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How to cite:

Mancini, Clara; Hirsch-Matsioulas, Orit and Metcalfe, Daniel (2022). Politicising Animal-Computer Interaction: an Approach to Political Engagement with Animal-Centred Design. In: Proceedings of Ninth International Conference on Animal-Computer Interaction, 5-8 Dec 2022, Newcastle, UK.

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Version: Accepted Manuscript

Link(s) to article on publisher's website:

<http://dx.doi.org/doi:10.1145/3565995.3566034>

<https://www.aciconf.org/conference-program>

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Politicising Animal-Computer Interaction: an Approach to Political Engagement with Animal-Centred Design

Politicising ACI

Clara Mancini

The Open University, clara.mancini@open.ac.uk

Orit Hirsch-Matsioulas

University of Haifa, ohirsh@staff.haifa.ac.il

Daniel Metcalfe

Technion - Israel Institute of Technology, daniel.met@technion.ac.il

While ACI researchers aspire to design animal-centred technology, they must operate within socio-economic systems that are not necessarily animal-centred. This creates a tension between researchers' endeavour to address the immediate needs of animals in specific situations through technological interventions, on the one hand, and these interventions' wider implications and consequences for the situation and life of various animal stakeholders beyond specific ACI projects, on the other hand. In this paper, we focus on the political nature of ACI, drawing from literature on political interaction design, which argues that designers should work towards social justice. Drawing from political philosophies, we then explore how extending the notion of social justice to animals might help define a political notion of animal centredness in ACI. Finally, through the lens of this notion of animal centredness, we consider the relevance of previously proposed strategies for political interaction design and propose an approach that could support ACI researchers' political engagement in animal-centred design.

CCS CONCEPTS • ~~Human-Computer Interaction~~ • **Animal-Centered Computing** • Interaction Design • Interaction design theory, concepts and paradigms

Additional Keywords and Phrases: Animal-Centred Design, Political Design, Animal Justice, Animal Centredness, Political engagement

ACM Reference Format:

First Author's Name, Initials, and Last Name, Second Author's Name, Initials, and Last Name, and Third Author's Name, Initials, and Last Name. 2018. The Title of the Paper: ACM Conference Proceedings Manuscript Submission Template: This is the subtitle of the paper, this document both explains and embodies the submission format for authors using Word. In Woodstock '18: ACM Symposium on Neural Gaze Detection, June 03–05, 2018, Woodstock, NY. ACM, New York, NY, USA, 10 pages. NOTE: This block will be automatically generated when manuscripts are processed after acceptance.

1 INTRODUCTION

Years ago, at the end of a presentation on Animal-Computer Interaction (ACI), someone asked us: “*Would you design a cow-friendly slaughterhouse?*”

This question perfectly encapsulates the extremes of a fundamental tension implicit within our field of research and practice. While ACI researchers aspire to design animal-centred technology, they must operate within socio-economic systems that are not necessarily animal-centred [Mancini 2017]. This creates a tension between researchers’ endeavour to address the immediate needs of animals in specific situations through technological interventions, on the one hand, and these interventions’ wider implications for and effects on the animals’ situation beyond specific ACI projects, on the other hand.

For example, designing a tracker to monitor dairy cows’ activity and physiological patterns to detect the early signs of lameness might spare Daisy the cow unnecessary discomfort, without interfering with her bodily functions and daily activities, if the tracker provides good wearability [Paci et al. 2019]. However, the same data might be used for less benign purposes [van der Linden 2022]. For example, it could be used to detect when Daisy is in oestrous so she could be successfully inseminated and subsequently give birth, only to have her new-born calf taken away from her, with negative consequences for both mother and baby [Wagner et al. 2015]. After a number of successful inseminations, and having mothered a number of calves, Daisy would eventually become less productive and, thus, no longer considered worth the cost of her keep, at which point she would be sent off to be slaughtered, transported for hours or even days to the place of her untimely demise [CIWF]. Ultimately, a device aiming to monitor cows’ welfare and featuring a wearer-centred design might end up improving the efficiency and profitability of a system whose functioning involves objectifying, taking away the agency, the produce and the life of the animals who are supposed to be at the centre of the design in question.

Where does this leave ACI researchers? What might be the boundaries of their responsibility? How might they influence the systems within which they operate beyond their immediate interventions? Undoubtedly, such ethical questions face any researcher whose work might have an impact on others but the need to consider these questions seems more obvious for researchers whose disciplinary values (in this case, animal-centredness) may find themselves at odds with the values of the socio-economic systems in which the researchers operate (in this case, those in which animals exist). While this issue has been acknowledged in ACI [Mancini 2017], there has been little discussion within ACI literature as to how researchers might go about dealing with it and what might help them do so. At a time when the community is intent on *defining tomorrow* [ACI2022] it seems appropriate to bring this discussion to the table.

