Introduction

Humans keep animals for different purposes: to produce food, to provide labour, for research purposes, for leisure, as companions, etc. Depending on the specific purpose, the external conditions and the animal species and type involved, humans provide care by means of different forms of housing and shelter, opportunities for species-specific behaviour, food, water, and veterinary control and treatment. The welfare of kept animals, i.e. how they perceive the conditions in which they live, is to a large extent determined by the quality of this care.

We focus here on farmed animals kept for food. However, the general principles of welfare assessment described in this chapter are applicable to a wide variety of settings. The welfare of farmed animals is in the first place the responsibility of farmers and those that directly care for the animals. High welfare standards generally result in reduced mortality, lower levels of injury and disease, and often higher productivity. Farmers strive for good levels of animal welfare, either because they want to provide good care for their animals or because of the favourable effects on production and thus farm economy, or both (Bock and van Huik, 2007). Moreover, since consumers nowadays expect good welfare for food producing animals, high welfare standards are more and more a prerequisite to access (international) markets. Thus, international financial institutions like the International Finance Corporation (IFC), whose policies are applied worldwide (Broom, 2017), recognise that businesses that enhance animal welfare are likely to have a competitive advantage in the global marketplace. The IFC has published a Good Practice Note entitled *Animal Welfare in Livestock Operations* (Mousseau et al., 2014) to increase awareness about the relevance of animal welfare and to guide investment practices in the field of livestock.

The interconnections between animal health and welfare and human health and welfare and their relation with environmental factors (climate change, biodiversity), are increasingly recognised by society at large (Pinillos et al., 2016, Olmos Antillón et al., 2021). This also contributes to a large public concern for animal welfare, as illustrated by the results of the special Eurobarometer on the attitudes of Europeans towards animal welfare (European Commission, 2016) that showed that 94% of citizens from the European Union (EU) believe it is important to protect the welfare of farmed animals. The importance of the welfare of farm animals has been gradually affirmed over the last 50 years, and citizens’ interest in the way these animals live and die seems to continue to increase (Peyraud and MacLeod, 2020).
In many countries, and especially in the EU, societal concern about farm animal welfare has been translated into a legislative corpus defining housing conditions and management practices for specific farm animal species (Blokhuis et al., 2008, Buller et al., 2018) as well as in private welfare assurance schemes and related labelling systems (Main et al., 2014).

It is for all of the above reasons that information on the welfare status of farm animals and how to improve related practices is important for all companies in the food chains, from farms to retail, and ultimately for consumers and the general public. Five broad groups of information demand may be distinguished (Blokhuis, 2018):

1. To provide farmers and other chain actors (e.g. transporters, slaughterhouses) with data to manage and improve animal welfare;
2. To give food retailers/restaurants the opportunity to brand products or their corporate identity;
3. To allow consumers to purchase products from animals with assured welfare;
4. To inform society about the welfare status of farm animals;
5. To regulate animal protection and to check compliance with such legislation.

Similar purposes can be found for other types of animals. For instance, zoos may use data on animal welfare to manage their animals (Purpose 1), to demonstrate their corporate responsibility (Purpose 2), to allow visitors to choose zoos according to the welfare of animal (equivalent to Purpose 3), to inform society about the level of animal welfare in zoos (Purpose 4), and such data can serve to develop appropriate legislation (Purpose 5). Because of the different purposes and use, the information in these different categories may have different forms and different levels of integration and detail. However, the information is always derived from the same set of measures by which the welfare of the animals involved is assessed. In this chapter, we address the various welfare assessment frameworks as well as the measures to check animal welfare. We then discuss how the results from measures can be assembled into information to meet the various purposes and use of animal welfare assessment.

**Welfare assessment frameworks**

**Domains of animal welfare**

Assessing the welfare of an animal is challenging because it is a multi-dimensional concept. For a holistic assessment of animal welfare one has to address all relevant domains. Domains of welfare can be described under three headings (Webster et al., 2015):

- Good biological functioning (including good health and vigour), here welfare is viewed as the satisfaction of biological needs, which are essential to life;
- Affective state (absence of stress, presence of positive experiences), here the emphasis is on what an animal experiences as being pleasant vs. unpleasant;
- Natural living, here one assumes that the impact of the farm environment is related to the deviation from the natural environment of the species, and that the extent to which natural behaviour can be expressed is an indication of welfare.

