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Sentience and pain in relation to animal welfare

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Summary

The concept of sentience, which concerns the capacity to have feelings, involves cognitive concepts and awareness. The cognitive capacities of parrots, corvids, cows, pigs and sheep are substantial. All vertebrates, including fish, are shown to have pain systems. There has been rapid development in animal welfare science, including pain assessment. Examples of new pain indicators in sheep and other species are presented.

Sentience

The term sentience has generally been used to mean that the individual has the capacity to have feelings (DeGrazia 1996, Kirkwood 2006). This capacity involves awareness and cognitive ability so is principally in the brain. A major change in attitudes to the idea of awareness and feelings in humans and other animals has occurred as studies of behaviour have become more detailed. In addition, brain mechanisms have been studied using new methods such as brain-recording and scanning: e.g. electroencephalography (EEG), positron-emission tomography (PET-scanning), magneto-encephalography (MEG) and frequency-modulated magnetic resonance imaging (fMRI). Sentience implies a range of abilities, not just having feelings. A definition is: a sentient being is one that has some ability: to evaluate the actions of others in relation to itself and third parties, to remember some of its own actions and their consequences, to assess risks and benefits, to have some feelings and to have some degree of awareness (Broom 2006c, 2014). All of these concepts and abilities require definition and evidence.

The idea that animals used by people should not be treated like inanimate possessions but should be protected from actions that might cause suffering, is very old and widespread in human society. The term 'sentient' is now used in legislation about animals. The European Union Treaty of Lisbon, (European Union 2007), says in the course of a statement about animal protection and welfare (Article 6b), "since animals are sentient beings…". This wording had the intention to protect the animals commonly used by man, for example on farm, in the laboratory, or as companions. It came about because public concern about animal welfare has increased in many countries during the last thirty years and especially in the last ten years.

The development of animal welfare science

Scientists and legislators now use animal welfare as a term that is a scientific concept describing a potentially measurable quality of a living animal at a particular time. Such usage has rapidly become widespread during the last thirty years (Broom 2011). However, the use of the term animal welfare was not always as a scientific concept, and indeed there are still many people who are not aware of the modern approach to the subject.

The author's (Broom1986) definition of the welfare of an individual as its state as regards its attempts to cope with its environment, refers to all coping systems and so includes feelings and health. It is now used by most welfare scientists and is also, in modified form, by the O.I.E. (World Organization for Animal Health). As explained by Broom (2014) p.28, the O.I.E. text reads like a committee document so has some imprecise parts in it: (a) welfare is not "how an animal is coping" but is a state that reflects how well it is coping; (b) the animal has to cope with its whole environment and "the conditions in which it lives" might not mean that to all people; (c) the term "innate" would not be used by any modern animal behaviour scientist as it implies uninfluenced by the environment and no behaviour is uninfluenced by the environment.

Welfare can be assessed using a wide variety of behavioural, physiological, clinical, brain function and other measures. Welfare is always poor when animals are diseased but pain and other aspects of poor welfare vary with severity of pathological effects and can be measured (Corke 1997, Corke and Broom 1998, Corke et al 2014). It is important to assess how good the welfare is as well as to evaluate poor welfare. The major changes in animal welfare science during the last 30 years have been the refinement in direct measures of animal welfare and the development of welfare outcome indicators that can be used by veterinary and other inspectors, as well as by those who use animals. Welfare outcome indicators have been developed by many scientists, including those involved in the E.U. Welfare Quality and Animal Welfare Indicators (AWIN) projects. Information on the subject is available at the Animal Welfare Science Hub www.animalwelfarehub.com.

