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ANIMAL WELFARE CONCEPTS

Donald M Broom

Welfare as a component of sustainability

Members of the public in most countries now have increasing concerns about the sustainability of systems for producing food and other products (Aland and Madec 2009). In addition to profitability of animal production systems and an acceptable price for the consumer, continuation of production now depends on the ethics of production methods (Broom 2010). Sustainability now has a wider meaning than it had in early writings on the subject (Herrero and Thornton 2012, Broom 2017). A system can be unsustainable, and a product can be considered to be of poor quality, because of negative impacts on human welfare, on animal welfare, or on the environment. A system or procedure is sustainable if it is acceptable now and if its expected future effects are acceptable, in particular in relation to resource availability, consequences of functioning, and morality of action (Broom 2014).

Poor welfare of wild or farmed animals is one of the major reasons why consumers may refuse to buy a product or may lobby governments, retail companies, or producers to insist on changes in production methodology. Scientific studies evaluating animal welfare provide the evidence required for such decisions. Sustainability has many components and consumers need a scoring system based on scientific evidence so that they can consider all components and decide what is sustainable (Broom 2021a).

Humans and other animals

Animals are living beings with a nervous system and mechanisms for obtaining energy, using energy, and reproducing. They derive energy by consuming other organisms and most have an effective means of locomotion and a range of sense organs. It is incorrect to use the word “animal” to mean solely farmed animals, owned animals, mammals, or warm-blooded animals, and also to say “humans and animals” since humans are animals. The idea that non-human animals are more aggressive, less controlled, or more subject to lust than the average human is also wrong (Broom 1998, Hofman 2014).

There is only one biology for all of the animals in the world and almost all mechanisms in humans are identical with those in many other species. It is difficult to find any human quality that is not shared with some other species, examples including: language, emotions, the notion
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of culture or society, cooperation, altruism, tool use, and a concept of the future (Clayton and Emery 2015, McBride and Morton 2018). Human abilities are also possessed by other animal species, at least to some degree, so research on other species is used to better understand humans. Every species has differences from all the others and humans have some more complex brain processing capacities and better mathematical logic, perception of time, complex reasoning, analytical capacity, and prediction of events than most other species. These are differences in degree rather than in absolute capability (Falk and Hofman 2012) and DNA sequencing shows that genetic differences among species, including humans, are small and the similarities large (Boffelli et al., 2004). Although humans favour their own species, the idea that humans are special, or more important than other animals, is not scientifically logical.

Cognition, awareness, emotions, and feelings are important adaptive mechanisms in animals. They occur in the brain and result from, or lead to, sensory mechanisms, muscular responses, glandular responses, and other bodily changes. The organs of the body, such as the heart, influence brain function, but thoughts and feelings are in the brain and not in the heart or any other part of the body. All of the analysis, thought, and emotional aspects of brain functioning are closely interlinked, so it is not useful for the concept of mind to be considered separately from the brain (Panksepp 2005, Broom 2003, 2014, LeDoux 2012). Cognition is having a representation in the brain of an object, event, or process, in relation to its context, where the representation can exist whether or not the object, event, or process is directly detectable or actually occurring at the time (Broom 2014). Awareness is a state during which concepts of environment, of self, and of self in relation to environment result from complex brain analysis of sensory stimuli or constructs based on memory (Broom 2014). There are several levels of awareness: unaware, perceptual awareness, cognitive awareness, assessment awareness, and executive awareness. A conscious individual is one that has the capability to perceive and respond to sensory stimuli (Broom 2014). A feeling is a brain construct involving at least perceptual awareness which is associated with a life regulating system, is recognisable by the individual when it recurs and may change behaviour or act as a reinforcer in learning (Broom 1998). An emotion is a physiologically describable component of a feeling characterised by electrical and neurochemical activity in particular regions of the brain, autonomic nervous system activity, hormone release, and peripheral consequences that may include behaviour (see discussions by Paul and Mendl 2018, Broom and Johnson 2019). Feelings are adaptive mechanisms that have evolved and include pain, fear, anxiety, sexual pleasure, eating pleasure, exhilaration, achievement pleasure, other sensory pleasure, social affection, guilt, anger, rage, malaise, tiredness, hunger, thirst, thermal discomfort, grief, frustration, depression, boredom, loneliness, jealousy, and lust (Broom 1998, 2014). Suffering is one or more bad feelings continuing for more than a few seconds or minutes. The concept of affect concerns emotions, feelings, moods, and affective dispositions (Sander 2013).