**Overall measures of animal welfare**

Some authors proposed single indicators as overall measures of welfare. Hurnik (1990) suggested using animal longevity as a measure of welfare, assuming that longevity indicates that the ani-
A third example comes from studies by Barnett and Hemsworth (1990) and Wagner et al. (2021) that address more directly the affective states, with emphasis on stress and behaviour. Barnett and Hemsworth (1990) propose to use free corticosteroid concentrations in blood to detect chronic states of poor welfare. Based on concomitant signs of increase in metabolic cost, immunosuppression, altered reproduction or growth, they set a threshold of 40% increase in free corticosteroid – compared to control environments – to conclude that animals are in a state of chronic stress. However, this is not considering that some diseases might be detrimental for welfare without inducing a corticoid release (i.e. not stressful). Wagner et al. (2021) identified abrupt changes in the circadian rhythm of activity in cows in case of disease or modifications in the environment (handling, mixing, etc.). The changes in rhythm are likely to reflect the malaise perceived by animals when sick or stressed. It is however unsure that a disease developing gradually or environmental conditions deteriorating slowly would lead to a detectable change in the circadian rhythm. Before using changes in corticosteroids or in rhythm as an overall measure of an animal’s welfare, it should be shown that these measures are sensitive to a wide range of adverse conditions.

Multi-criteria measurement of animal welfare

As explained above, to date there is no satisfactory single measure that covers the three domains of welfare. Such a measure should be sensitive to the effects of all the various factors in the animal’s (internal and external) environment that can affect its welfare. An alternative approach to get an overall picture of an animal’s welfare is to define criteria that cover all aspects of good welfare in terms of biological functioning, affective states or lack of naturalness, and then design a measuring framework through which the extent to which the criteria are fulfilled can be evaluated.

Several lists of welfare criteria have been proposed. The most influential is the list of “five freedoms” established by the Farm Animal Welfare Council (1992):

- Freedom from hunger and thirst;
- Freedom from discomfort;
- Freedom from pain, injury, or disease;
- Freedom to express normal behaviour;
- Freedom from fear and distress.

The five freedoms are widely used and form the basis of EU policy to develop legislation (e.g. European Commission, 2007) and by business operators to develop care protocols or certifica-
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tion schemes (e.g. the Freedom Food Scheme, Main et al., 2001). However, the five freedoms are not a fully adequate list of welfare criteria on which a holistic measurement framework can be based. First, some freedoms are partly redundant. For instance, “Freedom from discomfort” and “Freedom from pain, injuries, or disease” overlap because an uncomfortable lying area is often associated with injuries. Second, several freedoms contain independent items that require specific consideration. For example, by grouping hunger and thirst, there is a risk that the assessment framework proposes only one measure for the two items. These considerations led scientists from the Welfare Quality project to propose an adaptation of the five freedoms, resulting in a list of 12 independent criteria (Botreau et al., 2007b):

1. Absence of prolonged hunger: animals should not suffer from prolonged hunger, that is, they should have a suitable and appropriate diet;
2. Absence of prolonged thirst: animals should not suffer from prolonged thirst, that is, they should have a sufficient and accessible water supply;
3. Comfort around resting: animals should have comfort when they are resting;
4. Thermal comfort: animals should be neither too hot nor too cold;
5. Ease of movement: animals should have enough space to be able to move around freely;
6. Absence of injuries: animals should be free of injuries, for example, skin damage and locomotion disorders;
7. Absence of disease: animals should be free from disease;
8. Absence of pain induced by management procedures: animals should not suffer pain induced by inappropriate management, handling, slaughter, or surgical procedures (e.g. castration, dehorning);
9. Expression of social behaviours: animals should be able to express normal, non-harmful, social behaviours (e.g. grooming);
10. Expression of other behaviours: animals should be able to express other normal behaviours, that is, it should be possible to express species-specific natural behaviours such as foraging;
11. Good human–animal relationship: animals should not be afraid of humans and be handled well in all situations, that is, handlers should promote good human–animal relationships;
12. Positive emotional state: negative emotions such as fear, distress, frustration, or apathy should be avoided, whereas positive emotions such as security or contentment should be promoted.

