SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

SmartCow

an integrated infrastructure for increased research capability and innovation in the European cattle sector

Welfare, stress, pain

Véronique Deiss, INRAE
Alice de Boyer des Roches, VetAgro Sup and INRAE

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement n°730924

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Objectives of the course

- **Welfare and stress**
  - ✓ To define welfare and stress
  - ✓ To evaluate welfare and stress
- **Pain**
  - ✓ To define pain and explain the mechanisms
  - ✓ To identify the sources of pain
  - ✓ To cite pain indicators
  - ✓ To explain the 3S approach
  - ✓ To know the means to sooth pain

welfare: a mental state depending on the perception of the animal

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

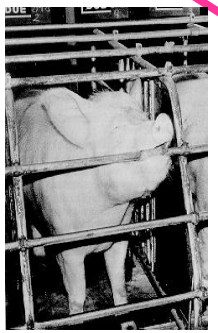
welfare

Harmony between an individual and his environment

Difficulty of adaptation

« Coping »

suffering



Perception Émotions

Adaptation

behavioural

physiological

Impairment of functions

Pathology, death

Veissier et al. 2007

Definition of welfare

An operational definition: **5 freedoms**

Freedom from pain, injury or disease

Freedom from discomfort

Freedom to express normal behaviour

Animal welfare

Freedom from hunger & thirst

Freedom from fear & distress and to express positive emotions

Farm Animal Welfare Council, 1992

SmartCow
an integrated infrastructure for increased research capability and innovation in the Europea

b. Design of measures

Welfare Quality

4 Principles	12 independant Criteria	33 On-farm measures
Good Feeding 	1. Absence of prolonged hunger	Body condition score
	2. Absence of prolonged thirst	Provision of water
Good Housing 	3. Comfort around resting	Behaviour at lying, Cleanliness of cows
	4. Thermal comfort	No measure available
	5. Ease of movement	Possibility for cows to walk
Good Health 	6. Absence of injuries	Lameness, Integument alterations
	7. Absence of diseases	Clinical observations : coughing, nasal discharge, ocular, discharge, vulvar discharge, diarrhea; Farm records: mastitis, mortality, dystocial, downer cow
	8. Absence of pain due to management	Dehorning practices
Appropriate Behaviour 	9. Expression of social behaviours	Agonistic interactions
	10. Expression of other species-specific behaviours	Access to pasture (No of days / year)
	11. Good human-animal relationship	Avoidance-distance test
	12. Positive emotional state	Qualitative behaviour assessment

Botreau et al, 2007
Botreau et al, 2009

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Measuring animal welfare on farms

b. Design of measures

Welfare Quality

→ Measures: Scientifically valid, reliable and feasible

Animal – based measures

Behavioural observations

Clinical observations

Ressource – based measures

Facilities

Practices

Measures are performed at 2 levels

Animal
(eg. BCS)

Herd
(eg. Access to pasture)

On-farm measures

- Body condition score
- Provision of water
- Behaviour at lying, Cleanliness of cows
- No measure available
- Possibility for cows to walk
- Lameness, Integument alterations
  Clinical observations : coughing, nasal discharge, ocular, discharge, vulvar discharge, diarrhea;
  Farm records: mastitis, mortality, dystocial, downer cow
- Dehorning practices
- Agonistic interactions
- Access to pasture (No of days / year)
- Avoidance-distance test
- Qualitative behaviour assessment

Botreau et al, 2007
Botreau et al, 2009

On-farm welfare-assessment protocols

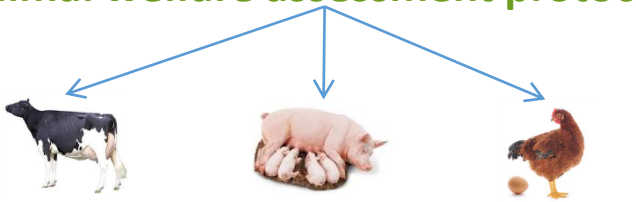
Welfare Quality® Science and society improving animal welfare

2004-2009

awin ANIMAL WELFARE INDICATORS

2009-2014

Developing on-farm animal welfare assessment protocols



Dairy cows

Sows and piglets

Laying hens

Fattening Cattle

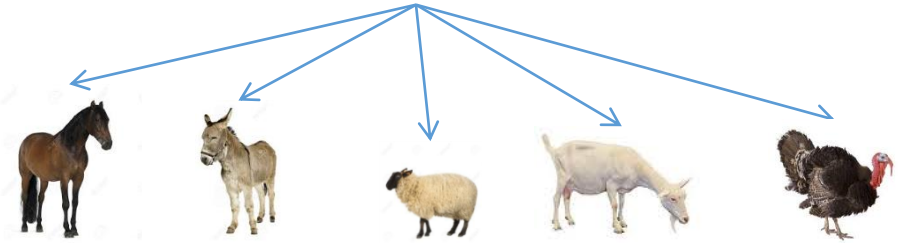
Growing pigs

Broiler chicken

Veal calves

Finishing pigs

Developing on-farm animal welfare assessment protocols



Horses

Donkeys

Sheep

Goats

Turkey

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

- Factors impacting welfare ……and our scientific results

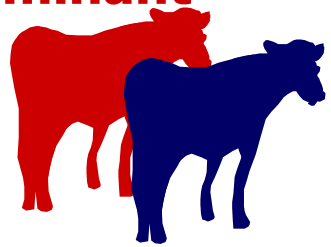
SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Absence of physical contact during food competition test

cattle

3 min competition test

dominant

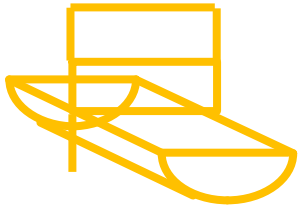


dominated

percentage of time spent eating by the dominated

4

47



68

74

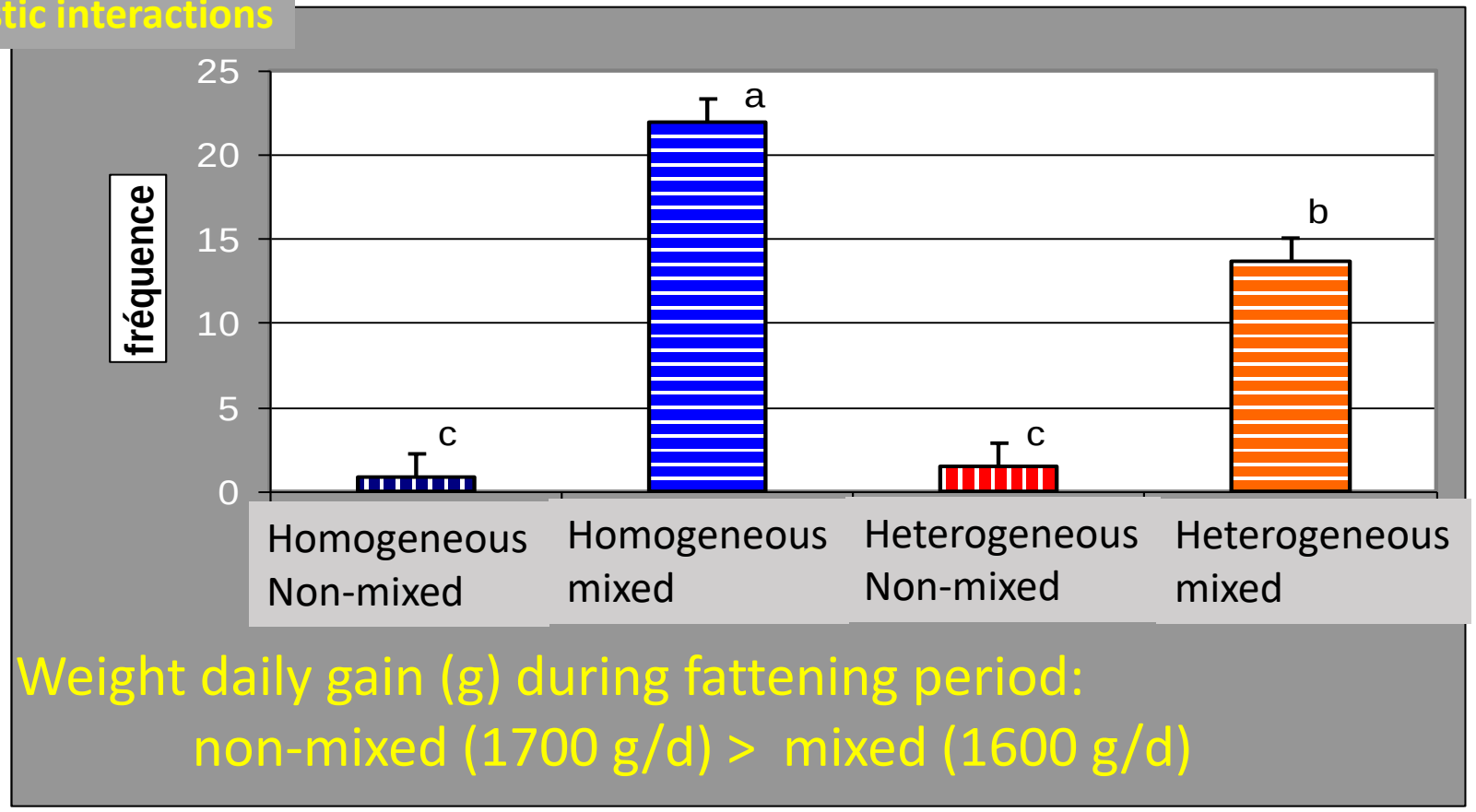
Protection of the head is essential

(Bouissou, 1980)

