Perspectives on assessing the emotional behaviour of animals with behaviour problems

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Introduction

Although the scientific study of emotion has a history of more than 150 years, with early pioneers in the 19th century such as Charles Darwin, William James and Walter Cannon; it is perhaps surprising that there is still no scientific consensus on what an emotion is. This is partly because of ongoing debate concerning the involvement of conscious feeling to an emotion. Setting this and the broader issue of animal consciousness aside, it is generally agreed that emotional processes define an organism’s personal relationship with its environment, in a way which results in an individualised response. Thus processing a wavelength of 475 nm so that it meets the criteria to be consistently recognised as the colour blue is not an emotional process, whereas processing it in such a way that it has a derousing/calming effect on that particular individual involves emotional processes. Likewise, identifying an object as a social stimulus is not an intrinsically emotional process, while classifying and responding to that stimulus in a particular way because of a perceived personal relationship with the individual (perhaps as its primary carer, dependent, potential sexual partner or affiliate) does involve emotional processes. Thus emotions affect perception, processing and both voluntary and involuntary processes. From this perspective, emotion does not necessitate conscious feelings, but it provides the foundation to the study of the individualisation of, and individual differences in, perception, cognition and behaviour.

Laboratory-based behavioural research has been critical to advancing our understanding of the emotional capacities of many species with which humans regularly interact within society, including both farm animal species such as pigs [1,2] and companion animal species such as dogs [3,4,5]. Interest in the emotional state of many of these species often has some practical (e.g. welfare, management) purpose, such as the assessment of their welfare [6,7], the control of problem behaviour [8-10,11] or the specific management of individuals within a particular setting [12,13]. Problem behaviour in this latter setting often relates to clusters of degrees of behaviours, emotional states and cognitions which are often not biologically unique to the specific problem reported by the animal’s keeper [14]. In the case of the element of emotional arousal, the problem here often relates to either the type of emotional arousal (e.g. angry, many dogs are scared by hot air balloons especially when the burner is used to help them gain height) or the intensity of emotional arousal [15] (e.g. it is normal and acceptable for a dog to be scared to some extent to a loud noise, but if this response is so intense that it results in destructive attempts to escape and self-harm when there are fireworks outside, this becomes a problem). Evaluating and managing such problems has a growing scientific basis and falls within the rapidly developing discipline of what is often referred to as clinical animal behaviour [15,16] or veterinary behavioural medicine [17]; there are currently three main paradigms underpinning this field’s scientific foundation [18,19]; referred to here as the Behavioral, Medical and Psychobiological Approaches. While trying to achieve a common goal in practice, they are based on different philosophical conceptualisations to the study of the emotional basis to animal behaviour which has implications for the type of assessment made of emotion and the evidence used in this process. This forms the basis for the current opinion piece.

Behavioral Approach

The Behavioral Approach to problem animal behaviour provided the original impetus for the development of the scientific discipline of clinical animal behaviour [18] and has developed it further in line with the discipline of Applied Behavior Analysis within clinical psychology [19]. It is grounded in the behaviorism of experimental psychology, with a positivist focus on observable events and the importance of the environment in shaping behaviour. Advocates and proponents include individuals with a background related to the clinical practice of applied behavioral analysis in humans such as Mary Burch, Jon Bailey [20] and Susan Burch and Bailey [20]; and Friedman [21], the develop of "new wave" of animal trainers focused on the use of positive reinforcement to shape behaviour such as Karen Pryor [22,23] and Ramirez [24,25], as well as individuals within the academic discipline of experimental psychology such as Wynne and co-workers [26,27,28]. The behaviourist tradition means processes within the central nervous system, like emotional state are not the focus of attention in either diagnosis or management, instead the focus is on the behaviour of the individual and the observable events which appear to control it, with treatment coming through the management of reinforcement schedules relating to the behaviour [27,28]. Nonetheless, emotional processes are clearly of interest and...
many advocates of this approach have expressed an enthusiasm for the discipline out of a direct concern for welfare and ethical behaviour management [27,29,30]. There is also growing expression of the need to recognise emotional processes within the field of behaviour analysis more broadly [31], even if information about their underlying mechanisms and how these might be of relevance appears to be generally less enthusiastically embraced. This exclusion of emotional consideration of behaviour potentially poses a limitation on the practical value of the process from both an animal welfare and clinical perspective, since behaviour alone is often not a reliable measure for inferring the underlying cognitive-emotional state which is at the heart of determining the animal’s well-being [32]. It may be assumed that if the behaviour changes so will the emotion, and this may be true in some cases, but there is a danger that the behaviour rather than emotion is reinforced such that welfare improvements are limited or delayed. For example, a dog may be reinforced to lie on a mat rather than follow its owner, but this does not mean it is relaxed about this. It might be argued that a good behaviour analyst would have the ability to use a variety of such techniques to achieve the same result (i.e. lie on the mat, not follow the owner). What is important is that the animal is relaxed while lying on the mat, and this must be the criterion for success of the treatment rather than the position assumed by the dog. To do this we need a systematic scientific process to infer emotion which goes beyond an indirect inference from just the overt behaviour of the animal, used by behaviourists.