To this end, we reflect on the political nature of ACI, drawing from literature on political interaction design, which argues that designers should work towards social justice. Drawing from political philosophies, we then explore the implications of extending the notion of social justice to animals and how this can help define a political notion of animal centredness in ACI. Finally, through the lens of this notion of animal centredness, we build on previously proposed strategies for political interaction design to propose an approach that could support ACI researchers’ political engagement in animal-centred design. We see this engagement as a continuous pondering of questions regarding the implications that design interventions might have within and beyond ACI projects, the answers to which might inform design decisions that in turn open further questions.

2 NOTIONS OF ANIMAL-CENTRED DESIGN AND RELATED CONCERNS IN ACI

From the start, ACI has been characterised by an ambition to research and design technology from an animal-centred perspective. This perspective has informed the design of applications to mediate daily human-animal relations [e.g. Cheok 2006, Nelson and Shih 2017, Pons et al. 2019], to improve animals' lives [e.g. Wallis et al. 2017, Carpio et al. 2017, Hirskyj-Douglas and Piitulainen 2020], to facilitate animals' activities in service of humans [e.g. Jackson et al. 2013, Robinson et al. 2014, Majikes et al. 2017], and to better understand animals' behaviour [Haladjian et al. 2017, Echterhoff et al. 2018, Menaker et al. 2022]. ACI's perspective has also informed principles [e.g. Mancini et al. 2016, Freil et al. 2017, French et al. 2020] and frameworks [e.g. van der Linden and Zamansky 2017, Mancini and Lehtonen 2018, Webber et al. 2022] for animal-centred design. Similarly, there has been much interest in the exploration of methods to account for animal perspectives by directly involving them in the design process, whether to inform new designs [e.g. Robinson et al. 2014, Byrne et al. 2017, Westerlaken and Gualeni 2016] or to assess animals' experience with systems [e.g. Hirskyj-Douglas et al. 2017, Ruge et al. 2018]. Moreover, ethical issues concerning the involvement of animals in ACI research have received significant attention, with researchers proposing various ethical perspectives to protect animal participants [e.g. Väättäjä 2013, Freil et al. 2017, Mancini 2017]. Altogether, this work has highlighted the importance of animal-centred processes and outcomes in ACI, particularly for enhancing animals' welfare as an approach to design [e.g. Hirskyj-Douglas and Read 2016, Mancini 2017] and as a design goal [e.g. Väättäjä 2014, van der Linden and Zamansky 2017, Webber et al. 2022]. Indeed, the potential benefits of ACI's animal-centred perspective for animal welfare have also been recognised in other application fields [e.g. Rault et al. 2015, Makinde et al. 2019]. Here the question arises as to whether the notion of animal centredness in ACI is synonymous with animal welfare or whether there might be more to it than is accounted for by notions of animal welfare.

At the same time, researchers have warned about the need to consider the wider implications of ACI interventions which aim to improve animal welfare. For example, Grillaert and Camenzind [2016] have pointed out that the well-intentioned design of animal technology to address welfare issues may result in the reinforcement of human practices that are at the origin of the welfare problem being addressed by the technology and that ultimately result in a worsening of the animals' situation (e.g. technology designed to entertain dogs who are left at home alone may result in their humans leaving them alone for even longer periods, as they delegate the solution of the 'dog at home alone' problem to the technology and thus discharge their responsibility for their dogs' welfare instead of giving them the company and interaction they crave). Researchers have also highlighted the multiformity and complexity of animal-computer interactions and how they can affect animals and humans. For example, Aspling [2020] has shown how human-animal relations are shaped through a multiformity of technology-mediated interactions; and, within the context of multispecies information networks, van der Linden [2021] has articulated the complexities that are involved in the use of technology to collect and process animal data, and the possible and sometimes negative consequences for animals (e.g. gathering data about animals' physiology or location that can be combined to infer information that in turn can be used to exploit them more efficiently and further commodify them). Finally, researchers have warned about the challenges to animal-centred research and design posed by interspecies differences and power asymmetries. For example, French et al. [2021] have stressed how animal-centred design is inevitably biased by the power dynamics that characterise human-animal relations where animals represent the weaker part. Along the same lines, Lawson et al. [2016] have expressed significant scepticism about the possibility for

animals to attain proper representation in the design process due to interspecies differences and communication barriers that inevitably prevent them from making their voice heard in a world that is entirely shaped by anthropocentric interests (e.g. the internet as we know it is completely inaccessible to dogs while an internet designed for dogs would be completely inaccessible to humans). These concerns highlight how ACI may affect animals, beyond the limits of specific projects, in the wider contexts in which they exist, almost invariably, in subordinate relation to humans. In other words, these concerns highlight the political nature of ACI [Chisik and Mancini 2019] and the need for ACI researchers to be aware of the different forces that are at play within and around the context of ACI projects. In this regard, we propose that thinking politically about ACI may help us question the standards according to which we measure animal-centeredness as well as address the wider implications of ACI for animals. Thus, we ask what it might mean to engage with the political nature of ACI and how ACI researchers might do so.

