The Sentience Shift in Animal Research

Heather Browning and Walter Veit

Abstract

One of the primary concerns in animal research is to ensure the welfare of laboratory animals. Modern views on animal welfare emphasise the role of animal sentience, i.e. the capacity of animals to experience subjective states such as pleasure or suffering, as a central component of welfare. The increasing official recognition of animal sentience has had large effects on laboratory animal research. The *Cambridge Declaration on Consciousness* (Low et al. 2012) marked an official scientific recognition of the presence of sentience in mammals, birds, and cephalopods. Animal sentience has furthermore been recognised in legislation in the European Union, New Zealand and parts of Australia, with discussions underway in other parts of the world to follow suit, such as the recent Animal Welfare (Sentience) Act 2022 in the UK. In this paper, we analyze this shift towards recognition of sentience in the regulation and practice in the treatment of laboratory animals and its effects on animal welfare and use.

Keywords: animal welfare; sentience; animal research; animal legislation

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1 Introduction

Laboratory animal research uses tens of millions of animals worldwide every year (Jones 2013), covering a diverse range of taxa.[1] The types of experiments performed range from hands-off observational studies of behaviour to invasive biomedical experiments, that can result in pain, pathology, and death; and are thus of special ethical concern (Beauchamp and DeGrazia 2019; DeGrazia and Beauchamp 2019; Browning and Veit 2022). One of the primary goals in this research is to safeguard the welfare of the animals used for the advancement of science. Indeed, more so than ever before, the welfare of research animals is given primacy in assessing potential research projects.

Modern views in animal welfare science emphasise the role of *animal sentience*, i.e. the capacity to experience subjective states such as pleasure or suffering, as a central component of welfare. Indeed, there is now a broad consensus that it is sentience that grounds welfare, as all and only those creatures that are sentient are those which are capable of experiencing the *pleasure* and *pain* that is central to welfare (Browning and Birch 2022). It is these experiences that grant a special kind of moral status onto sentient animals. This is perhaps most famously expressed by the founder of modern utilitarianism, Jeremy Bentham: "the question is not, Can they *reason*? nor, Can they *talk*? but, Can they *suffer*?" (Bentham 1879, p. 309, italics in original).[2] Although other types of organisms may be able to experience biological harms to their functioning, (e.g. the loss of an ant's leg,) sentient organisms can additionally undergo experiential harms such as pain and suffering, which *matter* to them.

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[1] Though primarily rodents.

[2] See Browning (2020b) for a defense of the Benthamite picture for animal welfare science.

Indeed, even if there are multiple ways of thinking about animal welfare (Veit and Browning 2020), a great majority of animal ethicists treat *sentience* as a necessary condition for welfare (Duncan 2006) and this then typically forms the boundaries for which animals we extend our welfare considerations to. While there are still substantial debates as to exactly which organisms can be considered sentient, a consensus has emerged that tends to include all vertebrates, cephalopods, and possibly even arthropods (Ginsburg and Jablonka 2019; Jones 2013; Low et al. 2012; Proctor 2012; Birch et al. 2021). The recognition of sentience in animals from the 1990s onwards has, thus, provided a radical shift in the way we view the moral status of animals and how we provide for and ensure their welfare.

The following paper analyses this shift and its significance for animal research and welfare. It is structured as follows: in **Section 2**, we will look at the development of the recognition of animal sentience. Here, **Section 2.1** will provide an overview of the recent efforts to recognise animal sentience in legislation and regulations. In **Section 2.2** we will look at the use of the historical **3 Rs** framework in protecting the welfare of research animals. In **Section 2.3**, we will discuss the shift towards sentience and the application of the precautionary principle in deciding which animals deserve protection. **Section 3** will cover how this shift impacts the lives of research animals in practice. In **Section 3.1** we will look at the ways in which recognition of sentience can influence attitudes of those working with research animals, and thus the welfare of the animals used. Additionally, in **Section 3.2** we will examine how recognition of sentience changes the types of housing and husbandry practices deemed appropriate for good welfare. Finally, in **Section 3.3**, we will look at how the shift towards recognition of sentience will change the ways in which animal research needs to be justified in order to be judged acceptable, and subsequently conclude the discussion in **Section 4**.

