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Perspectival pluralism for animal welfare

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Abstract
Animal welfare has a long history of disregard. While in recent decades the study of animal welfare has become a scientific discipline of its own, the difficulty of measuring animal welfare can still be vastly underestimated. There are three primary theories, or perspectives, on animal welfare - biological functioning, natural living and affective state. These come with their own diverse methods of measurement, each providing a limited perspective on an aspect of welfare. This paper describes a perspectival pluralist account of animal welfare, in which all three theoretical perspectives and their multiple measures are necessary to understand this complex phenomenon and provide a full picture of animal welfare. This in turn will offer us a better understanding of perspectivism and pluralism itself.

Keywords Perspectivism · Models · Pluralism · Methodological anarchism · Animal welfare

1 Introduction

Animal welfare has a long history of disregard. In early Western philosophy, Aristotle argued that animals lacked moral status as they lacked the capacity to reason, and this tradition continued through to the Cartesian perspective of animals as automata that lacked mental states (Regan and Singer 1976). This view has now been largely overturned in favour of one that recognises animals as sentient creatures with moral value, thanks to earlier work

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by Jeremy Bentham (1879) and more recently through attention gained by Peter Singer (1975) and Tom Regan (1983). Indeed, during recent decades, animal welfare has also become a scientific discipline of its own.[1] The difficulty of measuring animal welfare, however, can still be vastly underestimated. In this paper, we will argue for the use of perspectival pluralism for animal welfare and show that animal welfare provides a useful and novel case to explore the application of this approach for complex phenomena.

The paper is structured as follows: in **Section 2**, we explicate the philosophical doctrine of perspectivism and its links to pluralism. In **Section 3** we describe the different perspectives on animal welfare and in **Section 4** outline the current measurement methods. **Section 5** offers a perspectival pluralist approach to integrate these methods and provide a better scientific understanding of animal welfare. Lastly, **Section 6** concludes the discussion and points to some further avenues for future research on both perspectivism and animal welfare.

2 Perspectivism and pluralism

Perspectivism[2] has gained increasing prominence within the philosophy of science community as an alternative and "refreshingly new" (Massimi 2012, p. 25) competitor in the rather stale debate between scientific realists and anti-realists. Whereas realists take scientific measurement to reveal objective facts and truths about the underlying structure of the world, and anti-realists deny this; perspectivists take a middle ground in which the facts and truths revealed are dependent on some specific perspective. Despite the popularity of the view, there is no simple or straightforward definition of perspectivism that would capture the views of all of its proponents. Indeed, perspectivists can be found within both the instrumentalist and realist camps of science. Nevertheless, there is a conciliatory element to the various accounts that fits the label 'perspectivism'.

While the roots of perspectivism go back to major philosophical figures such as Nietzsche, Leibniz, Kant, and Wittgenstein (see Massimi 2012; Teller 2020), it was Ronald N. Giere (2006a) who introduced this perspective into the philosophy of science.[3] The following quote aptly illustrates Giere's motivation:

> *We simply cannot transcend our human perspective, however much some may aspire to a God's eye view of the universe. Of course, no one denies that doing science is a human activity. What needs to be shown in detail is how the actual practice of science limits the claims scientists can legitimately make about the universe.* (Giere 2006a, p. 15)

Scientific investigation is always relative to some perspective. Scientists have different perspectives, arising from their background theories and the capabilities of their

[1] See Browning (2020b) for an overview.

[2] Or *perspectivalism* - both have both been used interchangeably in the literature (see Massimi and McCoy 2020). As nothing hangs on the choice of usage between the two, we chose the former merely for the sake of brevity.

[3] Bas van Fraasen also contributed substantially to the rise of perspectivism, though he did not use the term and, contrary to Giere, argued for an anti-realist picture of science (Van Fraassen 2008).

measurement instruments, each of which can reveal only a partial view of the objects under investigation.

This leads naturally to the endorsement of a pluralist view (Giere 2006b). In this, perspectivism and pragmatism share a variety of features that illuminate the benefits of taking multiple perspectives on a phenomenon (see also Massimi and McCoy 2020). Unlike the historically received view in the philosophy of science, i.e. the Nagelian "view from nowhere" (Nagel 1989), in which a completely objective and "detached" perspective is preferred – perspectivists and pragmatists deny that such an entirely neutral or objective foundation exists from which science could proceed.[4] Instead, we require multiple perspectives if we are to gather an approximately complete picture. Given that no single perspective can offer a uniquely correct and complete picture of the world, use of multiple perspectives together can thus create a far richer understanding.[5] Contributions from feminist philosophy of science[6] have similarly undermined the popularity of 'Nagelian terminology' and talk of objectivity, yielding the subject to historians of science (Daston and Galison 1992, 2007) and the rapidly growing 'values in science' literature (see for instance Douglas 2009). Perspectivism, while sharing much with these two traditions, can nevertheless be understood as a distinctive movement.

