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Non-human Animals and a New Ethics for Engineering

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Introduction

The sixth mass extinction is underway. Earth's animal populations have declined by an average of 69% since 1970 [1], partly due to unsustainable use of land, water and energy, and resulting climate change. Indeed, non-human animals have long been disregarded and devalued under the rationalist worldview that persists in the culture of engineering. Engineering education has a role to play in addressing this crisis. However, as White wrote in his seminal paper over 50 years ago, "What we do about ecology depends on our ideas of the man-nature relationship. More science and more technology are not going to get us out of the present ecologic crisis until we find a new religion or rethink our old one" [2]. Although it could be argued that religious ideology remains influential, this paper suggests not a new religion, but that a new engineering ethics is needed and must, as Jonas [3] has called for, incorporate humility. But any new ethics must first dismantle the nature-technology distinction, and the perceived separation of humans and other animals, which are at the foundation of engineering design and practice. From there, engineering education might be better able to help prepare the next generation of engineers to address this ecological urgency.

A persistent schism

Students in a spring semester 2023 Engineering Ethics class at the University of Virginia were assigned an "ethical autobiography" essay during the first week of class. One of the essays submitted included the following paragraph:

> *I feel extremely connected to living beings. In my lab experience, I've had to morally consider the use of animals for research. I will not be very graphic here, but some of the lab procedures have been very shocking to me. I found that my elephant automatically made the decision for me. I carried on with the actions according to the people in my environment and did not question the research methods. After the fact, my rider really had to break down why I so easily accepted the reasoning behind this ethical decision. These animals are being used for research purposes in shocking ways, but at my core I know that there is the potential for creating a therapeutic that could save many human lives from life-threatening diseases. I found it necessary to completely separate my two moral identities: my empathetic, creature-saving side and my clinical, scientific side.*
> Madeline K.
> Biomedical Engineering Student

Another UVA biomedical engineering student shared during a class discussion that she must disconnect herself from her feelings when injecting toxic nerve agents, used for military research, into rats.

The split in identity expressed by these students reflects a larger cultural schism that began centuries ago:

As Franco notes:

> "René Descartes's (1596–1650) description of animals as "machine-like" was heavily criticized by many of his contemporaries, but nevertheless provided scientists a way to justify what would now be considered extremely gruesome experiments in a time when anesthesia, for humans and animals alike, was not available." [4] (p. 241)

Descartes's thinking marked a major break in human cultural evolution. Most cultures to that point did not, and many indigenous cultures still don't, see humans and animals as unequal or fundamentally different. Yet the Cartesian separation between mind and body – famously summed up as *Cogito ergo sum* ("I think, therefore I exist"), leads to the assertion that animals don't exist in the way that humans do. This anthropocentric assumption implicitly places a boundary between "animals" and "humans" by assuming that animals lack souls, intelligence, feelings, and consciousness, and can therefore be treated as objects that can be used for human purposes. This assertion is further supported by the human supremacy worldview, wherein humans are deemed superior by divine decree and are thus given unfettered dominion over all other life forms.

Franco [4] points this out in reference to other early philosophers of influence in ethics as pertaining to animals:

> "Baruch Spinoza (1632–1677) did not deny animals' ability to feel, but considered we should nevertheless "use them as we please, treating them in a way which best suits us; for their nature is not like ours. . ." (p. 241)

> "Immanuel Kant (1724–1804) would reject Cartesian mechanistic views, thus acknowledging sentience to other animals. However, Kant would not extend his concept of human intrinsic and inalienable dignity to other species. In his Of Duties to Animals and Spirits, and mirroring Thomas Aquinas's views on the subject, he observed that "all animals exist only as means, and not for their own sakes, in that they have no self-consciousness, whereas man is the end (...) it follows that we have no immediate duties to animals; our duties towards them are indirect duties to humanity." (p. 241)

