INTEGRATING PARAMETERS TO ASSESS ON-FARM WELFARE

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Abstract *Animal Welfare 2003, **12**: 529-534*

Given the absence of a 'Golden Standard' for the objective determination of welfare, the collection and interpretation of data involving different parameters is essential for assessing the well-being of farm animals. The choice of parameters and the relative weights assigned to each of them are crucial for the outcome of the assessment. Both elements involve a certain degree of subjectivity. In this paper we discuss the basics of different methods used to integrate welfare parameters, focussing on the issue of scientific objectivity. We begin by addressing parameter selection, the assignment of parameter weightings or rankings and the qualifications necessary for 'experts' designing and applying the methodology. Five different approaches to integrating parameters are then discussed. The paper does not state a preference for any method, but aims to encourage discussion of key elements involved with the on-farm assessment of welfare.

Keywords: *animal welfare, farm animals, husbandry, parameter integration, welfare assessment, welfare index*

Introduction

The lack of a 'Golden Standard' means that to determine welfare objectively, the collection and interpretation of data involving different parameters is essential. However, the choice of parameters and the relative weights assigned to each of them are crucial for the outcome of the assessment. Both elements involve a certain degree of subjectivity.

In this paper we begin by addressing parameter selection, the assignment of parameter weightings or rankings, and the qualifications necessary for 'experts' designing and applying the methodology. We then discuss the basics of different methods used to integrate welfare parameters.

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Aspects of integration

Choice of parameters

Integration starts with a decision on whether or not to select relevant parameters. Although there are exceptions (see 'Qualitative assessment' below), in most cases selection will take place. The choice of parameters is determined on the basis of feasibility, validity and repeatability.

The feasibility criterion can be particularly restrictive when assessing welfare on-farm. The often limited amount of time available for collection of the data and the circumstances under which they have to be collected preclude the use of most physiological parameters and several behavioural parameters. Aspects of the housing environment are often easier to measure. Selection based on feasibility is relatively easy and is often reported (eg Bartussek 1999). The validity of a parameter is less easy to determine. Although it is common sense to use a parameter only if it has relevance to welfare, choices are often based on assumptions rather than facts. Finally, parameters are useful only if they can produce repeatable data. Measurement of wind speed (draughts) in a farrowing building is both feasible and valid, but lacks repeatability.

Relative weightings

Any method that aims to integrate different parameters into a smaller subset or into one single index will have to weight the data. Weighting involves the assignment of a level of importance to a parameter, relative to the other parameters in the same subset or index. Different techniques are used. Most commonly, the score for a parameter is linked to a range or step. The minimum and maximum of each step are chosen arbitrarily, and are therefore part of the weighting process (eg 'score 1': less than 10 scratches on the skin, 'score 2': 10–50 scratches, 'score 3': more than 50 scratches). These scores can be added to scores generated from a different type of parameter (eg scores 1–3 for space allowance) to calculate an overall score. Ranges can also be labelled non-numerically (eg 'red': less than 1 m^2 per animal, 'amber': 1–2 m^2, 'green': more than 2 m^2). To generate an overall score from different parameters from these qualitative scores, the frequency of red, amber and green across different parameters can be counted to arrive at an overall conclusion. Less common are techniques that assign a weight to the actual value measured. Typically they result in equations such as: Welfare Score = a × (m^2 per animal) + b × (number of scratches) + etc. Often the equation or algorithm is much more complicated.

When assigning weights it is important to remember that by excluding a parameter it is also weighted: it receives a score of zero. The opposite is also relevant: by including more parameters on a given aspect of, for example, the environment, that environmental aspect gains importance (Bracke 2001). It follows from this that even the formulation of welfare legislation includes the assignment of relative importance to the parameters in the law, and constitutes a method of integration (albeit on a rough basis: 'yes, you comply' or 'no, you do not comply with the law').

Furthermore, parameters may not be independent of each other but may have an interactive effect on overall welfare. For example, it could be argued that the overall welfare value of the level of straw is dependent on the ambient temperature. At high temperatures the welfare advantages of a rootable substrate may be mitigated by the lack of a cool place to lie.

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Experts

The selection of parameters and the determination of their relative weights involve a certain level of expertise in the area of animal welfare. Sometimes, outside 'experts' are called in to help the developer of a system with this phase of development. Their background may have an important effect on their interpretation of relevance and importance of parameters. The following is a rather brief and much-simplified view of the options:

- *Laymen* (people not involved with animal husbandry) may have an unbiased view close to that of society at large, but their views may be too anthropomorphic.
- *Specialists* (such as veterinarians and ethologists) may look at welfare from their own area of expertise and perhaps not recognise signs outside that field of expertise.
- *Farmers* have day-to-day experience of the behaviour and health of their stock but may not be able to compare across farms.
- *Welfare scientists* seem, almost by definition, to have the right broad background. However, even their interpretation of welfare cannot be called 'value free' (Fraser 1995), and disagreements (eg on the welfare status of individually housed pregnant sows) are common.

Five different approaches

There are a number of different ways in which parameters can be integrated, taking into account the aspects mentioned above. With the following list of five very different approaches, we aim to encourage discussion of key elements involving methods for integrating welfare parameters. Although advantages and disadvantages are mentioned, it is not intended to state preferences for particular methods.