Cognition, feelings, awareness

How clever are farm animals? Many people assume that cows sheep and pigs have very limited cognitive ability but those who work with farm animals know that they often work out ways to beat the system imposed on them. For example, sows with a transponder on their collar that operates a feeding station learn how to operate this rapidly. When a sow found a collar that had fallen off another animal, she picked it up and got a free meal for several days before the farmer noticed that she was doing so. In order to compare learning ability in different species, behavioural scientists started to use operants. These are actions, such as lever-pressing, carried out by an individual with consequent effects on its environment and are studied in a situation controlled by an experimenter. In the comparative studies, some of these operants depended upon motor abilities that were easy for some species but were very difficult or impossible for other species. For example, using a hoof to press a lever. Hence no unbiased comparison of learning ability was possible. A set of studies by Kilgour (1987) largely overcame this problem by the use of modified Hebb-Williams mazes for animals of different sizes. These mazes start with a decision point where there are two or more possible directions to take, one being towards a concealed target reached after two further turns. Such a maze still has some bias, as a comparison of learning ability, in that animals that often have to navigate around their surroundings would have had more experience of a sequence of decisions about which way to turn. This might favour animals that use discrete pathways. However, individuals of all of the species tested have to do this to some extent and the locomotion required to respond in a maze is common to all. When the numbers of errors were measured, cows, sheep, goats and pigs performed less well than 5-year-old children but better than dogs, cats, rats, horses and several other mammals and birds. When speed of learning was compared in the same study, the sequence was very similar but dogs performed as well as the farm ungulates.

In other studies, cows, sheep, pigs and fish learned rapidly to discriminate other individuals of their own species, or to discriminate between humans (Kendrick et al 1995, Swaney at al 2001, Mendl et al 2002, Hagen and Broom 2003). A variety of studies of learning by farm animals, fish and other animals are reviewed by Broom (2007a, 2010, 2014). It has sometimes been assumed that farm animals are not very intelligent but this has been shown to be untrue by many recent studies. Does a chicken have a concept of an object when it is not directly detectable? Studies by Vallortigara and colleagues showed that, not only could young domestic chicks go to objects hidden behind screens but that when two or three objects were hidden behind screens, the chicks went to the screen with the larger number of objects (Rugani et al 2009). Can farm animals remember and use a visual symbol for a resource? Langbein et al (2004) found that goats could respond by carrying out an action, or operant, in order to get water when they saw one particular picture rather than others.

A complex array of concepts in pigs were evident from studies by Held et al (2000). Pigs were put in a room and allowed to find hidden food. On the next day they were returned to the room and they went immediately to the place where they had found food. If another pig was watching, the pig waited and did not go to the food if that other pig was known from previous experience to be able to steal from it. If the other pig was known not to steal, the food was immediately approached. These pigs must have had a concept of an object in the absence of that object, a concept of a location, and an ability to predict that in the future it might have the food item stolen from it.

The ability to learn what is in a mirror is demonstrated for only a few species, pigs being one of these. Broom et al (2009) exposed 4-6-week-old pigs to a mirror for the first time in such a way that they could see a food bowl otherwise out of view behind a barrier. The young pigs went behind the mirror to the apparent position of the food bowl. However, when given five hours experience of a mirror, they responded initially to it as if to another pig but later by looking at it as they moved. After this experience with the mirror, seven out of eight pigs tested moved away from the mirror and around the barrier to the food bowl.

Location by odour was prevented by fans and the naïve controls had exactly the same olfactory situation. To use information from a mirror and find a food bowl, each pig must have observed features of its surroundings, remembered these and its own actions, deduced relationships among observed and remembered features and acted accordingly.
In recent years there have been many studies of cognitive ability that lead to the conclusions that: (a) hardly any ability is uniquely human, (b) the best bird brains allow greater cognitive ability than any mammal except man, (c) learning by fish can be very complex, and (d) cognition in cephalopods, jumping spiders, ants and bees is much more sophisticated than we had previously thought. Communicating using symbols is possible for many animals so language is not just human. Using information from a mirror is now demonstrated for humans, chimpanzees, capuchin monkeys, pigs, elephants, dolphins, parrots and magpies (Gallup 1982, 2002, Reiss and Marino 2001, Plotnik et al 2006, Prior et al 2008), Broom et al (2009). A concept of future events is evident from work on many farm, companion and other animals (Mendl and Paul 2008).
Emotion, which has long been viewed as necessarily separate from intellectual activity, is now shown to be a facilitator of learning and a consequence of learning. An indication of the possible awareness of own actions and functioning comes from the studies of Hagen and Broom (2004) on young cattle. The heifers were put in a pen whose gate could be opened by pressing a panel with the nose, thus giving access to food 15m away. They learned to do this and at the time of learning showed an excitement response of increased heart rate and jumping or galloping. This "Eureka" effect was not shown by controls which just gained access to the reward or by heifers which had learned earlier how to open the gate. Evaluation of welfare can use the link between emotion and motivation or cognition, for example in studies of cognitive bias (Mendl and Paul 2008).