With the above in mind, the remainder of this paper explores the following two key issues: (1) what we take animal-centredness to be and (2) what it means to be political in relation to animal-centredness.

3 INTERACTION DESIGN AS A POLITICAL ACTIVITY

Various authors have argued that design is a political activity because it directly influences the lives of those who are exposed to its processes and outcomes, enabling or constraining possible actions in their daily lives [Löwgren and Stolterman 2004]; and that the political nature of design, in fact, reflects the ongoing contest between the forces and ideas that shape society [DiSalvo 2012]. Design involves making decisions that give form and function to the environments in which different stakeholders live and operate. Deciding who has a stake in a design, who is to benefit from it, what prospective beneficiaries need and how their needs are to be addressed are all political decisions based on the designer's understanding of the context for which they design and on the competing interests that need to be negotiated during the process. Thus, the decision as to who is at the centre of design and who is not at the centre is by nature a political one.

Given that design operates within existing social structures and power relations it is useful to consider the relationship of the design project with these external forces. In his examination of different forms of political engagement, Alexander [2014] argues that such engagement can be: (1) *separate* from the hierarchical systems that maintain social order, when members of society engage with one another freely as equals through dialogue and persuasion; (2) it can be *supportive* of said hierarchical systems, when those in power attempt to set shared standards that members of society may approve or disapprove of and when different parties negotiate decisions within those systems; or (3) it can be *subversive* of said hierarchical systems when those not in power challenge and disrupt the functioning of the existing system to bring about change. In a similar way, design activity may not engage with, support, or subvert new hierarchical systems that regulate and influence individuals' lives. Obrenović [2015] uses Alexander's understanding of politics to examine the political interaction between designers and other stakeholders, highlighting the different forms of power relations that may exist between designers and users depending on the level of participation and influence users have within the design process. These power relations are most notable when users have no choice but to adopt a design, as might be the case with various design projects. Furthermore, Obrenović highlights how, as political agents, while designers are in a position of relative power, they are also subject to the power of the socio-economic entities that make their work possible (e.g. private and public funders, commercial and academic institutions)

and are therefore under pressure to operate according to the standards (e.g. understandings, values, interests) of those entities.

In this regard, Khovanskaya et al. [2018] argue that, despite causing micro-disruptions to existing practices, new computing technologies simply tend to reinforce the status quo, albeit in new material forms. Similarly, they argue that the user-centred design process adopted in industry and taught in universities usually leads to the identification of requirements for new technologies that support existing ways of doing things instead of challenging them. However, since major social challenges (e.g. climate change, homelessness) derive from the perpetuation of existing socio-economic systems, the authors deem it no longer acceptable for designers to take an apolitical design stance that promotes new technologies as progressive while uncritically reproducing the status quo. For the authors, designers should resist the temptation to think in an 'engineering' way and design 'solutions' to simply help manage the current state of the world; instead, they should ask *why* and *how* things have come to be as they are, and set ambitious design goals that, beyond simply ameliorating its symptoms, challenge the current state. To this end, the authors suggest that designers should draw inspiration from theories that have a history of praxis and resistance (e.g. queer theory, postcolonial theory), which provide strategies for troubling the status quo. They also warn that designers should carefully consider and explicitly acknowledge any trade-offs between addressing immediate concerns and pursuing transformative goals that address systemic causes; and, as they work tactically within the systems of the status quo, designers should not lose sight of their political program for *working towards social justice*. Thus, political engagement in design is about considering the power relations existing among the different project stakeholders and how a design might favour one over another, as well as the power relations existing among the designers, the stakeholders impacted by the design and the wider socio-economic systems within which designing takes place.

Here the question arises as to how these considerations might be relevant for ACI. In particular, the question is what their significance might be if we extend the notion of social justice to nonhuman animals, and what the implications might be for ACI researchers and designers. To address this question, the next section briefly discusses relevant political theories of justice, with a particular focus on Nussbaum's [2006] *capability approach* to multispecies justice.

