

Animal Sentience: science, policy and 'real world' application



#animalsentience



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2 May 2019, Friends House, Euston

Conference organised by the RSPCA Science & Policy Group, the Uehiro Centre for Practical Ethics and the Wellcome Centre for Ethics and Humanities, University of Oxford, supported by grants from the Open Philanthropy Project and the RSPCA.

Background

Since 2009, the United Kingdom has been operating under article 13 of the Lisbon Treaty which states that the European Union and member states, “*shall, since animals are sentient beings, pay full regard to the welfare requirements of animals.*” However, after voting to leave the EU, the UK has had to decide which rules and provisions to retain. Controversy erupted when MPs voted against transferring this provision of the Lisbon Treaty to the UK post-Brexit. Though based on misunderstanding of the reasons for the outcome, a media firestorm ensued, clearly demonstrating the public’s interest in the subject and desire to protect both the UK’s official position on sentience and its widely perceived status as a global leader in animal welfare. Furthermore, the changing trade situation for the UK will inevitably raise new issues about how animal welfare standards are maintained and improved under trade agreements with countries that have lower standards. The potential for increased research collaborations with other countries with lower standards of laboratory animal housing, care and ethical review also raises concerns.

With this in the background, the Oxford Uehiro Centre for Practical Ethics and the Wellcome Centre for Ethics and Humanities at the University of Oxford, along with the RSPCA, is hosting this one-day conference highlighting important advances in the scientific understanding of sentience and discussing the appropriate ethical responses to these advances in practice, regardless of the final outcome of the Brexit deliberations. The conference will highlight cutting-edge research on mammals, birds, fish, and invertebrates including cephalopods and crustaceans, and other species, assessing their capacity to experience pleasure, pain and other positive and negative emotions. It will also provide the opportunity for a wide range of sectors to consider how this latest knowledge - and the hoped for explicit inclusion of the concept of sentience in UK law - can/should impact upon many aspects of decision making in policy making, trade and business and daily life for all citizens.

The conference aims to:

- Help inform the drafting, interpretation and implementation (in all areas of human-animal interaction) of the Sentience Bill and encourage all sectors/individuals to see the Bill as an opportunity to improve practice
- Propose criteria and process for deciding which animals are sentient – at present and in light of future evidence
- Identify the best way of raising awareness of animal sentience, and communicating the issues and implications of this, to all sectors and individuals
- Identify the key challenges associated with achieving changes in attitude and behaviour towards animals in all areas of daily life, in line with knowledge and evidence of sentience

Output:

Videos of most of the presentations, and workshop summaries, will be circulated to participants and made publicly available as soon as possible after the meeting. You will receive an email with a URL to access and share these materials.

Agenda

9.30	<i>Registration, tea, coffee, pastries</i>
10.00	Introduction to the day: Dr Julia Wrathall (Chief Scientific Officer, RSPCA) & Professor Mike Parker (Wellcome Centre for Ethics and Humanities, University of Oxford)
10.10	Opening overview: <i>How do we feel about sentience?</i> Mike Radford, School of Law, University of Aberdeen
10.25	<i>Update on plans around legislation.</i> Marc Casale, Deputy Director, Animal Welfare and Exotic Disease Control
Morning session: The Science of Sentience Chair: Dr Adam Shriver, Uehiro Centre for Practical ethics, Oxford University	
10.30	Science overview – <i>Sentience: enhanced capacities to experience, interact, anticipate, choose and survive.</i> Professor David Mellor - Massey University, New Zealand
10.45	<i>Applying the Precautionary Principle to the evidence for sentience.</i> Dr Jonathan Birch – London School of Economics
11.05	<i>Sentience in birds.</i> Dr Sarah Jelbert – Spin Up Science
11.25	<i>What do we know about sentience in fish?</i> Professor Felicity Huntingford - University of Glasgow
11.45	<i>Tea/coffee & biscuits</i>
12.05	<i>Are crustaceans sentient?</i> Professor Bob Elwood – Queen’s University, Belfast
12.25	<i>To know is to love: can a better understanding of behavioural, cognitive and emotional complexity improve attitudes to rodents?</i> Professor Daniel Weary – University of British Columbia
12.45	<i>What emotions and cognition can tell us about welfare and consciousness in farm animals.</i> Dr Alain Boissy – INRA (French National Institute for Agricultural Research), France
1.05	<i>Key points from morning:</i> Session Chair Dr Adam Shriver
1.15	<i>Lunch & tea/coffee</i>
Afternoon session: Ethical and Policy Implications for all Chair: Dr Julia Wrathall, Chief Scientific Officer, RSPCA	
2.00	<i>How sentience affects the implementation of the Animals (Scientific Procedures) Act 1986:</i> Dr Kate Chandler – Animals in Science Regulation Unit
2.15	<i>What causes ‘harm’ to animals?</i> Dr Penny Hawkins – RSPCA Science & Policy Division