2   Towards a Recognition of Animal Sentience

In recent years, there has been increasing recognition of animal sentience, both in public opinion and through official channels. While there has been widespread acceptance of animal sentience for centuries, both within the scientific community and the general public, this was largely ignored through much of the 20th century in favour of behaviourism, which focused entirely

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on external observations of animal behaviour without reference to their subjective experiences – a pattern which has only started reversing in the last few decades (Broom 2014, 2011; Dawkins 2008; Duncan 2006).

The shift towards increasing interest in and recognition of sentience can be demonstrated by the rise of direct research into animal sentience. Publications in animal sentience research increased tenfold in the 20 years from 1990-2011 (Proctor et al. 2013), leading to the creation of a new open access journal called "Animal Sentience" by the *Humane Society of the United States*. The 2012 *Cambridge Declaration on Consciousness* (Low et al. 2012) marked an official scientific recognition of the presence of sentience in mammals, birds and cephalopods: "the weight of evidence indicates that humans are not unique in possessing the neurological substrates that generate consciousness. Non-human animals, including all mammals and birds, and many other creatures, including octopuses, also possess these neurological substrates" (Low et al. 2012, p. 2). This Declaration came from a group of neuroscientists who had come together at a conference in Cambridge, on 'Consciousness in Human and non-Human Animals' in order to mark the serious scientific investigation into consciousness. Animal sentience is now a legitimate field of study and it is commonly accepted that we are able to gain indirect knowledge of animal feelings through a variety of behavioural and physiological measures. While there continue to be major disagreements on how best to study animal consciousness (Birch et al. 2022), this scientific shift towards a recognition of animal sentience led to an equally important shift towards legal recognition.

2.1 The Animal Sentience Shift in Legislation

While the earliest legislation regarding animal welfare was passed in England in the 19th Century, these laws were solely based on preventing cruelty to animals (Broom 2009), without any formal recognition of the sentience of the animals involved. Since then, across the world, numerous laws and protections have been put in place to prevent cruelty to animals and to safeguard their welfare. Where these regulations differ primarily is in which animals are afforded protections. Most recently, we are seeing an increasing shift towards including all animals that fall within the category of *sentient beings*.[3] This

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[3]Octopuses, and cephalopods more generally, have gained the most recent attention here (see e.g. Birch et al. 2021; New England Anti-Vivisection Society et al. 2020; Browning

is no accident. *Sentience* is used to determine which animals are under the protection of law, as well as provide the very justification for why they are and should be protected.

Perhaps the first *formal recognition* of animal sentience in law was the inclusion of the rights of 'sentient beings' in the the European Union (EU) constitution in 1997 (Hobson-West and Davies 2018); and the EU's 2007 Treaty of Lisbon states that "the Union and the Member States shall, since animals are sentient beings, pay full regard to the welfare requirements of animals" (European Union 2008, Article 13). Additionally, many of the EU member states have animal welfare laws which recognise sentience (Blattner 2019). In the UK, for instance, animal research is legislated under the Animals (Scientific Procedures) Act (ASPA) 1986. In the lead-up to 'Brexit', i.e. the departure of the UK from the EU, there was a huge call from professionals and the general public to ensure that recognition of animal sentience remained in UK welfare legislation (Clark 2017), and this has been successful with the recent passing of the Animal Welfare (Sentience) Bill. This Act will soon become UK law, recognizing all vertebrates, cephalopod molluscs, and decapod crustaceans as sentient. This legislation followed a commissioned report by Birch et al. (2021) that developed a rigorous methodology to assess the capacity to feel pain in other animals and argued that decapod crustaceans and cephalopod molluscs should be seen as sentient - a rare but excellent example for how the work of philosophers has impacted policy-making in this area.

