Sickness and Abnormal Behaviors as Indicators of Animal Suffering

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Abstract

The welfare status of an animal represents the integrated outcome of all sensory and other neural inputs from within its body and from the environment. These inputs are processed and interpreted by the animal's brain according to its species-specific and individual nature and experiences, and then are perceived consciously. That being said, for an animal to be able to perceive states that we believe would reflect its welfare, the animal must be alive and conscious, and it must also be sentient. Previous studies, which I cite and describe further later in this paper, show that the brains of animals, especially mammals, have enough complexity to process mental states. The mental abilities of an animal arise as a result of sensory and other neural inputs linked to nutritional, environmental, health and behavioral components of physical or functional abilities. They are also linked to cognitive-neural inputs and activity related to external challenge. All of these components are integrated and expressed mentally as varying degrees of thirst, hunger, weakness, debility, breathlessness, nausea, sickness, pain, distress, fear, anxiety, helplessness, boredom and so on.

Keywords: Bioethics, animal welfare, sentient, feelings, behavior, allostasis, stress, depression, cytokines, sickness behavior.

1. Introduction

Many scientific reports have shown that even animals possess the physiological requirements to be considered 'sentient'. Possessing a mastery of sentience, from a bioethical point of view, means that animals are not only objects of moral duties but also that they are the owners of rights. Pain perception in animals, in terms of physiological mechanisms of pain detection, has been indirectly confirmed by using central and peripheral analgesics on experimental animals in pharmaceutical research. In light of these findings, cognitive ethological studies have also found that animals can translate the central representation of pain perception not only as physical hurt but also as emotional suffering. Further experimental research has shown that emotional suffering can be generated through behavioral deprivation induced by an intensive farming system. It is clear that an animal's 'quality of life' depends on its possibility to express natural behavior. An animal's emotional suffering induces metabolic modifications that alter the organoleptic properties of animal products.

2. The adaptive response of stress

Scientific analysis of animal welfare have used a wide range of indicators as proxy measures of an animal's wellbeing (Broom and Johnson 1993; Squires 2003; Webster 2005). These indicators can be divided into four categories: pathological, physiological, behavioral and productive (Smidt 1983). Classically, stress is defined as a threat to physiological and emotional homeostasis to which the organism, in order to survive, responds with a large number of adaptive responses. Stress can be either acute or chronic. Chronic stress is at times referred to as 'distress'. It has been suggested that chronic stress can act as a predisposing factor in the onset of illness, especially in humans affected by depression, and that an individual's ability or lack of ability to cope with stress may be a predisposing factor to psychiatric illness (Zacharko and Anisman 1991; Willner 1995; Leonard and Song 1996). Because of these findings, physiological indicators have been used to measure animal welfare. Examples of these indicators include cortisol and beta-endorphin levels; assessments related to the nutritional status of the animals; and pathologic changes in specific tissues (such as heart, muscle, liver, adrenal glands, etc.) (Barbieri and Nassuato 2006). Any evaluation of physiological indicators should take into consideration the age of animals, as there is evidence that the ability to experience stress and pain is different in young animals than it is in adult animals (Fitzgerald 1999; EFSA 2005). In addition, animal welfare can be measured by studying an animal's behavioral responses to stressful situations. For example, one could measure the apparent motivation of an animal to obtain access to desired objects (such as food, a companion, or bedding) or to perform some specific behavior (feeding, social interactions, etc.) (Veissier et al. 2000).