**Medical Approach**

The Medical Approach, historically pioneered and advocated by certain veterinarians, such as Karen Overall [13,33] and Patrick Overall [13,33] and Pageat [34], is grounded in a positivist reductionism common in science (sometimes referred to, somewhat disparagingly, as “scientist-scientist”) [35]. This has become a widely promoted standard within evidence-based medicine [36,37], but is not without a growing number of critics [38], especially when it comes to conceptualising behavioural and psychological problems [39–41]. Critical to this perspective is the definition of problem behaviour often in terms of pathologies, which result in what is therefore perceived as abnormal behaviour [42]. This approach to medicine and abnormal behaviour or abnormality has been described as “abnormal=behaviour=abnormal behavior” [43]. For example, Overall’s more recent text [13] on the subject, only between 10 and 50 pages (depending on the criteria used) are dedicated to normal behaviour while about 140 pages relate to abnormal behaviour disorders in dogs. This approach is consistent with the dominant framework used for psychiatric diagnosis in much of Europe and North America: the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) [42].

While determining the mathematical relationship between signs in order to define a diagnosis is complex in medicine, this may not reflect a biologically meaningful reality. First, it may impose artificial boundaries on phenomena that, in reality, exist as a spectrum [43]; such as emotional expressions. Thus, from a Medical perspective, normal anxiety is perceived as something qualitatively different to the abnormal anxiety abnormal-related to problem behaviour. This can lead to a scientifically unsound (and therefore often fruitless) pursuit of diagnostic boundaries [44] of pathological states such as anxiety to strengthen the diagnostic process and emotional inference. When differences are, in reality, more ones of degree, e.g., based on diagnosis, emotion, or welfare state, this does not mean that arbitrarily or there will be a proportion of individuals sitting in an ill-defined area between the more clearly definable extremes that allow the dichotomy: as a consequence the biomarker will inevitably lose sensitivity and specificity [45,46]. Another challenge to the biological validity of this approach relates to the biological accuracy of the collection of signs used to make the inference of an emotional problem. For example, separation anxiety in dogs as a behavioural diagnosis has been relatively superficially largely from the co-occurring signs of destructiveness, elimination, vocalisation and/or hypersalivation in the actual or virtual absence of the owner in a number of trials aimed at developing a medical treatment for this problem [47–50]. However this collection of signs describes a behavioural syndrome or presenting complaint rather than a mechanistically discrete biological entity, as is implicitly by the development of a pharmaceutical treatment [51]. At just a theoretical level the emotions of fear, frustration and social panic are likely to be involved to varying degrees in a given case [15], and it is notable that in all of the large clinical studies using either of the serotonin re-uptake inhibitors around 15% of subjects do not respond to the generic treatment programme [49,52,53]. This does not seem to be a problem of owner compliance, since with a bespoke treatment programme, 100% of subjects have been reported to improve [54]. Given this, the most likely explanation for this lack of response would seem to be that 15% of dogs meeting the definition of separation anxiety for inclusion in these studies from the simple clustering of behavioural signs, may have a condition that is mechanistically different. Thus the co-occurrence of signs while mathematically elegant is not biologically reliable when trying to make inferences about the emotional state of animals in a field setting. An artificial demarcation of boundaries between normal and abnormal along a spectrum can also be predicted to result in an overlap between categories and multiple diagnoses in order to avoid gaps between the clusters themselves [14]. This phenomenon has perhaps not been noted [44,45] among case reports of behavioural problems in the Journal of the American Medical Association, with the average case of aggressive behaviour in the dog being described as having between two and three forms of aggression (average 2.4 diagnoses/case), for example, anxiety/fear-based and redirected aggression [55].

In summary, the Medical Approach to making inferences about emotional state in problem behaviour cases focuses on the identification of co-occurring behavioural signs and physiological changes that can be used to distinguish signs of interest relating to the supposed abnormality of the response. Although there may be problems with strict adherence to this approach for the definition of problem behaviour, that does not mean the approach of using a wider range of objective measures of animal behaviour and physiology to help define their underlying emotional state should be abandoned; rather it is an approach from the outset. This has led to an interest in developing scientifically robust methods for the assessment of all subjective elements of the problem, from owner report through to the animal’s perceived emotion and inference of, a distinct abnormality which is problematic from a biological perspective, since this is not consistent with evolutionary theory.