2.30	<p>Breakout Workshops on specific aspects of ‘sentience in the real world’</p> <p>Workshop 1</p> <ul style="list-style-type: none"> • Topic: Challenges and approaches to achieving appropriate behaviour change around sentience • Facilitator: Dr Trent Grassian - Human Behaviour Change for Animals <p>Workshop 2</p> <ul style="list-style-type: none"> • Topic: Applying the harm-benefit analysis across all areas of policy affecting animals • Facilitator: Dr Ngaire Dennison - University of Dundee <p>Workshop 3</p> <ul style="list-style-type: none"> • Topic: Implications of sentience for policy makers and businesses: impact on law making/implementation, CSR policies and practices • Facilitator: Dr Rebecca Garcia – Animal & Plant Health Agency <p>Workshop 4</p> <ul style="list-style-type: none"> • Topic: What does animal sentience mean for animal owners and carers? • Facilitator: Dr Daniella Dos Santos – British Veterinary Association <p>Workshop 5</p> <ul style="list-style-type: none"> • Topic: What should animals’ sentience mean for their representation in governmental systems? • Facilitator: Dr Dan Lyons - Centre for Animals and Social Justice <p>Workshop 6</p> <ul style="list-style-type: none"> • Topic: What does it mean to be sentient in the real world and how should that influence attitudes and behaviour of the wider ‘public’? • Facilitator: Dr Reuben Message - University of Oxford <p>Workshop 7</p> <ul style="list-style-type: none"> • Topic: Implications of sentience for all levels of industry (e.g. farming & food industries) • Facilitator: Professor David Main – Royal Agricultural College <p>Workshop 8</p> <ul style="list-style-type: none"> • Topic: What should the criteria and process be for deciding which animals are sentient? • Facilitator: Dr Charlotte Burn – Royal Veterinary College
3.30	Collect <i>afternoon tea/coffee</i> and move to:
3.45	<p>Reporting back. Chair: Dr Julia Wrathall</p> <p>Each group will feedback on one or two key points</p>
4.20	Wrap-up and ‘what happens next’: Dr Julia Wrathall
4.30	End

How do we feel about sentience?

Mike Radford, School of Law, University of Aberdeen

Implementation of the Government's (originally reluctant) commitment to incorporate the concept of animal sentience into domestic law remains work in progress. The issues raised are complex and potentially far-reaching. It is essential that those within the scientific community with the relevant expertise both engage with the ongoing debate and understand the significance of the way in which the eventual legislation is drafted. In considering the desired impact on public policy, there needs to be informed debate about: what is meant by sentience and whether it is desirable to adopt a legal definition; the scope of the species intended to benefit; the nature of any duty which the law imposes, its intended consequences, and the appropriate mechanisms for holding to account those on whom any new legal duty is imposed.