As humans and other complex animals develop, there is a stage when they become aware of themselves and of their interactions with their environment. Some of this occurs when an individual learns to avoid a painful action, like chewing their own foot. During development, the ability appears for a human and many other animals to experience pleasurable states such as happiness and aversive states such as pain, fear, and grief. This is when the individual becomes sentient. Sentience means having the capacity to have feelings, including having the levels of awareness and cognitive ability necessary to have feelings. A sentient being is one that, in order to have feelings, has abilities such as the 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, and to have some degree of awareness (Broom 2014). Thus individuals, including humans, are not sentient at early life stages or when they have some brain pathologies
or injuries. The current scientific view is that sentient animals include mammals, birds, reptiles, amphibians, fish, cephalopod molluscs, and decapod crustaceans. The decisions about sentience are important because sentient animals are better protected by law.

**Welfare**

With the exception of studies of animal disease, which can greatly improve welfare, animal welfare science hardly existed 40 years ago but it has developed rapidly since then (Broom 2011). During this time, concepts have been refined and a range of methods of assessment have been developed. Challenges to animal functioning and responses to these are a major biological study area. Examples of challenges and associated inability to control interactions with the environment result from (i) pathogens; (ii) tissue damage; (iii) attack or threat of attack by a conspecific or predator; (iv) other social competition; (v) complexity of information processing in a situation where an individual receives excessive stimulation; (vi) lack of key stimuli such as a teat for a young mammal or social contact cues; and (vii) lack of overall stimulation (Broom and Johnson 2019, Broom 2021b). Systems that respond to or prepare for challenges are coping systems and coping means having control of mental and bodily stability (Broom and Johnson 2019). Coping requires the functioning of the nervous system, including the brain, so it is limited to animals. Adaptation can occur without nervous system involvement. Potentially damaging challenges may come from the environment outside the body or from the environment of systems within it.

Coping attempts may be unsuccessful in that control is not achieved but, as soon as there is control, the individual is coping. Coping systems may respond to short-term or long-term problems, or to both. The responses may involve brain activity, endocrine, immunological, or other physiological responses or behaviour but these various types of responses are interdependent. While brain changes regulate bodily coping responses, adrenal changes can have consequences for brain function, lymphocytes have opioid receptors and can alter brain activity, and heart rate changes can be used to regulate mental state and further responses (Broom 2019).

Most coping systems require feelings as a part of their functioning, for example, pain, fear and aspects of pleasure, all of which are adaptive (Broom 1998, Fraser 2008). Coping systems in humans and other species have simple aspects and also complex brain functioning. Investigations of welfare evaluate how easy or difficult it is for the individual to cope with the environment and how great the impact of positive or negative aspects of the environment is on the individual. An individual with no problems to deal with is likely to be in a good state, including good feelings, as indicated by body physiology, brain state, and behaviour. Another individual may be unable to cope with problems in life. Prolonged failure to cope results in cessation of growth, reproduction, and eventually life. A further individual facing problems may use its coping mechanisms and cope but only with difficulty. The signs of success in coping, of failure to cope, or difficulty in coping and associated feelings, can be measured. The welfare of an individual is its state as regards its attempts to cope with its environment (Broom 1986), and this includes feelings and health. Welfare is thus a characteristic of an individual animal during a certain time interval and the state of the individual can be assessed. Hence, welfare will vary on a range from very good to very poor. Welfare concerns how well the individual fares, or goes through life, and since welfare is defined as a state, it is not grammatically correct to refer to the "welfare state" of an individual. Whilst the mean welfare in a population can be described, we cannot refer to the welfare of a population or an environment.