In the USA, animal research is under the oversight of the *Animal Welfare Act*, though due to industry lobbying, this excludes most of the animals commonly used, such as rats, mice, birds, and agricultural animals (Ferdowsian et al. 2020). All vertebrates are covered by research guidelines (e.g. *Guide for the Care and Use of Laboratory Animals*) (Ferdowsian et al. 2020) but these are not legally mandatory, and there are "a patchwork of laws, regulations, guidelines, policies, and principles — each pertaining to a different subset of animals" (Chandna 2020, p. 46). Currently, there is no recognition of sentience within this legislation, though some of the state laws do so.

Elsewhere, New Zealand recognises animal sentience in its *Animal Welfare Act 1999* (New Zealand 2018), as does Quebec in its *Animal Welfare and Safety Act* (Quebec 2019). Within Australia, last year the Australian Capital Territory passed amendments to the *Animal Welfare Act 1992* (ACT

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2019), including recognition that "animals are sentient beings that are able to subjectively feel and perceive the world around them" (ACT 2019, p. 3), and other Australian states are looking to follow.

There are moves to try and push this shift more globally. The 2005 Compassion in World Farming (CIWF) conference resulted in the passing of a resolution: "This conference calls on the UN, the WTO, the World Animal Health Organisation (OIE) and their member governments to join us in recognising that sentient animals are capable of suffering, and that we all have a duty to preserve the habitat of wild animals and to end cruel farming systems and other trades and practices which inflict suffering on animals" (Webster 2006, p. 1). Similarly, the World Society for the Protection of Animals (WSPA) is lobbying for a Universal Declaration on Animal Welfare, which is strongly based around animal sentience. [4]

There is then the question as to what role the legislation and regulations surrounding animal research can play. While policy-making can, and should, act to prevent harmful practices, Rollin and Hickey (2020) argue that regulatory change is necessary, but insufficient for lasting changes in behaviour and attitudes. Legislation, they argue, only provides a baseline for the treatment of animals. It will describe which animals should be protected and which minimal levels of protection they will receive, but will not form a set of guidelines for best practice. What is needed is a change in ethical thinking, not just in the rules: "we must work toward a broader understanding (among scientists, the public, legislators) about the why that undergirds our animal welfare ethos, not merely the what of any current regulatory framework" (Rollin and Hickey 2020, p. 54). Nevertheless, changes in legislation can lead on this front.

Laws both come into existence as a reflection of public attitudes, as well as guiding development of those attitudes (Broom 2009). So while legislative and regulatory recognition of sentience can be seen as a result of a public push towards the same, it can also lead to future changes in public opinion and normalise these attitudes. The ways in which society perceives, or constructs, their concepts of what it means to be an animal, and to be sentient, has a strong impact on regulation and practice in this area (Hobson-West and Davies 2018). Legislative change may occur as a result of a 'push' by a vocal minority. It will then lead to normalisation and further change through the

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[4]https://www.worldanimalprotection.ca/sites/default/files/media/ca_-_en_files/case_for_a_udaw_tcm22-8305.pdf

rest of society.

While legislation itself can be insufficient for full protection of animals from suffering, due to exclusions and loopholes, the spirit of the legislation can also effect change in the attitudes of the public and those in relevant industries. There are strong links between the content of legislation and community attitudes and behaviour: "popular understanding and popular acceptance must precede legislation; after legislation has been enacted, they are the crucial link in the process of enforcement" (Wei 2006, p. 101). The minimal frameworks provided by policy-makers are given meaning through their enaction within society. Not only does this require compliance with the legislation, but an understanding and implementation of the underlying theory and values. Wei (2006), for instance, argues that real change in animal welfare standards necessarily requires education and legislation to work in tandem in order to both influence public attitudes and to ensure protections. Linzey (2012) describes four roadblocks to recognition of animal sentience - misdescription, misrepresentation, misdirection, and misperception. These all relate to the way we conceive of and understand animals. Official public recognition of sentience will affect these representations and, thus, the very way people see and relate to animals. One of the earliest and perhaps most influential examples of this kind can be found the introduction of the ideas of humane treatment of research animals in the 1950s through the development of the '3Rs' framework Russell and Burch (1959).