Sentience: Enhanced capacities to experience, interact, anticipate, choose and survive

David J Mellor, Massey University, New Zealand

General statements about sentience

1: Biological integration and connectedness are the foundations of sentience

Each sentient animal is a living embodiment of dynamically unified and integrated forms, functions, behaviours and related capacities to have experiences, all of which features are observable in combinations that are unique to each species and evolved to secure species survival within particular environments (Ledger and Mellor 2018; Mellor 2018). Each such animal therefore expresses discoverable forms of biological integrity whilst operating as a whole entity within its ecological niche (e.g., Ledger and Mellor 2018).

2: Sentience incorporates experiences of welfare-relevant negative and positive affects

Sentience, as exhibited by an animal, may be characterised as a capacity to have negative and positive feelings, perceptions or subjective experiences that matter to the animal and that affect its welfare (Mellor 2018; Ledger and Mellor 2018). Generically these experiences are referred to as affects (Fraser 2008; Mellor et al 2009; Mellor and Beausoleil 2015; Mellor 2016a).

Negative affects which have intensities and/or durations above tolerably low levels tend to be welfare compromising, whereas positive affects tend to be welfare enhancing (Mellor 2015a,b; 2016a,b; 2017). Negative and positive affects therefore have animal welfare significance, so that both must be considered.

3: Sentience means that animals experience different affects consciously

In the context of sentience, the word experience is taken to mean conscious experience (Ledger and Mellor 2018; Mellor 2016, 2018).

Sentience requires the operation of nervous systems of sufficient sophistication to detect and process particular stimuli in ways that give rise to subjective experiences (Mellor and Diesch 2006; Mellor 2010). In other words, the nervous system must have the capacity to transduce impulses in sensory nerves and related structures into experienced sensations, feelings or emotions – i.e., affects (Mellor et al 2009).

For these affects to be experienced, the nervous system, whatever its level of complexity, must have the capacity to express, and/or sustain a state or states of consciousness.

4: Within a species, the stage of neurobiological development is significant

In species regarded as sentient, there is a period after conception when the developing nervous system is too immature to support sentience.

In the young of land mammalians, for example, sufficient maturity of the brain is not achieved or expressed until several months after birth (e.g., marsupial), several days-to-weeks after birth (e.g., bears, cats, dogs, ferrets, hamsters, mice, rats and rabbits), or several minutes-to-hours after birth

(e.g., guinea-pigs, ungulates, many primates) (Mellor et al 2005; Mellor and Diesch 2006, 2007; Mellor 2010; Mellor and Lentle 2015).

Achievement of the sentience milestone coincides with the time when these young first leave the maternal pouch or the protective den, nest or other enclosure, or when, immediately after birth outdoors, the young first enter the relatively unprotected external environment (Mellor and Lentle 2015).

5: During development, the onset of sentience confers cognitively-enhanced capacities to respond behaviourally to unpredictable postnatal environments

The onset of cognitive awareness confers a high degree of behavioural flexibility that allows the young to respond more effectively to the unpredictability of the environments they encounter after birth (Mellor and Lentle 2015).

As just noted, this sentience-based, enhanced cognitive capacity takes several months, days-to-weeks or minutes-to-hours before it is expressed behaviourally in these different groups of young mammals. It is apparent that the onset of this cognitively-based flexibility in the young of each group coincides with their first exposure to variable environments that require such autonomous behavioural responsiveness (Mellor and Lentle 2015).

The survival-enhancing implications of this during the rest of the animal's life are obvious (Mellor and Lentle 2015).

6: Sentience includes a capacity to communicate and interact with others

Animals' ability to communicate or otherwise interact within their own species, and with other species including human beings, is an expression of their sentience. Such communication requires inputs from externally directed sense organs, for example, for touch, temperature, taste, smell, hearing and/or sight (Mellor 2018).

One or more of these familiar senses may exhibit an exaggerated capacity (Nielsen 2018); this enables the affected species to successfully engage with what would otherwise be insurmountable challenges posed by their ecological niche (Mellor and Lentle 2015; Mellor 2018). For example, extreme acuity of sight in eagles and sensitivity of smell in dogs (Mellor 2018).

