Animal Welfare Science and Bioethics Centre

Professor David J Mellor
Professor Kevin J Stafford
Co-Directors

Collaborating Centre for Animal Welfare
Science and Bioethical Analysis:
Founding Partner

http://animalwelfare.massey.ac.nz

Animal Emotions, Behaviour and the Promotion of Positive Welfare States*

Professor David J Mellor
D.J.Mellor@massey.ac.nz

*Mellor (2012).
New Zealand Veterinary Journal – in press
Areas considered

• Introduction
• Motivational urges and drives
• Emotional action-orientated systems
• Implications for welfare codes
• Concluding remarks
Introduction

• Ideas about animal welfare have evolved over 30 years
• Early ideas focused on:
  – Biological function and restoring imbalances or disturbances
  – For example, dehydration, energy shortage, injury
  – Minimising –ve experiences – e.g. thirst, hunger, pain

• Affective states were then given increasing attention:
  – Largely based on behavioural observations
  – Focus still on minimising –ve experiences
  – For example, anxiety, fear, loneliness, boredom
Introduction

• Ideas about animal welfare have evolved over 30 years
• Early ideas focused on:
  – Biological function and restoring imbalances or disturbances
  – For example, dehydration, energy shortage, injury
  – Minimising –ve experiences – e.g. thirst, hunger, pain
• Affective states were then given increasing attention:
  – Largely based on behavioural observations
  – Focus still on minimising –ve experiences
  – For example, anxiety, fear, loneliness, boredom
• Now, AW is equivalent to what the animal experiences

Introduction

• AW is a state within an animal
• It is the integrated outcome of:
  – Internally generated sensory inputs
  – Externally generated sensory inputs
  – Giving rise to subjective, emotional or affective states
  – Experienced consciously
Introduction

• **AW is a state within an animal**
• It is the integrated outcome of:
  – *Internally generated* sensory inputs
  – *Externally generated* sensory inputs
  – Giving rise to *subjective, emotional or affective states*
  – *Experienced consciously*
• **Still, there is a strong emphasis on –ve states**
  – Thirst, hunger, pain, anxiety, fear, loneliness, boredom

Introduction

• **It is accepted that:**
  – Such experiences cannot be measured directly
  – BUT the biological states or external situations that give rise to them can be *managed*
  – E.g. manage water/food supply, avoid or treat injury, minimise emotional threats, provide company or variety
Introduction

• It is accepted that:
  – Such experiences cannot be measured directly
  – BUT the biological states or external situations that give rise to them can be managed
  – E.g. manage water/food supply, avoid or treat injury, minimise emotional threats, provide company or variety

• Also, there is now an increasing emphasis:
  – On promoting +ve experiences
  – While continuing to minimise –ve experiences

Introduction

• These +ve states include:
  – Pleasure, comfort, contentment, curiosity, playfulness

• BUT ‘functionalists’ are uneasy about such affective states:
  – Cannot be monitored easily with biological function indices
  – Rely heavily on behavioural indices that have ill-defined functional (neurophysiological) foundations
  – Therefore appear to ‘functionalists’ to be only marginally credibility
Introduction

A major purpose here:

Is to show that there is an increasingly secure scientific understanding of the neurological foundations of affective states and the motivational drives that energise and direct their associated behaviours.

In other words:

To functionally validate the use of selected behaviours as indices of the emotional contents of +ve affective states such as pleasure, comfort, contentment, curiosity and playfulness.
Introduction

RELAX

This talk will NOT be an obscurantist discourse on complex neurophysiology or neuropsychology

BUT

There WILL be some brief and very easily understood descriptions of relevant neurological mechanisms

[More detail is provided in my paper]

Introduction

Another major purpose

Is to show:

That minimising –ve experiences can at best produce neutral welfare states

And

That by refocusing our understanding we can replace nett –ve welfare states with +ve states
Areas considered

- Introduction
- Motivational urges and drives
- Emotional action-orientated systems
- Implications for welfare codes
- Concluding remarks

Motivational urges and drives

- Health and survival depend on homeostatic mechanisms
- Their critical role is interactions between the internal and external environments of the body
- These interactions are active not passive
Motivational urges and drives