Perspectivism in science can arise in two ways - in observation (measurement) and in theory (Giere 2006a). Measurement is perspectival in that measurement instruments and human observation are necessarily limited and occur from a particular viewpoint - no instrument can measure everything. So too is the creation of theories perspectival: "in creating theories ... scientists create perspectives within which to conceive of aspects of the world" (Giere 2006a, p. 59). Theories are also partial, and each will rule some things out. Thus the way we theorise may limit the way we understand phenomena. A striking example of the strength of theoretical perspectivism can be seen in biological research on the major transitions in individuality. The traditional picture of the major transition towards multicellular organisms associated 'cheating cells' occurring in a group arrangement (i.e. in a gametheoretic sense) as an evil that somehow needs to be 'eradicated' to enable a transition towards a higher-level Darwinian individual. However, a number of theoretical biologists suggested taking a 'different perspective' that allows a re-interpretation of 'cheating' cells within multicellular arrangements instead as proto germ-cells playing the role of 'saviors' for group-level entities and 'scaffolds' for the evolution of multicellularity.[7] Here, it was perspectival pluralism that enabled a new explanatory strategy that was not even conceivable in the traditional paradigm.

We are thus aligning ourselves with Massimi's more deflationary vision of perspectivism as a view of *how* scientific knowledge about nature is obtained, rather than what scientific knowledge *is* (Massimi 2012). This shift in how perspectivism is understood softens the boundaries of the position and moves it much closer to other 'pluralist' thinkers in the literature such as Sandra Mitchell (2002, 2003, 2009, 2020), Helen Longino (2012, 2013, 2016, 2019), and philosophers of science more generally

[4] This tension points to an interesting relationship here between what have been dubbed 'existentialist' and 'scientistic' philosophies that insist on the meaninglessness and absurdity of the 'objective' stance (from nowhere) for the perspective of human beings (see Camus 1955; Nagel 1971; Rosenberg 2011; Veit 2018).

[5] A similar idea is present in Railton's (1978, 1981) concept of an 'ideal explanatory text' containing all the information relevant for the explanandum at hand.

[6] An excellent overview of the development of this literature is provided in Longino (2017, 1987).

[7] See Rainey and Kerr (2010); Hammerschmidt et al. (2014); Veit (2019a).

associated with what have been dubbed the *Stanford School* and *Minnesota School* respectively.[8] A trend in the work of Nancy Cartwright and her 'followers' since "How the laws of physics lie" (Cartwright 1983) has been to emphasize the need for models due to the chaotic patchwork that is nature. It is thus not surprising that her work has similarly been placed within a perspectival pluralist framework even if she herself didn't make use of 'perspectivist' language (Pearce 2013; Teller 2020; Veit 2020).[9]

Different methods and models offer different perspectives and ways of gaining knowledge. One of the most radical forms such a pluralist perspectivism can take is the "strong model pluralism" articulated in Veit (2019b): "for almost any aspect *x* of phenomenon *y*, scientists require multiple models to achieve scientific goal *z*" (pp. 92–93). This thesis is intended to explain the usage of multiple highly idealized and abstract models that seemingly contradict each other. In the scientific study of morality, for instance, the use of such simple models is common, and one needs to appreciate the perspectival nature of the contributions by this large set of models, as one that only jointly illuminates a phenomenon as complex as human morality (Veit 2019c). In this paper, we merely want to suggest that animal welfare is a phenomenon just as complex and thus similarly requires a radical perspectival pluralism. After all, it is only rarely if ever the case that much can be learned by a single method, experiment, or measurement - science requires pluralism and diversity even on the lowest scale. Interpreted literally, such arguments evoke the anarchist spirit of Feyerabend (1975) and this is by no means unintentional. As Veit et al. (2020) argues, a proper understanding of the nature of models in science would force us to accept a sort of *Feyerabendian* "model anarchism". At the lowest individual level it thus becomes hard to resist the radically relativist conclusion that anything goes.

This *human vantage point* thus naturally raises a number of familiar philosophical issues such as the problems of measurement, realism, pluralism, modelling, and representation. Here, we will demonstrate how the study of animal welfare as a scientific phenomenon provides an attractive case to illustrate the strength a pluralist perspectivism has to offer. Animal welfare is a complex concept, of which there are multiple theoretical perspectives and associated different measurement methods, each with differing strengths and weaknesses and which shed light on different aspects of the phenomenon of welfare. We will demonstrate how, taken together, these jointly offer a much more illuminating picture of the scientific phenomenon of interest than any would if taken individually. As we shall show, this diversity is to be embraced, rather than avoided.

3 Animal welfare perspectives

Metrics for the measurement of animal welfare play a range of diverse roles throughout science and policy-making (e.g. Browning 2018a, 2018b; Browning and Maple 2019). Measurement of animal welfare relies on a particular underlying conceptual understanding of welfare and what it is composed of (Browning 2020a), which we will examine in more detail in the next section. As we have discussed, theorising is itself

[8] See Kellert et al. (2006) for a landmark volume on scientific pluralism.
[9] This is particularly noticeable in her latest work (see Cartwright 2019).

perspectival, and we can thus take different theories to represent different perspectives on a concept. There are several different such theories, or perspectives, on animal welfare (Duncan and Fraser 1997). Welfare is a 'thick' concept, one which requires an evaluative, as well as a scientific understanding (Robbins et al. 2018), and thus a welfare concept must also capture normative concerns. The three primary views are what Green and Mellor (2011) describe as the 'three orientations': biological function, natural living, and affective state. These three theories have been discussed at length in the literature, analysing their various strengths and weaknesses (e.g. Appleby and Sandøe 2002). Each of these concerns different sources of value, as well as differing theoretical commitments. In this paper, we argue that all three different perspectives are necessary to understand a phenomenon as complex and diverse as animal welfare, both in terms of providing a broader conceptual understanding, and in supporting a range of different measures.