Other species exhibit unique sensory modalities, for example, the generation and detection of ultrasonic echolocation (e.g., in whales), the detection of weak electromagnetic fields emanating from prey (e.g., in sharks), or an exquisite sensitivity to airborne chemicals (e.g., via sensors in the forked tongue of reptiles) (Seifel and Collins 1993; Schwenk 1995; Holland et al 2004; Hopkins 2010; The Scientists 2017).

7: The Five Domains Model integrates sentience into animal welfare assessment

The existence of sentience is affirmed by well-validated, up-to-date neurophysiology, affective neuroscience, other biomedical and veterinary clinical sciences and behavioural science.

These sciences, and others, provide secure foundations for the Five Domains Model. Thus, use of the Model to assess animal welfare gives expression to the understanding conveyed by these sciences regarding what animal welfare is currently considered to represent (Hemsworth et al 2015; Mellor 2015a,b; Mellor and Beausoleil 2015; Mellor 2016a, 2017).

Furthermore, use of the Model recognises sentience to be the capacity of animals in numerous taxa to both have and respond to subjective experiences, a recognition which is now fully incorporated into our understanding of animal welfare and its management (Mellor 2016a, 2017).

Statutory acknowledgement of sentience

The statutory acknowledgement that animals are sentient is exceptionally important because it asserts the opposite of what appeared to be vociferously disallowed by dogmatic behavioral scientists in the 50 years or so before about 1995, i.e. that animals' behaviour could be described but that it was unscientific to interpret behaviour in terms of the animals' motivations and/or what they may be experiencing subjectively (a view strongly challenged by Jaak Panksepp 2005 and others).

For at least 20 years there has been overwhelming neurophysiological, affective neuroscience and behavioural science evidence supporting the existence and welfare significance of sentience for those animals that exhibit it through their behaviour (e.g., Fraser 2008; Panksepp 2005; Yeates and Main 2008; Mellor 2015a,b; Mellor 2016a).

Thus, what is now acknowledged by statutory references to sentience is the fact that animals exhibit the capacity to have negative and positive feelings, perceptions and subjective experiences that matter to them and affect their welfare.

Q1: What does the word 'matter' mean in the context of animal welfare?

The word 'matter' is well chosen. It relates to both negative and positive experiences, not just positive ones. Negative experiences 'matter' in two ways:

First, survival-critical negative experiences matter because, in being negative, they impel the animal (i.e. motivate it with a sense of urgency) to engage in behaviours that secure its survival (examples are breathlessness for breathing, thirst for drinking, hunger for eating, pain for escape from or avoidance of injury) (Mellor and Beausoleil 2015; Mellor 2017).

Second, negative experiences are of two main types, i.e., survival critical ones (e.g., breathlessness, thirst, hunger, pain) and situation-related ones (e.g., anxiety, fear, frustration, loneliness). Both of them matter, i.e., they are of concern, when the intensity and/or duration of their unpleasantness, aversiveness or noxiousness exceed tolerably low levels (Mellor and Beausoleil 2015; Mellor 2016a, 2017).

Positive experiences also 'matter' in two ways: First, quite simply because they are pleasurable (e.g., Yeates and Main 2008; Mellor 2015a,b,c; Mellor and Beausoleil 2015). Second, because when an animal anticipates them, participates in generating them and then recalls them after the event, positive feelings, emotions or subjective perceptions enhance the overall hedonic experiences that animals may have in ways that may improve their Quality of Life (e.g., Green and Mellor 2011; Mellor 2012; Mellor and Beausoleil 2015; Littlewood and Mellor 2016; Mellor 2017).

Q2: Phylogenetically, which animals are sentient?

In operational terms it is possible to avoid arguments about where a sentience 'divide' might lie, i.e., arguments about which animals are and are not sentient. This may be done by conservatively including in statutes only those animals whose sentience may be asserted with some confidence.

For example, the New Zealand Animal Welfare Act 1999 plus Amendments, in common with other statutes, is definitive, yet open-ended, and includes reference to developmental stages.