This meaning of welfare is widely used by animal welfare scientists and is close to the usage dating back to Shakespeare’s time of how well an individual fares, or goes through life. The sci-
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Scientific definition is quite different from referring to welfare as a service or other resource given to an individual such as handouts to the poor. Welfare scientists all agree that animal welfare is measurable and hence is a scientific concept (Fraser 2008, Broom and Johnson 2019). Welfare involves mental aspects so research on welfare involves measurements of brain function and of its consequences for behaviour and physiology. Animal welfare indicators give information about positive and negative feelings and other coping mechanisms such as those that affect health. The OIE follows this definition when writing about what is meant by animal welfare although some of their explanatory wording is not precise.

Some other attempts to define welfare have placed sole emphasis on feelings (Duncan and Petherick 1991). However, feelings only comprise part of the mechanisms used by individuals to cope with their environment. Those mechanisms that do not involve feelings, for example, those that are used to cope with pathology and other negative or positive impacts of the environment, are an important part of welfare. Fraser (1999) pointed out that when members of the public talk about animal welfare, their ideas often include the functioning of the animals, the feelings of the animals and the naturalness of the environment. Rollin (1995) advocated that “animals should be able to lead reasonably natural lives” and both Rollin and Fraser (Fraser 2008) refer to the importance of understanding animal needs. These authors did not say that naturalness contributes to a definition of welfare or should be part of welfare assessment. Appleby and Hughes (1997) explain what they mean by welfare using a diagram in which naturalness is a circle partly overlapping with two other circles labelled function and feelings. I consider this diagram to be misleading. The state of an individual trying to cope with its environment depends on its biological functioning, i.e. on its nature. Natural conditions have affected the evolution of coping mechanisms and the needs of each species. Gygax and Hillman (2018) state “Natural behaviour in this sense involves reaching adequate goal states for all persistent or recurring wants that arise in a given environment”. Any environment provided should meet the needs of the animal but does not have to be the environment in the wild. Conditions in the wild can lead to starvation, disease, predation, and hence very poor welfare (Yeates 2018). The overlapping circles diagram is incorrect because the concept and definition of welfare does not include naturalness and because feelings are a part of function. Hence, if there were three circles, they would have to be superimposed on one another.

The term “well-being” is sometimes used interchangeably with “welfare”, but well-being is sometimes less precise in usage and can be taken to refer more to the positive while it is important that the concept of welfare ranges from negative to positive. Welfare is the word used in English versions of European legislation. Despite colloquial usage, most American scientists and the American Veterinary Medical Association now use welfare rather than well-being. A further term, “quality of life” is often used to refer to people, or companion animals, who are ill or recovering from illness. Both quality of life and welfare can be good or poor but, while welfare can refer to short-term situations, quality of life is not normally used for a short time-scale, such as one or two hours or days. Quality of life means welfare during a period of more than a few days (Broom 2007, 2014) and can be assessed using the wide range of welfare indicators. Subjective measures of quality of life should be rigorously verified, both for humans and for non-humans (Green and Mellor 2011).

The concept of “a life worth living” could be based on scientific information but is ethical, or policy-related, rather than scientific. Who decides when it is worth living or not worth living (Broom 2014)? If the individual is not human, it is a human evaluation rather than an evaluation by the subject, so conclusions may be erroneous (Broom 2014, 2021b). The idea of “a life worth living” is not scientifically usable (Green and Mellor 2011).
Health

Health, like welfare, varies over a range from good to poor. Health refers to brain and body systems that combat pathogens, tissue damage, or physiological disorder so health can be defined as the state of an individual as regards its attempts to cope with pathology (Broom 2006). Welfare is a broader term so health is a part of welfare. At the time of the World Health Organization statement “health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” the word welfare was not being used in a scientific way. However, since welfare is essentially the same concept as well-being, WHO was defining health as an aspect of welfare. Most people limit health to conditions related to pathology, physical or mental. The environment has a major impact on human and non-human health, but it is not scientifically correct to refer to the health of the environment. The environment is not self-regulating and no coping is involved.

