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Using behaviour to assess animal welfare

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Abstract

Rather than construct lists of many different welfare indicators and give each of them the same weight, I argue that the assessment of animal welfare should be directed at answering two key questions: 1) Are the animals healthy? 2) Do they have what they want? Behaviour has a major role in answering both. Behaviour is currently used to help answer the first question through its use in the clinical and pre-clinical assessment of pain, injury and disease, and potentially could have an even greater role, particularly if used in conjunction with new technology. Behaviour is also of crucial importance in gauging what animals want, most obviously in the use of choice and preference tests, but also through other methods that are particularly suitable for on-farm welfare assessment. These include quantitative observations of the spatial distribution of animals and of behavioural 'indicators' of what animals want, such as vocalisations.

Keywords: *animal welfare, behaviour, choice, clinical assessment, pain, preference*

Introduction

Much progress has been made over the last few years in developing new indices of animal welfare, but while it is now widely accepted that there is no single measure that can be used by itself (Dawkins 1980; Broom 1988; Mason & Mendl 1993), the plethora of behavioural, biochemical and physiological measures we now have available has brought with it a problem: how do we integrate all of them to give a true picture of an animal's state of welfare? Should we just construct check-lists — the longer the better — of all of the 'measures of welfare' we can think of, or should we put more weight on some than others on the grounds that some measures are more reliable or better than others? I shall argue that, despite the variety of measures it is now possible to make, there are really two questions — and only two questions — that we need to answer about animal welfare. The first question is "Are the animals healthy?", and the second is "Do the animals have what they want?" For both questions, the way an animal behaves is already a key part of their answer and, with technological advances, it is set to become even more important in the future.

The two components of good welfare

Animal health is the foundation of all good welfare (Fraser & Broom 1990; Appleby & Hughes 1997; Dawkins 2001). It would be difficult to dispute the idea that freedom from injury, disease and deformity are the first essentials for the good welfare of any animal, but most people — scientists and lay people alike — mean more by the term 'welfare' than just physical health. They mean mental well-being too. They mean something that includes the animals not being fearful, that is, not trying to get away from situations that they dislike, and not frustrated or deprived because they are trying to find something that they are deprived of or are denied access to. They mean that the animal has what it wants and is not having to endure things that it does not like.

So the two questions, "Are the animals healthy?" and "Do they have what they want?", are between them a succinct way of capturing both the physical and mental aspects of animal welfare and, by being relatively simple and straightforward ways of expressing what most people want to know about animal welfare, they point the way to obtaining the kind of evidence that we need and should be collecting. Asking these two questions together avoids the ambiguity and confusion that has arisen over the term 'need' (Dawkins 1983; Petherick & Rushen 1997). Animals can be said to need food and water in the sense that without them they will die. In this sense, an unmet 'need' affects animal health (Question 1). But the term 'need' can also be used to refer to cases where the animals do not die or suffer ill health if they are deprived, but may nevertheless 'want' something in the sense of being highly motivated to obtain it (Question 2). For example, if birds of species that normally migrate are held in captivity, they become very restless in the autumn and repeatedly attempt to escape even though they are provided with food and water. They have a behavioural need to migrate (they 'want' to migrate) even though their health is good (Dawkins 1983, 1990). Asking what animals want and supplementing this with information about what is good for their health makes this distinction much more clearly than asking a single, ambiguous question about what they need.

A further advantage of using the 'two questions' approach to animal welfare is that it cuts across the common arguments about whether different proposed measures of welfare are or

are not valid. For example, the fourth of the 'Five Freedoms' proposed by the Farm Animal Welfare Council (FAWC 1992) is the "freedom to display most normal patterns of behaviour", but this still leaves open the question of whether animal welfare is compromised if a captive animal fails to show all of the behaviour normal to a free-living member of its species. We can begin to answer this by asking whether an animal that is able to behave naturally is a) healthier and/or b) shows evidence of wanting to behave in that way. It might turn out that behaving in a natural way means that the animal moves around more and has healthier bones and lives longer, in which case we could justify the importance of expressing behaviour on physical health grounds. Or the animal might show evidence not only of choosing to perform the behaviour when it has the opportunity to do so, but also of actually working hard to be able to perform it. If so, this would be convincing evidence that, for this particular animal, being able to perform this particular species-typical, natural behaviour did indeed contribute to its welfare. But if there were no such evidence that the animal was either healthier or particularly minded one way or the other whether it could do the behaviour, there would be no real evidence that its welfare would be improved if it were able to do it. In other words, it is not the naturalness or otherwise of the behaviour that is critical, but the extent to which it can, in any given instance, be linked to either physical health or what the animal does or does not want.