2.2   Frameworks for Animal Welfare Protection

Perhaps the most central framework for assessing and ameliorating the welfare impact of research on animals has been the '**3 Rs**'. First introduced in 1959 by Russell and Burch in *The Principles of Humane Experimental Technique*, this framework recognises that research can be harmful to animals and proposes three distinct strategies to minimise harm: replacement, reduction and refinement. **Replacement** involves, wherever possible, either replacing the animals used with a non-animal substitute, such as cell and tissue cultures, or artificial and computer models. If this is not possible, then they recommend substitution of so-called 'higher' (sentient) animals, such as mammals, with 'lower' (less sentient) animals, such as invertebrates.[5] The re-

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[5]Though, with at least some invertebrates now being considered candidates for sentience, this move should now be seen as more controversial(Mikhalevich and Powell 2020;

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placement of 'higher' animals with 'lower' animals typically relies on the idea that lower animals will have a lower degree of sentience, and thus suffer less, or may not even be sentient at all, and thus not of welfare concern (Hobson-West and Davies 2018). However, it could also be defended on the grounds that 'lower' animals may have simpler welfare needs, placing less value on freedom and exploration, and thus at less risk of feeling deprived (Browning and Veit 2021). **Reduction** means reducing the numbers of animals used. This is usually done through careful attention to experimental design and ensuring sufficient animals are used to create statistically significant test results, without using any more than needed, thus avoiding unnecessary harms. Finally, **refinement** is implemented in cases where the other two strategies are not available. This involves altering experimental design so that potential harms are minimised, both within the experiments themselves, and within housing and husbandry practices.

Application of the 3 Rs since they were introduced has resulted in fewer animals used and less harm done within animal research. Kirk even calls it "*the* ethical approach to governing animal-dependent science" (2018, 623). However, this framework is often seen as insufficient for ensuring the welfare of research animals (Monamy 2017; Tannenbaum and Bennett 2015). While the reasons for this are manyfold, they can be grouped together under a more core problem, that is the omission of animal sentience.

Nevertheless, even with a recognition of animal sentience, we are directly led towards the challenge of establishing which animals are sentient and thus awarded protection. Where legislation is in place to protect sentient animals, the boundaries of these protections will rely on where we take sentience to lie. There is a role here for scientific research into animal sentience to tell us which animals these may be, as seen for example in Birch et al. (2021). However, there will also be a necessary application of the *precautionary principle*, to advise on what to do in cases of uncertainty.

2.3 The Precautionary Principle

The precautionary principle demands that in cases of uncertainty we should attempt to err in the interest of caution. Where legislation has previously simply targeted specific groups of animals, the boundaries have been clear and empirically undisputed. Where legislation instead aims to include an-

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Browning and Veit 2020a).

imals on the basis of sentience, there is a problem of uncertainty in trying to determine which animals actually are sentient and thus protected. It is important that we have a way of ruling on which animals should be covered, when the evidence is not decisive.

Here, the precautionary principle advises that under uncertainty about the sentience of an animal, "we should 'give the animal the benefit of the doubt' or 'err on the side of caution' in formulating animal protection legislation" (Birch 2017, p. 1). Roughly, the idea is that we do much more harm in mistakenly denying protection to a sentient animal than in awarding it to what turns out to be a non-sentient animal - "Where there are threats of serious, negative animal welfare outcomes, lack of full scientific certainty as to the sentience of the animals in question shall not be used as a reason for postponing cost-effective measures to prevent those outcomes" (Birch 2017, p. 3).