4 EXTENDING THE NOTION OF SOCIAL JUSTICE TO ANIMALS

Widely acknowledged as a major contemporary treaty in political philosophy, Rawls' highly influential *Theory of Justice* [Rawls 1971] (later restated as *Justice as Fairness* [Rawls 2001]) is grounded in the *social contract* tradition represented by Locke, Rousseau and Kant. In Rawls' theory, justice emerges when social institutions, policies and rules are informed by principles of justice that persons in an *original position*, in which they are equal and have no vested interests, agree upon as mutually advantageous. Although generally appreciated for its principled liberalism [Sen 2009], Rawls' contractarianism has been criticised, for example, because it relies excessively on the role of institutions in delivering justice with little consideration for the actual conditions that may determine individuals' ability to attain justice [Sen 2009]; because it focuses on preventing injustices from entering society but has little to say about how to rectify injustices that have already entered society and that perpetuate the oppression of some [Mills 2009]; and, fundamentally, because it presupposes that those who negotiate the social contract must have equal capacity for rational reasoning and self-representation, thus excluding humans with cognitive disabilities and nonhuman animals [Nussbaum 2006]. In contrast, in her political treaty *Frontiers of Justice*, Nussbaum [2006] argues that a theory of justice should be able to account

for asymmetries of power, capacity and moral rationality, so that justice could be extended to all those for whom it is relevant, including nonhuman animals. For the author, animals are *agents capable of a dignified existence*, with corresponding *needs for flourishing* and related *goals they actively pursue*, to which they have a *moral entitlement*. Therefore, while they may not be able to negotiate with humans mutually advantageous principles of justice, they are nevertheless subjects of justice for whom such principles must be negotiated. While in the contractarian tradition the treatment of animals is an issue of compassion and their maltreatment is contrary to human dignity, in Nussbaum's theory their treatment is an issue of *justice* and the maltreatment of animals is contrary to *animal dignity*. This distinction between humans' *obligation to a compassionate treatment* of animals and animals' *entitlement to a just treatment* has correspondence with the difference between the position of animal welfare advocates, who call for laws that require the humane treatment of animals, and animal rights advocates, who extend to animals the Kantian idea that human beings should be treated as ends and not as means and who, thus, oppose any human use of animals [Sustain 2005]. At the same time, Nussbaum's position is aligned with positions that leverage the notion of animal dignity as a way of bridging the gap between human rights and animal rights [Blichitz 2009].

Nussbaum's theory is influenced by Aristotle's idea that humans and other animals are fundamentally akin since we are all made of organic matter; in this regard, her position is consistent with Deckha [2015]'s argument that justice should be extended to animals on the grounds of the vulnerability which derives from the material embodiment that both humans and animals share. Another influence on Nussbaum's theory is Marx's proposition that one's true functioning depends more on the opportunity one has to engage in life activities than on quantifiable resources; in this regard, Nussbaum's position is consistent with Sen [2009]'s argument that justice depends on individuals' actual realisation, which in turn depends on their capability to do things they have reason to value. Here, Nussbaum's theory contrasts with utilitarian approaches, including those that have dealt with issues of animal justice such as those of Bentham [1789-1823 ed.] and Singer [1980], on the grounds that the balance between pleasure and pain is too crude a measure to assess animals' functioning. Instead, the author argues, animals' functioning must be evaluated based on the opportunity they have to pursue capabilities they value (e.g. an animal might choose to undertake an activity that causes them pain but that has enough value to them for them to want to undertake it). Furthermore, contrary to utilitarianism, within Nussbaum's theory, violating the entitlements of individuals in order to advance societal interests (e.g. inflicting pain on a few in order to reduce the pain of many) is in principle unjustifiable. In this regard, her position is more closely aligned with Rawls' liberalism, and the value it places on personal liberty and its inviolability. However, the author agrees with utilitarianism [Bentham, 1789-1823 ed.; Singer, 1980] that species is not a relevant criterion for determining the moral worth of an animal, except for the fact that it implies certain capacities, and that individual sentience is a key consideration when assessing the harms that an animal can suffer and thus their moral worth. Additionally, consistent with Rachels [1990]' utilitarian position, she admits that restrictions on an animal's autonomy may be harmful regardless of sentience because they may take away something that is valuable to the animal (e.g. limiting an animal's free movement may frustrate their capabilities regardless of their conscious interest in free movement). Furthermore, Nussbaum rejects the utilitarian position that painless death is not harmful to animals because they do not have a conscious interest in the future. Instead, she argues that at least animals who have memory likely have a sense of their life as extended over time and thus have an interest in the future. Overall, the author argues for a *disjunctive approach* to moral consideration whereby, if a creature has "*the capacity for pleasure and pain or the capacity for movement from place to place or the capacity*

for emotion and affiliation, and so forth” [Nussbaum 2006, p. 362], then they have moral standing and are entitled to justice.