The biological function perspective focuses on the physical wellbeing of an animal. This includes its physical health, growth rate and reproduction. In particular, this approach has been characterised by a focus on stress and its resultant physiological effects (Duncan and Fraser 1997). This approach was popular in the early days of animal welfare science, through the 1980s and 1990s (e.g. Broom 1988). This was largely due to a behaviourist preference for objective measures, and a reluctance to discuss or engage with the emotions or mental states of animals within a scientific context. It is often based in an underlying commitment to evolutionary considerations, that take the biological functioning and fitness of an organism to be centrally determinant of its welfare (Barnard and Hurst 1996). In this, it has some connections to the natural living perspective. This perspective typically links most closely with a human-centred ethics, in which the welfare of animals is important to ensure high levels of production and success within animal industries, particularly agricultural. Here, the biological functioning of animals matters to serve these economic ends, whereas their feelings are of little concern except insofar as they may cause physical effects, such as stress.

This is the major drawback to this perspective: that in this way physical functioning misses what are typically taken to be important aspects of welfare. An animal can be entirely fit and healthy, but still feel bored, lonely and frustrated, and thus have poor welfare. As the science progressed and acknowledged the importance of psychological wellbeing, this approach - at least as taken alone - fell out of favour, and it is now almost always used in combination with others. Although physical functioning is not sufficient for describing welfare, it is still highly important. Physical health and fitness will have large impacts on animal welfare; and an animal that is sick or injured will have compromised welfare.

The natural living perspective focuses on the wild state of animals and their ability to function according to how they have been shaped by evolution. This approach recognises the 'telos' of animals, the "physical, behavioural, and psychological interests that have been programmed into them in the course of their evolutionary development" (Rollin 2006, pp. 300–01). In particular, as opposed to the focus on physical functioning found in the biological functioning perspective, it is often used to emphasise the importance for animals of expressing their natural behaviours. This perspective is aligned with an animal rights ethics, that centres the animals themselves as sources of value; in particular their dignity and flourishing, which are taken to be closely linked

with natural living. Here, the ability to perform those set of behaviours that the species has evolved for is considered to be of the highest value in creating a flourishing animal (Nussbaum 2009).

The natural living perspective has been criticized for its limitations, as many aspects of the 'natural' lives of animals (i.e. those experienced in the wild) can be detrimental to welfare (e.g. predation, disease) (Mellor 2015). An animal can be living a perfectly natural life, but suffer immensely from these effects. It is therefore typically used instrumentally, in identifying living conditions or behaviours that may be beneficial to welfare as understood through one of the other approaches (Browning 2019). In the absence of other confounding factors, natural living is often a good guide to those conditions and behaviours that will benefit welfare (Špinka 2006). There is thus an underlying rationale for this perspective that should not be entirely discarded but instead incorporated into the understanding and measurement of welfare.[10]

The affective state perspective takes welfare to consist in the mental states, or affects, of animals and is also often known as the 'feelings-based' approach (Duncan and Fraser 1997). Here, it is the positive and negative experiences animals undergo - and their associated affects - that determine their welfare. Positive feelings (such as comfort or curiosity) increase welfare, while negative feelings (such as hunger or pain) decrease welfare. The welfare of an animal is then simply a function of the number of positive and negative experiences over a lifetime. Only those conditions that influence the subjectively experienced mental states of animals will be counted as welfare impacts. This perspective is typically used within utilitarian ethics, which take as morally important the amount of pleasure or suffering experienced by individuals - including animals (Singer 1975). Under almost all conceptions, the feelings of animals - their pleasure and suffering - is central to considerations of welfare. As such, the affective state perspective is now commonly accepted as necessary for welfare. However, it is often considered insufficient. An animal may experience nothing but happiness lying around eating chocolate, but the resulting health compromise will lead to poor welfare.

Many authors take the three perspectives together and endorse a multicomponent or 'tripartite' framework (e.g. Fraser 1999; Jones 2013; Maple and Perdue 2013). For example, Fraser argues "that animals should *feel well* by being free from prolonged or intense fear, pain and other unpleasant states, and by experiencing normal pleasures; that animals should *function well* in the sense of satisfactory health, growth and normal behavioral and physiological functioning; and that animals should *lead natural lives* through the development and use of their natural adaptations" (Fraser 1999, p. 178, italics in original). Here, it seems that the authors are taking these as three different components within a multifactorial theory, rather than genuinely distinct perspectives. However, we think that the differences between these theories are too deep for the possibility of easily combining them in this way. As we have discussed, each of these theories contains different values and background assumptions that resist integration, as well as the different measurement methods we will introduce in the next section. Use of all three perspectives is judged to be crucial for a complete conceptual understanding

[10] As Dennett illustrates, this sort of adaptive reasoning or "reverse engineering" is often useful, both in everyday and scientific reasoning, and should thus not be ignored when we are trying to understand animal welfare (see Dennett 1995, 1998, 2017; Veit et al. 2020).

and for the measurement of welfare. Particularly, this diversity of perspectives may better reflect the intuitive judgements that accompany the folk concept of welfare (Robbins et al. 2018).