Welfare Quality project partners then designed measuring protocols for different species and types of animal, with precise measures for each criterion, to cover all welfare aspects while eliminating redundancies (Welfare Quality, 2009c, Welfare Quality, 2009b, Welfare Quality, 2009a). Other scientists and stakeholders used the same Welfare Quality criteria to design measurement frameworks for species not covered by the initial project such as sheep, goats, horses, turkeys, rabbits, mice, and dolphins (AWIN, 2015a, AWIN, 2015c, AWIN, 2015b, Clegg et al., 2015, Dalmau et al., 2020, Spangenberg and Keeling, 2016).

In the Welfare Quality protocols, the 12 criteria are grouped into principles. The grouping is done in such a way that, within a given principle, the criteria may compensate one another to some extent, whereas this is not the case between principles. Four principles are distinguished:

- Feeding (Criteria 1 and 2), addressing whether animals are properly fed and supplied with water;
- Housing (Criteria 3 to 5), addressing whether animals are properly housed;
• Health (Criteria 6 to 8), addressing whether animals are healthy;
• Behaviour (Criteria 9 to 12), addressing whether the behaviour of animals reflects optimised emotional states.

Inclusion of positive welfare

Frameworks to measure animal welfare may vary with time because new scientific knowledge allows the use of better or easier-to-apply measuring methods, or scientific studies substantiate changing societal values. The five freedoms focus on the prevention of animal suffering. Only “freedom to express normal behaviour” refers to positive affective states or “positive welfare”, i.e. requires that animals are provided with more than what is essential for them not to suffer. Boissy et al. (2007) discussed the existence of positive affective states in animals and provided avenues to detect them from observation of behaviour (play, grooming, and exploration).

Mellor and Beausoleil (2015) proposed a framework for welfare assessment based on five domains. The first four domains – nutrition, environment, health, and behaviour – are close to the four Welfare Quality principles. The fifth domain covers mental states that derive from the resources provided regarding the first four domains (e.g. hunger and thirst when the provision of food and water – domain “nutrition” – is insufficient). Mellor and Beausoleil (2015) insisted on the necessity to minimise negative affective states and at the same time to promote the positive ones (e.g. pleasures due to the taste of food or to satiety) even if not all negative experiences can be removed. It is now recognised that the environment should provide opportunities for animals to experience positive emotional states (Mellor, 2016) and that animals should live “a life worth living” (Farm Animal Welfare Council, 2009). The 12 Welfare Quality criteria can still guide the development of welfare measures. These measures should nevertheless allow more space for addressing positive states rather than only eliminating the poor ones.

Measures of animal welfare

Categories of measures

Once criteria for good welfare are defined, measures are required that can be applied in practice to assess to what extent the criteria are fulfilled. There are many measures available, some of them require specialised equipment and can only be used under experimental or laboratory conditions (like detailed behaviour observations or invasive physiological measures of stress), others can be applied in practice on farms or at slaughter (e.g. skin lesions). It is beyond the scope of this chapter to describe measures in detail. We will only address the main categories of measures and focus on measures to assess animal welfare in practice.

Measures are often divided into two categories. The first category comprises measures related to resources in the animal’s environment and to the management of the animals that are crucially important for the quality of the animals’ lives. These include, for example, the availability and quality of litter and space, feeding routines, or animal handling.

In contrast to these resource and management measures, the second category focuses on aspects of the animal’s health, physiology, and behaviour that are measured in/on the animal. These measures more directly relate to the animal’s welfare. Examples are measures of rectal temperature, blood level of cortisol, lameness, fearfulness, or wounds.

The first category is also referred to as “input-based measures” and the second category as “output-based measures”. Clearly, these two categories of measures are closely related since the actual status of the animals depends on the quality of available resources and how these are applied and managed. The advantage of input measures is that they are relatively easy to define
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and assess (especially resources). That is why most requirements in welfare regulations refer to this type of measure. However, there are also difficulties with the use of input measures. Animals differ in their genetic structure, early experience, and temperament, and may therefore experience the same environment in different ways. Even very similar environments may be managed differently by the stockperson, further affecting the animal’s experience of a particular situation.