**Psychobiological Approach**

The Psychobiological Approach developed by the author and colleagues [11,15] is grounded in the application of the affective neuroscience of normal functional systems [56,57] within an evolutionary context [58]. Affective neuroscience provides a basis for core emotional systems to be differentiated and emphasises their importance in the development of evolutionarily adaptive behavioural strategies that may be served by a variety of behaviour actions [59]. Specifically, this approach is concerned with the role of the brain’s reward system in the motivation of behaviour, which involves explicit consideration of the owner’s opinion this Psychobiological Approach provides a rigorous scientific framework for the inference of emotion by achieving the following:

1. By the development of a pharmaceutical treatment 
2. By redefining the mechanisms controlling it with a functional evolutionary context, there is a systematic scientific process to infer emotion which goes beyond an indirect inference from just the overt behaviour of the animal, which is the process used by behaviourists.

**Behavioral Analysis**

This approach is based on the hypothesis that animals’ behaviour is controlled by a combination of contextual, motivational, and emotional factors [60]. Critical to this perspective is the definition of problem behaviour often in terms of pathologies, which result in what is therefore perceived as emotional behaviour or abnormal behaviour. This approach is grounded in a positivist reductionism common in science (sometimes referred to, somewhat disparagingly, as “scientist-scientist”) [35]. This has become a widely promoted standard within evidence-based medicine [36,37], but is not without a growing number of critics [38], especially when it comes to conceptualising behavioural and psychological problems [39–41].

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There is also growing expression of the need to recognise emotional processes within the field of behaviour analysis more broadly [36,37] that may, in some cases be primarily classified on the basis of their relationship between the subject and the trigger, rather than the stimulus

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behaviour (its consequences), in order to not only determine reinforcers (as is done within the Behavioral Approach), but also to make testable hypotheses about the motivation (biological goal) of the behaviour. At a practical level, this potentially provides greater predictive power and parsimony concerning how the behaviour might be managed (for example in the case of a dog who is guarding its food bowl and toys, and who is territorial there may be a general issue associated with emotional frustration which can be addressed by a single programme focussed on increasing frustration tolerance [71] rather than a series of exercises aimed at desensitising the animal to these specific situations [12]; this focus on emotional response will also simultaneously reduce the risk of aggression in other contexts which may not have been identified as specifically problematic by the owner); critical to the evaluation of these emotional hypotheses is the application of the hypothetico-deductive method which mandates the exclusion of competing inferences through falsification [72]. This is at odds to some extent with the more traditional verification of diagnoses through the accumulation of positive evidence (such as physiological markers of the problem) that is common within the medical approach to diagnosis.

There is a need to recognise the role and impact of animal emotions in both laboratory and field-based behavioural research, even if the research is not itself focused on this topic, since it has implications for both the potential validity of research results and understanding the welfare of the subjects involved. Protocols for such practical assessment are available from those working with the assessment of problem behaviour. The Psychobiological Approach described provides a systematic structure for framing testable hypotheses about the emotional processes involved in the problem behaviour, in relation to 4 key components: appraisal, arousal, behavioural tendency and communication relating to the emotional situation.

This approach does not provide definitive evidence for the emotions being expressed at any given time (and certainly does not prove or seek to address the issue of animal feelings), but it does provide a more comprehensive and scientifically defensible process than has been used to date. Most importantly, it provides a framework for the inclusion of the assessment of emotion within the evaluation of the behaviour of animals in a field setting and framework for integrating both current and future empirical research, for example testing the hypothesis that different emotional contexts are associated with consistent and differential facial expressions associated with communication of that emotion.

### Conclusion

There is a need to recognise the role and impact of animal emotions in both laboratory and field-based behavioural research, even if the research is not itself focused on this topic, since it has potential implications for both the potential validity of research results and understanding the welfare of the subjects involved. Protocols for such practical assessment are available from those working with the assessment of problem behaviour. The Psychobiological Approach described here, makes no assumption about the normality or abnormality of the subject or its behaviour, and explicitly acknowledges the role of emotion in behaviour, which are limitations inherent to the Medical and Behavioral Approaches respectively (see Figure 1). This makes the method more broadly applicable: its focus on generating falsifiable hypotheses relating to competing hypotheses concerning the emotions being expressed, also makes the process inherently scientific in its methodology, even though emotions are, by their nature, subjective states.