Based on these considerations, Nussbaum identifies basic capabilities, which would afford animals the opportunity to flourish and which they would be entitled to pursue in a species-specific way as a matter of justice:

- *life* – animals are entitled to continue living, regardless of whether they have a conscious interest in life, unless incurable suffering makes death preferable; although this is especially important for sentient animals, killing any animal is only justified for certain defensive purposes
- *bodily health* – animals are entitled to live a healthy life; those who live under human control should be afforded the means to do so and wild animals should be able to live in environments that support their health
- *bodily integrity* – animals are entitled to be protected against violations of their bodily integrity, such as mutilations that are not for their benefit and that are incompatible with their flourishing
- *senses, imagination and thought* – animals are entitled to be protected against practices that constrain and inflict pain, and to freely interact with an environment that is pleasing and stimulating, and conducive to flourishing
- *emotions* – animals are entitled to experience a range of nurturing emotions and attachments, and for these not to be warped by enforced isolation or fear
- *practical reason* – animals who have the capacity to frame goals, projects and plans should have the opportunity to do so
- *affiliation* – animals are entitled to forming and managing rewarding intra-species and inter-species affiliations, and to dignifying human-animal interactions
- *other species* – animals are entitled to live with concern for and in relation to other species, and to benefit from multispecies interdependences
- *play* – animals are entitled to have access to conditions that support play, including appropriate spaces and stimuli, and the presence of conspecifics
- *control over environment* – animals are entitled to have control over their own environment and to safeguard the integrity of their territory; working animals are entitled to respectful and dignified working settings and conditions.

We propose that Nussbaum’s capabilities approach provides a useful benchmark for considering social justice in relation to animals and defining a political notion of animal-centredness in ACI, as we discuss in the next section.

5 THE CAPABILITIES APPROACH TO ANIMAL JUSTICE AS A MEASURE OF ANIMAL-CENTREDNESS

On the one hand, while the capabilities in question have correspondence with welfare-related parameters identified by animal welfare frameworks that have informed ACI work, they also exceed those parameters. For example, the framework of the Five Freedoms [Brambell 1965], often referred to within ACI [e.g. Väättäjä 2014, Freil et al. 2017], frames welfare in terms of basic freedoms: *from thirst, hunger and malnutrition; from discomfort; from pain, injury and disease; from fear and distress; to express normal behaviour*. Each of these basic freedoms is necessary for an animal to achieve one or more capabilities but, even taken collectively, they do not account for all of the capabilities. Similarly, the Five Domains Model [Mellor et al. 2020], also referred to

within ACI [e.g. Webber et al. 2022], frames welfare in terms of positive and negative influences related to animals': nutrition; physical environment; health; behavioural interactions with the environment, with other animals and with humans; and the mental states that result from all these influences. Each of these influences is likely to determine the extent to which an animal is able to achieve different capabilities but, again, not all of the capabilities are accounted for. Most notably, the *life* capability is not addressed by these frameworks: consistent with a utilitarian view, (painlessly) ending an animal's life is not generally regarded as a welfare issue [Stamp Dawkins 2012]. Additionally, consistent with a contractarian view, animal welfare issues are generally framed in terms of human obligations rather than in terms of animal entitlements [Broom, 2011], which arguably diminishes the relevance of animals' *agency* across all capabilities. Thus, compared to welfarist perspectives, the capabilities approach provides more stringent underpinnings for a political notion of animal-centredness.

On the other hand, the capabilities approach is consistent with the non-speciesist [Mancini, 2011] and multispeciesist [Westerlaken, 2020] perspectives that have been advocated by ACI researchers, as a direct reflection of the values characterising HCI's human-centred perspective, which ACI has inherited. However, compared to anti-speciesism philosophies [Dunayer 2004], the capabilities approach provides more nuance and flexibility because it does not demand the abolition of all instrumental relations with animals (even e.g. working dogs) and does not demand animal equality, as proposed by some ACI researchers [North 2016] and as contested by others [Grillaert and Camenzind 2016]. Instead of arguing that humans' and animals' basic capabilities should be equally fulfilled, Nussbaum's approach specifies a minimum threshold for their *adequate* fulfilment, below which justice is not done and above which inequalities are not unjust. Also, within the approach, respectful practices that develop animals' excellences compatibly with their characteristics (e.g. appropriate training, dignified work) are regarded as potentially beneficial because they enable animals to fulfil their capabilities and, thus, to flourish. In contrast, while certain practices that harm animals (e.g. vivisection) might still be deemed necessary by human society, their injustice should be openly acknowledged to help expedite the development of morally justifiable alternatives.