As discussed above, all the perspectives contain something of importance to animal welfare, capturing different sources of value as well as conditions that will impact welfare, and any of them taken alone risk missing the whole picture. Welfare is complex and thus no single theory will provide sufficient information about all its parts. There are also multiple, complementary methods of measurement of animal welfare, each of which is based in different welfare theories and necessarily captures a different perspective, and as we will now show, should also be used together to best capture a complete picture of animal welfare.

4 Measuring animal welfare

As discussed in Section 2, perspectivism is present in both theory and measurement. Different theories and measurement techniques each come from a limited perspective and can not on their own reveal all there is to know about complex phenomena. This is also the case for animal welfare. As well as the theoretical perspectives described above, there are different ways of measuring welfare that operate with different methods and background assumptions. These can be located within the three theoretical perspectives and, as we will show, when combined can give a far richer picture of animal welfare than any single measurement taken alone.

There are numerous measures for animal welfare, which can be grouped as physical, behavioural and environmental. Each of these categories contain a number of different measures, which reflect different processes within the animals or external environmental conditions. Physical and behavioural indicators are measures taken of various properties of the animals themselves, and are also collectively known as 'animal-based' indicators. These indicators stand causally 'downstream' from welfare - they are the effects we observe resulting from changes in welfare. By contrast, environmental indicators are measures of the conditions in which the animals live. These stand causally 'upstream' from welfare - they are the causes of changes in welfare (Browning 2020b). None of these indicators are intended to measure welfare in its entirety, but rather to shed light on some small part of an animal's condition. This reflects the perspectivalism inherent in measurement - these are necessarily limited and can only provide a partial view of the phenomenon of welfare. For this reason, taking different measurements together will be essential for a complete picture of animal welfare. Indeed, as we will show, many current animal welfare measurement frameworks do just this, in an attempt to fully understand and describe welfare.

Measures of biological functioning are primarily physical measures. These measures rely on background assumptions about the effects of health and functioning on welfare, based in the theory within the biological functioning perspective; particularly the degree to which welfare is compromised by the malfunctioning of different bodily systems. They include a variety of health data, such as blood tests, organ function tests, presence of injury or lameness etc. Physiological indicators can also tell us about the level of stress an animal is experiencing. The most commonly used of these is measuring cortisol, or its byproducts, in the blood, saliva, or faeces. Cortisol is a

hormone associated with the stress response, and so elevated levels can indicate the presence of stress and possible corresponding reduction in welfare. Vital signs, such as heart rate or body temperature, can similarly indicate the presence of stress, as well as disease or injury. Some behavioural measures can also be used within this perspective - for example, movement and activity level can indicate physical health. Sick and injured animals can often be identified by changes in behaviour such as withdrawal from social companions and loss of interest in eating, drinking or other preferred activities.

Measures of natural living are primarily behavioural. The relevant behavioural measures are ethograms, and presence or absence of abnormal behaviours. Ethograms are used to look at the behavioural repertoire of a captive animal to see how much time it spends in different behaviours (activity budget) and the range of behaviours it performs. Comparing these to those of wild relatives can provide information on how closely the life of the captive animal matches that of its 'natural' state.[11] This relies on background assumptions about the appropriate level of similarity between wild and captive animals. Preference and motivation tests can additionally be used to show which behaviours of this type the animal most values (Dawkins 1990). Additionally, the presence or absence of abnormal behaviours are indicative of natural functioning. Stereotypies are repetitive behaviours such as pacing, swaying, or self-plucking and their presence typically assumed to signal boredom or frustration, where an animal is unable to perform a highly motivated behaviour and instead redirects its energies into the observed unnatural stereotypy (Duncan and Fraser 1997).

Within the affective state perspective, the primary measures are also behavioural. In particular, there are two 'whole animal' measures that aim to assess the overall subjective experience or mood of an animal – Qualitative Behavioural Assessment (QBA) and cognitive bias testing. In QBA, experienced observers (such as animal keepers or scientists) make assessments about the overall welfare status of an animal based on what they see of its behaviour, demeanour, body language, vocalisations etc. (Wemelsfelder et al. 2001). This method shows high reliability across observers (Wemelsfelder et al. 2001) and has been validated through correlation with other relevant physiological and behavioural indicators (Wemelsfelder 2007). Cognitive bias testing similarly aims to measure the overall 'mood' of an animal; representative of the cumulative affective welfare state of an animal, a function of the combined positive and negative experiences (Mendl et al. 2010). Mood will affect cognitive processes, creating measurable cognitive biases that can be used to gain information about welfare (Boissy and Lee 2014). Another behavioural indicator of affective state is preference testing. Preference tests give animals choices between different alternatives to see which they will choose, and how hard they will work for it, giving information on the strength of their preferences for different conditions (Dawkins 1983). Background theory and assumptions play an especially strong role within measures of affective state, as the links between observed behaviour and internal feelings cannot be determined empirically but only ever supported.

These animal-based measures give us valuable information about the welfare state of an animal. However, what they don't tell us about is which conditions are causing welfare change. For this, we use environmental measures. Environmental indicators are measures taken of the environmental conditions in which animals live. They can include information

[11] Though caution must be taken in interpreting these results (see e.g. Veasey et al. 1996a, b; Browning 2019)

about food type and availability, temperature, air flow, light levels, resting places, stockmanship and provision of behavioural opportunities (e.g. dirt floors for chickens to dustbathe). These indicators tell us about the causes of welfare changes for animals and can be used within any of the animal welfare perspectives. They link to the background theories in each of the perspectives, where the presence of conditions which promote physical health, natural behaviour and positive experience will be considered to be positive indicators of welfare, while those which may cause disease or injury, behavioural restriction or negative affects will be considered to be negative indicators of welfare. Environmental measures can also be used as proxies for other animal welfare measures, where they are found to correlate well. For example, if type of flooring correlates with prevalence of lameness, then we could simply observe flooring type as a proxy for this health measure.