As pointed out above in relation to there being only one biology, the definition and discussion of the terms health and welfare make it clear that they apply to many kinds of animals. A central principle of the one health concept is that health means exactly the same for non-human animals as it does for humans. The one health strategy encourages interdisciplinary collaboration and communication in relation to all aspects of interactions with the environment and health care for humans and non-human animals (Karesh 2014). It has long been recognised that human psychiatry and medicine could learn from research on farm and other animals and vice versa (Broom 2001a, 2001b) but progress has been slowed by the attitude that human research was quite different from that on other animals. The one welfare approach emphasises that the concept of welfare is identical when applied to humans or to non-human animals (Garcia Pinillos et al., 2015, Broom 2017) and should be incorporated into teaching about both (McGreevey et al., 2020, Broom 2021b). When the welfare of any individual is poor, there is increased susceptibility to disease so improving welfare generally reduces disease. For example, there is similarity between post-partum problems in pigs and humans (Daigle 2018). In order to utilise this approach effectively, all humans and non-humans should be considered as individuals so herd treatment is not always sufficient.

A consequence when concepts such as biology, health, welfare, stress, pain, etc. have the same meaning for all animals, including humans, is that other words should also have the same meaning for all species. For example, euthanasia means killing an individual for the benefit of that individual and in a humane way (Broom 2007b, 2017). Hence euthanasia does not just mean humane killing and should not be used when pet or laboratory animals are humanely killed for the convenience of their owner.

Stress

When an individual is said to be stressed the normal meaning is that the individual is subjected to a potentially or actually damaging effect of its environment. However, there has been a confusing range of uses of the term stress. As a consequence, some scientists have limited the use to a single physiological response mechanism: hypothalamic–pituitary–adrenal cortex (HPA) activity. Equating stress with HPA axis activity renders the word redundant, because we could just say HPA axis activity, and this is not in accord with usage as such activity is temporarily increased during courtship, mating, active prey catching, and active social interaction. Also, many other responses to challenges can occur. Another meaning of stress equates it with stimulation but if most impacts of the environment on an organism are called stress, then again the term has no value. Stimuli that benefit individuals would never be called
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stressors by most people. Stress is an environmental effect on an individual which overtaxes its control systems and results in adverse consequences and eventually reduced fitness (Broom and Johnson 1993). Responses to stress and short-term consequences of stress may be called strain. When coping is not possible and failure to cope leads to reduced fitness, the individual is stressed. Fitness reduction occurs if there are indications that fewer offspring bearing the genes of that individual would reach future generations. Brief or long-term effects that would not have such consequences may cause poor welfare but are not called stresses. It is my view that it is better to define stress as above than to subdivide stress into eustress, that does not harm, and distress, that does harm. If there is no harm it is not stress. Stress indicators include substantial immunosuppression, injury, behaviour abnormality, and physiological overload that increases the chances that food acquisition or the ability to avoid dangerous aggression will be reduced. Hence the above definition of stress distinguishes minor disturbances to an animal’s equilibrium, perhaps with some necessity for energy usage but with no consequence for fitness, from disturbances that reduce fitness or are likely to do so (Broom and Johnson 2019). The definition of stress could be used for plants or any other living organism, whereas welfare applies only to animals. Distress describes the state of individuals that are stressed but also those subject to other effects.

Needs

A need is a requirement, which is part of the basic biology of an animal, to obtain a particular resource or respond to a particular environmental or bodily stimulus. The need is in the brain and mediates effective functioning of the animal. Needs may be met by physiology or behaviour but the need itself is not physiological or behavioural (Toates and Jensen 1991). Studies of motivation are important for investigating needs. How hard will the individual work for a resource or an opportunity for action? Motivational mechanisms depend on biological functioning in that species. Another approach to finding out what are the needs of individuals is to assess the welfare of individuals whose needs are not satisfied (Hughes and Duncan 1988, Dawkins 1990, Broom and Johnson 2019). In human psychology research, the idea of a hierarchy of needs general to all individuals is not helpful. The evaluation of how well human needs are fulfilled (Taormina and Gao 2013) often involves asking human subjects, a methodology open to systematic bias. Most work on non-human species is more objective.