- Health and survival depend on homeostatic mechanisms
- Their critical role is interactions between the internal and external environments of the body
- These interactions are active not passive
- They are focused on basic functions: e.g.
  - Respiratory gas exchange
  - Fluid (water/electrolyte) balance
  - Nutrient supply and utilisation
  - Thermal equilibrium
  - Responses to injury

Motivational urges and drives

- These interactions involve purposeful behaviours at various levels of complexity
- These behaviours are essential for survival
- They involve various motivational urges and drives
- These urges and drives represent the subjective elements of these instinctual behavioural patterns
Motivational urges and drives

- These urges and drives include:
  - Hunger for air (breathlessness)
  - Thirst
  - Hunger for specific minerals
  - Hunger for energy-dense food
  - Pain
  - Sensations accompanying visceral functions such as micturition or defecation
  - Desire for sleep after severe deprivation
  - Avoidance of change in body core temperature


Here we are keeping it simple
Motivational urges and drives

- These urges and drives have **two key characteristics**:  
  - A **commanding specific sensation**:  
    - They often make only *mild intrusions* into consciousness  
    - BUT, when strong, they can *dominate consciousness*  
    - They are *subjectively distinct* – we do not mix them up  
  - A **compelling specific intention**:  
    - *Thirst* generates a compelling intention to *drink*, NOT eat or *defecate*  
    - *Air hunger*, due to suffocation, generates a compelling intention to *fight for breath*

**A striking feature of each urge and drive**

- Once the *motivated behaviour* achieves its *objective* there is a *precipitous decline* in both the *sensation* and the *intention*:  
  - Air hunger is extinguished rapidly with a few deep breaths  
  - Thirst with drinking of water  
  - Salt hunger with ingestion of salt  
  - General hunger with the speedy consumption of food

- *Brain imaging studies* show neural correlates with the changes in these urges or drives
Motivational urges and drives

Brain imaging studies:

- **Intense activation** in particular cortical regions:
  - When marked *air hunger* is at its height
  - When marked *thirst* is at its height

- **Deactivation** in these cortical regions accompanies:
  - *Rapid extinction* of air hunger with *restoration of breathing*
  - *Rapid extinction* of thirst with *drinking to satiation*

- The cortical activation and deactivation, respectively, are linked to the onset and rapid loss of conscious awareness of these urges and drives

---

Motivational urges and drives

A reminder:

- These urges and drives are derived from sensory ‘scanning’ of the internal conditions of the body

Animal welfare implication

- This pattern of cortical activation/deactivation supports the view that minimisation of such urges and drives (which are –ve mental states) merely moves the associated welfare state from –ve to neutral, NOT beyond neutral to +ve
Areas considered

- Introduction
- Motivational urges and drives
- Emotional action-orientated systems
- Implications for welfare codes
- Concluding remarks

Emotional action-orientated systems

*Further reminder:*
- Long proposed, now widely accepted that animals can also have +ve experiences
- Thus, it is likely that AW compromise may result from factors that prevent +ve experiences
- Promoting good AW thus requires BOTH the minimisation of –ve and the promotion of +ve experiences
- Such experiences are subjective, emotional and/or affective in character
Emotional action-orientated systems

Motivational urges and drives – yet another reminder:

• These arise from sensory ‘scanning’ of the internal conditions of the body via ‘interoreceptors’

Emotional or affective states:

• These arise from sensory ‘scanning’ of the external circumstances of the body
• The sensory receptors are ‘exteroreceptors’ such as those in the eyes, ears, nose and skin

Emotional action-orientated systems

Emotional or affective states

• These include:
  – anxiety, depression, disgust, fear, rage –ve states
  – affection, contentment, happiness, playfulness +ve states

• Brain excitation and imaging studies (human/animal):
  – An established neural circuitry is involved
  – Each emotion engages brain regions in distinctive patterns of activation and deactivation
Emotional action-orientated systems

• Jaak Panksepp’s *neuropsychological thinking and research* are important here:
  – To date, they have *not* been imported into *animal welfare science* thinking to any great extent
  – In part because of the *discursive character of his writing*
    • High quality, a delight to read, but lengthy and hard work
  – In part because of its *neurophysiological complexities*
  – In part because he attributes intentionality and *emotional contents to behaviour* – ideas that are only now regaining credibility