Indicators of animal welfare are strongly perspectival. All of the proxy indicators described above give us some limited information about an aspect of animal welfare - whether an animal is healthy, whether it has opportunities for some range of natural behaviours, whether it is experiencing positive or negative affective states. Any single measure on its own will not provide much information about welfare - like a single torch, it will only light up one small part of the whole. While they may be useful in specific contexts - such as answering a question about adequate nutrition, or whether an animal is feeling fearful - they will fall short for most applications in which we want to judge the entire welfare state of an animal, such as when we are comparing the overall quality of different husbandry systems. For these, we need an integration of multiple perspectives.

5 Integrating perspectives on animal welfare

All the measures described in the previous section are taken from different perspectives. Any single proxy measure will only give a small piece of information from a limited perspective and use of a plurality of methods of measurement is thus our best approach to measuring welfare. The measurement types all have different benefits and drawbacks. For example, behavioural measures such as QBA and cognitive bias testing can be vulnerable to bias in observation and measurement, due to the partially subjective nature of the assessment (Beausoleil and Mellor 2011). Indeed, perspectivists have pointed out that this type of subjective bias is a problem inherent within science, however, pluralism with regard to different perspectives is likely to minimize potential biases introduced through researchers. Other physical measures will be vulnerable to other kinds of bias in interpretation, for example in terms of how strongly the measured indicators are taken to impact welfare. Using multiple measures alongside one another will allow us to gain the benefits of each method, while offsetting their drawbacks. Different types of welfare measure strengthen one another and provide complementary perspectives. They also throw light on different aspects of animal welfare and any one alone will not provide a complete picture. For example, if we failed to include an indicator for social behaviour in a highly social animal held in a solitary environment, we might conclude that welfare was good, even though an important component of natural behaviour is missing. For these reasons, they are strongest when used in combination through a pluralist approach. It is for these reasons that their combined use is not only beneficial but necessary (see also Van Fraassen 2008 and Wolff 2020 on the relation between perspectivism and measurement more generally).

There are a number of assessment frameworks which aim to integrate a range of proxy measures, bringing together different of perspectives in a version of a perspectival pluralist approach. These frameworks include the Five Domains (Mellor and Beausoleil 2015), Welfare Quality (Botreau et al. 2007), and SOWEL and related models (Bracke et al. 2002). They recognise that no single proxy measure will be sufficient for determining welfare and so use a variety of different indicators, representing different perspectives that tell about some limited aspect of welfare. These are typically grouped into different 'principles' (Botreau et al. 2009) or 'domains' (Mellor and Beausoleil 2015) which are roughly the same across the different frameworks - feeding, housing, health and behaviour, based on the original 'Five Freedoms' framework for animal welfare (FAWC 1979). A number of specific subcriteria are determined for each of these: for example the 'nutrition' domain would contain components for amount of food, amount of water, timing of feeding etc. These subcriteria are then measured using the types of proxy indicators described above. The different measures are brought together using various aggregation procedures to create a final overall welfare score.

Although proxy measures brought together in these frameworks, can provide a lot of detail about animal welfare, care must be taken with selection and aggregation procedures. These will depend strongly on the underlying perspective taken. Not all aspects of welfare will have the same impact, and the level of impact we take them to have will depend on the particular perspective - biological functioning will weight illness and injury highly, while affective state will prioritise types of psychological suffering. Currently, the weighting procedures are often based on expert assessment, which makes them highly opaque and unreliable (Spoolder et al. 2003). The SOWEL-type models do better in attempting to take weightings from available literature (Bracke et al. 2002), but these are all still firmly grounded in the perspectives of the individual scientists making the judgements, and related background assumptions regarding, for example, the relationship between preferences and welfare.

Another related concern regarding the risks in bringing together multiple perspectives and measurements for a pluralist study of animal welfare is that the measures and recommendations arising from each may conflict. For example, many zoos used to have concrete and tiled cages, which allowed for maximising welfare from a physical functioning perspective, through thorough cleaning and disinfecting. However, the lack of environmental complexity and mental stimulation detracted from welfare from both the natural living and affective state perspectives. Similarly, allowing an animal to choose its own preferred food would be a benefit from an affective state perspective in creating positive feelings of taste pleasure and satiety, but a drawback from a physical functioning perspective due to weight gain and malnutrition. It is important, when adopting a plurality of perspectives, to ensure that there is a way of adjudicating between their competing demands and setting weightings between the different components. However, there is no 'objective' or 'perspective-neutral' viewpoint from which to assess the weightings of various inputs.