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Mixing beef bulls at the beginning of fattening

Agonistic interactions



Weight daily gain (g) during fattening period:
non-mixed (1700 g/d) > mixed (1600 g/d)

Mounier et al., 2006

→ mixed bulls exchanged more agonistic interactions than unmixed bulls
→ mixing bulls reduce growth

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Social density

survey of 78 fattening farms

kg taurillon / m²	165	210
Tail necrosis	no	yes
pneumona	23%	40%
diarrhea	3%	6%
lameness	5%	7%

Bisgaard Madsen, 1987

high density promotes disease development

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

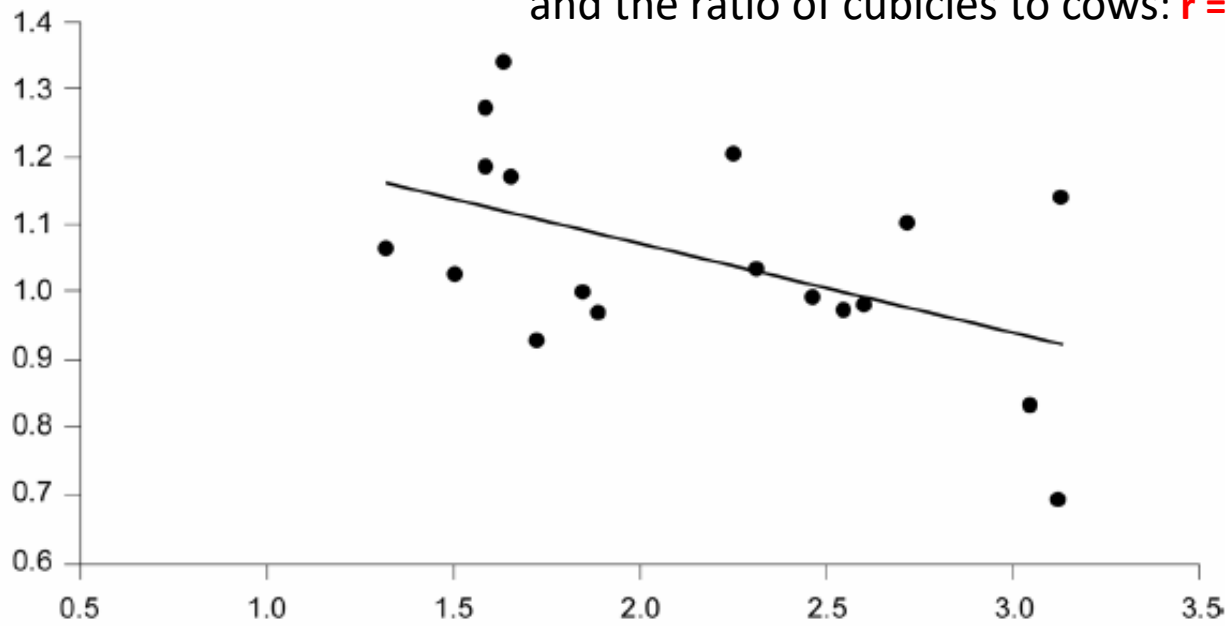
Ratio
Nber cubicles/ Nb cows

More cubicles than cows

1 cubicle per cow

fewer cubicles than cows

Negative correlations between locomotion score and the ratio of cubicles to cows: **r = - 0.505**



Insufficient resting space is associated locomotion problems

Bowell et al, 2003

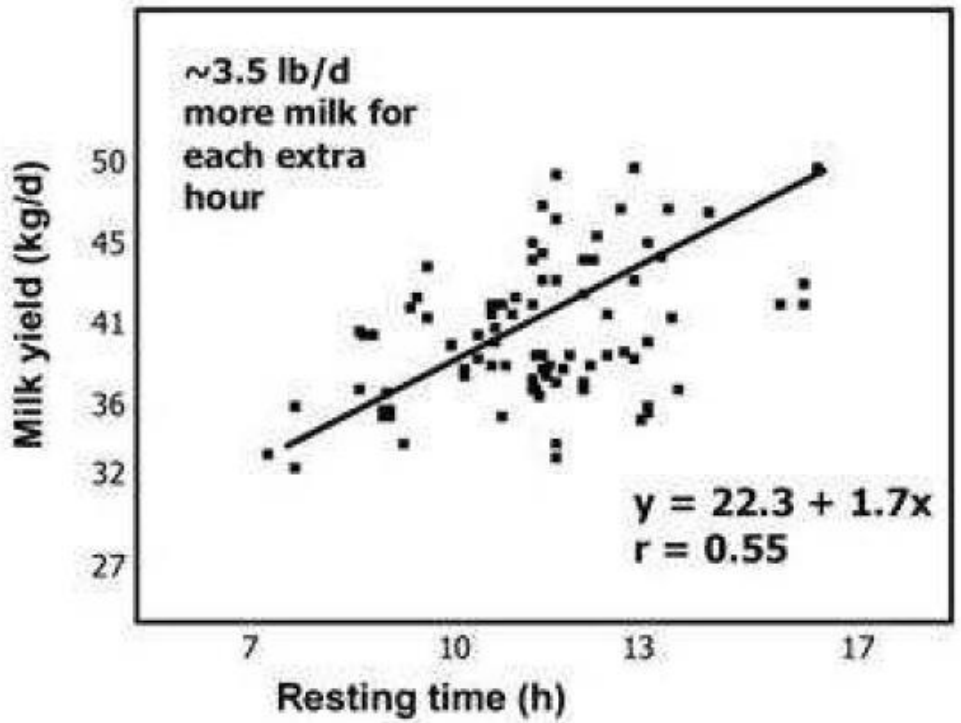


Figure 1. Relationship between resting time and milk yield in dairy cows (from Grant, 2004).

→ Milk production is correlated with time spent lying down

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Objectives of the course

- **Welfare and stress**
- To define welfare and stress
- To evaluate welfare and stress
- **Pain**
  - To define pain and explain the mechanisms
  - To explain the 3S approach
  - To identify sources of Pain
  - To know how can we measure pain ?
  - To define and use grids to assess pain
  - To Pain alleviation

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Minimising Pain promotes Welfare

Good feeding	1	Absence of prolonged hunger
	2	Absence of prolonged thirst
Good housing	3	Comfort around resting
	4	Thermal comfort
	5	Ease of movement
Good Health	6	Absence of injuries
	7	Absence of diseases
	8	Absence of pain
Appropriate Behaviour	9	Expression of social behaviour
	10	Expression of other specie-specific behaviours
	11	Human-Animal relationships
	12	Positive emotional state

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

What is pain ?

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Definition and mechanisms of Pain

IASP
International Association for the Study of Pain

« **A**n unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage »

« An aversive sensory and emotional experience (…), it changes the animal's physiology and behaviour to reduce or avoid damage, to reduce the likelihood of recurrence and to promote recovery »

Molony and Kent, *1997*

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Which animal can feel pain ?

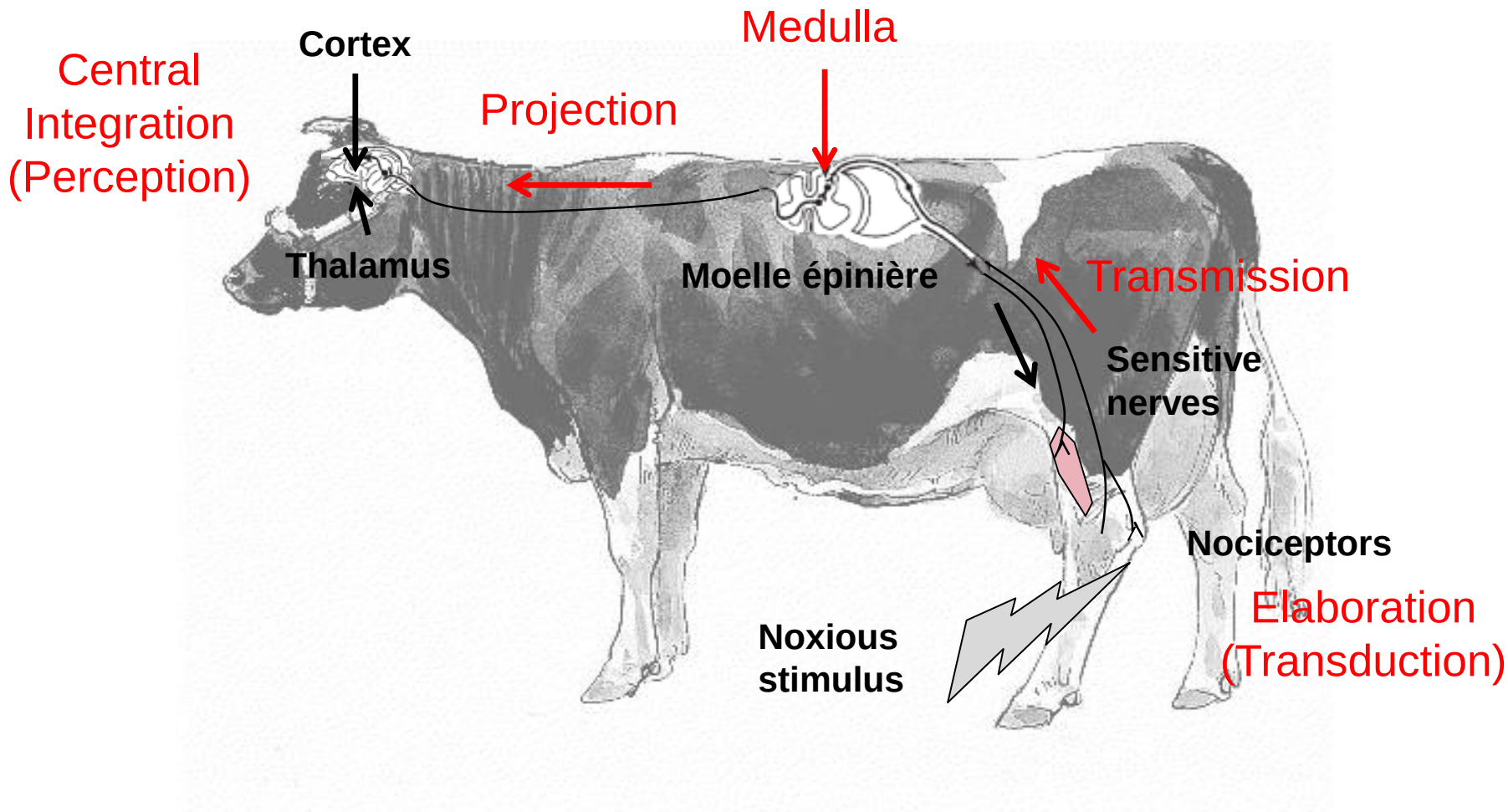
What scientific research has shown:

An animal is able to feel pain if there are :

- Receptors sensitive to noxious stimuli
- Receptors linked to a central nervous system by nerves
- Whole animal responses to noxious stimuli (physiological and behavioural changes) differ from those to innocuous stimuli
- Evidence of long-term motivational change that might include rapid learning
- In case of pain, analgesic treatments change the animal pain responses to noxious stimuli

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

→ Cattle can feel pain!



Adapté de : Handbook of Veterinary Pain management, 2015

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Outline

- Objectives
- Welfare and Stress
- Pain
  - Definitions and mechanisms
  - The 3S approach
  - Sources of Pain
  - How can we measure pain ?
  - Grids to assess pain
  - Pain alleviation

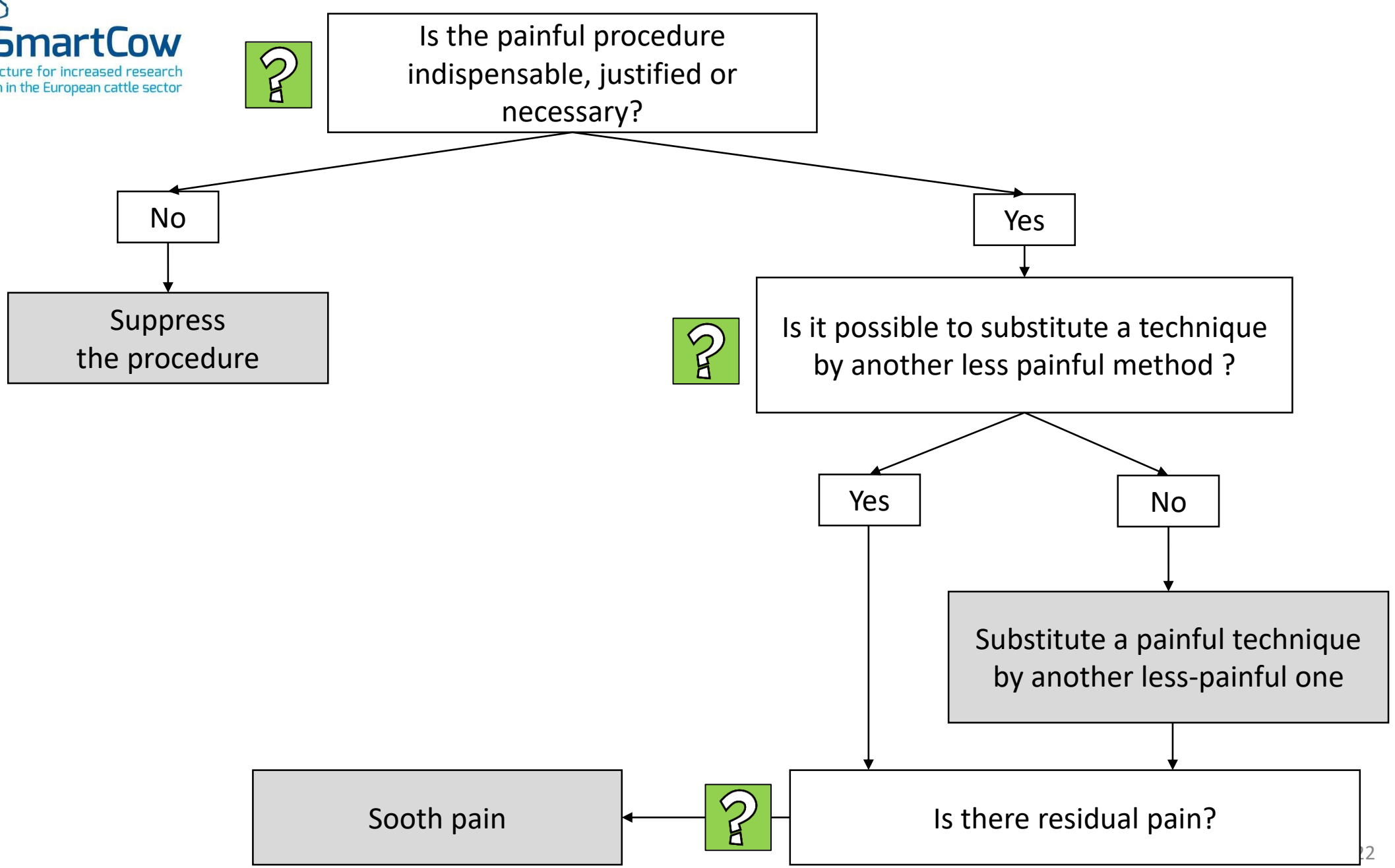
SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

The 3s Approach

3s Approach : Suppress / Substitute / Soothe

- **Suppress** the procedures that are a source of pain but not indispensable
- **Substitute** the painful procedure by the least painful procedure
- **Soothe** pain caused by procedures considered inavoidable
  - Prevention and treatment of pain
  - Care and peri-surgical environment

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector



SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Outline

- Objectives
- Welfare and Stress
- Pain
  - Definitions and mechanisms
  - The 3S approach
  - Sources of Pain
  - How can we measure pain ?
  - Grids to assess pain
  - Pain alleviation

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Sources of pain in cattle

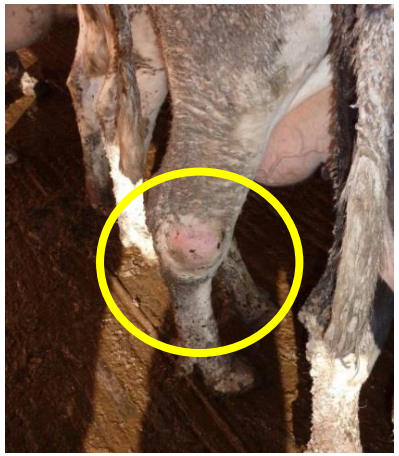
Branding

Disbudding / dehorning

Conflicts

Castration

Surgeries



Skin alterations

Parturition

Lameness

Mastitis and other infectious diseases

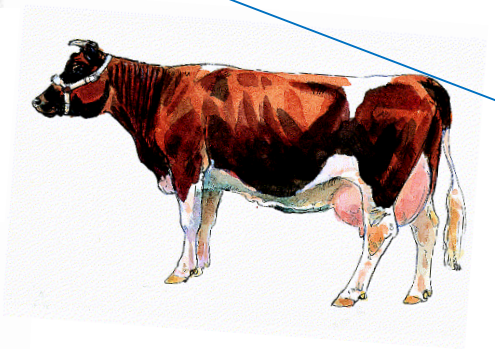
SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Outline

- Objectives
- Welfare and Stress
- Pain
  - Definitions and mechanisms
  - The 3S approach
  - Sources of Pain
  - How can we measure pain ?
  - Pain alleviation

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

How can we measure pain ?