The same argument can be applied to clarify the role of other controversial proposed welfare measures such as stereotypies, which are fixed, often repeated sequences of behaviour with no obvious function. Broom and Johnson (1993) argue that an animal's welfare is poor if stereotypies take up more than 40% of its active time. However, Mason and Latham (2004, pp 57–69, this issue) show that stereotypies can under different circumstances indicate neutral or even good states of welfare, for example, through being a way in which an animal enriches its own environment or calms itself down. Whether a given stereotypy indicates good or bad welfare is therefore not an inherent property of it being a stereotypy, but needs to be judged against its effects on animal health (such as whether the animal damages itself through performing the behaviour) and whether it will work to perform the action (ie it wants to do it).

Although commonly referred to as "stress hormones", corticosteroid measurements taken in isolation are often difficult to interpret in welfare terms because levels rise not only when the animal is in a situation we assume to be stressful, but also when engaged in activities such as eating and copulation (Toates 1995). Here too, asking the two key questions of whether or not the animal's health is at risk, and whether the animal shows evidence of wanting to escape from or avoid a situation, can help in the interpretation of the changes that are observed.

Rather than construct longer and longer lists of more and more 'measures' of welfare, we should be validating the ones that we have in terms of how well they answer these two crucial questions. For example, a recent study (Dawkins *et al* in press) looked at three different measures of welfare in laying hens — levels of corticosteroids, as measured in the birds' faeces (Cockrem & Rounce 1994; Wingfield *et al* 1997; Dehnhard *et al* 2003), changes in the quality of egg shells (Solomon 1997), and what the birds themselves wanted. This latter measure involved an experiment in which pairs of birds were placed in one of two similar choice boxes for a period of 5 days. Each box consisted of one compartment in which there was food, water and a nest box, which was attached to a second compartment. For one treatment the second compartment had a bare wire floor ('barren') and for the other treatment the compartment had an identically sized floor of wood-shavings, plus a box of sprouting wheat ('enriched'). The measure of preference was the relative amount of time the birds spent in the second compartment. The results showed that, right from the beginning of the experiment, the birds with access to the enriched compartment spent significantly more time in their second compartment than did birds with access to the equally sized barren compartment. But while this indicated that the hens had a preference for the enriched environment, the birds with access to the enriched environment also had higher levels of faecal corticosterone and a greater loss of shell thickness than did the birds with access to the barren environment. A 'list' approach to this result would be forced to conclude that the barren environment was better for hen welfare than the enriched one because two measures (corticosterone level and shell quality) pointed in that direction and only one measure (what the birds preferred) pointed the other way. A 'two questions' approach, on the other hand, would give primacy to the birds' own preferences and would suggest that both of the other measures were simply indicating that the birds were more aroused by the environment that they 'liked'. What the birds wanted is thus not just another measure of welfare, but a necessary piece of evidence that gives valence and meaning to the more physiological measures of corticosterone level and shell quality.

Behaviour and welfare

In addressing the issue of how we can use behaviour in the assessment of animal welfare, we next need to ask what behaviour can tell us about animal health and also what it can tell us about what animals want. Behaviour has a number of major advantages in welfare studies. Not only is it non-invasive (does not involve breaking the skin), but it is also in many cases non-intrusive (does not even disturb the animal). Behaviour is also the result of all of the animal's own decision-making processes — "the final common path" as Sherrington (1906) called it. It is also "the expression of the emotions" (Darwin 1872) — the ultimate phenotype. The advent of cheap video technology and computer image processing means that we can look forward in the not-too-distant future to widespread surveillance of the behaviour of animals with automatic recognition of behaviour in zoos, farms and laboratories. If commercial companies can already market systems that can be installed in car parks to distinguish people walking up to cars to drive them away legitimately from people walking up to cars with the intention

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of stealing them, or to tell the difference between someone standing around on the side of the road and someone standing at the kerbside waiting to cross, the time cannot be far away when comparable technology is used to tell us a great deal about animal behaviour, and so automatically that it can be used routinely and will bypass any criticisms of subjectivity or arbitrariness.