In most cases, we have only partial evidence of the presence of sentience in an organism. Sentience is a function of mental states, which are necessarily hidden from direct observation. Even if we are fairly confident in the capabilities of indirect measures to reflect subjective states, this will not give us certainty.[6] There will always be some remaining doubt as to whether we are dealing with a sentient animal or not and thus whether it should be extended protection. Because we will never have complete certainty as to the sentience of some animal, giving any animal moral consideration on the basis of sentience will involve the application of the precautionary principle to some degree. However, this can be true to a greater or lesser extent, based on how confident we are about our evidence, similar to the challenging case of neural organoids, i.e. artifically grown brain tissue made to resemble the human brain (Birch and Browning 2021). This is why Birch (2017) argues that we need an objective method of deciding on use of the precautionary principle and outlines a framework its application.

In particular, the precautionary principle requires that we set a lower evidential bar for action than we otherwise might - where there is the threat of serious harm, we will act on more scant evidence (Birch 2017). This is not an attack on scientific standards, but in line with scientific practice involving potential harms to *human* welfare (e.g. medical research, product legislation, and engineering projects). We merely extend our concern for welfare from

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[6]Which is not to deny that these measures are still important. Even anecdotal evidence alone can give us increased confidence in the sentience of animals (Browning 2017).

human to non-human animals more generally. Waiting to gain conclusive evidence risks too much harm: "[i]f we underestimate the taxonomic range of animal sentience, and thereby exclude from the scope of animal protection some species that should be included, the threat to animal welfare is not simply that one animal will be subjected to preventable pain in the laboratory, but that millions of animals per year will" (Birch 2017, p. 4).

In the case of sentience, this leaves us with several choices - we could always assume sentience, without strong evidence of its absence, or conversely, rule out all animals for which we do not have strong evidence. If we want to avoid these extremes, we should instead look for a middle ground in which we set a low but still significant evidential bar. Birch suggests "statistically significant evidence, obtained by experiments that meet normal scientific standards, of the presence of at least one credible indicator of sentience in at least one species of that order" (Birch 2017, p. 5). Such indicators could include self-administration of analgesics, and evidence of motivational trade-offs made by the animal. Once we have determined an animal to be sentient (or possibly sentient) by this rule, we would then include them within relevant legislation.

Humans are prone to various anthropomorphic biases towards animals, and typically animals that are more like 'us' are found to be more appealing. Recognition of sentience as the important moral and legal feature helps to eliminate these biases and create a more objective way of deciding which animals are worthy of protection (Blattner 2019). There is a further worry, though, that in these cases, decisions about whether to grant or withhold attribution of sentience may vary depending on the usefulness of the animal (Blattner 2019). Particularly, when considering the **replacement** criterion, in which sentient animals are replaced by less- or non-sentient animals, the cost of awarding sentience to 'lower' animals used may be quite high. Here, an objective framework such as is described above will be particularly useful, as it prevents such value judgements from interfering in the decision-making process.

3 The Sentience Shift in Practice

3.1 Researcher and Caretaker Attitudes

One hitherto underappreciated way in which recognition of sentience may change the welfare of animals used in research, is through the influence on the attitudes of the researchers and caretakers who work with them. How we feel about animals naturally influences how we treat them. It is well established that the attitudes of caregivers towards their animals is an important determinant towards the way they will be treated (Hemsworth and Coleman 2010; Hemsworth et al. 1993). Increased positive attitudes towards animals by researchers and caregivers will change their behaviour, and thus improve the welfare of the animals. Positive human-animal interactions can increase the welfare of animals in human care, while negative interactions can decrease it (Cole and Fraser 2018; Hemsworth and Coleman 2010). For example, Waitt et al. (2002) found that laboratory primates with positive relationships with their caregivers would more easily approach and accept food, and were less disturbed by routine husbandry; in general showing more behaviours indicative of positive welfare, such as foraging and affiliative interactions. For this reason, improving human-animal relationships can be seen as a form of **Refinement** to improve animal welfare (Waitt et al. 2002).