Regardless, these concerns do not make integration an unachievable task. We can still proceed even if we do not consider there to be any single privileged way of combining the perspectives into a single model. Instead, there may be multiple methods, each themselves based on the different background assumptions, normative commitments, and individual preferences that arise from each perspective. The problem

of determining weightings may not be an empirical one, as there might be no privileged 'correct' set of weightings. Instead, we look for one which best suits our purposes. In making animal welfare assessments, these purposes are typically for making decisions about where best to use our resources to maximise welfare. Here, we might consider using robustness reasoning (Wimsatt 2007). This would entail comparing the decisions recommended by different models, and preferentially selecting those recommended by many or most models. Or where trying to determine whether a particular intervention is a good use of resources, we could then observe whether it gives a predicted welfare increase across the different models. In practice, often the recommendations from the different welfare perspectives align, and so this should not be excessively demanding.

Perspectival pluralism for animal welfare allows us to integrate multiple perspectives, both theoretical and practical. We have described three primary theoretical perspectives on animal welfare - the biological function, the natural living and the affective state perspectives. Any of these perspectives on their own are incomplete, and a complete understanding of animal welfare requires use of the plurality of these together. Their combined use, along with multiple methods of measurement gives us the best picture of the phenomenon we are studying.

6 Conclusion

In this paper, we have argued for the use of different theories and methods for conceptualising and measuring animal welfare and that the existence of such widely varying methods is a *feature* not a *bug*. As perspectivists, such as Giere (2006a), Van Fraassen (2008), Wimsatt (2007), Mitchell (2020), Massimi (2012), Teller (2020), Chang (2012), and Veit (2019b, 2020) have argued, multiple scientific perspectives are a source of strength rather than a weakness. Complex phenomena such as welfare may very well require the use of different tools and methods. This does not have to lead to scientific anti-realism about the phenomenon of welfare, but rather points to a more sensible and pragmatic account of scientific realism that takes the complexity of phenomena and the limits of the human mind and our scientific tools seriously. As Massimi and McCoy argue:

> *Pluralism is, first and foremost, a powerful resource in the hands of perspectivists because it shows how they can accommodate and strive to integrate a plurality of explanations for the same phenomena in some areas.* (Massimi and McCoy 2020, p. 3)

Perspectivism raises not only philosophical puzzles when applied to specific scientific problems such as the measurement of welfare, but also for metadebates in the philosophy of science literature more generally. Our aim here was to illustrate the benefits of a perspectivist pluralist approach through the case of animal welfare science. Animal welfare is real and measurable, and although incredibly complex, no less so than its human counterpart. More work needs to be undertaken in order to fully understand the importance of diverse perspectives and methods, but we are confident that our analysis of animal welfare allows us not only to better understand animal welfare itself, but also illuminates several of the more general philosophical puzzles raised by perspectivism.

Importantly, however, we hope that the foregoing analysis has demonstrated a way to partially escape the limited human perspective via the use of a plurality of diverse methods to explore a complex phenomenon.

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References

Appleby, M. C., & Sandøe, P. (2002). Philosophical debate on the nature of well-being: Implications for animal welfare. *Animal Welfare, 11*(3), 283–294.

Barnard, C. J., & Hurst, J. L. (1996). Welfare by design: The natural selection of welfare criteria. *Animal Welfare, 5*(4), 405–433.

Beausoleil, N.J. and Mellor, D.J. (2011). Complementary roles for Systematic Analytical Evaluation and qualitative Whole Animal Profiling in welfare assessment for Three Rs applications. *Proceedings of the 8th World Congress on Alternatives and Animal Use in the Life Sciences, Montreal, Canada*, 21–25.

Bentham, J. (1879). *An introduction to the principles of morals and legislation*. London: T. Payne & Son.

Boissy, A., & Lee, C. (2014, April). How assessing relationships between emotions and cognition can improve farm animal welfare. *Revue Scientifique et Technique de l'OIE, 33*(1), 103–110.

Botreau, R., Veissier, I., Butterworth, A., Bracke, M. B. M., & Keeling, L. J. (2007). Definition of criteria for overall assessment of animal welfare. *Ani-mal welfare-potters bar then wheathampstead, 16*(2), 225.

Botreau, R., Veissier, I., & Perny, P. (2009). Overall assessment of animal welfare: Strategy adopted in welfare quality R. *Animal Welfare, 18*(4), 363–370.

Bracke, M. B. M., Spruijt, B. M., Metz, J. H. M., & Schouten, W. G. P. (2002, July). Decision support system for overall welfare assessment in pregnant sows a: Model structure and weighting procedure. *Journal of Animal Science, 80*(7), 1819–1834.

Broom, D. M. (1988). Needs, freedoms and the assessment of welfare. *Applied Animal Behaviour Science, 19*(3–4), 384–386.

Browning, H. (2018a). No room at the zoo: Management euthanasia and animal welfare. Journal of Agricultural and Environmental Ethics 31(4), 483–498. https://doi.org/10.1007/s10806-018-9755-2.

Browning, H. (2018b). Won't somebody please think of the mammoths? De-extinction and animal welfare. *Journal of Agricultural and Environmental Ethics 31*(6), 785–803. https://doi.org/10.1007/s10806-018-9755-2.

Browning, H. (2019). The natural behavior debate: Two conceptions of animal welfare. *Journal of Applied Animal Welfare Science*, 1–13. https://doi.org/10.1080/10888705.2019.1672552.

Browning, H. (2020a). Assessing measures of animal welfare. Preprint. http://philsci-archive.pitt.edu/17144/.

Browning, H. (2020b). *If I Could Talk to the Animals: Measuring Subjective Animal Welfare*. Ph. D. Thesis, Australian National University. https://doi.org/10.25911/5f1572fb1b5be.