Behaviour is already used widely in the clinical assessment of animal health and in particular in the assessment of pain (Rutherford 2002). One example is the use of gait scores to assess the leg health of broiler chickens (Kestin *et al* 1992). Chickens are observed walking and are assigned a score from 0 (healthy legs and normal walking) to 5 (unable to walk). The advantage of using behaviour is that the underlying pathology of lame birds is very variable and can be due to abnormalities of cartilage, infection of the joints or distorted bone growth (Thorp 1994; Bradshaw *et al* 2002), whereas simply scoring the ability of the bird to walk gives a quick, on-farm method of assessing leg health in large numbers of birds. Different gait abnormalities can be related both to leg pathologies and also to the biomechanical consequences of those pathologies. Furthermore, the fact that birds with poor gait scores also choose to self-administer analgesic drugs (Weeks *et al* 2000) means that gait scores can be linked not only to physical health but also to what the birds want (reduction of pain). There is, of course, a need for careful validation of all scores used in clinical assessment and it may turn out that they need to be tailored to different sorts of pain. However, as a quick guide to diagnosis we can only look forward to greater use of behaviour in this field, not only for current, observable pathology, but also, even more excitingly, for sub-clinical or pre-clinical diagnosis where behaviour might become an 'early warning system' of trouble yet to come unless appropriate action is taken.

In the assessment of what animals want there are three distinct ways in which behaviour can be used. The first and most obvious is in the direct measurement of choice and preference, including the use of demand analysis (Fraser & Matthews 1997). I propose to say relatively little about this here, partly because these topics will be covered in some detail in other papers in this issue, but also because the 'conventional' choice tests that involve offering animals a choice of options or allowing them to 'work' for access to commodities are quite difficult and cumbersome to transfer to on-farm work. Acknowledging the value of such tests 'behind the scenes', I feel it is very important that we also turn our attention to developing ways of assessing preference that can be used for on-farm, in-the-field or at-the-zoo welfare assessment without the need for complex apparatus. As these topics are less well covered in other papers in this issue, I would like to point to two promising approaches with an emphasis on what we might do in the future and not just on what has been done in the past. Both of the approaches I shall discuss are indirect measures of preference and of what animals want.

The first of these alternative approaches involves making use of the results of previous choices that animals have made, using and extending methods used by ecologists to study habitat preferences in wild animals. Because these methods involve leaving wild animals where they are and not catching them or imposing artificial choices upon them, they are ideally suited to the assessment of what undisturbed animals want in the places where we are most concerned for their welfare — in zoos, on farms, in the home or in large commercial laboratories. I refer to these as ecological or *in situ* measures of preference.

For example, one of the problems with developing good systems for growing free-range broilers is that, even when provided with access to the outside, many birds simply do not venture far from their houses and some never leave their houses at all (Dawkins *et al* 2003). The result is that many free-range birds never 'range' at all and so are free-range in name only. Their reluctance to leave their houses strongly suggests that the range is not providing them with the habitat that they want. By using the same methods used by ecologists to find out what free-flying farmland birds want by way of habitat, we showed that chickens are attracted to trees and are much more likely to come outside if there are trees nearby and, within a given range, to cluster differentially under trees (Dawkins *et al* 2003). The positions of the birds in relation to environmental features and to the different habitats available to them give as clear an indication of what the birds want as any choice test. Similar methods could be used in a much wider variety of commercial situations, for example, to evaluate how much intensively housed animals 'like' an environmental enrichment provided for them.

As well as indicating what animals like or dislike about the physical aspects of their environments, spatial distribution can also tell us about how close they want or do not want to be to other animals. McBride and colleagues (1963), Stricklin and colleagues (1979) and Keeling (1995) have all suggested that the distribution of animals in space is a valuable *in situ* way of revealing how they respond to each other. Animals that crave close contact will form clumps, those that have a different degree of aversiveness to each other will space out, whereas those that do not care will distribute themselves at random. Their spatial pattern will indicate the social choices that they have made, and changes in such patterns with stocking density or degree of crowding will be particularly important in helping us to decide whether animals want more space (Keeling 1995).