Though these are the musings of men long deceased, their influence persists in the relative disregard of non-human animals across the spectrum of engineering, e.g., energy production, food production, deep-sea mining [5], missile testing, pharmaceutical development, communications, transportation and other systems that disrupt habitat and migration patterns. In our socio-technical world, engineered systems and human life are entangled in a complex web of cause and effect; we are now beginning to grasp how integral non-human animals are in the larger web of the engineered world. For example, the health of both humans and marine animals is threatened by the presence of polycyclic aromatic hydrocarbons [6]. Together, human, and non-human animals must evolve and adapt for survival, especially given that in the human-made world, animals are biologically, neurologically, and psychologically vulnerable to the influences of engineered systems and devices. But that evolving co-relationship is lopsided in that engineered tools, systems, and devices, are used by humans on non-human animals,

directly and indirectly for: food, materials in household goods and clothing, entertainment and sport, transportation and labor, companionship, and in research. This "means to an end" treatment of non-human animals raises questions of ethics. This is so even when non-human animals are deployed benignly with technological devices that could lead to incredibly important discoveries. For example, in a study of melting glaciers, the head of a southern elephant seal was tagged with an ocean sensor which indicated its unusual movement into Antarctic waters that would normally be inaccessible due to glacial ice, providing evidence to researchers that melting of the Denman Glacier may be a major threat to global coastlines [7]. Well intended and seemingly harmless, was the animal's welfare considered in the design of that device and, if not, ought it to have been?

Engineered systems and technological devices are often deployed at the expense of non-human animals who are either disregarded or valued only as 'natural resources' for human purposes. There are many examples of this such as the anthropogenic noise pollution (caused by airplanes, automobiles, trains, watercraft, construction, mining, etc.) that "not only affects acoustically oriented animals, but that noise may reverberate through biological communities through indirect effects to those with no clear links to the acoustic realm, even in adjacent quiet environments" [8]. Oil spills are another example. Ensuing from the Santa Barbara oil spill of 1969, the declaration of environmental rights stated that "we must extend ethics beyond social relations to govern man's contact with all forms of life and with the environment itself" [9]. And yet post Santa Barbara were the *Amoco Cadiz* Oil Spill of 1978, the Kolva River oil spill of 1994, BP's Deep Water Horizon spill of 2010, and the Exxon Valdeze spill in 1989, among others. What happened to extending ethics to govern man's contact with all forms of life?

Homocentric engineering ethics

Today's engineering research and technological designs are generally pursued for the sake of "good," and are homocentric (grounded in society) in orientation. For example, it was people, not migrating birds, that were the focus of engineering the "Tribute in Light" installation commemorating September 11, by illuminating lower Manhattan. But:

> "By twist of fate, the anniversary of the Sept. 11 attacks coincides with a much older yearly ritual: the migration of birds across New York City as fall approaches. The convergence creates a spectacle that is eerily beautiful, yet according to one study endangers some 160,000 birds a year, starkly illustrating the perils of humans and animals sharing an urban ecosystem." [10]

'Making the world a better place' and 'improving the quality of life' are commonly stated intentions of engineering research and are implicit in the professional codes of engineering. But these codes explicitly preference human welfare, and are otherwise mute on responsibilities pertaining to non-human animals:

- The National Society of Professional Engineering decrees that professional engineers should hold paramount the safety, health, and welfare of *the public*". [11]

- The American Society of Civil Engineers puts forth as a fundamental principle that they "utilize their knowledge and skills to enhance the quality of life *for humanity*". [12]
- "In recognition of the importance of our technologies in affecting the quality of life throughout the world," the IEEE includes in its code "to improve the understanding by *individuals and society* of the capabilities and societal implications of conventional and emerging technologies, including intelligent systems" and "to treat *all persons* fairly and with respect…." [13]
- For the NSF, "the responsible and ethical conduct of research involves not only a responsibility to generate and disseminate knowledge with rigor and integrity, but also a responsibility to:
    - conduct peer review with the highest ethical standards,
    - diligently protect proprietary information and intellectual property from inappropriate disclosure,
    - and treat *students and colleagues* fairly and with respect." [14]

While the natural environment may be of concern to individual engineering researchers, these homocentric codes of engineering ethics are still rooted in the mechanistic thinking of the 17th century, where reference to non-human animals is largely omitted. There are ethical guidelines for research involving animals, but they may warrant reconsideration, given new developments and debates over animal bioengineering. Animal welfare policies and initiatives in the USA are minimal in their standards of care and limited in which animals are included. (By contrast, in the UK, standards are high and inclusive based on animal sentience.) Is engineering able and willing to embrace sentient-centric ethics? That would mean giving credence to the moral significance of sentience in animals; the capacity to perceive and experience feelings such as pleasure, joy, pain, and distress.

Being that humans and non-human animals are integrally connected in the larger web of life, and the impacts of engineering on non-human animals are having increasingly profound implications for their lives, and for ours, engineering education has significant responsibility, and an important contribution to make in healing the ecosystem.