Definition: Any live member of the animal kingdom that is a vertebrate, or that is any octopus, squid, crab, lobster, or crayfish (including freshwater crayfish).

The capacity to modify the list: From time to time by the Governor-General, by Order in Council, may specify that particular additional animals be included for the purposes of this Act.

Inclusion of developmental stages: Sentient animals are also considered to include any mammalian fetus, or any avian or reptilian pre-hatched young, that is in the last half of its period of gestation or development, plus marsupial pouch young

Exclusions: Any animal in the pre-natal, pre-hatched, larval, or other such developmental stage, apart from young in the last half of their period of gestation or development as indicated above.

General comments about statutory acknowledgement of sentience

From the viewpoint of animal welfare science understanding, adopting the notion of sentience represents a succinct acknowledgement of what has long been accepted among most animal welfare scientists. It does not take us further than our current understanding; nor does it indicate that future emphases should take different directions from the latest ones that have already been well canvassed by animal welfare scientists and the organisers of this conference. But, this statutory recognition does represent an important guideline for public understanding, especially with regard to improving empathetic interactions of people with animals.

Other questions still require our attention:

Q3: Phylogenetically, is there a sentience 'divide'?

Q4: Is such a 'divide' arbitrary or coherent?

Q5: What criteria would make the discrimination coherent?

Q6: Should we consider a sliding scale of degrees of sentience?

Q7: What criteria would provide a coherent basis for such scaling?

Q8: Should we assign a confidence factor to each conclusion?

Q9: What relevance does each of these questions have to the development of public policy, the framing of statutes, and to responsibly contributing to discussions about retaining social licence to continue current animal use practices across a wide range of taxa?

Acknowledgements

I gratefully acknowledge helpful discussions about sentience with numerous colleagues, and particularly in the more recent past, Ngaio Beausoleil, Craig Johnson and Kat Littlewood at Massey University, and Mark Fisher and Kate Littin at the Ministry for Primary Industries.

References: see Appendix 1, page 19

Animal sentience and the precautionary principle

Jonathan Birch, London School of Economics

1. The problem of animal sentience

Sentience (broad sense) = the capacity to feel = the capacity to have any form of subjective experience. Sentience (narrow sense) = the capacity to have subjective experiences with an attractive or aversive quality, such as feelings of pain, suffering, pleasure, frustration, anxiety, fear, happiness and joy.

Q: Which animals are sentient (in the narrow sense)?

It seems really important to know the answer. But it's very unclear how we can know. When we look at the brains and behaviour of non-human animals, we find a mix of similarities and differences. When is there enough similarity for us to conclude that the animal is having subjective experiences?

2. The case of decapod crustaceans

Q: Are decapod crustaceans (crabs, lobsters, crayfish, shrimp, prawns etc.) sentient? Does it matter?

Context: The number of decapod crustaceans eaten by humans annually has been estimated at about 1.6 trillion, of which about 200-400 billion are farmed (fishcount.org.uk). These animals have no welfare protection at all in nearly all countries. Practices such as live boiling, live carving and eyestalk ablation are common in the food processing industry.

A positive case for decapod sentience?

- Like fish, decapods have nociceptors (evidence from crayfish and shrimp).
- Like fish, decapods make motivational trade-offs, e.g. trading off the severity of a shock against the quality of a shell (evidence from hermit crabs).
- Like fish, decapods also learn to avoid places at which they received a shock (evidence from shore crabs).
- No good evidence of responsiveness to opioids—but is that a deal-breaker?

3. The “Animal Sentience Precautionary Principle” (ASPP)

Q: What is the right policy response to the severely limited evidence we have?

When there is a risk of a seriously bad outcome if action is delayed while we await more evidence, it makes sense to apply a precautionary principle (Birch 2017a):

ASPP: Where there are threats of serious, negative animal welfare outcomes, a lack of full scientific certainty as to the sentience of the animals in question shall not be used as a reason for postponing proportionate measures to prevent those outcomes.