Overall, Nussbaum recognises that there are inevitable conflicts of interest requiring that some human (and some animal) non-essential capabilities be limited so that the essential capabilities of other animals might be fulfilled. Thus, the question arises as to what non-essential privileges humans might consider curtailing, and under what conditions, so that animals could meet their basic needs. Furthermore, in line with the political view of design discussed above, we may also ask whether these considerations should just focus on the animals' interaction with designed systems or whether their focus should be broadened to the wider context in which the interaction takes place, prompting questions such as: does the designed system reinforce a wider status quo that is incompatible with animal stakeholders' basic capabilities? Might it be used to (intentionally or unintentionally) harm the animals? What might be the effects of the designed system on other (nonhuman and human) animals who might not have been identified as stakeholders at the beginning of the design process? Table 1 lists the basic animal capabilities that, we propose, could define a political notion of animal-centredness in ACI, along with examples of related questions researchers could ponder to determine the animal-centredness of their work. For ACI researchers, who find themselves having to negotiate the political boundaries between their animal-centred work and the human-centred socio-economic systems within which their work takes place, these are difficult questions to address. Nevertheless, they ought to at least be pondered, with an eye to the immediate needs of the design problem at hand and, at the same time, an eye to the wider and longer-term

implications of their interventions. To this end, the next section discusses an approach that could help ACI researchers deal with the challenge.

Table 1 - Examples of questions that could help ACI researchers assess the animal-centredness of their work

ASSESSING THE ANIMAL-CENTREDNESS OF ACI PROJECTS	
ANIMAL CAPABILITIES [Nussbaum 2006]	EXAMPLES OF QUESTIONS FOR RESEARCHERS
Life	Does the work directly or indirectly impact animals' entitlement to life?
Bodily Health	Does it support or hamper animals' health in the short or long term?
Bodily Integrity	Does it respect or injure animals' bodily integrity directly or indirectly?
Senses, Imagination, Thought	Does it enhance or worsen animals' sensory & cognitive ability at any point?
Emotions	Does it provide nurturing or warping emotions in any way?
Practical Reason	Does it enable or frustrate animals' capacity to frame goals and plans?
Affiliation	Does it allow animals to have rewarding intra- and inter-species affiliations?
Other Species	Does it allow animals to benefit from multispecies interdependencies?
Play	Does it directly or indirectly support or suppress animals' play behaviour?
Control Over Environment	Does it restrain or enable animals to control and manage their environment?

6 A SOCIAL JUSTICE-ORIENTED INTERACTION DESIGN APPROACH FOR ACI

As mentioned above, ACI has inherited its animal-centred perspective from HCI, where researchers have grappled for some time with the challenge of leveraging its disciplinary human-centred perspective to address systemic, wicked problems such as poverty, homelessness, or discrimination [Kolko 2012], which arise from social injustice. However, the divergence between disciplinary perspective and research context that HCI researchers must grapple with is arguably even greater when it comes to ACI, because in human society animals are not recognised the same entitlements that are recognised to humans [UN]. By default, unlike free-living animals, those who live under human control (i.e. managed animals) are legally regarded as property, even though companion animals are sometimes given a legal status that recognises their sentience and places them above inanimate possessions [Hankin 2020]. However, with the exception of very few individuals (e.g. Cecilia the chimpanzee in Argentina, Kwan the elephant in Pakistan), whose personhood has been recognised by a court of law, animals have no legal rights, because in the international legal system the attribution of rights is tied to the recognition of personhood [Wise 1999]. Free-living animals, who are not regarded as property, have no legal rights either; for example, when their territories are usurped for human development purposes, they are not entitled to compensation, which has prompted legal experts to advocate for the legal recognition of wildlife property rights [Bradshaw 2022]. For the time being, though, the legal status of humans and the legal status of animals remain fundamentally different, despite society's increasingly widespread concern with animal welfare, on the one hand, and notwithstanding the persistence of realities such as modern slavery, on the other hand. Consistent with Nussbaum's distinction discussed above, while failing to comply with a human's rights is a crime against the individual whose rights are being breached, failing to meet animal welfare obligations is a failure to meet a legalised duty of compassion (in a Rawlsian sense). According to the United Nations' Universal Declaration of Human Rights [UN], human rights are, so to speak, *absolute*, they are possessed by a subject and cannot be taken away or breached (except to safeguard the rights of other subjects, e.g. against violence). In contrast, animal welfare obligations are, so to speak, *relative*, they are incumbent upon those who interfere

with a subject compatibly with anthropocentric societal interests (e.g. in some countries rats are not protected by animal welfare laws because they are extensively used in vivisection).