Thus, resource- or management-based measures provide information about the risks for welfare but do not always reliably predict the effect on animal welfare in a particular situation. Therefore, research has been focusing on the further development of animal-based measures, which are considered to show the “outcome” of the interaction between the animal and its environment (housing design and management). To be suitable to assess animal welfare in practice, measures must be specific, in that they measure what they are supposed to measure, and they must be sensitive, repeatable, and feasible in practical conditions (Knierim et al., 2021). For some of the welfare criteria listed above, the available measures do not fulfil these requirements. For example, thirst is difficult to measure with simple methods unless the animal is very dehydrated, in which case a pinch skin test can be used (when the skin of a dehydrated animal is pinched it does not immediately resume its initial shape). Similarly, the pain induced by dehorning cannot be measured at the time of a farm visit because dehorning may have occurred a long time ago. In such cases where animal-based measures are not available, we need to rely on resource- or management-based indicators (Blokhuis et al., 2019).

At present, the protocols to assess animal welfare are based mainly on observations of animals (e.g. clinical signs, body condition) or the environment (e.g. number and cleanliness of drinkers), and to a lesser extent on interviews with farmers (or slaughter plant managers, e.g. about procedures for pain management) and on the collection of data from farm records (e.g. mortality). Gathering all information with a protocol, like that provided by Welfare Quality, may require several hours or even a full day on a single farm. Such welfare assessments are therefore often applied infrequently, e.g. farms may be visited once a year for a certification scheme, or only a sample of farms are visited, e.g. under the cross-compliance scheme the European Union requests that 1% of farms are inspected in each Member State per year. The frequency with which measures are taken depends on the intended use. For example, if a food retailer wants to brand a product based on a design characteristic of the housing (e.g. “cage free” eggs or “pasture based” beef), a yearly or biennial assessment may be appropriate. But, for management purposes, measures have to be taken much more frequently. Indeed some measures are only useful when outcomes are available on a daily basis (e.g. detection of a disease).

Automatic monitoring

Modern technology in the area of Precision Livestock Farming (PLF) can help to make measurements more continuous and thereby more applicable in daily welfare management. PLF entails the automated monitoring of livestock to enable farmers to optimise production, and the health and welfare status of their animals. Sensors are now available to record a number of parameters on animals or their environment. Animal activities can now be detected thanks to accelerometers, locating systems, or image analysis; coughing can be detected from sound analysis and fever from infrared cameras; the animals can be automatically weighed; etc. This offers the possibility to obtain data continuously and at an individual level (at least in large species like cattle and pigs) and allows progression from a periodic assessment to continuous monitoring, with a view to detecting problems as soon as they occur and to be able to remedy them quickly (Faverdin et al., 2021). Similar sensor-based systems are now used on zoo animals and in lab animals to monitor temperature, heart rate, or activity.
To date, sensors provide only partial information about animal welfare. The focus of PLF is primarily on production and health indicators, which have straightforward impacts on farm profitability. There is therefore a risk of redefining welfare solely in terms of production and health, ignoring aspects such as expression of positive behaviours (Buller et al., 2020). To avoid this pitfall one needs to further develop digital tools to more specifically address animal welfare.

**Qualitative assessment**

In humans, the quality of life is often assessed by questioning people about how they feel regarding a number of items (how is their social life, or their feeling of happiness, their amount of pain, the extent to which they are limited in their everyday life due to disease?) (e.g. Kahneman and Deaton, 2010, de Jong et al., 2012). People answer questions on a visual analogue scale, e.g. from 0 to 100. A similar approach can be used in animals, but with an external observer rating the behaviour of an animal according to predefined terms. For instance, Wiseman-Orr et al. (2006) developed a questionnaire to measure the Health-Related Quality of Life of dogs affected by chronic joint disease. This includes 109 descriptors of the dog’s attitude (apathetic, complaining, etc.) to be rated on a 0-6 point scale, where 0 corresponds to a descriptor not appropriate to the dog and 6 corresponds to a descriptor that very well fits to the dog’s attitude. In a similar vein, Wemelsfelder and her collaborators developed a Qualitative Behaviour Assessment (QBA) approach whereby the observer describes an animal or a group of animals, using descriptors decided by the observer or pre-defined (Wemelsfelder and Lawrence, 2001). QBA was introduced in the Welfare Quality protocol, with both positive and negative aspects addressed with descriptors such as playful/active and fearful/depressed, respectively. QBA addresses not only what the animals do but also how they do it (e.g. they move in a way that suggests play vs. fear). Qualitative rating and machine learning can be combined to automatically classify an animal behaviour from pictures or videos (Neethirajan et al., 2021). Therefore, in the future PLF techniques might be used to detect animals’ activities as well as their internal state.