Physiological indicators

Lesional indicators

Production performance indicators

Behavioural indicators

Prunier et al. 2013

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

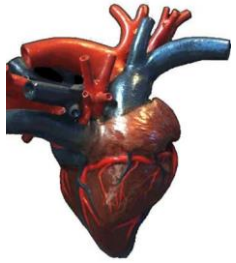
Physiological indicators of pain

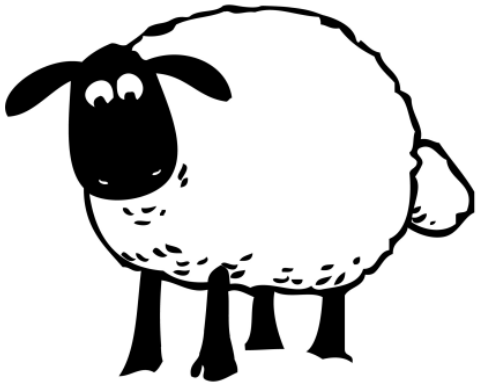
Indicators	Pain
Adrenalin	↗
Cortisol	↗
Cardiac frequency	↗
Respiratory frequency	↗
Cutaneou temperature	↘
Pupilary diametre	↗
Sudation	↗

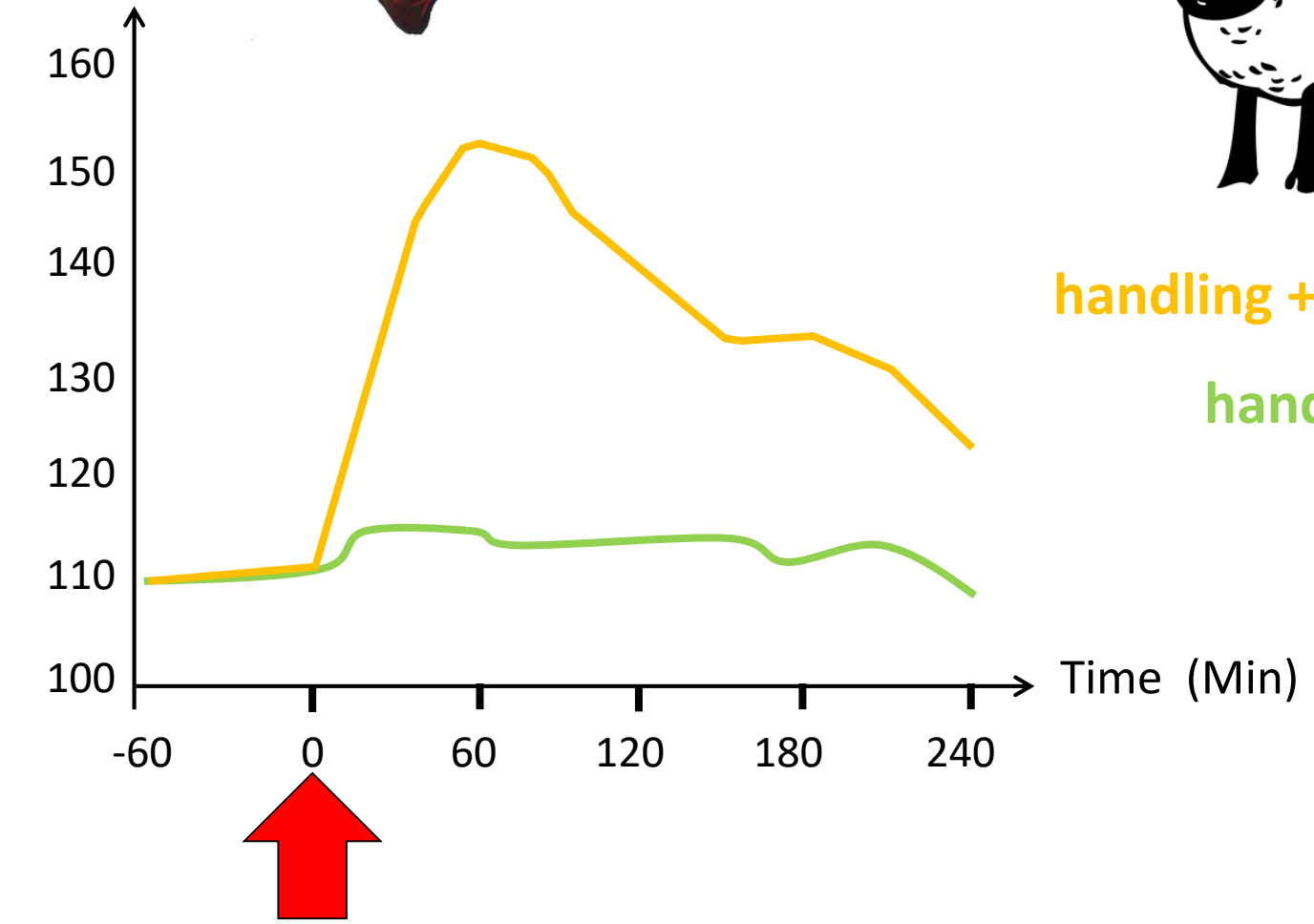
Others factors of stress

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Physiological indicators of pain







handling + castration

handling

Peers et al., 2012

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Physiological indicators of pain

- **Sensitive**

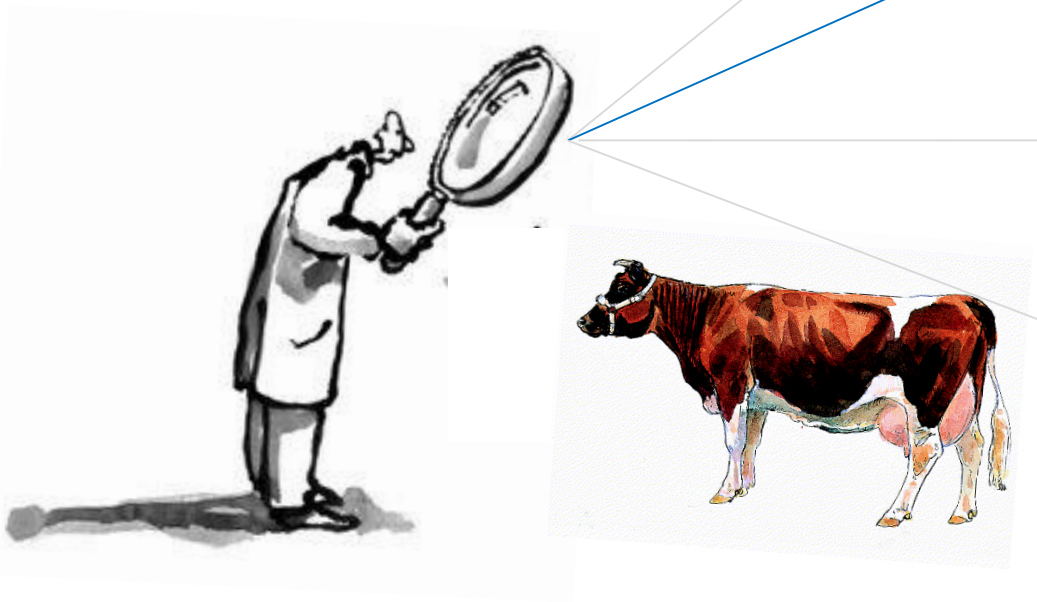
BUT

- **Not specific**: we need to take into the context to correctly interpret their variation
- **Often invasive** *BUT* not always (e.g. cortisol in saliva, respiratory rythm…)
- **Often « complicated »** if laboratory assays are needed *BUT* not always (e.g. respiratory rythm…)

Prunier et al. 2013

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

How can we measure pain ?



Physiological indicators

Lesional indicators

Production performance indicators

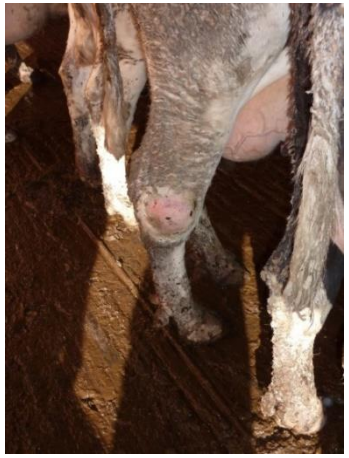
Behavioural indicators

Prunier et al. 2013

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Lesional indicators of pain

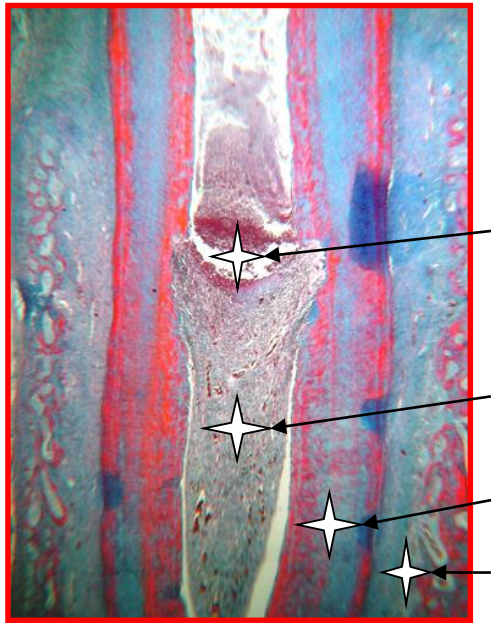
External



Photos: L. Mounier

Internal

Piglet teeth,
cut when 1day old
withdrawn at 28d old (*Hay et al 2004)*



SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Lesional indicators of pain