Like other precautionary principles, ASPP is a broad commitment that needs supplementing with a detailed framework guiding its application. In recent work I have sought to construct such a framework (see Birch 2017a, b for details). The framework offers a principled basis on which to extend, as a precautionary measure, animal welfare protection to decapods—and it offers a general framework for dealing with other contested cases of sentience.

References:

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- Birch, J. (2018) Animal cognition and human values. *Philosophy of Science* 85:1026-1037. doi.org/10.1086/699744
- Elwood, R. W. (2017) Do invertebrate responses to noxious stimuli offer insights into pain and sentience? *Origins of Consciousness Workshop*, LSE, 7 June 2017. youtube.com/watch?v=eA9U0s2xdjg

Sentience in birds

Sarah Jelbert, Spin Up Science & the University of Cambridge

There is little debate among animal behaviour researchers, at this point in time, that birds are sentient beings, capable of experiencing suffering. There does however, remain substantial variation in public perception of 'intelligence' among birds, and the extent to which rights and empathy should be extended towards different species as a result (take, for example, parrots as compared to chickens). In this talk I will highlight some recent advances in our understanding of avian cognition, focussing on behavioural demonstrations which are, arguably, indicative of consciousness in some species. I will address the question of whether more 'intelligent' species, ought to be considered as more sentient than less 'intelligent' species, in the context of birds. And whether it is appropriate, or even possible, to compare and rank cognitive abilities across diverse taxa. I will conclude by highlighting some of the major differences in species ecology, such as group-living and prolonged care for offspring, that may shape a particular species' behavioural response to negative stimuli. This is significant, given that it is often these behaviours that are ultimately interpreted as evidence for differential levels of sentience or consciousness in animals.

What do we know about sentience in fish?

Felicity Huntingford, University of Glasgow & Victoria Braithwaite, Penn State University, USA

Having discussed briefly what the word 'sentience' means and the difficulty of ascribing sentience to non-human animals, we describe two broad, complementary strategies for investigating sentience in fish.

The first involves drawing deductions about sentience from careful observation of fish behaviour. In this context, we illustrate: the well-developed cognitive capacities displayed during territorial interactions among breeding cichlid fish; a good fit between seabream behaviour and physiology and the predictions of a two-dimensional model of core affective/emotional state developed for humans; and various levels of complexity in the behavioural response of fish to harmful/noxious stimuli.

The second strategy is to draw deductions about fish sentience from their brain structure, looking in fish for the brain mechanisms that generate the emotion of pain in mammals. Finally, we try to pull this information together, looking for a consensus on levels of sentience in fishes.

Are crustaceans sentient?

Bob Elwood, Queen's University, Belfast

Animals face hazards that cause tissue damage and have immediate nociceptive reflexes that protect them from such damage. In addition, some taxa have evolved the capacity for pain experience, that is they are sentient. The function of pain appears to be linked to long-term changes in motivation brought about by the unpleasant nature of the pain experience.

Pain presumably enhances long-term protection through behaviour modification based, in part, on memory of the unpleasant feeling. I consider behavioural and physiological criteria that might help to distinguish nociception from pain in crustaceans. Rapid avoidance learning and prolonged memory indicate central processing rather than mere reflexes and are consistent with the experience of pain. Complex, prolonged grooming or rubbing may be beyond mere reflex and demonstrate an awareness of the specific site of stimulus application. Trade-offs with other motivational systems indicate central processing, and a noxious experience might affect behaviour for at least 24 hours.

Recent evidence of fitness enhancing, anxiety-like states is also consistent with the idea of pain. Physiological changes in response to noxious stimuli mediate some of the behavioural change, and some of these physiological changes are due to the noxious stimulus not the behavioural response. Thus, available data go beyond the idea of just nociception and open the idea of sentience. However, defining pain in animals with respect to our own experience leads to great difficulties of total proof. Thus, pain in animals should not be defined with human experience as the reference point.

To know is to love: can a better understanding behavioural, cognitive and emotional complexity improve attitudes to [laboratory] rodents?