*Panksepp (2005). Consciousness and Cognition 14, 30-80*

---

Emotional action-orientated systems

• Thus, Panksepp’s *neuropsychological thinking and research* are not well known in animal welfare circles:
  – Recently I have made an attempt to correct this omission
  – I have distilled Panksepp’s key insights and the supporting evidence into a few easily understood paragraphs
  – These give more detail than I shall provide here

Emotional action-orientated systems

- Panksepp and colleagues have conceived of seven emotional action-orientated systems and outlined their cogent neuropsychological foundations:
  - SEEKING +
  - FEAR -
  - RAGE-ASSERTIVENESS* +/- (RAGE)
  - BONDING* +/- (PANIC)
  - CARE +
  - PLAY +
  - LUST +

The names are capitalised purposely

Emotional action-orientated systems

- SEEKING system:
  - Its embedded emotional content includes
    - Compelling exploratory urges
    - Involving wanting and expectancy
    - Leading to engaged aliveness and excitement
  - Behaviourally expressed as goal-directed, energised exploration of or interaction with the environment

- Neural circuits include those associated with +ve affect or reward
Emotional action-orientated systems

- **FEAR system:**
  - *Generates* –ve affects of
    - Anxiety
    - A sense of threat
    - Fear
  - *Behaviourally expressed as nervous vigilance, freezing or flight*
  - *Neural circuits* include those for *threat recognition* and others for *behavioural evasion of threat*.

---

Emotional action-orientated systems

- **RAGE-ASSERTIVENESS system (two elements):**
  1. **RAGE**
     - *Generates* strongly –ve affects of
       - Anger, rage and highly aroused urges to defeat, dominate or defend
     - *Behaviourally expressed as species-typical offensive or defensive enraged attack behaviours*
     - *Neural circuits* include those for *rage expression* and *threat recognition* with some involvement of the *FEAR circuits*
Emotional action-orientated systems

• RAGE-ASSERTIVENESS system (two elements):
  2. ASSERTIVENESS
  – Generates +ve affects of energised, goal-directed wanting and expectancy driven by appetitive and consummatory urges
  – Behaviourally expressed as highly focused predatory stalking and attack, or focused and engaged foraging
  – Neural circuits involved are merged with those of the SEEKING system that engender a sense of reward

• BONDING system (two elements):
  1. Drive to experience +ve affects
  – Generates a strong drive to attain and retain the comfortable and comforting +ve affects of affectionate companionship or protection
  – Behaviourally expressed through initiation of and responsiveness to species-typical prosocial or affiliative interactions
  – The circuits involve neuroactive agents such as endogenous opioids, oxytocin, vasopressin and noradrenaline, as well as circuits for detecting thermotactile and odour cues
Emotional action-orientated systems

• BONDING system (*two elements*):
  2. Drive to avoid –ve affects
   – *Generates* a strong drive to avoid separation-induced anxiety or panic, or isolation-induced loneliness
   – *Behaviourally* expressed through attempts to *reunite with bonded others*, or, when unsuccessful, as *depressive inactivity*
   – *The circuits* involve *neuroactive agents* such as endogenous *opioids, oxytocin, vasopressin* and *noradrenaline*, as well as circuits for detecting *thermotactile and odour cues*

Emotional action-orientated systems

• CARE, PLAY and LUST systems:
  Manifest +ve affects via:
  – *Protective and empathetic* maternal care
  – *The joyfulness* of play
  – *The appetitive eroticism* and *orgasmic pleasures* of lust
  – *Behaviourally* expressed in *system-specific and species-typical* ways
  – *Neural circuits* involve *specific neurochemicals and neuroactive hormones* that generate these particular *prosocial and affiliative emotions and behaviours*
Areas considered

- Introduction
- Motivational urges and drives
- Emotional action-orientated systems
- Implications for welfare codes
- Concluding remarks

Implications for welfare codes

- *Promotion of +ve affective states:*
  
  To date, the primary rationale for this has been:
  
  – *Behaviour-based assessments of motivation to satisfy perceived needs, wants or preferences*
  
  – A key example is *environmental enrichment* initiatives
  
  – *Panksepp’s concepts* and their *neuropsychological support* may *strongly reinforce* the largely behavioural basis for most such initiatives taken to date
Implications for welfare codes

- **Replacement of –ve states with +ve states:**
  
  Manipulation of the FEAR system:
  
  - Anxiety, fear and nervous vigilance may be replaced by calmness and harmonious interactions with other animals and human beings.
  