The current status of animals in human society makes it somewhat easier and somewhat harder to do what Dombrowski et al. [2016] describe as “*attending to power relations*” and “*foregrounding politics surrounding oppression*” through design processes and outcomes: easier because human-animal power relations and the politics surrounding animal oppression are, more often than not, clearly expressed within the organisation and functioning of anthropocentric socio-economic systems and thus very obvious; harder because, given their institutionalisation and societal legitimisation, they are often not recognised as unjust and thus more difficult to deal with. Consistent with this, while ACI frameworks have been proposed to help researchers address the ethical issues related to the processes and immediate outcomes of ACI projects, ethical issues related to the wider implications of such projects have so far been left to individual researchers to deal with [Mancini 2017, Webber et al 2022]. While this acknowledges the fact that different ACI researchers may hold different views on human-animal relations and politics, there is still a need to support researchers’ ethical and responsible engagement in ACI research.

To help researchers and designers work, not only in a technologically minded way but also ethically and responsibly, towards addressing systemic social justice problems, Dombrowski et al. [2016] develop a *social justice-oriented interaction design* approach. The authors propose six design strategies, corresponding to what Lötter [2011] regards as the dimensions of social justice, and three commitments which they think researchers and designers need to make in order to implement these strategies. Below we briefly present these strategies and commitments, and we discuss their relevance for ACI in relation to a notion of animal-centredness informed by the capabilities approach to animal justice. We also add strategies and commitments that we believe are relevant for specific challenges faced by ACI researchers and designers, which arise from the tension between animal-centred work and human-centred (or otherwise-centred) socio-economic systems. While different ACI researchers will come to their own conclusions on issues of animal justice and on the wider implications of the work they undertake, the strategies and commitments discussed below are intended to foster their ethical and responsible engagement by helping them to ponder the issues involved and, for those who wish to do so, by helping them question and even challenge the status quo.

6.1 Reinterpreting strategies and commitments for political ACI

Dombrowski et al. [2016]’s proposed strategies comprise the following:

- *Designing for transformation* involves recognising that over time social justice evolves into more inclusive understandings, so designers need to take a long-term view when designing to address the socio-economic and political relations that produce social injustices. For ACI researchers, this might mean considering that notions of social justice may eventually evolve to include animals and framing design problems accordingly, so that design processes and outcomes might be more likely to contribute towards achieving animals’ basic entitlements. For example, Westerlaken [2020] frames her interaction design projects within imagined ‘multispecies worldings’, which informs the way in which she attends to the agencies of the animals she works with, allowing her designs to gradually evolve with their participation and, more importantly, allowing her to explore important issues of animal justice in a constructive way.
- *Designing for recognition* involves identifying unjust practices, policies and laws, as well as those who are impacted in order to enable their stories and experiences to come to the fore and inform the framing of

design problems. For ACI researchers, this might mean explicitly acknowledging how the socio-economic systems in which their projects take place might impact animals and how the framing of design problems might contribute towards reinforcing or challenging the status quo. For example, it might include considering how the language we use to describe a group of animals may influence our attitude towards them and how we relate to them within a design project, as Hwang [2013] points out in her *Living Among Pests – Designing the Biosynthetic City*, urging us to “reexamine our deeply engrained preconceptions of the ‘pest’”.

- *Designing for reciprocity* involves focussing on how different forms of participation could be enabled to foster more equitable engagements, and open opportunities for contestation and change within uneven relations. For ACI researchers, this highlights the importance of recognising animals’ agency as technology users and participants in society. In this regard, through their analysis of the interaction between humans and their dogs on a leash, Sadetzki and Hirsch-Matsioulas [2021] challenge the conception that humans are in control of dogs’ behaviour when they restrain them with a leash. Instead, the authors show how both entities use the leash as a form of ‘tug of war’ and a bi-directional communication medium. Their work offers an inter-species design model according to which each actor affects the other’s movements because both sides are tethered to each other. Based on this model, the authors suggest that technologies should be designed to make human-animal relations less uneven by enabling the entities that participate in social interaction to negotiate their desires and needs on a ‘level playing field’.
- *Designing for enablement* involves enabling those affected to develop their capacities and fulfil their potential by creating opportunities for change at the individual level as well as at the level of practices and policies. For ACI researchers, this might be achieved by designing technologies that enable animals to modify their surroundings in pursuit of their capabilities and express their capacity for volition and, thus, stand out as subjects of moral worth. For example, the work of van Weeghel et al. [2016] aims to give farmed animals means to influence their environment through the expression of intrinsically motivated behaviours, allowing the animals to demonstrate that they are not passive receivers of husbandry practices but can be active contributors. While this does not free the animals from the farming cycle, it nevertheless promotes their perception as proactive goal-oriented beings worthy of greater consideration.
- *Designing for distribution* involves endeavouring to ensure that benefits, including opportunities and access to resources such as goods, power and knowledge, as well as burdens, including work and resource limitations, are distributed equitably. In ACI, this might involve design interventions that ensure animals’ continued and safe access to habitats, such as smart animal crossings [Mancini et al. 2022]; or designing technologies that enable animals to undertake activities through which they can contribute to society and from which they can themselves benefit. One interesting example is the *Crowbar* by van der Vleuten et al. [2018], which rewarded crows with food for picking up littered cigarette buds and dropping them into a collection bin; having considered the potential burdens of this seemingly rewarding activity on the crows’ health, the designers decided to discontinue the project.
- *Designing for accountability* involves holding responsible those who foster or benefit from the oppression of others by providing mechanisms for sharing knowledge among marginalized groups or about those in power in order to hold them to account. When it comes to ACI research, sharing knowledge among marginalized groups (in this case, the animals) might be more challenging, albeit still worth considering (we do so in our concluding section). Additionally, researchers might engage politically by designing interventions that hold those in power accountable. For example, monitoring technology might be used to follow animals’ life stories