**Implementation: From welfare measurement to assessment**

Assessing animal welfare involves much more than providing results obtained from various welfare measures. Assessing the welfare of an animal or a group of animals implies that outcomes from these measures are interpreted – e.g. compared to reference values. Information about the welfare status of animals can be used for different purposes and these may require different levels of integration, from no integration at all (e.g. in the form of a dashboard for farmers and other animal caretakers to have an overview of what is going well or wrong on the farm or other form of animal facility in case of, e.g. zoo or lab animals) to an overall assessment (e.g. for labelling purposes).

**Reference values**

Farmers and farm advisors may use welfare assessment to highlight positive and negative aspects on a farm, during transport, or at slaughter. Results from welfare measures can identify welfare problems and help farmers and other chain actors identify corrective action and improve animal welfare (the first purpose of a welfare assessment listed in the Introduction). There is no need to aggregate the data. Each welfare aspect is addressed separately and often compared to a reference value. One way to produce reference values is to use the distribution of results of a population of farms. With such a benchmarking approach the results of a farm can be compared to the average
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or to first, second, or third quartiles of the population. With this approach, farms from the lowest category (e.g. first quartile) may improve over years but remain in the lowest category (Mullan et al., 2021), which may discourage people from trying to improve. A reference value can also be defined a priori, as an absolute target to be achieved. For instance, experts may consider that on a dairy farm there should be no more than 5% lame cows. Reference values can also be minimum standards defined by legislation, often based on expert opinion. In that case, comparing the results of a farm with the reference corresponds to checking compliance with legislation (the Purpose 5 listed in the Introduction).

If the frequency or the severity of a problem is above the reference value, corrective action at farm level – and not only at individual level – should be put in place. For instance, if too many cows in a herd are lame, a lameness control plan should be decided (Leach and Whay, 2008). Another approach is to define a target value based on the initial situation. For example, the defined goal may be to reduce the incidence of lameness by 5%.

Producing results in the form of a gradient of welfare

When comparing to reference values, the results are expressed as “the farm is above the reference value for a certain aspect” – meaning that the welfare is good, vs. “the farm is below the reference value” – meaning that the welfare is not good. However, one does not know how good a good farm is or how bad a bad farm is. For this it has to be decided if the parameter that is measured indicates a mild or large welfare impact (positive or negative) on the animal. For example: “how large is the suffering experienced by a lame animal?”, or “how pleasant is the presence of a social partner?”. There are scientific methods available to study such questions. For instance, to evaluate how pleasant the presence of a social partner is, the animal is placed in an experimental setting where it is measured how much it will work to get access to the social partner (Holm et al., 2002). However, this would give no information about the amount of social reward the animal experiences in its real life, where it will be in contact with various partners. Similarly, one could imagine assessing how painful lameness is to an animal by offering access to a painkiller and measure the uptake (Danbury et al., 2000). Again, this would not tell us how much the lame animal actually suffered during specific lameness episodes in its real life. Therefore, such experimental results are generally complemented with expert opinion: based on the literature or their own experience, experts estimate the consequences in terms of pain, fear, discomfort, pleasure, etc. that are likely to be experienced by animals given the signs observed in them (e.g. lesions, abnormal behaviour) or the environment in which the animals lives (e.g. individual housing, tethering). This approach was used in the Welfare Quality project. Experts in animal behaviour or health were shown sets of results taken from animals or their environment and asked to attribute a value from 0 (very low welfare) to 100 (excellent welfare). Discussions between experts allowed consideration of various points of view and helped in reaching a consensus. Then functions were designed according to these experts’ opinion to compute the results of a farm for the various measures into a value-score (between 0 and 100). This was done for the 12 criteria of the Welfare Quality scheme.

Overall welfare assessment

It may be required to not only check a series of welfare items but also to produce an overall assessment. To assess the welfare of animals in various conditions to be able to recommend, or not, those conditions, measures of health, behaviour, stress, vigour, etc. of the animals are generally applied. The information is then often integrated in an informal way, taking into account
the severity of problems (e.g. the consequences of a given housing condition on the animal) and the frequency of that problem in a population, before a judgement is made. Such an approach is used by the European Food Safety Authority (EFSA) to prioritise welfare issues (e.g. EFSA AHAW Panel (EFSA Panel on Animal Health and Welfare), 2014). A similar informal aggregation of information is used for official farm inspections. The EU asks its Member States to check that farms comply with the EU legislation to protect animals. The inspectors are provided with checklists to verify each point of the legislation. Then, after a farm visit, the inspector formulates a conclusion in the form of, e.g. minor, moderate, or major non-compliances. This implies some sort of implicit aggregation, which is left open to the inspectors (Lomellini-Dereclenne et al., 2017).