Staff attitudes towards their animals will be influenced by a variety of factors, such as "early training, traditional practices, acquisition of knowledge from others subsequent to any training, personal experience and general beliefs and philosophy" (Broom 2009, p. 344). In particular, perceiving animals to be intelligent improves the treatment from caregivers (Browning 2019b). This trend was observed by Waiblinger et al. (2002), who found that stockpersons who perceived cows as intelligent creatures who enjoyed tactile contact would then place higher value on interacting with the animals and show more patience with them. Considering animals as sentient beings with emotions and personalities, rather than mere automata evolved for a particular niche, does not just lead to consideration of their ability to suffer. It can also lead to recognition of the range of positive states they can experience, and perhaps lead people to view them as individuals, creating increased understanding and compassion (Proctor 2012).

Although those who work with laboratory animals are often accused of being heartless, it is actually common for human-animal bonds to form under these circumstances (Bayne 2002). An important part of the human-animal

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relationship is a perception of animals as individuals, with their own personalities and preferences, which closely ties to ideas of sentience. Explicit acknowledgement of sentience encourages researchers and caretakers to empathise with the animals they work with as feeling creatures (Bayne 2002). Those working with laboratory animals often construct unofficial hierarchies as to the sentience level of the animals they work with, and roughly form bonds more strongly with those they see as higher in the ranking (Hobson-West and Davies 2018).[7] This can then lead to improved treatment of the animals which are the recipients of these bonds. Recognition of animal sentience can influence the attitudes and behaviour of researchers and caretakers and thus improve the welfare of research animals.

3.2 Housing and Husbandry

Recognition of sentience can also change the way in which we view the welfare of the animals used in research, and assess the potential harms occurring within experimental procedures and, importantly, in their housing and husbandry. This may be considered as part of the **refinement** in the 3Rs. Though usually applied only to experimental techniques, housing and husbandry can also be relevant - what Russell and Burch (1959) referred to as 'contingent inhumanity' (in contrast to the 'direct inhumanity' inflicted directly through experimental technique). This includes effects across the whole life - breeding, transport, health, handling, housing and euthanasia (Flecknell 2002).

One of the biggest implications of sentience is the capacity of an animal to have psychological, as well as just physical, welfare. Not only can an animal be harmed by illness or injury, but also through experiences that they find unpleasant, or being denied positive experiences. This makes a significant difference when considering what matters for housing and husbandry. Not only must an animal's physical needs be met - nutritious food, hygienic conditions - but so must their psychological needs - physical and sensory comfort, access to social companions, opportunities to perform motivated natural behaviours[8]. This is linked to an increasing focus on affective states as the crucial components of welfare . Instead of thinking about what

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[7]The causal direction may also work in reverse - one may be more susceptible to attribute sentience to an animal they have spent time and bonded with.

[8]Though we must be careful on how we interpret the link between natural behaviours and welfare - see Browning (2020c)

provisions or conditions animals have, caretakers instead view this through the lens of which negative and/or positive affects (feelings) they are creating or removing in an animal (Mellor 2016).

This is evidenced, for example, by the ever-increasing focus on provision of environmental and behavioural enrichment - objects and activities that provide challenge and mental stimulation for animals in zoos and laboratories alike (Baumans 2005; Browning-Jones and Moro 2006; Coleman et al. 2013). Previously, enrichment for laboratory animals has been neglected, largely due to the presumed requirement for controlled environments to ensure accuracy of results (Young 2003). However, there is now recognition that this is not necessary for any but the strictest experimental protocols, and that actually animal stress can actually bias results; thus provision of enrichment is becoming increasingly common (Young 2003).