When investigating brain and behaviour in humans and other animals, academics should use precise scientific methodology to describe observations, to experiment, to analyse results and to write about these but should not be afraid to use concepts such as emotion, feeling, mood, pain, fear, happiness, aware, conscious, stress, need and welfare in presenting results. No concept should be avoided because there might be those who would criticise the use of complex concepts on the grounds that there must be parsimony in all description. If the subject is complex, some of the concepts must be complex.

Each concept used in cognition, awareness and animal welfare research should be properly defined in scientific writing rather than just being referred to in descriptive but imprecise ways.

High levels of cognitive ability may often help animals to cope with their environment. Hence a given level of a problem, such as pain, may be less in more complex animals than in simpler animals. There is a possibility that animals may have fear of possible future adversity. The relationships between negative feelings, such as fear and pain, and the role of cognition in the coping abilities of the animal should be investigated further and considered when evaluating the risk of poor welfare. Cognitive ability should also be considered when designing methods of enriching the environments of captive animals.

Pain

Pain is an aversive sensation and feeling associated with actual or potential tissue damage (Broom 2001 a,b). Its occurrence in animals is discussed by (Sneddon et al 2014). The management of pain in farm animals is often inadequate, resulting in poor welfare (Crook, 2014; Huxley and Whay, 2006). The reasons commonly cited by veterinarians for not administering analgesia to farm animals include difficulties in recognising and quantifying pain (Huxley and Whay, 2006; Ison and Rutherford, 2014; Lizarraga and Chambers, 2012). There is an evident need for an objective, reliable scoring tool that can be effectively used to recognise and assess pain severity.

Facial expression scoring systems for pain assessment have been recently developed for use in rodents, rabbits and horses (Dalla Costa et al., 2014; Langford et al., 2010; Leach et al., 2012, McLennan et al in prep). The procedure in Cambridge for onvestigating pain in sheep involved visiting eleven commercial farms when disease was reported, and evaluating the changes in clinical condition and facial expressions across recovery time. Of 111 sheep over one year of age, 73 were identified as having footrot by a veterinarian through lameness and lesion scoring. These sheep were matched with 38 control sheep identified as having no sign of footrot or other disease. All sheep were assessed for lameness using the five point gait scoring method devised by Ley et al. (1992). Photographic images of sheep faces were taken on the day of disease identification after lameness and lesions were scored. Thermography was also used. All sheep were treated on the same day after images had been collected with antibiotic (tulathromycin subcutanerous and topical chlortetracycline) and with the non-steroidal anti-inflammatory meloxicam (subcutaneous). All sheep were revisited during their recovery period and facial images were recorded on day 90. Animals were reassessed for lesions and lameness to establish that they were fully recovered. A study of 17 sheep with mastitis and 12 control sheep was conducted in the same way but without topical antibiotic use.

The sheep pain facial expression scale involved scoring five facial areas; orbital tightness, cheek tightness, ear position, lip and jaw profile, and nostril and philtrum position. These areas are scored as abnormal expression present (2), partially present (1), or not present (0). A total pain score of 1-10 was determined by adding the individual scores for each of the five areas for each set of photographs. On the first day, the total pain score was higher in the sheep with footrot than in controls ($p = 0.0005$) but at 90 days after treatment there was no difference. Sheep with mastitis also had a higher total pain score than controls ($p = 0.01$). Trained observers scored faces similarly.

Prompt recognition of pain through the use of the scale will enable farmers and veterinarians to treat and manage their flocks better, reducing the impact of pain on their sheep, thus improving welfare and production. The scale should be used together with other measures of pain.

In another study of actigraphy (McLennan et al 2015) , ten ewes that were lame with footrot were chosen and carefully matched with ten non-lame healthy control ewes for age and weight. Their activity was monitored with an Actiwatch Mini in a small, waterproof box (350mm x 200mm x 350mm) attached to a standard collar fitted around the neck (Piccione et al. 2007, 2011). All ewes accepted the collars without apparent disturbance. The device contains an omnidirectional accelerometer to monitor the occurrence and intensity of movement producing an activity count.

Lameness affected the overall activity level with lame ewes being more active than control ewes at night (p<0.05. Lameness also reduced the activity level of ewes whilst walking (p<0.001), standing or standing ruminating (p<0.001). The results demonstrate the potential of using automatic monitoring devices to help identify lame sheep on farm as part of an automated husbandry system. The current limitation to actigraphy is the requirement to download data rather than observing in real time.

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