Control systems in animals, including humans, have evolved in such a way that the means of obtaining an objective have become important to the animal (Toates and Jensen 1991, Broom 2017). Resources such as food and appropriate physical conditions may not be sufficient to fulfil needs as the animal may need to perform a certain behaviour and be seriously affected if unable to carry out the activity, even when the objective of the activity is present. Many species have been shown, by the use of operant and other techniques, to work for food even in the presence of food (Inglis et al., 1997). A pig needs to root and manipulate materials while a chicken needs to search for and find food items. Pigs have a strong preference to root in soil or to chew deformable material such as straw and small branches and will work for the opportunity to do so (Hutson 1989). Chou et al., (2020) found that pigs preferred beech twigs to spruce twigs but used all twigs, and also a rubber toy. More substantial solid materials like metal bars do not meet the needs. Broiler chickens given soldier fly larvae were more active, walked more, and had fewer leg disorders (Ipema et al., 2020). Hens need to dust-bathe (Vestergaard 1980) and hens and sows need to build a nest before giving birth or laying eggs. The terminology used in motivational strength estimation is that developed for micro-economics, for example, demand, price, elasticity, consumer surplus (Matthews and Ladewig 1994, Kirkden et al., 2003).
For welfare evaluations in species whose needs have been investigated, the rather general ideas of freedoms or domains are not now required since the more scientific approach using needs can occur (Broom and Johnson 2019, Broom 2021b). Indeed freedoms, like rights, can be rather questionable concepts leading to harmful consequences. Hence it is better to consider the obligations of each person to animals that they use (Broom 2003, 2014, Mellor 2016). A list of the needs of a species has been the first step in Council of Europe recommendations and EU scientific reports on that species’ welfare for over 30 years. For some wild and zoo species, where knowledge of needs is somewhat lacking, consideration of a range of domains is useful as a guideline for the needs of members of a species.

**Pain and other feelings**

Pain is a significant aspect of poor welfare. The concept that pain is limited to humans or mammals has long been thought improbable. Melzack and Dennis (1980) stated: “The nervous systems of all vertebrates are organized in fundamentally the same way”; and “the experience of pain is often inferred from the behaviours of mammals, and it is not unreasonable to attribute pain experience to birds, amphibia and fish” (and presumably, reptiles). Pain detection and processing mechanisms in fish and other animals are reviewed by Sneddon (2019), who explains precise assessment methods. It is often said that pain is difficult to study in non-human animals because they cannot report pain or its severity. However, human self-reporting of pain, for example on a scale from no pain to very severe pain, may be unreliable. People can lie about their own pain or deceive themselves, so more recent guides to pain assessment in humans include chapters on direct measurement. If this is not done, non-human pain studies are often better than those used for humans.

It is useful to call pain receptors nociceptors but any other distinction between nociception and pain is a consequence of attempts to emphasise differences between humans, or mammals in general, and other animals (Wall 1992, Broom 2014b, Broom and Johnson 2019). In sentient animals, most reactions to output from nociceptors involve high-level brain activity because of the great importance of learning from tissue damage and other harms. Other sensory systems do not have different names for simpler and more complex aspects. It is misleading to make a distinction between nociception and pain in sentient animals.

Other feelings which, like pain, are adaptive mechanisms that have evolved include fear, anxiety, sexual pleasure, eating pleasure, exhilaration, achievement pleasure, other sensory pleasure, social affection, guilt, anger, rage, malaise, tiredness, hunger, thirst, thermal discomfort, grief, frustration, depression, boredom, loneliness, jealousy, and lust (Broom 1998, 2014). Some of these, like fear and depression, can be worse than pain and evidence for them is available from both direct studies, such as oxytocin concentrations indicating forms of pleasure, or indirect studies such as judgement bias that indicate the “glass half-full/glass half-empty” distinction (Kis et al., 2015, Mendl and Paul 2020).

**Magnitude of good or poor welfare**

When considering the impacts of treatments or conditions on welfare, the duration of the state is important. The magnitude of good or poor welfare is a function of intensity and duration. Since long-term problems of a certain severity are worse than short-term problems, poor living conditions that lead to poor welfare are generally the most important to the animals involved and hence to concerned consumers. A range of welfare assessment studies can
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be used to consider mean welfare over a long time-scale and to identify individuals whose welfare is poor over much of their life, usually because their living conditions do not meet their needs.

References


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