An overall assessment may also be necessary in certification schemes with a view to brand products and to allow consumers to purchase products with assured welfare (Purposes 2 and 3 mentioned in the Introduction). A scheme may focus on some aspects of animal welfare or cover all aspects. Farms may be asked to achieve a certain degree of compliance in all aspects or a percentage of them. Providing many welfare scores (e.g. one for each criterion of welfare) does not ease the communication. Rather a summary information may be delivered in the form of a single score. Aggregation into an overall assessment is often done with a view to categorising farms according to the quality of animal welfare they provide, as in the Welfare Quality protocols (Botreau et al., 2009). Several issues need to be carefully addressed when the information from several criteria (e.g. absence of thirst, absence of hunger) is merged: one should determine if some criteria are considered more important than others, and more importantly, if compensation between criteria is allowed; e.g. can lack of expression of natural behaviour be compensated by good health? (for a review of constraints upon criteria aggregation see Botreau et al., 2007a). In an ideal world, the animal’s point of view regarding balancing of criteria should be taken into account. But the methodology for that does not exist yet. Again, we have to rely on expert opinion. In the Welfare Quality project, experts – who could be animal scientists, social scientists, or stakeholders – were asked questions such as “When a farm scores 40 for health and 60 for behaviour (on a 0 = ’very poor welfare’ to 100 = ’Excellent welfare’ scale), what score do you give for the combination of the two?”. Some experts attributed more importance to some criteria than to others. In the example above, veterinarians proposed a summary score lower than ethologists did, whereas the opposite was observed when a farm scored 60 for health and 40 for behaviour. This reflected the higher importance that veterinarians attributed to health and the higher importance attributed by ethologists to behaviour. More importantly, a few experts allowed compensation between criteria, e.g. good health compensating for poor behaviour or vice versa. However, most experts did not allow full compensation between criteria: for them a score of 40/100 added to a score of 60/100 always produced a summary score less than 50/100, so that the summary scores are highly influenced by the lowest criterion-scores. There is no objective truth about this, only diverging points of views, and the mathematical methods to aggregate the data need to reflect the reasoning of experts consulted (Botreau et al., 2008). The process by which data are interpreted and aggregated must then be transparent and explicit, so that users can check if the reasoning matches their own reasoning (Veissier et al., 2011). This is the reason why in the Welfare Quality project all the formulas are given and illustrated by examples.

To inform citizens (Purpose 4 listed in the Introduction), either specific information can be given or a summary information. For instance, the prevalence of lameness in broilers can be of interest for citizens. In general however, more integrated information will be provided, e.g. in the form of a statement like “only a certain percentage of farms present severe non-compliance with the legislation to protect farm animals”. In that case a comparison with minimum standards
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Conclusions

Animal welfare is a multi-dimensional concept, embracing good health, physical comfort, possibilities to perform natural behaviour, positive experiences, etc. The assessment of welfare can serve different purposes. For example, it can be used to guide production processes and management (on farms, during transport, and at slaughter) or provide consumer information in assurance schemes. The choice of measures depends on the purpose, but a holistic assessment of animal welfare needs to address all of its dimensions.

Assessing the welfare state of an animal requires outcome-based measures, e.g. clinical signs or behaviour, which result from an interaction between the animal and its environment (i.e. the way it is housed, fed, and managed). Resource- or management-based measures are also essential a posteriori to identify causes of a poor welfare state or a priori to estimate risks for poor welfare.

One should nevertheless distinguish between the measurement of poor (or good) welfare (e.g. evidence of illness or disturbed behaviour, or evidence of positive experiences), and assessment of welfare. The latter depends not only on the evidence from measures but also on the value attributed to them. Science can provide guidance for such assessment but societal/ethical concerns also play a determining role. Animal welfare scientists (who belong to the field of natural sciences)
should engage with people having interest in animal welfare and the scientists studying those people (from social sciences and humanities) to build together animal welfare assessment tools.

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