There is an important role here for animal welfare science, in determining which conditions are best for animals. There is some concern that "our judgement of what represents" **refinements** is unfortunately all too often based upon "little more than common sense" with researchers and care-takers making "assumptions about animals and their feelings that often have little scientific basis" (Flecknell 2002, p. 76). Instead, we should turn to the outputs of welfare science as a more objective source of guidance.

3.3   Justifications for Animal Research

Finally, recognition of sentience will change the way we approach the practical justification for the use of animals in research more generally. Typically, a justification for a potentially harmful practice will rely on the ratio of benefit to harm. A harmful procedure may be considered justified if there is a substantial proposed benefit. One of the consequences of a shift towards a recognition of animal sentience is that this increases the scope of possible harms inflicted in animal research, both within the procedures, and the housing and husbandry conditions. A range of harms that are not always considered - particularly psychological and social harms (Ferdowsian et al. 2020) - would have to be scrutinized in more detail:

> "If considered, risks associated with animal research would include, but not be limited to: harms associated with breeding and transport; separation from parents, siblings, and other conspecifics; an inability to control access to that which meets one's

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own basic needs; a lack of safety and security; thwarting of an animal's preferences; an inability to fulfill one's full developmental potential; deprivation of a normal, species-appropriate, natural environment; and being killed"

<div align="right">– Ferdowsian et al. (2020, p. 27)</div>

Thus, when making these calculations, the proposed benefits must correspondingly be higher. Additionally, Galgut (2015) argues that animals are currently undervalued in cost/benefit calculations regarding animal research. A shift towards recognising sentience may tip this balance. Indeed, belief in animal sentience has been found to be negatively correlated with general support for the use of animals in research (Knight et al. 2009) and thus would increase the requirement for justification. This is possibly the greatest change that we will see as a consequence of recognition of sentience - the higher bar set for justification of research, and thus a resulting overall reduction in the number of studies and animals used. Because animals are typically not the beneficiaries of the research benefits, there is a case to be made such that these benefits must be even more significant in order to justify such research.

Research on animals is typically considered justifiable for human benefit. It is still generally thought of as necessary to conduct research on animals, at least in situations such as medical research, where human interests are thought to outweigh animal interests (Ferdowsian et al. 2020). However, the public support for biomedical research on animals is declining. Around half of Americans now consider medical testing on animals to be unacceptable (Ferdowsian et al. 2020). Some even advocate for very strong protections for animals in research, that mirror those for humans, based in autonomy, beneficence and justice (Ferdowsian et al. 2020). The degree to which research is considered essential can depend on the species used. In the USA, for instance, biomedical research on chimpanzees has now been phased out due to their high intelligence, and proposals are underway to follow suit with all nonhuman primates (Ferdowsian et al. 2020). Similarly in the EU, where great ape research has been banned and other nonhuman primates are being phased out (Ferdowsian et al. 2020). Here it seems likely that the perceived sentience of the animals under consideration has played a core motivating role. The UK ASPA legislation requires differential justification for use of different groups of animals, which appears also to be roughly based on degree of sentience - primates require extremely strong justification of work being done only to prevent "debilitating or potentially life threatening con-

ditions in man" (Hobson-West and Davies 2018, p. 682). However, this has been criticised as merely being based in perceived sentience, from a societal perspective, rather than a reflection of objective facts about the capacity for suffering (Hobson-West and Davies 2018).

There are several different types of benefits that can be used to justify use of animals in research. One of the weaker is the 'advancement of knowledge' for its own sake, without a specific clear target-directed goal in mind (Tannenbaum 2019). Research for the advancement of knowledge can take several forms, such as 'curiosity-driven' research in which the collection of knowledge for its own sake is valued or 'exploratory' research in which future discoveries and potential benefits are intended but unpredictable (Tannenbaum 2019). The strength of the *knowledge justification* will rely on which specific end is being pursued.