  - By minimising visual, auditory, olfactory, environmental, handling and other cues that may engender a sense of threat.
  
  - Also, otherwise fearful animals may thereby enjoy the enlivening rewards of exploratory and appetitive behaviour generated by the SEEKING system.

Implications for welfare codes

- **Replacement of –ve states with +ve states:**
  
  Manipulation of the SEEKING system:
  
  - Boredom may be replaced by the enlivening rewards of exploratory and appetitive behaviour.
  
  - By improving the levels of environmental complexity and variety available for the animals.
Implications for welfare codes

• Replacement of –ve states with +ve states:
  Manipulation of the BONDING system:
  – Loneliness, isolation, helplessness, separation distress and feelings of abandonment may be replaced with feelings of affectionate companionability and of being secure and protected
  – By promoting affiliative interactions with compatible animals (including human beings) and minimising the separation of bonded animals

• Replacement of –ve states with +ve states:
  Manipulation of the CARE, PLAY and LUST systems:
  – +ve prosocial and affiliative emotions could be reinforced if management practices were to be directed towards the CARE and PLAY systems and, probably limited to breeding animals, the LUST system
Implications for welfare codes

- **Replacement of –ve states with +ve states:**
  - Manipulation of the RAGE-ASSERTIVENESS system:
    - *Frustration and anger* may be minimised by all of the above initiatives
    - Also by a continuation of existing *breeding and culling* programmes that target temperament
    - Also by keeping only mutually compatible animals together in groups

Areas considered

- Introduction
- Motivational urges and drives
- Emotional action-orientated systems
- Implications for welfare codes
- Concluding remarks
Concluding remarks

• To date, our approach to improving animal welfare has been largely through activities designed to reduce –ve subjective, emotional or affective states.

• We now have an improved understanding of the characteristics and neurological foundations of internally generated motivational urges and drives, including air hunger, breathlessness, thirst, salt hunger and general hunger.

• This understanding supports the view that minimising –ve experiences can at best produce neutral welfare states.

Concluding remarks

• BUT acceptable or good animal welfare is more than the mere absence of –ve subjective, emotional or affective states.

• It also includes the presence (and promotion) of +ve states.

• Such +ve experiences may include feelings of satiety, vitality, reward, contentment, curiosity and playfulness.

• They are generated, in part, by sensory ‘scanning’ of the external circumstances of the animals.
Concluding remarks

- Panksepp’s concepts extend understanding of the neuropsychological foundations of the intensionality and emotional contents of particular behaviours.
- They include his detailed accounts of the seven emotional action-orientated systems of SEEKING, FEAR, RAGE-ASSERTIVENESS, BONDING, CARE, PLAY and LUST.
- They thereby also provide a functional rationale, reinforcing the behavioural one, for the replacement of –ve with +ve affective states.

We may therefore expect that the rationale that animal welfare improvement should be based on promoting +ve states, while still minimising –ve states, will now receive a boost.
Concluding remarks

It is instructive to list what those +ve and –ve experiences might now be considered to include:

– **Positive experiences**
  - satiety, appetitive and consummatory satisfaction, reward, goal-directed engagement, curiosity, vitality, playfulness, calmness, contentment, affectionate companionability, and feelings of security

– **Negative experiences**
  - Many types of pain, thirst, hunger, weakness, debility, breathlessness, nausea, sickness, anxiety, fear, nervous vigilance, boredom, loneliness, isolation, helplessness, frustration and anger, and other as yet unspecified forms of distress

Concluding remarks

What may those +ve and –ve experiences include?

– **Positive experiences** may include:
  - satiety, appetitive and consummatory satisfaction, reward, goal-directed engagement, curiosity, vitality, playfulness, calmness, contentment, affectionate companionability, and feelings of security

– **Negative experiences** may include:
  - Many types of pain, thirst, hunger, weakness, debility, breathlessness, nausea, sickness, anxiety, fear, nervous vigilance, boredom, loneliness, isolation, helplessness, frustration and anger, and other as yet unspecified forms of distress

*This is a much wider focus than has been usual to date*