- **Very useful** because they can indicate a potential source of pain

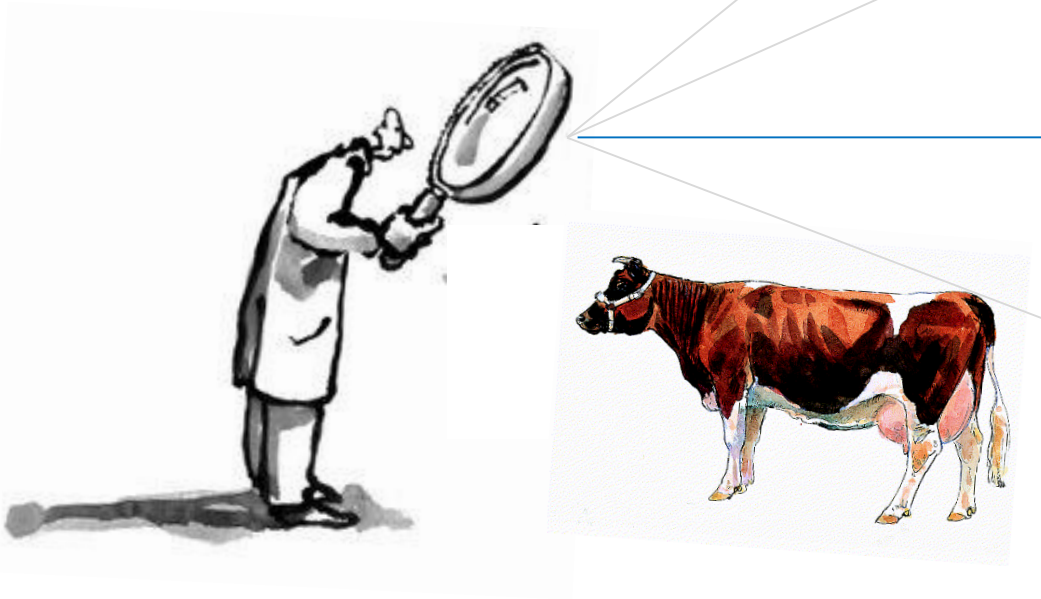
BUT

- **A lesion does not always induce pain**
- **Lesions** can be **internal** or **external**

Prunier et al. 2013

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

How can we measure pain ?



Physiological indicators

Lesional indicators

Production performance indicators

Behavioural indicators

Prunier et al. 2013

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Production performance indicators

- Calves 3-6 w old, disbudded at under different drug protocols

- **Growth rate** from D-3 to D+15 :
  - Calves disbudded without pain relief : 0.53 kg / d [0.47-0.60]
  - Calves disbudded with pain relief : 0.65 kg / d [0.62-0.68]

- **Growth rate** from D16 to D30 :
  - Calves disbudded without pain relief : 0.66 kg / d [0.61-0.71]
  - Calves disbudded with pain relief : 0.74 kg / d [0.69-0.80]

→ Dairy calves disbudded with no pain relief had slower growth rates than calves receiving pain relief.

Bates et al. 2016

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Production performance indicators

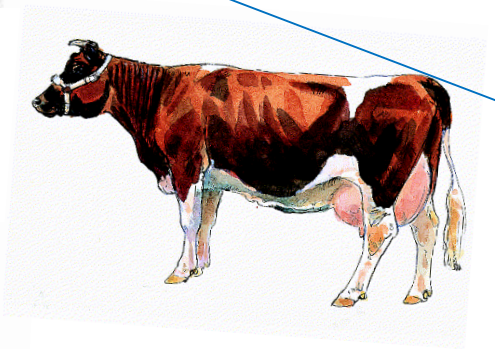
- Indicators **not very sensitive :** visible effects if intense or extended pain
- Indicators **not very specific :** numerous other causes possible

BUT

- **Easy to use** on farms

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

How can we measure pain ?



Physiological indicators

Lesional indicators

Production performance indicators

Behavioural indicators

Prunier et al. 2013

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Behavioural indicators of pain

General Behaviour

Specific Behaviour

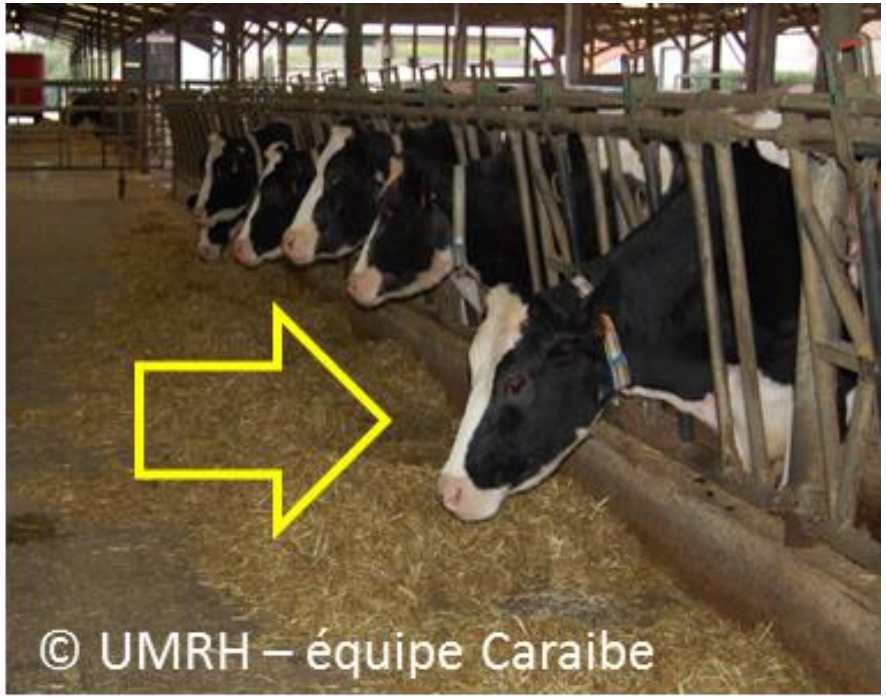
What kind of behaviour can we observe ?

- General Activity and social behaviour (isolation)
- Withdrawal movements (reflex)
- Behaviours and posture to reduce stimulation of the painful area
- Behaviours directed towards the painful area
- Vocalisations
- Expression Faciale

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Behavioural indicators of pain: General activity and social behaviour

Apathy



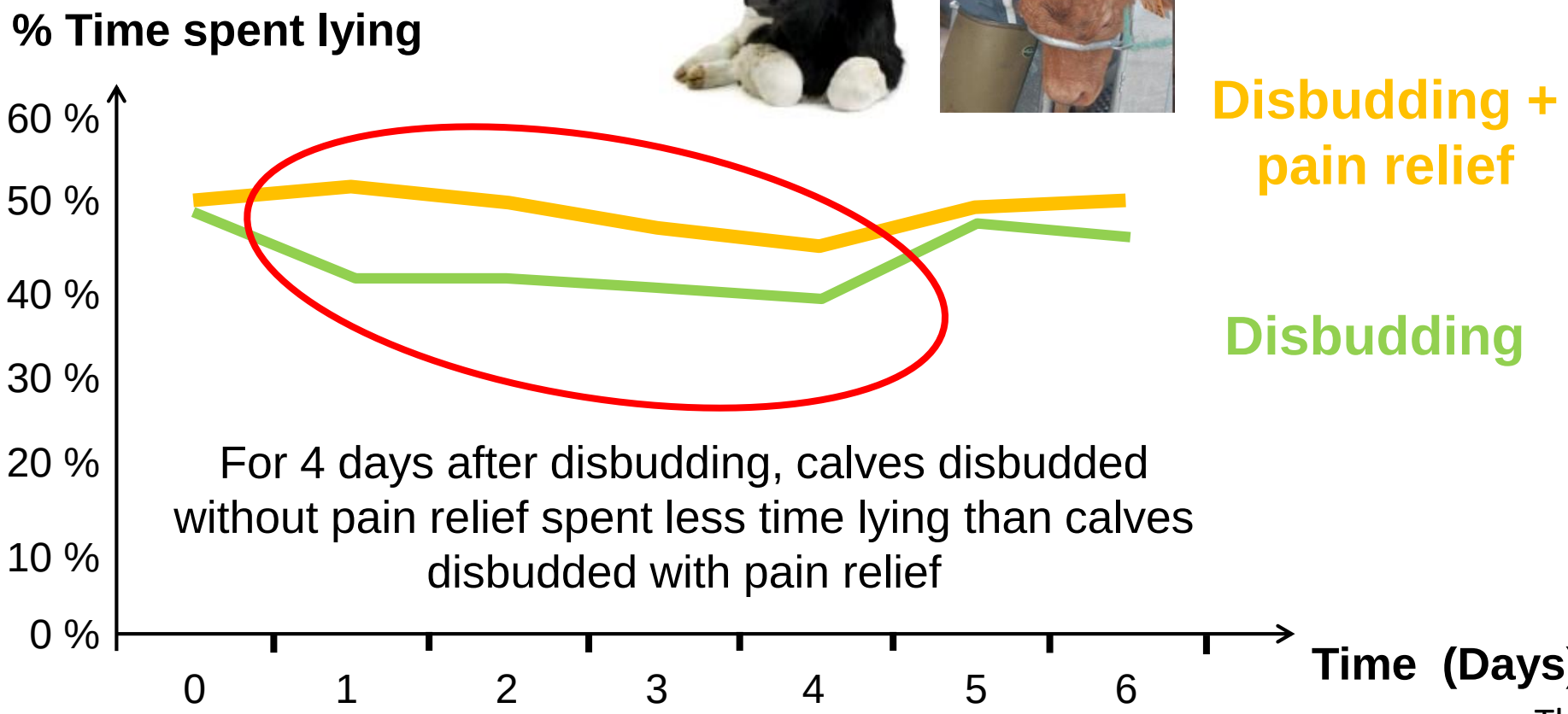
Isolation, desynchronisation

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Behavioural indicators of pain: General activity and social behaviour