The stress response is a conserved, physiological coping reaction to adverse environmental conditions. Examples of adverse environmental conditions can include physical or psychological constraints, injuries, trauma, poor microclimate and infectious diseases. Under these circumstances, immune responses such as stress and inflammation are an ancestral, overlapping set of responses aimed at neutralizing the stimuli perturbing homeostasis (Ottaviani and Franceschi 1998). The complex interaction between the immune system and the stress/inflammation complex has mainly developed through the phylogenetic evolution of vertebrates in which a redundant, diversified system of cytokines and chemokines develops. Behavioral responses to psycho-sensorial stimuli and immune responses to antigenic stimuli can be viewed as two subsystems of an integrated complex aimed to provide optimal conditions for the host's survival and adaptation. This integrated complex is based on a signalling feedback network regulated by neuroendocrine and immunological mediators. Acute and chronic stress conditions have repercussions not only on an animal's physical homeostasis, but also on its emotional homeostasis. Allostasis is an adaptive and dynamic strategy, actuated by complex living organisms to maintain a balance between their own physiological systems – involved in homeostasis process – and the external environment, in response to both predictable and unpredictable events (McEwen 2000; McEwen and Wingfield 2003).

3. Short and acute stress

This allostatic system is elicited by animals through different coping strategies based on the type and duration of stress stimuli. The Hypothalamus Pituitary Adrenal-axis (HPA-axis) system and Hypothalamus Pituitary Gonads-axis (HPG-axis) system are activated when an animal is under short-term stress conditions and exhibiting proactive and reactive coping strategies, and fight/flight reactions. Animals actuate these physiological and behavioral modifications during daily routines that have an energetic 'cost' for an organism such as feeding, sheltering, breeding, and migration. These well-known physiological and behavioral responses are regulated by the sympathetic branch of the autonomic nervous system. Simultaneously, activation of the HPA-axis induces the release of Corticotrophin Realising Factor (CRF) by the hypothalamus, stimulating synthesis and release of the AdrenoCorticoTropic Hormone (ACTH) which in turn stimulates the adrenal glands to activate the glucocorticoid hormones and increases levels of catecholamine (adrenalin and/or noradrenalin). Severe or long-term stress can lead to a disturbance of physiological and behavioral homeostasis and an emotional state identified as distress, which includes reduced productive or reproductive fitness, passive coping strategies and illness. Depression in humans is characterized by high levels of CRF which causes

HPA-axis over-activation. Hypercortisolaemia is also a common abnormality found in depression in human patients (Owens and Nemeroff 1991; Dinan 1994). In fact, in depressed subjects, there seems to be a defect in the inhibitory cortisol feedback mechanism which acts on CRF secretion, leading the organism to maintain elevated cortisol levels and reduced immunological activity (Dinan 1994). Moreover, cytokines and prostaglandins mediate sickness behaviors, such as lethargy, anorexia, curtailment of social and reproductive activities (Hart 1988). They have also been associated with a concurrent decrease in learning and in memory – both of which are maladaptive responses towards an unsuitable environment (Dunn and Swiergiel 1998; Dantzer 2001). Cytokines are secreted in response to both infectious and non-infectious stimuli, such as experimental stress conditions in rodents has shown (Lemay, Vander, and Kluger 1990; Zhou et al. 1993; Shintani et al. 1995; Deak et al. 1997).

Friedman et al. demonstrated the capacity of cytokines to enter the Central Nervous System (CNS) after an increase in the permeability of the Blood Brain Barrier (BBB) in mice subjected to an acute swim stress (Friedman et al. 1996). Additional studies have attempted to evaluate and characterize the controversial role of BBB permeability under stress conditions (Minami et al. 1991; Goujon et al. 1995; Plotkin et al. 2000; Ovadia et al. 2001).

Currently, it is postulated that cytokines produced in the periphery organs act predominantly on the circumventricular organs within the brain, particularly via the *organum vasculosum of the laminae terminalis* (OVLT) (Hopkins and Rothwell 1995). BBB permeability is not as dense in the circumventricular organs as it is in other parts of the brain. At the OVLT, cytokines are believed to bind to glial cells, which in turn produce cytokines and other mediators such as prostaglandins, particularly PGE_2. Other studies have shown the presence of an active transport mechanism that could be the way of entry through the BBB when plasma concentrations of cytokines are very high (Banks, Kastin, and Durham 1989; Banks et al. 1991).