The second 'indirect' group of methods for discovering what animals want is to look for behaviour that accompanies or is correlated with situations that they want or want to get away from. The rationale here is that we can use conventional choice tests to find out what the animals want (and how much they want it) using equipment that is as complex as we like. Then, if we put the animal in the presence of situations that, by its overt choice, it shows us that it likes or dislikes, we can look for behaviour or vocalisations that are characteristic of those two situations. Once we have identified these correlates of positive and negative choice, we can leave the laboratory and venture out onto the

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farm to see if we can find evidence of those same behaviours *in situ*. Because of the work we have previously done, we are now in a position to interpret the behaviour we see as indicating that the animal is in the presence of something it likes or, conversely, something it does not like. The behaviour we observe on a farm is a surrogate for the choice that the animal would make if it could. One clear example of this is the vocalisations made by piglets when they are hungry (Weary & Fraser 1995). The vocalisations can be interpreted because they have previously been validated against the physical health of piglets and also related to what they would like to eat if given the opportunity. They are known to be good surrogates for what the animal wants.

Vocalisations may perhaps be a rather special case of an indicator of what an animal wants because they are signals, that is, behaviours that have specially evolved to alter the behaviour of another animal, in this case the sow, and which can therefore be 'listened in on' by humans concerned with piglet welfare. But many animals may experience unpleasant or damaging situations with no possibility of other animals coming to their aid in the way that mothers will come to the aid of their offspring. We would not therefore expect them to send out 'signals' and the indicators of their state may be somewhat harder to read. Nevertheless, behaviours indicative of situations that animals do not like, such as bill-wiping in hens after tasting something unpleasant, may be prime candidates for indicators that are not signals. Hughes (1983) found that head-shaking increased when a strange bird was introduced to a flock of hens. We need to extend our search for such potential indicators. The animals may be trying to tell us something and we need to be able to interpret what that is. Here again, new technology and new methods of automatically processing large amounts of data could revolutionise how we use behaviour. It might turn out that something as simple as the amount of movement in a flock or herd is a very good predictor of something that is about to happen, such as an outbreak of tail-biting. On the other hand, we may find that we need an extensive search with new statistical approaches to find the 'indicators' that we are looking for.

I do not have the space to mention other ways in which behaviour has been or could be used in welfare assessment. Many people, such as geneticists wanting to select particular types of animal for breeding, use measures of behaviour such as those derived from open-field tests or tonic immobility tests, or even just use the responses of animals when approached by a human, as measures of 'fear' (Jones 1997), but it is often not clear how these tests should be interpreted in welfare terms. Does an animal that takes a long time to recover from tonic immobility have poorer welfare than one that takes a short time? Once again, we need validation in terms of linkage to the two key questions. We cannot assume that these are valid measures of welfare until we have shown how they relate to what we really want to know.

Conclusion

I come back to the somewhat arrogant assertion that I made at the beginning: that there are two things, and only two things, which we need to know in order to assess animal welfare. All of the measures that we might want to use have to be validated in terms of the extent and effectiveness with which they tell us about animal health and about what the animals themselves want. Theodosius Dobzhansky famously said "Nothing in biology makes sense except in the light of evolution". With apologies to Dobzhansky for misquoting him, it is equally true that "Nothing in animal welfare makes sense except in the light of health and what the animals want". We are entering a new era in which I believe behaviour will become even more important as a tool in welfare assessment than it has been up to now, and will be even more widely used, not only by academics looking at small numbers of intensively studied animals, but also by farmers, veterinarians, zoo keepers and people wanting to do on-farm audits. Far from being the poor relation of so-called 'hard science' measures of welfare (physiology and biochemistry), we need behaviour to make sense, particularly through its role in telling us what animals want. Because of the difficulty of interpreting physiological measures of welfare, as well as the stress they may cause when they are taken, there is an increasing need to find more reliable and less invasive methods of welfare assessment. The most obvious, least intrusive and potentially most powerful alternative of all is the animal's behaviour.

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