Apathy

Behavioural indicators of pain: General activity



Theurer et al, 2012

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

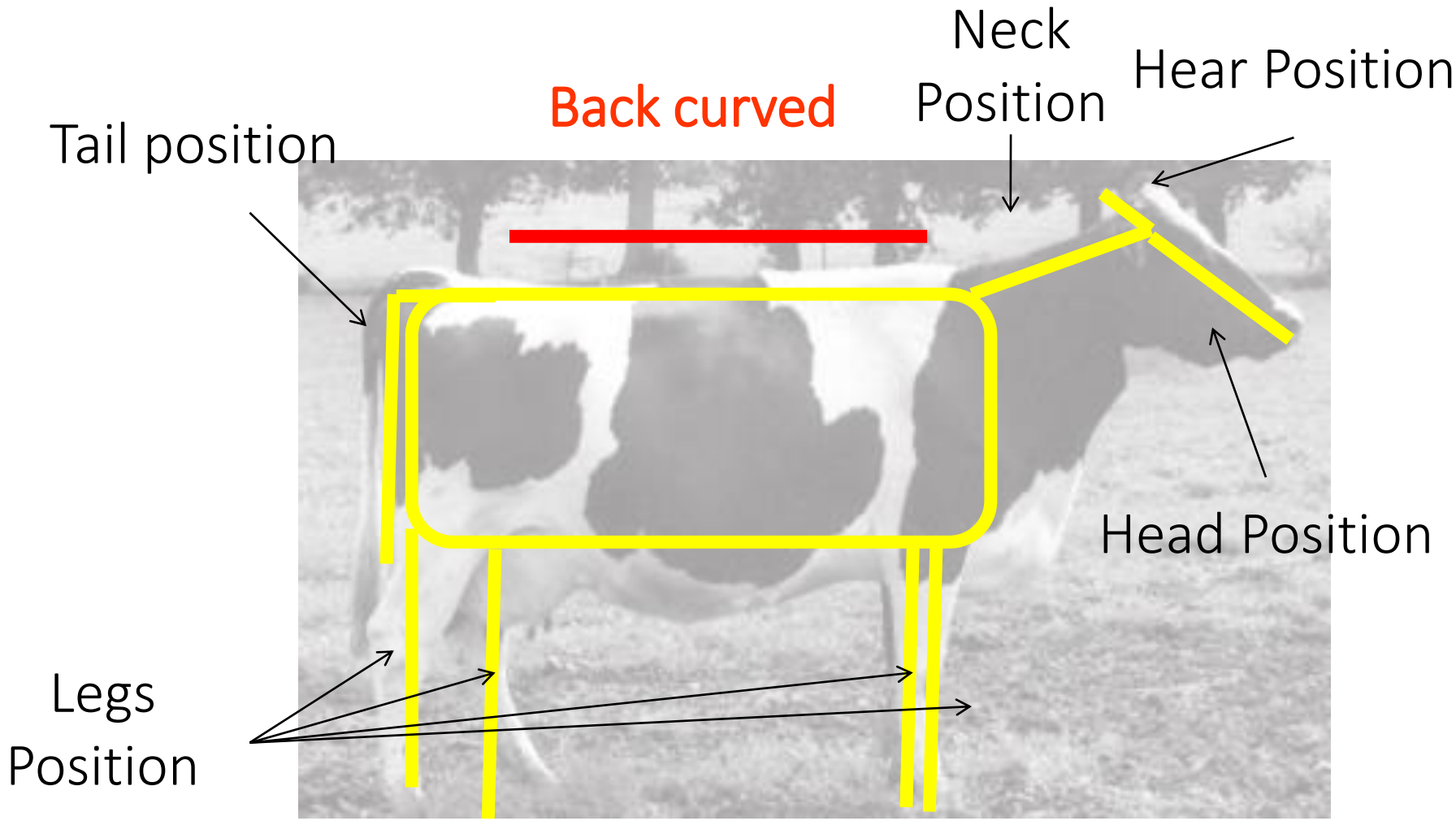
Behavioural indicators of pain: **withdrawal movements**

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Behavioural indicators of pain: **behaviours to reduce stimulation**

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

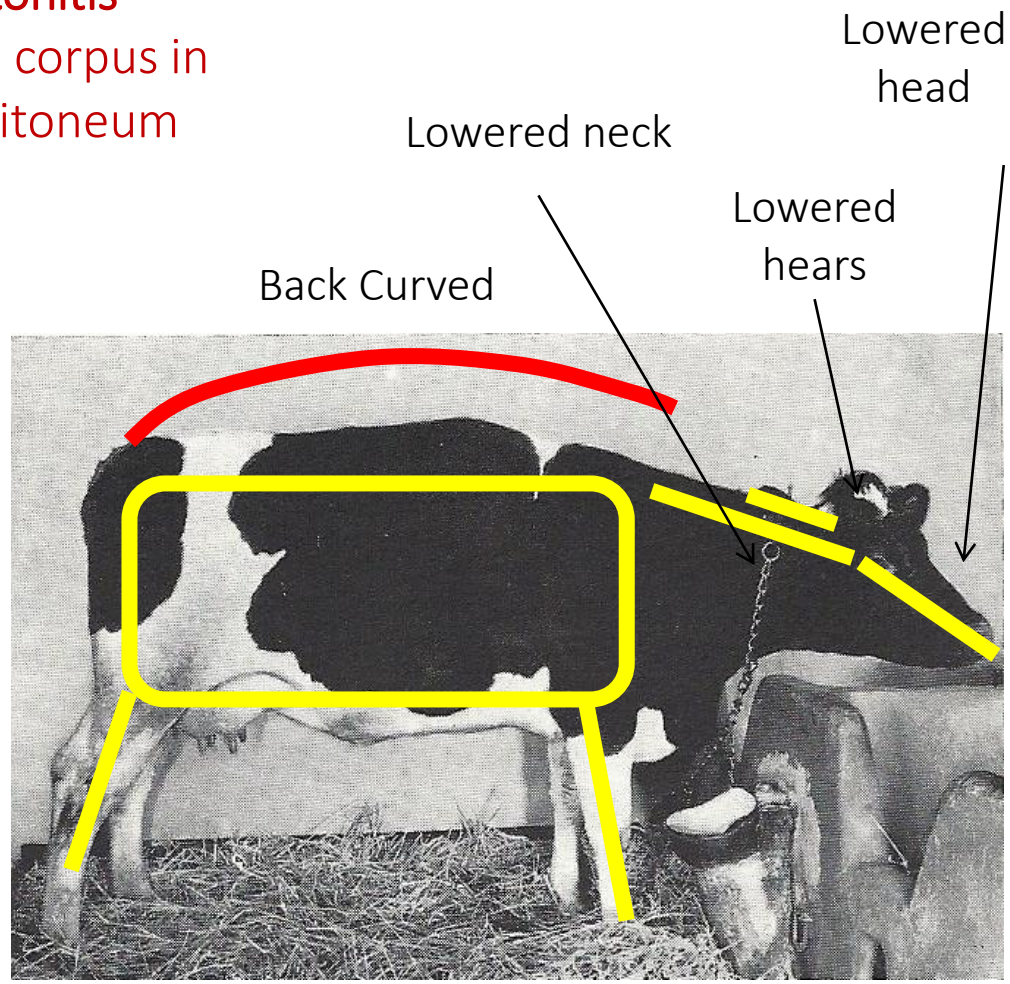
Behavioural indicators of pain: **behaviours to reduce stimulation**



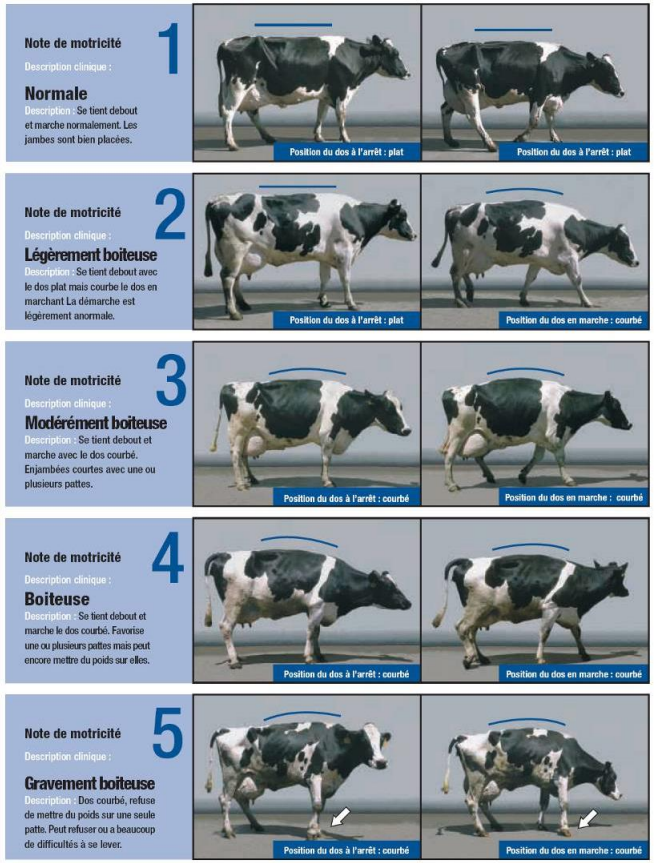
SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Behavioural indicators of pain: **behaviours to reduce stimulation**