Engineering education is well positioned to provide future engineers with the capacity to consider animal welfare in design, development, and deployment of new engineered devices, as an ethical responsibility. Additionally, engineering education offers an opportunity for students to learn how to address animal-related problems in existing engineering systems. Animal ethics in engineering is a topic warranting curricular consideration, however; conventional approaches to ethics may need to be revisited to address urgent ecological issues.

Calls for "a new ethics"

In 1984, Hans Jonas wrote in The Imperative of Responsibility: In Search of an Ethics for the Technological Age that "new kinds and dimensions of action require a commensurate ethic of foresight and responsibility which is as novel as the eventualities that arise out of

the works of Homo Faber in the era of technology" [3] (p. 18). This writing is still pertinent after all these years, Jonas feared "an apocalypse threatening from the nature of the unintended dynamics of technical civilization," (p. 202) leading to the desolation of the planet. Jonas included man as an object of technology, having turned on himself and imposed himself on nature in such a way that "calls upon the utter resources of ethical thought, which never before has been faced with elective alternatives to what we considered the definite terms of the human condition" [3] (p. 18). It seems that Homo Faber's technology also includes non-human animals who, for Jonas, "are psychophysical individuals with common but varied forms of organic identity and living capacities" (p. 6) with important and valuable significance for themselves and perhaps for others.

Since Jonas' writing 40 years ago, there have been a variety of calls for new ethics for engineering. For example, pertaining to gender, Basart et.al suggested inclusion of the 'feminine' perspective as being:

> "essential for the complete development of the moral life of the engineering profession and of the awareness of the fact that this is a profession made up of both male and female professionals. Thus, specific behaviour coming from the feminine part is necessary in order to contribute to enriching the features of the engineering profile." [15] (p. 412)

Similarly, Riley [16] (p. 198) sought "not only to make the case that engineers should pay attention to feminist ethics and engineering ethicists make more use of feminist ethics traditions in the field, but also to provide some avenues for how to approach integrating feminist ethics in engineering."

Concerns over the need for new approaches to engineering ethics have also emerged over the insufficiency of traditional engineering research ethics to address developments in bioengineering R&D. As expressed in Hyun's writing [17]:

> "Complex multi-cellular constructs like M-CELS pose a unique problem for bioengineers that other engineered constructs made from non-living matter do not entail – namely the potentially unpredictable nature of biologically autonomous, self-organizing human cells." [np]

Hyun calls for "a fresh approach that utilizes contemporary engineering ethics, which accepts that engineering itself is a value-laden activity and that the values that drive design decisions are often themselves ethical in nature." His call for a new ethics arises from his concern about "advances in stem cell science and bioengineering giving rise to many types of synthetic living models of human biology." [17]

Similarly, Nienke de Graeff et.al. [18] have indicated a need for more scholarly consideration on the ethics of genetic engineering for non-human animals saying,

> "Our findings illuminate several key considerations about the academic debate, including a low disciplinary diversity in the contributing academics, a scarcity of

> systematic comparisons of potential consequences of using these technologies, an underrepresentation of animal interests, and a disjunction between the public and academic debate on this topic." (p. 10) "They call for a "broad range of academics to get increasingly involved in the discussion about genome editing, to incorporate animal interests and systematic comparisons, and to further discuss the aims and methods of public involvement." (p.10)

The "Animal Turn"

Attention turned to non-human animals with Ruth Harrison's Animal Machines in 1964, and Peter Singer's Animal Liberation in 1975, but that concern remained largely nascent in academic literature over the decades to follow. In her seminal piece of 2007, "On the Animal Turn," Ritvo [19] pointed to the emergence of animals as a more frequent focus of scholarship in the humanities and social sciences. Grusin [20] and others have since further documented the animal turn Ritvo identified. To their point, Animal Studies, including those found in STS programs, have proliferated in higher education. For example, Cornell's STS 4101 - *The Entangled Lives of Humans and Animals* course draws on readings from Anthropology, Science & Technology Studies, and animal trainers and behaviorists [21]. And Brown University's STS Animal Studies program includes a course in *Animals & Ethics* [22].