Browning, H. and Maple, T.L. (2019). Developing a Metric of Usable Space for Zoo Exhibits. *Frontiers in Psychology 10*, 791. 10. 3389/fpsyg.2019.00791.

Camus, A. (1955). *The myth of Sisyphus: And other essays*. Random House digital, Inc. translated from the French original (1942) by Justin O'Brien.

Cartwright, N. (1983). *How the Laws of physics lie*. Oxford: Oxford University Press.

Cartwright, N. (2019). *Nature, the artful modeler: Lectures on laws, science, how nature arranges the world and how we can arrange it better*. Chicago: Open Court.
Chang, H. (2012). *Is water H2O?: Evidence, realism and pluralism*. Springer.
Daston, L., & Galison, P. (1992). The image of objectivity. *Representations, 40*, 81–128.
Daston, L. and Galison, P. (2007). Objectivity. Zone Books.
Dawkins, M. S. (1983). Battery hens name their price: Consumer demand theory and the measurement of ethological 'needs'. *Animal Behaviour, 31*(4), 1195–1205.
Dawkins, M. S. (1990). From an animal's point of view: Motivation, fitness, and animal welfare. *Behavioural and Brain Sciences, 13*(1), 1–9.
Dennett, D. C. (1995). Cognitive science as reverse engineering several meanings of "Top-down" and "Bottom-up". In Studies in Logic and the Foundations of Mathematics, Volume 134, pp. 679–689. Elsevier.
Dennett, D. C. (1998). *Brainchildren: Essays on designing minds*. MIT Press.
Dennett, D. C. (2017). From bacteria to Bach and back: The evolution of minds. WW Norton & Company.
Douglas, H. (2009). Science, policy, and the value-free ideal. University of Pittsburgh Press.
Duncan, I. J., & Fraser, D. (1997). Understanding animal welfare. In M. Appleby & B. O. Hughes (Eds.), *Animal welfare* (pp. 19–32). New York: CAB International.
Farm Animal Welfare Council (FAWC). (1979). Farm animal welfare council press Statement. Retrieved from http://webarchive.nationalarchives.gov.uk/20121010012427/http://www.fawc.org.uk/freedoms.htm.
Feyerabend, P. (1975). Against method. Verso.
Fraser, D. (1999). Animal ethics and animal welfare science: Bridging the two cultures. *Applied Animal Behaviour Science, 65*(3), 171–189.
Giere, R. (2006a). *Scientific Perspectivism*. Chicago: University of Chicago Press.
Giere, R. N. (2006b). Perspectival pluralism. In S. H. Kellert, H. E. Longino, and C. K. Waters (Eds.), *Scientific Pluralism*, chapter 2, pp. 26–41. Minneapolis: University of Minnesota Press.
Green, T. C., & Mellor, D. J. (2011, November). Extending ideas about animal welfare assessment to include 'quality of life' and related concepts. *New Zealand Veterinary Journal, 59*(6), 263–271.
Hammerschmidt, K., Rose, C. J., Kerr, B., & Rainey, P. B. (2014). Life cycles, fitness decoupling and the evolution of multicellularity. *Nature, 515*(7525), 75–79.
Jones, R. C. (2013). Science, sentience, and animal welfare. *Biology and Philosophy, 28*(1), 1–30.
Kellert, S. H., H. E. Longino, and C. K. Waters (2006). Scientific pluralism. Univ of Minnesota Press.
Longino, H. (2012). Knowledge for what? Monist, pluralist, pragmatist approaches to the sciences of behavior. In *Philosophy of Behavioral Biology*, pp. 25–40. Springer.
Longino, H. (2016). Foregrounding the background. *Philosophy of Science, 83*(5), 647–661.
Longino, H. E. (1987). Can there be a feminist science? *Hypatia, 2*(3), 51–64.
Longino, H. E. (2013). Studying human behavior: How scientists investigate aggression and sexuality. University of Chicago Press.
Longino, H. E. (2017). Feminist epistemology. *The Blackwell guide to epistemology*, 325–353.
Longino, H. E. (2019). Scaling up; scaling down: What's missing? *Synthese*, 1–15.
Maple, T. L. and Perdue, B. (2013). Zoo animal welfare. Animal Welfare Series. Berlin: Springer.
Massimi, M. (2012). Scientific PERSPECTIVISM and its foes. *Philosophica, 84*, 25–52.
Massimi, M. and McCoy, C.D. (2020). Understanding Perspectivism: Scientific challenges and methodological prospects. Routledge.
Mellor, D. J. (2015). 1. Positive animal welfare states and reference standards for welfare assessment. *New Zealand Veterinary Journal, 63*(1), 17–23.
Mellor, D. J., & Beausoleil, N. J. (2015, August). Extending the 'five domains' model for animal welfare assessment to incorporate positive welfare states. *Animal Welfare, 24*(3), 241–253.
Mendl, M., Burman, O. H. P., & Paul, E. S. (2010). An integrative and functional framework for the study of animal emotion and mood. *Proceedings of the Royal Society B: Biological Sciences, 277*(1696), 2895–2904.
Mitchell, S. D. (2002). Integrative pluralism. *Biology and Philosophy, 17*(1), 55–70.
Mitchell, S. D. (2003). Biological complexity and integrative pluralism. Cambridge University Press.
Mitchell, S. D. (2009). Unsimple truths: Science, complexity, and policy. University of Chicago Press.
Mitchell, S. D. (2020). Perspectives, representation, and integration. In M. Massimi and C. D. McCoy (Eds.), *Understanding Perspectivism: Scientific Challenges and Methodological Prospects*, pp. 178–193. Routledge.
Nagel, T. (1971). The absurd. *The Journal of Philosophy, 68*(20), 716–727.
Nagel, T. (1989). The view from nowhere. Oxford university press.
Nussbaum, M. C. (2009). Frontiers of justice: Disability, nationality, species membership. Harvard University Press.