Peritonitis
(external corpus in the peritoneum



Lameness Assessment



SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Behavioural indicators of pain: **behaviours to increase stimulation**

Cow with important visceral pain

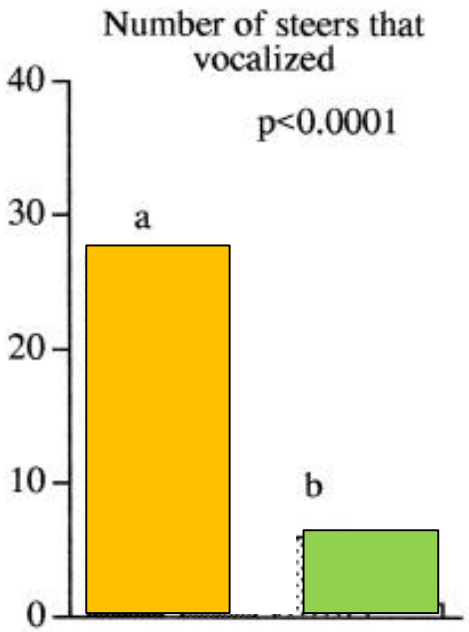
- Antalgic posture of the legs
- Hit herself with the rear legs

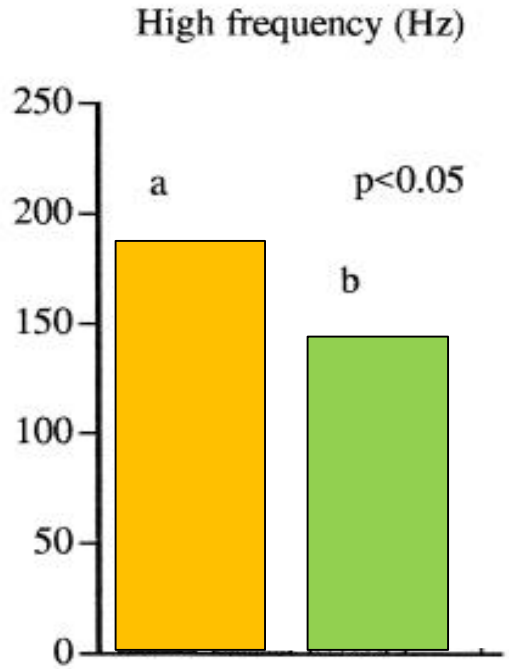
Behavioural indicators of pain: **Vocalizations**

Branding

Handling + **Branding**

Handling





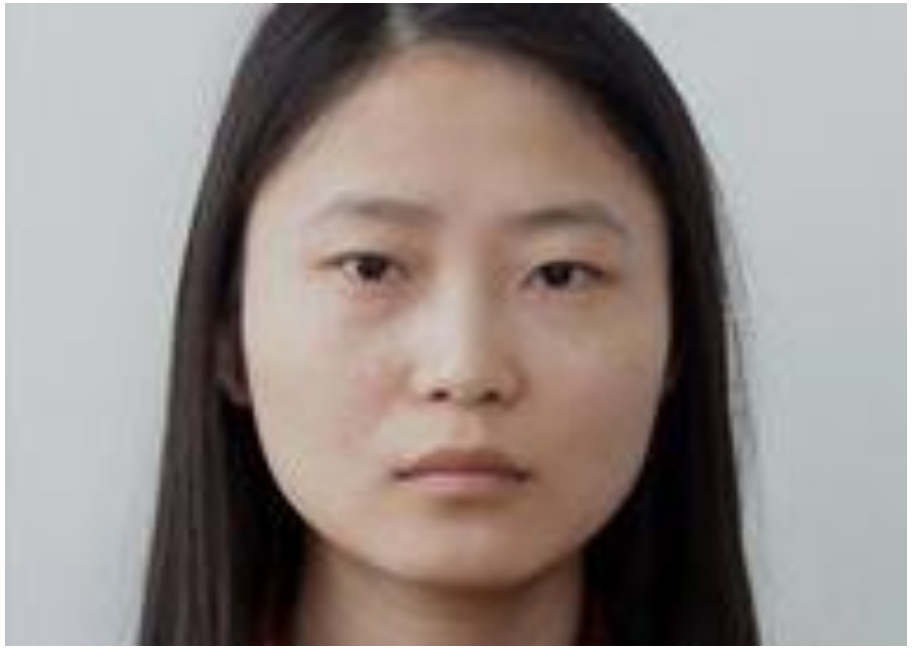
→ Branded steers are more numerous to vocalize

→ Their vocalizations have higher frequency

Watts & Stookey, 1999

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Behavioural indicators of pain: **Facial expression**



No pain

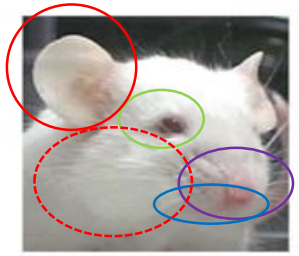
Pain

Prkachin & Kenneth M, 1992, Pain
Photos : Sun et al., 2017, Nature

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

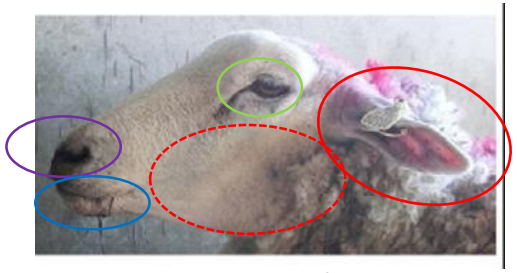
Behavioural indicators of pain: **Facial expression**

Mouse



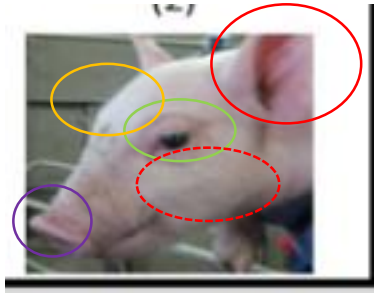
Langford et al., 2010

Sheep

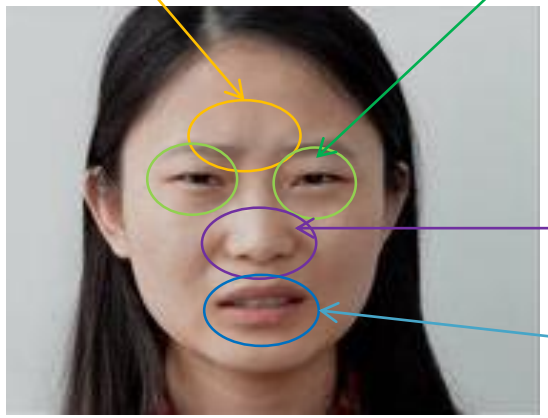


Mc Leenan et al, 2016

Piglets



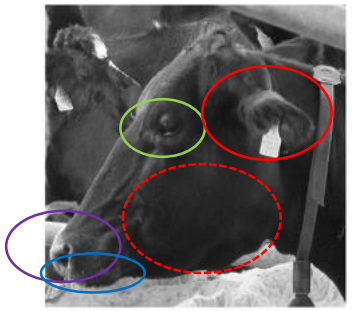
Di Giminiani et al, 2016



Douleur

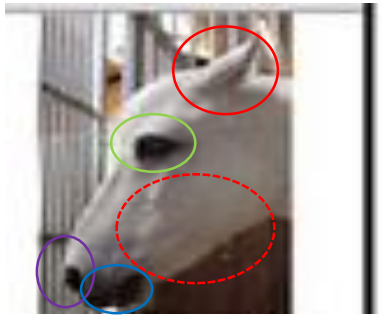
Sun et al., 2017

Cattle



Gleerup et al., 2015

Horse



Dalla Costa et al., 2014

3 other indicators:
Ears, vibrissae, jaws

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Behavioural indicators

- **Non invasive** and easy to see
- **Sensitive** and appear very quickly

BUT

- Often considered as « subjectives » and fewly reliable
- → Need to properly define what has to be observed and to train observers!
- Not always **specific**

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Outline

- Objectives
- Welfare and Stress
- Pain
  - Definitions and mechanisms
  - The 3S approach
  - Sources of Pain
  - How can we measure pain ?
  - Grids to assess pain
  - Pain alleviation

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Pain assessment grids in cattle

→ **Many papers describe** the cattle **responses** to various situations (disbudding, mastitis, etc…)
→ **Few papers** propose **Grids, these being developped in particular contexts :**

Diseases (various)

Applied Animal Behaviour Science 171 (2015) 25–32

Contents lists available at ScienceDirect

Applied Animal Behaviour Science

journal homepage: www.elsevier.com/locate/applanim

Pain evaluation in dairy cattle

Karina Bech Gleerup[a,*], Pia Haubro Andersen[b], Lene Munksgaard[c], Björn Forkman[a]

[a] University of Copenhagen, Department of Large Animal Sciences, Copenhagen, Denmark
[b] Swedish University of Agricultural Sciences, Department of Clinical Sciences, Uppsala, Sweden
[c] Aarhus University, Department of Animal Science, Aarhus, Denmark