Approach 1: Scoring Systems

This approach is arguably the one that is most commonly used. Welfare assessment schemes such as the TGI (or Animal Needs Index; Bartussek 1999; Hörning 2001), the DVI (Bokkers 1996) and Freedom Foods (Main *et al* 2001) use this approach to integrate parameters. However, although their general structure is similar, the schemes differ substantially. There are four basic steps:

- *Step 1* involves the listing of all relevant parameters based on literature evidence and expert judgement.
- *Step 2* consists of the weighting of these parameters relative to each other. As discussed above, this can be done in a number of different ways. The weighting is done by experts on the basis of data from literature as well as their own opinion.
- *Step 3* is usually included and involves setting thresholds and limits for 'pass' and 'fail'.
- *Step 4* involves on-farm testing. If necessary, adjustments to steps 1–3 are made if there is a mismatch between the perceived welfare status on farms and the outcome of the assessment.

Advantages

This is a simple, logical and transparent method based on scientific literature knowledge. It allows for the inclusion of thresholds as well as the substitution of one parameter for another ('compensation').

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Disadvantages
There are a number of subjective steps. 'Overcompensation' is possible (allowing serious welfare disadvantages of a housing system to be compensated for by a number of minor advantages), but could be prevented by setting minimum requirements.

Approach 2: A Decision Support System

A method pioneered by Bracke (2001) attempts to capture the known relationships between parameters (Bracke calls them 'attributes') in a computerised database and make them available for welfare assessment. The development involves the following steps:

- *Step 1* identifies the model's domain (animals and husbandry systems), defines welfare and de-composes it into functional elements or needs.
- *Step 2* lists available statements in literature on welfare-related parameters in quantitative terms and links them to the needs.
- *Step 3* assigns relative weights to parameters based on literature statements on the importance of the parameter to maximum and minimum levels of welfare, using the dimensions of intensity, duration and incidence.
- *Step 4* validates the model by comparing its score of the level of welfare in a number of housing systems to that given by a number of internationally recognised welfare experts.

Advantages
A complex set of information from literature is integrated into one model, in which only 'simple' data has to be entered to obtain a welfare score. The method probably attains the highest level of objectivity possible. Points of criticism can be easily evaluated in a quantitative way.

Disadvantages
The method is a black box: only the expert who developed the model knows the ins and outs, weaknesses and strengths. It takes a lot of time and effort to construct the model.

Approach 3: Multivariate statistics to determine relative weights

Multivariate statistics have been used in animal behaviour studies to reduce large numbers of parameters to smaller independent subsets (eg Spoolder *et al* 1996) and to calculate their relative contribution to a known dependent variable. Potentially, they could be used to calculate weightings for a set of parameters in relation to an independently generated overall welfare score. The steps would include the following:

- *Step 1* invites a number of recognised experts to give an overall welfare score based on their own experience to a large number of husbandry situations.
- *Step 2* is to document as many animal- and housing-related parameters as possible in each of the husbandry situations.
- *Step 3* links the scores of the experts to the parameters measured through multivariate statistical techniques. These techniques will identify relevant and irrelevant parameters, and give a relative weighting to each.
- *Step 4* checks the internal validity of the model by testing the outcome using different husbandry situations and different experts.

Advantages
This approach makes the selection and weighting of parameters an objective process, albeit in relation to an expert's opinion of the welfare situation.

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Disadvantages
The design of the model relies heavily on the opinion of the experts who provide the initial welfare scores. Many data are needed to build the model with all of its parameters.

Approach 4: 'Classic' post-hoc interpretation of results

Welfare parameters can be collected on farms without any *a priori* attempt to relate them to each other. The integration of the parameters and the conclusion with respect to overall welfare is formulated at the end of the report or paper.

- *Step 1* involves a decision on which parameters to measure on the farm.
- *Step 2* is to collect the relevant data per parameter.
- *Step 3* describes the outcome of the study per parameter, and draws conclusions on the level of welfare based on the author's opinion of the relative weighting of each parameter.

Advantages
The method is transparent: the records of individual parameters are maintained throughout the process and can be checked and reinterpreted if necessary. No expertise is needed on variables other than those studied. The method is easy to apply.

Disadvantages
The integration of data at the end ('end conclusion') cannot be standardised: its outcome depends on the relative importance assigned by the researchers to the parameters measured.

Approach 5: Qualitative assessment — integrating parameters through 'whole animal' observations

A method pioneered by Wemelsfelder *et al* (2001). Experienced observers of behaviour are instructed to integrate perceived details of an animal's behaviour into qualitative assessments of behavioural expression (eg calm, nervous, relaxed, anxious). These assessments provide information about an animal's experience of its situation, and may assist in the interpretation of quantitative welfare indicators.

- *Step 1* is to assign 'whole animal' qualitative scores to groups of animals during farm visits.
- *Step 2* is to use these scores to help interpret measured quantitative parameters through multivariate statistical mapping techniques.

Advantages
This is a relatively direct form of integration that takes place during the observation of animals on-farm. It is potentially a cheap and flexible method that includes every potential aspect of welfare.

Disadvantages
The method relies heavily on experts' interpretations of behaviour. The 'whole animal' end scores cannot be traced back to measurements of separate parameters.

Animal welfare implications

Farm animal welfare can benefit from good on-farm welfare assessment in a number of ways. It allows direct feedback to the manager on weaknesses and strengths, it aids policy makers in their decisions, and it can be developed into a marketing tool through which good welfare practice pays itself back. Welfare assessment almost by definition involves the

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integration of different parameters. Integration can be carried out in a number of different ways and inevitably involves human judgement. Identifying the structure behind the integration process will highlight the advantages and disadvantages of each approach and will also make transparent the points at which human judgement is required.

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