The more significant argument concerns the practical benefits that can accrue to both humans and animals. The US Government Principles for the Utilization and Care of Vertebrate Animals Used in Testing, Research, and Training states that "[p]rocedures involving animals should be designed and performed with due consideration of their relevance to human or animal health, the advancement of knowledge, or the good of society." (quoted in Tannenbaum 2019, p. 2). Research that provides direct benefit to humans or animals, in terms of improving health or wellbeing, is typically the type considered suitably justified, so long as the pain and distress inflicted is not too great.[9] Use of animals in biomedical research is currently central to the field - "indeed, animal research is arguably not just *a* method. It is *the* method of scientific inquiry" (Hobson-West and Davies 2018, p. 672).

Assessment of proposed animal research typically proceeds through approval by an ethics committee, such as an Animal Ethics Committee (Australia) or IACUC (Institutional Animal Care and Use Committee) (USA). These committees consist of a number of members, both science and welfare experts, and the general public. They are responsible for reading research proposals and assessing the potential harms against the proposed benefits, approving or denying accordingly. However, it is extremely rare that protocols get rejected, and most will simply receive recommendations for modification in line with the 3Rs to reduce the impact on animals (Ferdowsian

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[9]An interesting recent example is de-extinction projects, which aim to 'resurrect' extinct species for a variety of proposed benefits to both humans and animals, but have until now paid little attention to the welfare of the animals involved (Browning 2018; Browning and Veit forthcoming)

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et al. 2020).

The recognition of sentience should thus lead us to expect to see stricter requirements to justify the use of animals in research. A plausible ethical principle for assessing potential research is: "Any harm (including pain or distress) that an animal research project will cause the animals must be justified by the value of the project, and the greater the harms an animal research project will cause animals, the greater must be the value of the project to justify these harms" (Tannenbaum 2019, p. 17). Due to the increased scope for harm in sentient animals, there would be more or stronger potential benefits required to justify their use. This could thus lead to a decrease in the number of animal-based projects, as such stronger justifications will not always be forthcoming.

4 Conclusion

Animal sentience is a, if not *the*, key component of animal welfare. The recognition of this fact has led to a recent shift towards inclusion of sentience within animal welfare legislation, which has had effects on their care and welfare, including in changing attitudes towards animals, improving their care, and strengthening the justification required for their use.

As this shift continues into the future, there will also be new avenues opened for future research. One of these avenues lies in the further refinement of our understanding of which animals possess sentience and to what degree they might do so. If different animals have different capacities for suffering, this will affect legislation regarding their use and require scientists to develop ways of measuring subjective animal welfare as a consciously experienced state, which will be far from easy (Dawkins 1998; Browning and Veit 2020b; Browning 2020a, 2022a). While we cannot directly access the phenomenological experience of other animals, a phenomenological perspective might nevertheless useful in order to think about developing better scientific frameworks for thinking about animal welfare (Veit and Browning 2021). It will be especially important to address the difficulty of making interspecies comparisons of welfare (Budolfson and Spears 2019; Browning 2022b) - a problem that only becomes more pressing as we expand the moral circle of animals considered sentient, yet unlikely to experience the same extent of positive and negative feelings. A more gradualist picture that pays attention to the differences in complexity between species, rather than mere boundaries

of sentience, will be important here (Godfrey-Smith 2020; Veit and Huebner 2020; Veit 2022). The need for a rigorous investigation of animal sentience with a plurality of methods across the animal tree of life opens a special continuous role for *animal welfare science*, in providing necessary information on the welfare impacts of different housing and husbandry conditions, that can then form the basis of change. The ban of great apes in research, and the new protections being brought in for cephalopods, should only be considered the beginning.

The recognition of sentience in animals will thus provide a radical and much-needed shift in the way we view their moral status and provide for their welfare, and will strongly impact the care and use of animals in research, a long-awaited and very welcome development.

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