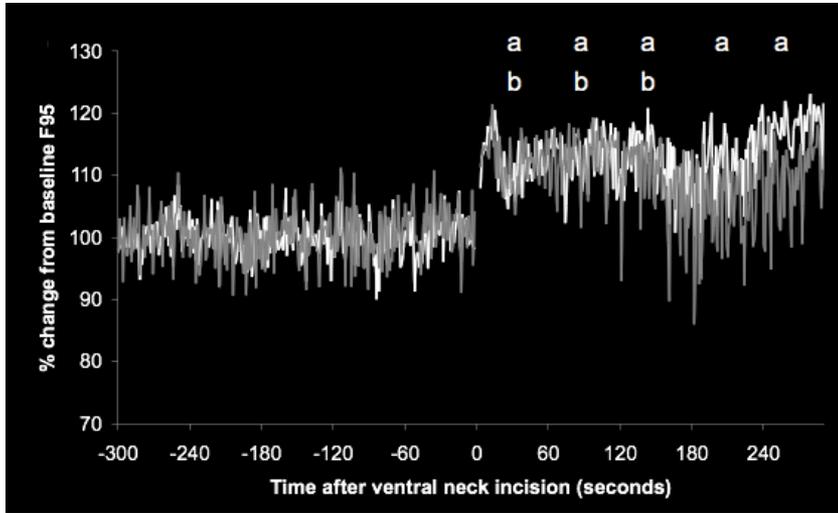
Effects of Surgical Dehorning



GA only

GA + LA

Effects of Ventral Neck Incision



Possible Mechanisms of EEG Responses

Noxious Stimulation Due to Transection of Sensitive Tissues

Hypoxaemia Due to Failure of Blood Supply

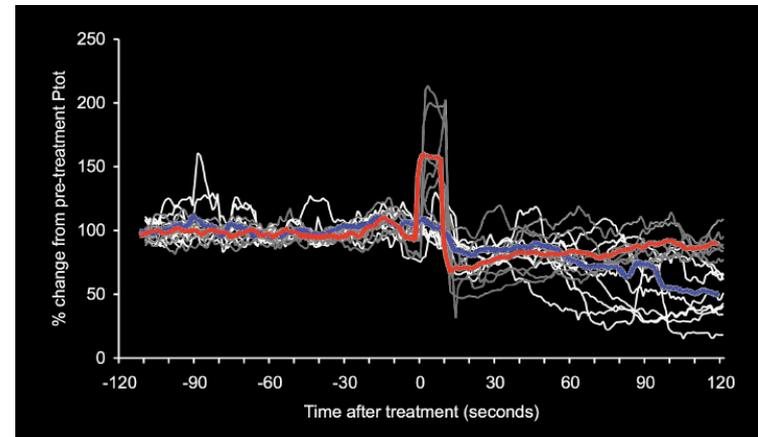
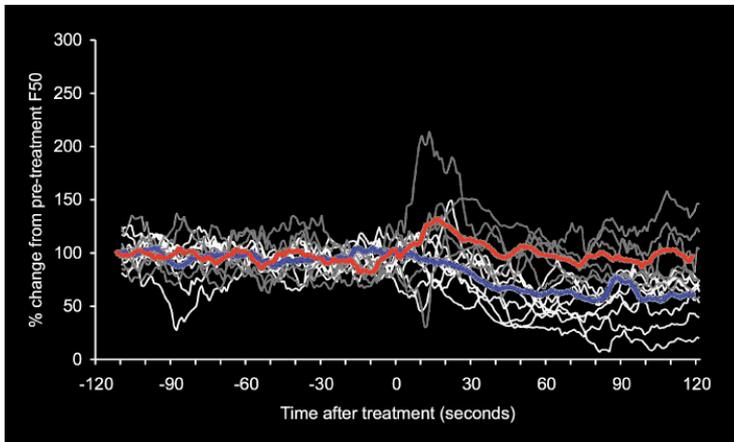
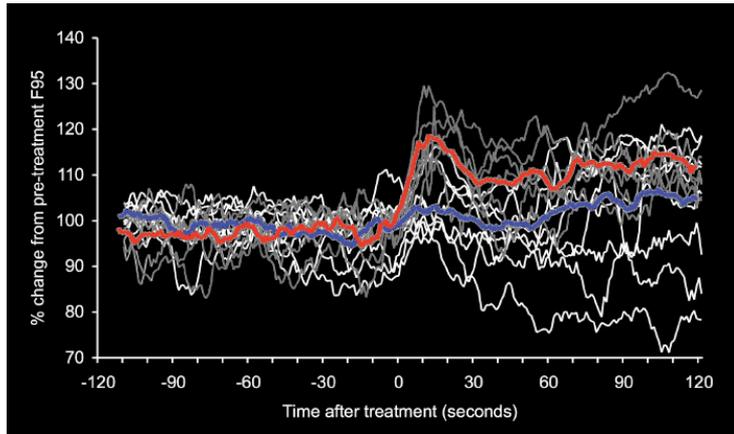
Vessel Incision



Neck Tissue Transection



Vessel Incision & Tissue Transection



Overall Conclusions

The minimal anaesthesia model for pain evaluation has been validated in cattle by scoop dehorning (a known noxious stimulus). This response was abolished by local anaesthesia.

Ventral neck incision elicits a cerebrocortical response that would be perceived as pain for the duration of consciousness.

Severing only the exposed vasculature did not elicit a response indicating this is not responsible for the cerebrocortical response.

Transecting the neck tissues elicited a response indicating that this is primarily responsible for the cerebrocortical response.

Overall Conclusion

These studies demonstrate clearly for the first time that the act of slaughter by ventral neck incision is associated with noxious stimulation that would be likely to be perceived as painful in the period between the incision and loss of consciousness. In cattle, this can be as long as 60 seconds or more (Newhook and Blackmore 1982).

Summing Up - Areas considered

- **Animal welfare – animals’ subjective experience**
- **The significance of pain – attitudes and attributes**
- **Ideas about humane slaughter**
- **Re-evaluation of neck-cut slaughter**