Daniel M. Weary, Cathy A. Schuppli & I. Joanna Makowska, University of British Columbia, Canada

Providing scientific evidence of sentience may be enough, in some cases, to spur changes in attitudes and behaviours towards animals. For rodents like mice and rats, however, there exists a vast amount of scientific evidence showing their cognitive and emotional complexity, but this evidence seems to have translated poorly in terms of attitudinal and behavioural changes among those responsible for their care. In this presentation we show examples of housing and training methods for laboratory rodents intended to provide those responsible for their care with immediate, direct evidence of their complexity. We argue that allowing people to witness animal sentience first hand helps motivate changes in the ways these animals are cared for.

What emotions and cognition can tell us about welfare and consciousness in farm animals

Alain Boissy, INRA UMR Herbivores & French Reference Centre for Animal Welfare

There has been growing interest in the study of emotions in animals in the past decades, resulting in the emergence of new disciplines referred to affective neurosciences and cognitive ethology. Emotions are intense, short-lived affective reactions to specific events associated with specific body changes whereas welfare is a long-lasting mental state. They can be characterised by two main dimensions (Kron et al., 2015): arousal (bodily activation or excitation) and valence (positive or pleasure and negative or displeasure). An emotion is classically described by behavioural and physiological expressive components and by a subjective component, which, strictly speaking, is the emotional experience (Dantzer, 1989). The subjective component is difficult to access in non-human animals, as they do not have the verbal language. However, if animals are not able to tell us in words what they like and dislike or what they want or want to escape from, their behaviour can be used as a convincing substitute. There are different ways for obtaining an animal's points of view. Recent studies inspired of appraisal theories developed in cognitive psychology to study human emotions provide strong candidate frameworks to have a better access to the nature of emotional experiences in animals (Boissy et al., 2007; Veissier et al., 2009). In my presentation, I shall focus on cognitive abilities of the animals and their relationships with emotions. Cognition is to do with information processing and refers to the range of processes involved in the acquisition, storage and manipulation of information from the environment (Shettleworth, 2009).

The first two parts of the presentation will summarise the work conducted in sheep the last twenty years to study the relationships between emotions and cognition. First, I will briefly present the elementary cognitive processes the animals use to evaluate their environment and that are responsible of their emotional experiences. I will conclude that farm animals not only express emotional responses but also feels a wide range of emotions, including fear, rage, despair, boredom, disgust and happiness.

Second, I will show how emotional experiences can change the perception of the environment by altering the evaluative processes, i.e. attention and judgement biases. These emotional modulations of the evaluative processes are generally interpreted as having adaptive value by helping a frightened individual to pay attention to, to memorize and to make judgments on threatening circumstances (Mendl and Paul, 2004; Fiacconi et al., 2015).

A third part of the presentation will explore welfare and consciousness in animals. Consciousness is defined here by the capacity for the animal to be aware of his emotional experiences. A better knowledge of the relationships between emotions and cognition should give a new insight into the existence of consciousness in animals, at least in its phenomenal sense. Evidence for the existence of conscious cognitive processes in humans (Leventhal and Scherer, 1987) triggers the search for comparable processes in some other animals. The same gradient of consciousness in emotional experiences in humans can be transposed to animals, depending on the level of the cognitive processes used to appraise the eliciting situation. Based on the results reported in the first parts, I will discuss that the animals are not only sensible to events but that they have memory of events and mental images of non-current events (e.g. for predictability/anticipation of negative vs. positive events, and controllability). Finally, the conscious emotional experience in animals can also be supported by the concepts of "empathy" and "emotional contagion" particularly relevant for social animals. Expression and perception of emotions play a crucial role in the regulation of social interactions (Panksepp, 2010). Familiarity, social affiliation, sociability and past experience play a crucial role in emotional contagion. In conclusion, even if it does not allow concluding firmly the question of whether the animals are fully conscious, the current knowledge provides new insights for further answering the question of sentience and consciousness in animals with a scientific perspective.