Mastitis

J. Dairy Sci. TBC:1–13
https://doi.org/10.3168/jds.2017-12796

Behavioral and patho-physiological response as possible signs of pain in dairy cows during *Escherichia coli* mastitis: A pilot study

Alice de Boyer des Roches,*[1] Marion Faure,* Alexandra Lussert,† Vincent Herry,† Pascal Rainard,‡ Denys Durand,* and Gilles Foucras†

Castration

de Oliveira *et al. BMC Veterinary Research* 2014, **10**:200
http://www.biomedcentral.com/1746-6148/10/200

BMC Veterinary Research

RESEARCH ARTICLE Open Access

Validation of the UNESP-Botucatu unidimensional composite pain scale for assessing postoperative pain in cattle

Flávia Augusta de Oliveira[1†], Stelio Pacca Loureiro Luna[2*†], Jackson Barros do Amaral[3], Karoline Alves Rodrigues[2], Aline Cristina Sant'Anna[4], Milena Daolio[2] and Juliana Tabarelli Brondani[2]

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Pain assessment grids in cattle

Applied Animal Behaviour Science 171 (2015) 25–32

Contents lists available at ScienceDirect

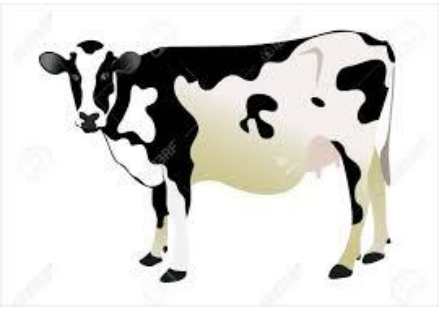
Applied Animal Behaviour Science

journal homepage: www.elsevier.com/locate/applanim

Pain evaluation in dairy cattle

Karina Bech Gleerup[a,*], Pia Haubro Andersen[b], Lene Munksgaard[c], Björn Forkman[a]

[a] University of Copenhagen, Department of Large Animal Sciences, Copenhagen, Denmark
[b] Swedish University of Agricultural Sciences, Department of Clinical Sciences, Uppsala, Sweden
[c] Aarhus University, Department of Animal Science, Aarhus, Denmark



3 levels
(expert-based levels)

6 indicators

Table 4
The Cow Pain Scale including the pain specific behaviours.

Score	0	1	2
Attention towards the surroundings	Active and attentive The cow is active: eating, ruminating, grooming etc. The cow is attentive and/or attention seeking/curious	Quiet/depressed The cow is not active, avoiding eye contact, may move away from the observer	
Head position	High/level of withers The cow is active, eating, ruminating or is contact seeking/curious	Level of withers The cow is *not active*, not eating, ruminating, grooming or sleeping	Low The cow is *not active*, not eating, ruminating, grooming or sleeping; may lie down quickly after getting up
Ear position	Both ears forward *or* one ear forward or back and the other listening	Ears back/asymmetric ear movements Both ears back or moving in different directions (not forward or back)	Lambs' ears Both ears to the sides and lower than usual; the pinna facing slightly down
Facial expression	Attentive/neutral look The cow is attentive, focused on a task (eating, ruminating) or sleeping	Tense expression/strained appearance The cow has a worried or strained look, furrows above the eyes and puckers above the nostrils	
Response to approach	Look at observer, head up, ears forward or occupied with activity (grooming, ruminating)	Look at observer, ears *not* forward, leave when approached	May/may *not* look at observer, head low, ears *not* forward may leave slowly
Back position	Normal	Slightly arched back	Arched back

Pain assessment grids in cattle

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

de Oliveira et al. BMC Veterinary Research 2014, 10:200
http://www.biomedcentral.com/1746-6148/10/200

BMC Veterinary Research

RESEARCH ARTICLE Open Access

Validation of the UNESP-Botucatu unidimensional composite pain scale for assessing postoperative pain in cattle

Flávia Augusta de Oliveira[1†], Stelio Pacca Loureiro Luna[2*†], Jackson Barros do Amaral[3], Karoline Alves Rodrigues[2], Aline Cristina Sant'Anna[4], Milena Daolio[2] and Juliana Tabarelli Brondani[2]

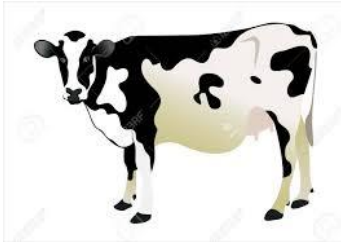
5 indicators;
3 levels per indicator
(observation-based levels)

Figure 1 Characteristic signs of pain in cattle after orchiectomy. A - Head below the line of spinal column; **B** - Hind limbs extended caudally when in standing posture; **C** - Moves and arches the back when in standing; **D** - Kicking/foot stamping; **E** - Licking the surgical wound; **F** - Lying down in ventral recumbency with full or partial extension of one or both hind limbs.

Item	Score/Criterion
Locomotion	• (0) Walking with no obviously abnormal gait.
	• (1) Walking with restriction, may be with hunched back and/or short steps.
	• (2) Reluctant to stand up, standing up with difficulty or not walking.
Interactive behaviour	• (0) Active; attention to tactile and/or visual and/or audible environmental stimuli; when near other animals, can interact with and/or accompany the group.
	• (1) Apathetic: may remain close to other animals, but interacts little when stimulated.
	• (2) Apathetic: may be isolated or may not accompany the other animals; does not react to tactile, visual and/or audible environmental stimuli.
Activity	• (0) Moves normally.
	• (1) Restless, moves more than normal or lies down and stands up with frequency.
	• (2) Moves less frequently in the pasture or only when stimulated.
Appetite	• (0) Normorexia and/or rumination.
	• (1) Hyporexia.
	• (2) Anorexia.
Miscellaneous behaviours	• Wagging the tail abruptly and repeatedly.
	• Licking the surgical wound.
	• Moves and arches the back when in standing posture.
	• Kicking/foot stamping.
	• Hind limbs extended caudally when in standing posture.
	• Head below the line of spinal column.
	• Lying down in ventral recumbency with full or partial extension of one or both hind limbs.
	• Lying down with the head on/close to the ground.
	• Extends the neck and body forward when lying in ventral recumbency.
	(0) All of the above described behaviours are absent.
	(1) Presence of 1 of the behaviours described above.
	(2) Presence of 2 or more of the behaviours described above.

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Pain assessment grids in cattle



J. Dairy Sci. TBC:1–13
https://doi.org/10.3168/jds.2017-12796

Behavioral and patho-physiological response as possible signs of pain in dairy cows during *Escherichia coli* mastitis: A pilot study

Alice de Boyer des Roches,*[1] Marion Faure,* Alexandra Lussert,† Vincent Herry,† Pascal Rainard,‡ Denys Durand,* and Gilles Foucras†

8 indicators
2 to 3 levels per indicator
(expert-based levels)

Table 1. Description of criteria evaluated in the behavior evaluation scheme

Item	Score and criterion	Maximum score
General attitude: Attention toward the surroundings and head position (Hudson et al., 2008; Prunier et al., 2013)	• (0) Cow active or attentive, and has her head at or above the line of spinal column • (0.5) Cow not active, does not look at the observer • (1) Cow avoids eye contact, is not active, not sleeping and not ruminating • (1) Cow's head below the line of spinal column	2
Ear position (Gleerup et al., 2015)	• (0) Both ears forward or one ear forward or back and the other moving back and forth • (1) Ears lower than spinal column, with an increased distance between ears and the opening facing downwards	1
Facial expression (Gleerup et al., 2015)	• (0) Attentive or neutral look with no furrows above nostrils • (1) Strained look with furrows above nostrils	1
Standing posture (de Oliveira et al., 2014)	• (0) Normal standing: standing, walking, eating, or investigating with no apparent abnormalities • (1) Standing unsteadily, sometimes the body leaning against a wall, or back arched standing, or standing with weight shifting on hind legs	1
Limb posture (de Oliveira et al., 2014)	• (0) Normal posture of the legs • (1) Standing with hind limbs extended caudally, or a leg held in suspension, or forelegs and hind legs brought closer	1
Lying position (Robertson et al., 1994)	• (0) Normal sternal recumbency • (0.5) Sternal recumbency with the hindlimbs partially or fully extended • (1) Lateral recumbency with one shoulder on the ground, with full or partial extension of one or both hind limbs	1
Miscellaneous abnormal behaviors (Hudson et al., 2008; Prunier et al.,2013)	• (0) Normorexia or rumination • (1) Foot stamping • (1) Hyporexia or anorexia • (1) Absence of rumination	3
Tail position (Mølgaard et al., 2012)	• (0) Normal position of tail • (0.5) Central part of tail slightly pressed against udder base • (1) Central part of tail pressed against udder base	1
Clinical signs (Hudson et al., 2008)	• (0) Normal eyes, smooth hair coat, no shivering • (1) Presence of eyes sunken into orbits • (1) Obviously erect hair coat • (1) Shivering of muscles • (1) Shivering • (1) Panting	5

SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

Grids to assess pain

- There is no « gold standard grid »
- Published grids were developped according to:
  - The situation assessed (e.g. castration, mastitis etc)
  - The species : *Bos tauros vs. Bos indicus*