Pearce, J. V. (2013). The potential of perspectivism for science education. *Educational Philosophy and Theory, 45*(5), 531–545.
Railton, P. (1978). A deductive-nomological model of probabilistic explanation. *Philosophy of Science, 45*(2), 206–226.
Railton, P. (1981). Probability, explanation, and information. *Synthese*, 233–256.
Rainey, P. B., & Kerr, B. (2010). Cheats as first propagules: A new hypothesis for the evolution of individuality during the transition from single cells to multicellularity. *Bioessays, 32*(10), 872–880.
Regan, T. (1983). *The case for animal rights*. London: Routledge & Kegan Paul.
Regan, T., & Singer, P. (Eds.). (1976). *Animal rights and human obligations*. New Jersey: Prentice-Hall.
Robbins, J., Franks, B., & von Keyserlingk, M. A. (2018). 'More than a feeling': An empirical investigation of hedonistic accounts of animal welfare. *PLoS One, 13*(3), e0193864.
Rollin, B. E. (2006). *Animal rights and human morality* (3rd ed.). New York: Prometheus Books.
Rosenberg, A. (2011). *The atheist's guide to reality: Enjoying life without illusions*. New York: WW Norton & Company.
Singer, P. (1975). *Animal liberation: A new ethics for the treatment of animals*. London: Jonathan Cape.
Špinka, M. (2006). How important is natural behaviour in animal farming systems? *Applied Animal Behaviour Science, 100*(1–2), 117–128.
Spoolder, H., De Rosa, G., Hörning, B., Waiblinger, S., & Wemelsfelder, F. (2003). Integrating parameters to assess on-farm welfare. *Animal Welfare, 12*(4), 529–534.
Teller, P. (2020). What is Perspectivism, and does it count as realism? In M. Massimi and C. D. McCoy (Eds.), *Understanding Perspectivism: Scientific Challenges and Methodological Prospects*, pp. 49–64. Routledge.
Van Fraassen, B. C. (2008). Scientific representation: Paradoxes of perspective. Oxford University Press.
Veasey, J. S., Waran, N., & Young, R. (1996a). On comparing the behaviour of zoo housed animals with wild conspecifics as a welfare indicator. *Animal Welfare, 5*, 13–24.
Veasey, J. S., Waran, N., & Young, R. (1996b). On comparing the behaviour of zoo housed animals with wild conspecifics as a welfare indicator, using the giraffe (Giraffa camelopardalis) as a model. *Animal Welfare, 5*, 139–153.
Veit, W. (2018). Existential nihilism: The only really serious philosophical problem. *Journal of Camus Studies*, 211–232. 10.13140/RG.2.2.26965.24804
Veit, W. (2019a). Evolution of multicellularity: Cheating done right. *Biology & Philosophy 34*(3), 34. https://doi.org/10.1007/s10539-019-9688-9.
Veit, W. (2019b). Model pluralism. Philosophy of the Social Sciences 50(2), 91–114. https://doi.org/10.1177/0048393119894897.
Veit, W. (2019c). Modeling morality. In À Nepomuceno-Fernández, L. Magnani, F. J. Salguero-Lamillar, C. Barés-Gómez, and M. Fontaine (Eds.), *Model-Based Reasoning in Science and Technology*, pp. 83–102. Springer. https://doi.org/10.1007/978-3-030-32722-4_6. Veit, W. (2020). Model anarchism. *Preprint*. https://doi.org/10.13140/RG.2.2.36694.47683.
Veit, W. (2020). (forthcoming). Review of Nancy Cartwright's nature, the artful modeler: Lectures on Laws, science, how nature arranges the world and how we can arrange it better. *Philosophy of Science*. https://doi.org/10.1086/711505.
Veit, W., Dewhurst, J., Dolega, K., Jones, M., Stanley, S., Frankish, K., and Dennett, D. C. (2020). The Rationale of Rationalization. *Behavioral and Brain Sciences* 43, e53. 10.31234/osf.io/b5xkt.
Wemelsfelder, F. (2007). How animals communicate quality of life: The qualitative assessment of behaviour. *Animal welfare-potters bar then wheathampstead, 16*, 25.
Wemelsfelder, F., Hunter, T. E., Mendl, M., & Lawrence, A. B. (2001). Assessing the 'whole animal': A free choice profiling approach. *Animal Behaviour, 62*(2), 209–220.
Wimsatt, W. C. (2007). *Re-engineering philosophy for limited beings: Piecewise approximations to reality*. Cambridge: Harvard University Press.
Wolff, J. E. (2020). Representationalism in measurement theory. Structuralism or Perspectivalism? In M. Massimi and C. D. McCoy (Eds.), *Understanding Perspectivism: Scientific Challenges and Methodological Prospects*, pp. 109–126. Routledge.