The animal turn in engineering ethics literature is nascent. A quick scan of the table of contents of engineering ethics textbooks reveals a trend over the last few decades to include sustainability as a topic of concern, which in a few refers specifically to animals. For example, Vesilind and Gunn's 1998 edited volume, *Engineering, Ethics, and the Environment*, includes a case called "Running Over Box Turtles," and a section on "Extending the Moral Community to Include All Life [23]." A chapter called "Cultivating the Virtue of Respect for Nature" is included in the 6th edition of Harris and Pritchard's 2019 *Engineering Ethics: Concepts and Cases* [24]. Chapter 8 in the fifth edition of Martin, Zhu, and *Ethics in Engineering* is titled "Engineering and Environmental Ethics in the Anthropocene" and includes a small section explaining the theory of sentient-centered ethics [25]. An Amazon.com books search for 'Engineering Ethics, Animals," brings up many titles, beginning with *Animals and the Fukushima Nuclear Disaster* (The Palgrave Macmillan Animal Ethics Series) [26] followed by *The Routledge Handbook of Animal Ethics* (Routledge Handbooks in Applied Ethics) [27]. A Google Scholar search under the same topic of, turns up many articles pertaining to genetic engineering of animals, and animal experimentation. On refining that search for publications since 2019, an article on "Welcoming Robots into the Moral Circle: A Defence of Ethical Behaviourism" [28] comes up first, reflective of the push by some to expand the established boundaries of life as defined include technological creations. Also, a topic of more recent interest: laboratory grown meat [29]. Although STS and other academic fields have begun to take an interest in non-human animals, the topic is thinly addressed in engineering ethics literature. And yet, as the primary source of learning and training for aspiring engineers, engineering education has a responsibility to include in its curriculum ethical considerations of animal welfare in the development and deployment of new engineered systems, and in existing engineering systems.

Resources for a new engineering ethics

A good place to introduce engineering students to the idea of engineering with a focus on ethics and animals are engineering projects that specifically attempt to address animal welfare, such as painting blades to increase their visibility at the Smøla wind-power plant in Norway, where the annual bird fatality rate was reduced at the turbines with a painted blade by over 70% [30]. Temple Grandin's design of a more humane cattle handling system [31] is another example.

STS literature has a growing body of synergistic writings pertaining to ethics and animals. Also pertinent are the fields of Animal Geographies and Multispecies Ethnography. As Hovorka explains:

> "Animal geographies are at their core grounded in ethical commitments and emancipatory practices to improve the lives of animals. Since the late 20th century, animal geographers have addressed the silence around animals in social theory and have remapped the moral landscape and balance of power alongside efforts from environmentalists, those championing rights of marginalized human groups, and animal advocates. Core ethical concepts have emerged from animal geographies, emphasizing context-specific, place-based, and embodied encounters as part of moral assessments of human–animal relations." [32] (p. 12)

As such, Animal Geographies could be used to form a determination of the value conflicts and cultural factors which put animals at risk of harm under the impact of engineering and technological development. This seems to be an important place to start given that:

> "Animal geographers 'investigate how humans think about, place, and engage with animals, how animals shape human identities and social dynamics, as well as how broader social cultural, political economic, and ecological processes influence animal distributions, circumstances, behaviours, experiences, and well-being [33]." (p. 127)

And that:

> "Animal geographies at their core explore human–animal relations through attention to animality, animal spaces, and beastly places as grounded in eclectic and integrative methodological approaches and ethical commitments to improving more-than-human lives." [33] (p. 131)

The work of Multispecies ethnographers might also be considered a resource to draw on in the creation of a new ethics for engineering. As Münster and Locke claim:

> "Multispecies ethnography must thus be seen as a part of a larger quest in the social sciences and humanities to replace dualist ontologies by relational perspectives, to overcome anthropocentrism by pointing to the meaningful agency of nonhuman others,

> and to highlight the intersections between ecological relations, political economy and cultural representations." [34] (p. 1)

Another key resource is *The Animal Turn: Digitizing Animal Protection and Human-Animal Studies Collections* from NC State, a project funded by a grant from the Council on Library and Information Resources [35]. There are many such documents, reports, and studies that would be well adapted for this purpose.

Closing thoughts

One ethical perspective on tending to the welfare of animals is largely about self-interest, in that animals are essential to a sustainable ecology. Another perspective is that of minimizing suffering. Which begs the question, what would it mean for engineering ethics if non-human-animals are in fact sentient, as many scientists are beginning to discover [36]? (For the UK it has meant revision of its animal welfare act [37].) What would it mean for engineering if it turns out that Descartes was mistaken, and the entire premise of the mechanistic universe was a misunderstanding? If engineering writ large were able to move towards a holistic frame of understanding, wherein life is not composed of a set of discrete machines but functions as an interconnected whole, then what would be considered "good," or "harmful," "duty," or "virtuous," in the design of engineered systems and the practice of engineering? That is a conversation worth having with engineering students; bringing the concern of animal welfare into engineering education, through ethics, is essential if we are to effectively address our current environment crisis.