

Perspectives on assessing the emotional behaviour of animals with behaviour problems

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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.

Scientific approaches to making inferences about the emotional state of animals are important in many practical settings, such as animal welfare and problem behaviour management. The field of clinical animal behaviour has a growing scientific basis and evidence-based approach, and appears to have three main paradigms, with different perspectives on both the importance of this process and how it can be achieved. The Behavioural approach is grounded in classical behaviourist and applied behaviour analysis, and accordingly makes little reference to emotion in assessment, but it is nonetheless clear both practitioners and academics view animal emotion as an important consideration in evaluating the ethics of what they do. By contrast the Medical approach draws on approaches used in psychiatry. This emphasises the importance of physical evidence in the form of both behaviour and physiological parameters to validate the diagnosis; however this approach emphasises the value of these as markers of abnormality and disorder, rather than normal emotional response. Only the Psychobiological approach which uses a synthesis of affective neuroscience, ethology and psychology proposes a rational framework and systematic process for specifically making the inference of emotion. Critical to this approach is the construction of hypotheses concerning potential emotional expression in a patient that can be tested for falsification at four levels derived from component process theory. This approach has the potential to be more widely used in field setting to make the inference of emotion.

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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** **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 **real-world** **real-world** purpose, such as the assessment of their welfare [6,7], the control of problem behaviour [8,9,10,11] 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.g. 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.g. it is normal and acceptable for a dog to be scared to some extent **of** **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 [11,17]; there are currently three main paradigms underpinning this field's scientific foundation [11]: 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 **new wave** **new wave** of animal trainers focused on the use of positive reinforcement to shape behaviour such as **Karen Pryor [22,23] and Ken Pryor [22,23] and** Ramirez [24,25], as well as individuals within the academic discipline of experimental psychology such as **Glenn Wynne 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 (note the practitioners are called behaviour analysts in line with the US tradition, hence the spelling, will change back elsewhere as appropriate) will pick up on the subtle differences between a relaxed and non-relaxed dog on a mat and will not stop until the former is achieved, but in the author's clinical experience this is not common practice and in any case is a less efficient process than acknowledging and focusing on the management (including reinforcement) of emotion. 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, which is the process 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 'scientism' or 'scientism' [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 or "behaviour disorders": 'abnormal' behaviour or 'behaviour disorders'. For example, in Overall's more recent text [13] on the subject, only between 10 and 50 pages (depending on the criterion 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 has considerable appeal, 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" or "abnormal anxiety" related to problem behaviour. This can lead to a scientifically unsound (and therefore often rather fruitless) pursuit of distinctive biomarkers [44] of pathological states such as anxiety to strengthen the diagnostic process and emotional inference. When differences are, in reality, more ones of degree, either the boundary may be made somewhat 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 defined 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 implied 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 serotonergic agents clomipramine or fluoxetine, around 15% of subjects do not respond to the generic treatment programme [48,52,53]. 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 them [14]. This phenomenon has recently been noted [44,11] 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 the emphasis on and inference of, a distinct abnormality which is problematic from a biological biology 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]. Individualised behaviour occurs in response to certain classes of emotionally competent stimuli [60] that may, in some cases be primarily classified on the basis of their relationship between the subject and the trigger, rather than the stimulus's physical properties [61]. Accordingly this approach broadly embraces positivistic aspects from the preceding two approaches in a synthesis with an explicit recognition of the phenomenological features of problem behaviour [62,63], i.e. that is problem behaviour is a report by another (usually the owner or carer) that they are finding certain behaviour difficult to manage or live with; as such it consists of not only the empirical elements of the behaviour (which are the primary focus of the preceding two approaches) but also the phenomena associated with human perception of this behaviour (which must be given equal initial consideration). Depending on the problem, management of either of these elements may result in successful resolution of "the problem" or "the problem". For example, the owner who complains about their cat's problematic vocalisation may not realise that she is in oestrus, but when this is explained, the behaviour may become less of a concern and so "the problem" or "the problem" resolved, even though the behaviour has not been changed. Although it is to be hoped that a competent practitioner using whatever approach may recognise the cause of such behaviour, there is a risk that biases within their approach may lead someone pursuing a Behavioral Approach to generate a need to reconditioning the animal's behaviour, and a Medical practitioner to seek potentially unnecessary physical interventions such as medication or surgical neutering as a first line. By contrast, the starting point within the Psychobiological Approach, is the phenomenon of the owner's perception of their animal's behaviour, which involves explicit consideration of the owner's perceptions as well as the patient's behaviour cat 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 emotional state. The specific and systematic assessment of the emotional aspects of the behaviour, is one of the innovative features of this approach, which uses a triangulation of evidence from four observable sources (the context of the behaviour(s), the level of arousal shown, the general goal of all related behaviours, and the communicative signals emitted), which have been derived from the component process approach to emotion espoused by Klaus Scherer Scherer and co-workers [64,65]. However, the approach is not exclusively concerned with the assessment of animal emotion, central to the approach is the distinction between behavioural context, motivation and emotion, all of which are important evaluations but which historically have been confused [66]. In the author's opinion this Psychobiological Approach provides a rigorous scientific framework for the inference of emotion by achieving the following:

- a. Through recognising the value of phenomenological theory there is a more coherent basis for the distinction between observation and inference throughout the process of assessment. This begins with the definition of the presenting complaint which is more than a specific behaviour (the logical basis of a physical reductionist approach), but includes how that behaviour is being perceived; it carries through to treatment, which focuses as much, or more (depending on the case) on owner perception of the behaviour which has given rise to the initial concern.
- b. By placing the behaviour and the mechanisms controlling it within a functional evolutionary context, there is a stronger case for biological validity [67]. Bizarre behaviour associated with captivity, e.g. for example fence walking, may be the product of "evolutionary rules of thumb" being applied within an environment to which the animal is not adapted [68], rather than a breakdown in the system controlling behaviour. The behaviour that results may then be rationalised as being maladaptive but not malfunctioning [69], even in the case of behaviours that are not seen in a wild setting [70]. Many adaptive emotional expressions in captivity may be adaptive (e.g. flight and running around looking for a safe haven in response to a loud noise) but problematic for owners in their home. This challenges the medicalisation of behaviour problems and its emphasis on pathological processes. It does not, however, exclude the value of the physical and behavioural data generated by the Medical Approach; rather, it seeks to reframe it within a context of adaptive effort.
- c. By using the objective approach of Applied Behavior Analysis, the Psychobiological Approach structures the examination of evidence relating to the trigger of the behaviour (antecedents), the form of the behaviour (what the behaviour looks like) and what reinforces or inhibits the

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 focused 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.

- d. The component process model of emotion [64,65] 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.
- e. The component of appraisal, allows the posing of hypotheses about whether relevant potential emotionally competent stimuli are present (e.g., for example is the behaviour associated with an event which could be appraised as frustrating to the animal? ~~ie~~ That is a restriction to autonomous control (a fuller list of categories used in a clinical behaviour setting have been described elsewhere [11;15,73] and have been derived from a review of the common emotional behaviour networks in the brain of mammals);
- f. the component of arousal focuses attention on whether this is consistent with the postulated emotional responses being considered (e.g.g. in the case of a frustrated animal there should be clear signs of increased arousal, some of which may be externally observable such as pupillary dilation and pilo-erection);
- g. the component relating to action tendency seeks to use the scientific principle of parsimony to evaluate the range of behaviours being displayed in order to examine the simplest emotional explanation that will explain the complete behavioural repertoire noted at the time of arousal (not just those that are causing the problem) (e.g.g. in the case of frustration, the animal's response will typically involve a focus on the goal to the exclusion of other activities alongside increased effort directed towards accessing or protecting whatever resource is being denied);
- h. the fourth component relates to the communicative features of emotional arousal and requires a testing of the potential emotional explanations for the behaviour against what is known about the signalling repertoire of the species (e.g.g. in the case of the frustrated dog, this involves a pricking of the ears, and more general forward and upwards posture, as well as potential threat displays).

The evidence concerning each is used to triangulate what potential explanations can be falsified. For example, a dog showing just these signs is clearly not fearful, which is a common interpretation of the emotional basis to the resource guarding dog, where the frustration at the potential loss of a resource is often referred to an ~~anxiety~~ anxiety (implying engagement of the emotional fear system) about potential loss [22].

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~~ 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, e.g. 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.

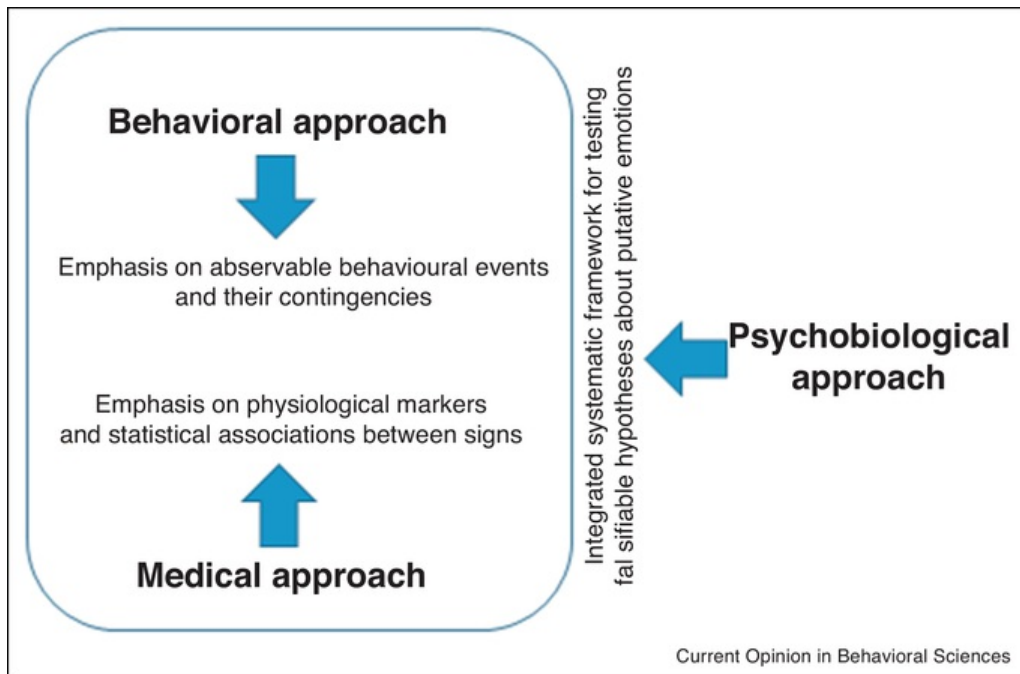


Figure 1 Main contributions of different paradigms (shown in bold) within clinical animal behaviour to the assessment of animal emotion in the field.
alt-text: Figure 1

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Highlights

- Three paradigms (Behavioral, [Medical and Pysural](#), [Medical and Ps](#)ychobiological) are identifiable in clinical animal.
- Each approach has its own perspective on emotional expression and its importance.
- Evidence for animal emotion must be systematic and falsifiable to be scientific [Assessing animal emotion in field settings](#).

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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