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**Figure 1:** Man contributions of different paradigms (shown in bold) within clinical animal behaviour to the assessment of animal emotion in the field.
References and recommended reading

Papers of particular interest, published within the period of review, have been highlighted as:

• of special interest
++ of outstanding interest

References


2. E. Murphy, R.E. Nordquist and F.J. van der Staay, A review of behavioural methods to study emotion and mood in pigs, Sus scrofa, Applied Animal Behaviour Science, Anim. Behav. Sci. 159, 2014, 9–28. Although focused on pigs, this review highlights the lack of quality performance metrics and ethological validity to many behavioural methods for studying emotional reactions and mood. They critically review the following, many of which have been borrowed from the laboratory animal field: open field tests, elevated plus maze, light dark crossing, novel object tests, human interaction tests, open door/emergence tests, cognitive bias tests and conditioned discrimination tests, as well as more general assessments of emotional behaviour including play, vocalisation, anticipatory behaviour and qualitative behavioural assessment methods.


5. A. Miklosi and E. Kubinyi, Current Trends in Canine Problem Solving and CognitionCurrent Directions in Psychological ScienceCurrent Directions in Psychological Science Current Directions in Psychological Science Trends in canine problem-solving and cognition, Curr. Dir. Psychol. Sci. 25, 2016, 300–306. This review focuses on the explosion of research that has taken place on dog cognition since the late 1990 and argues how domestic dogs, through their co-habitation with people, status as omnivorous carnivora and with a well


11. D.S. Mills and R. Erbakan, 4. ISAE, ethology and the veterinary profession, In: J Brown, Y. Seddon and M. Appleby, (Eds.), Animals and ethology and more of applied ethology: 50 Years and More of Applied Ethology, 2016, Wageningen Academic Publishers, 966–981. In this review the authors highlight how the study of behaviour has been instrumental to the veterinary profession and the seminal role of 19th century and early 20th century veterinarians in shaping the field of applied ethology globally. This paper also illustrates the problems that arise from a common failing to distinguish motivational from emotional elements of behaviour in the diagnostic process. As a result it was found that in a series of case reports, patients have an average of 2.4 problems ascribed to them.


23. K. Pryor, Don't shoot the dog, 1984, Bantam.


26. E.N. Feuerbacher and C.D. Wynne, Application of functional analysis methods to assess human–dog interactions, Journal of Applied Behavior Analysis, 49, 2016, 1–5. This sort case series describes the systematic application of functional behaviour analysis to the assessment of the role of the owner in reinforcement of dog behaviour. Specifically they assessed the effects of being alone, being with the owner, being given attention by the owner, the presence of a comfortable bed and toys on the behaviour of dogs. They found that simply access to the owner may serve as a reinforcer in a behavioural shaping paradigm.


Machine learning models for predicting animal welfare in clinical settings: A systematic review and meta-analysis.


C.R. Ralph and A.J. Tilbrook, Invited Review: Review the usefulness of measuring glucocorticoids for assessing animal welfare, Journal of Animal Science, 94, 2016, 457–470. This review highlights the many ways in which glucocorticoids (cortisol and corticosterone) are a non-specific marker of stress by examining the physiological pathways associated with their synthesis, release and clearance within the context of either a biological functioning or affective states framework for assessing animal welfare. The authors highlight the need to interpret changes in glucocorticoid levels from a functional physiological perspective before inferring its significance in relation to animal welfare. This involves a deep understanding of the neurophysiology that facilitates HPA axis activation.


Queries and Answers

Query: The author names have been tagged as given names and surnames (surnames are highlighted in teal color). Please confirm if they have been identified correctly.
Answer: Yes

Query: As per journal stylesheet specification Abstract must consist of 120 words, kindly rephrase or provide new abstract of not more than 120 words.
Answer: see attached and below: note deliberate use of US spelling as it relates to US discipline of Behaviorism of Skinner: The field of clinical animal behaviour has a growing scientific basis, with three main paradigms having different perspectives on the assessment of animal emotion. The Behavioral approach, grounded in classical behaviorism, makes little reference to emotion in assessment, despite covert recognition of its importance. The Medical approach, drawing on human psychiatric approaches, emphasizes the importance of physical evidence (behaviour descriptions and physiological parameters) for validation of diagnoses centred on abnormality and disorder. The more recent Psychobiological approach synthesizes affective neuroscience, ethology and psychology to propose a systematic and rational framework for making inferences about emotion, that result in the construction of testable (falsifiable) hypotheses relating to four domains derived from component process theory using field-based evidence.

Query: As per journal stylesheet specification "Conflict of interest statement" is mandatory. Please provide "Conflict of interest statement."
Answer: The author is one of the originators of the Psychobiological model, but has no competing financial interests or conflicts to declare

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