How sentience affects the implementation of the Animals (Scientific Procedures) Act 1986

Kate Chandler, Animals in Science Regulation Unit

The Home Office oversees the regulation of the use of living animals in scientific procedures in England, Scotland and Wales. This is carried out by the Animals in Science Regulation Unit (ASRU) under the Animals (Scientific Procedures) Act.

The UK's three-tier licensing system provides a framework for authorising research using animals. It ensures that animal research and testing is only undertaken where no non-animal alternative tests exist, and under rigorous controls where suffering is kept to a minimum.

The legislation provides a rigorous regulatory system, underpinned by the 3Rs (Replacement, Reduction and Refinement), which ensures that animal research and testing is carried out only where no practicable alternative exists and under controls which minimise suffering.

The concept of animal sentience is recognised in the Animals (Scientific Procedures) Act and is considered when minimising the suffering of the animals used in science. For example, project licence holders are required by law to use the types of animals with the lowest capacity to experience pain, suffering, distress or lasting harm; the procedures that cause the least pain, suffering, distress or lasting harm; and are most likely to provide satisfactory results.

Anaesthesia must be used during testing unless it would frustrate the purpose of the procedure, and analgesics or other pain-relieving methods must be used to reduce any pain that the animal may experience once the anaesthesia wears off.

Specific species and life stages of animals are protected under the Animals (Scientific Procedures) Act. In addition, some species (dogs, cats, primates and equidae), are specially protected under the Animals (Scientific Procedures) Act.

These concepts are used by the Animals in Science Regulation Unit and by those working with animals under ASPA to keep suffering to a minimum.

What causes 'harm' to animals?

Penny Hawkins, Research Animals Department, RSPCA Science and Policy Group

When paying regard to the welfare of sentient animals, it is essential to consider what causes them harm, and how they might be affected. People sometimes think of 'harms' solely in terms of physical pain, but sentient animals can also experience psychological stress, and distress if they are unable to cope with physical discomfort or pain, or their environment or stressful life events.

Stress, and distress, can be caused by many different factors. For example, in the case of wild animals, close encounters with humans can be stressful, as it is likely that humans are perceived as predators by individuals of many species. Even if humans try to minimise disturbance and keep their distance, field studies have shown that animals may be stressed, and their welfare affected, regardless of whether they show any stress-related behaviours that can be detected by humans. As another example, poor understanding of animal behaviour can cause stress to companion animals. For example, many owners believe their dogs can feel 'guilty' and treat them accordingly, although the animal is actually responding to their owner's body language and tone of voice, and does not understand the context.

Unfortunately, harms such as these can become 'normalised', or are hidden, if people are not able to recognise welfare impacts on animals, or if the animals who are affected are not visible to them (for example, wild birds who cannot access their usual roosting areas due to bird netting).

A 'critical anthropomorphism' approach, combining empathy with objective evidence provided by animal welfare science, is a good way to predict what will cause harms to animals. For example, this could include considering how an animal might perceive and interpret their world, on the basis of their senses, habitat and behaviour; whether they are (broadly) usually a predator or prey; and whether they are domesticated or otherwise used to human contact. It is critically important to seek evidence for any assumptions that are made about animal welfare, or harms, and apply the precautionary principle when making judgements.

Further reading:

- Indicators of animal suffering (from *Animal Ethics*): animal-ethics.org/sentience-section/animal-sentience/indicators-animal-suffering/
- The guilty looking companion: blogs.scientificamerican.com/dog-spies/the-guilty-looking-companion/
- Ecotourism can put wild animals at risk, scientists say: phys.org/news/2015-10-ecotourism-wild-animals-scientists.html
- Heart rate responses provide an objective evaluation of human disturbance stimuli in breeding birds: ncbi.nlm.nih.gov/pmc/articles/PMC4806616/
- Tourism-induced disturbance of wildlife in protected areas: A case study of free ranging elephants in Sri Lanka: sciencedirect.com/science/article/pii/S2351989415001067

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