Cytokines and their receptors have been identified in many tissues, including in the peripheral and central nervous system (Schobitz, Holsboer, and Ron de Kloet 1994). Histochemical studies using rodent and human tissues have revealed that IL-1, IL-6 and TNF-alpha are expressed in neurons and glial cells within the CNS under non-inflammatory conditions, albeit in small quantities (Schobitz, Holsboer, and Ron de Kloet 1994).

Thanks to their general properties of pleiotropism, redundancy, synergism and antagonism, cytokines have an integrated and interdependent function in the immunological system. They operate within a complex network and may act either synergistically or antagonistically, thus influencing the production of cytokines from other cell types and inducing a consequent neuroendocrine and immune response associated with behavioral changes. However, the exact relationship between cytokines and characteristics of depression remain to be identified. Elevated cytokines levels (e.g. IL-1, IL-6, TNF-alpha, IFN-gamma) contribute to some aspects of the abnormal behaviors in animals and atypical symptomatology, including increase in sleeping, muscle fatigue, and decrease of eating (Dantzer 1991; Dantzer 2001; Anisman and Merali, 2002). Altered cytokine activity seen in animal and/or human depression may actually be caused by increased stressor perception (or actual experience) and is believed to be based specifically on the duration of the stress. Situations which cause discomfort, such as unsuitable environment or lifestyle conditions, lead to a reduced perception of uplifting events and increased feelings of loneliness with consequent physiological and emotional alterations, where cytokines have an important role as biomodulators (Ravindran et al. 1995; 1999).

4. Stress and animal welfare

Animals kept in laboratories and/or intensive housing systems are exposed to different stress situations and often do not have the possibility to avoid aversive stimuli by showing specific adaptive reactions. Broom stated that welfare is poor when the individual has difficulty in coping with its environment (Broom 1991). When the environment also causes a reduced fitness level, an animal may fail to cope with stress, and abnormal sickness behaviors may occur (Wiepkema 1987; Dantzer 1991; Cronin, Wiepkema, and Hofstede 1984; Wechsler 1995; McEwen 2000; McEwen and Wingfield 2003).

The protection and the welfare requirements for animals is an area covered by a wide range of EU legislation (these protections are created most commonly in the interest of guaranteeing the quality of animal products such as meat, eggs, and milk). Consumers are sensitized to animal welfare campaigns because of slogans like “The quality of food depends on health and welfare of the animal that produce it”.

Because we have witnessed a demonstration of animals’ negative ‘capacity’, such as pain and suffering, we must intuitively consider the possibility that animals also have positive ‘capacity’, such as intention, expectation and gratification. Both of these capacities ensure emotional homeostasis. Many studies have found that animals in intensive husbandry systems are unable to express a normal range of behavioral patterns. The occurrence of abnormal behavior in animals is therefore an expression of a central alteration of their emotional sphere.

To prevent poor welfare, indicative of a poor physical and emotional state, housing systems should be designed to allow animals to perform specific behavioral habits and achieve physical and behavioral homeostasis.

5. Conclusion

From an anthropocentric view, animals are often considered only for their utility for humans – but this should not always be so. Mental and physical integrity, in a holistic sense, determine an animal's capacity. It's possible to ensure this integrity through the satisfaction of all animal needs – all of which can be achieved through different animal behaviors. If animal integrity is injured then altered emotional homeostasis can eventually translate to abnormal behavior. Animal integrity is ensured when animals can live in an environment that allows them to manifest their full 'capacity', not only those capacities that are 'convenient' for humans [1]. In fact, by recognizing animals' positive and negative capabilities, it follows our duty to ensure them the possibility to cope with their environment in order to live a good life.

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[1] For convenience of humans, animals use both therapeutic and empathic capacities in different ways during pet therapy. The capacity of animals to take care of patients is a demonstration of emotional intelligence.

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