and give visibility to the experienced realities of individual animals who live in captivity (e.g. in shelters, zoos, farms) enabling those on the outside to develop a sense of personal connection and shared responsibility, and giving to those on the inside the opportunity to justify their practices.

As mentioned above, to pursue these strategies during the design process, Dombrowski et al. [2016] propose that designers need to make three key commitments:

- *Commitment to conflict* – Instead of seeing conflict as a hindrance to the progress of the design process, designers should embrace a diversity of perspectives that are likely to lead to vigorous disagreement and to open spaces for contestation, as they collaborate with those who work to end oppression and give marginalized voices the opportunity to have a say. Within specific ACI projects, this might manifest in stakeholders' willingness to debate how interventions might affect animals' entitlements and to make design decisions that could result in progress towards animal justice. Beyond ACI projects, this might manifest in the ACI community's willingness to organise activities during which participants from different camps could debate political issues in ACI. Within or beyond projects, these debates could involve the participation of *animal justice advocates*, who would act as animal representatives to ensure that issues of animal justice are considered, and whose role could be played by individuals who are working to end animal oppression and have relevant expertise, or by individuals delegated by the community to develop such expertise. Although power-relations among human debaters and conflicting agendas representing different epistemologies, discourses and standpoints might well hinder the development of constructive discussions, we believe that such discussions are worth attempting.
- *Commitment to reflexivity* – Instead of downplaying the role of their values and subjective experience, designers should acknowledge their own positionality, values and politics, and actively reflect on how their own vision of the world influences design processes and outcomes, and how their practices are situated within a wider cultural and political context. Within ACI research, this would involve acknowledging the illusion of value-free scientific objectivity and, instead, committing to pursue what Harding calls 'strong objectivity' [Grasswick 2016] by critically examining the role of social situation in the development of knowledge, exposing cultural assumptions and agendas that may affect researchers' perceptions of animals and their framing of ACI design problems in relation to animals' capacities and issues of animal justice. To this end, Ruge and Mancini [2022] propose an ethics toolkit to support animal-centred research and design, by helping researchers to articulate their own and their projects' ethical baselines, and to develop a series of ethical guiding statements to support ethical situated decisions during the research process. In this way, the toolkit could enable ACI researchers to explicitly acknowledge their ethical perspective within the knowledge they develop.
- *Commitment to personal ethics and politics* – Instead of striving to maintain a neutral position, designers should commit to a personal political and ethical stance, which can provoke them to ask tough moral questions about their involvement in research and design projects, and enable them to focus on the potential that these have to address social injustice. Within ACI, making this commitment is potentially more complex than it is within HCI, because of the abovementioned divergence between disciplinary values and societal values with regards to animals. Although researchers might be prepared to commit to a personal ethical stance as to what constitutes animal-centred research and design within specific projects, they may not be ready to commit to one or other political stance beyond said projects. We suggest that, if researchers have

not yet developed a political stance with regards to issues of animal justice, developing their personal position could increase their self-awareness as potential agents of change, foster their imagination and strengthen their integrity as researchers. In this paper, we propose Nussbaum's capabilities approach as a political stance on animal justice and as a measure of animal-centredness. Others' stances may be different but taking a stance and committing to it is the key.

6.2 New strategies and commitments for political ACI

In addition to the six strategies and three commitments proposed by Dombrowski et al. [2016], we propose three additional strategies and one additional commitment, which we believe are particularly relevant for ACI, and animal-centred research and design. We humans live and, to various degrees partake, in socio-economic systems that, to various degrees, discriminate against other animals with little consensus about their ethical treatment. Thus, the resulting ambivalence of humans' relations with animals and their systemic oppression call for strategies that could be applied to challenge, or at least question, the status quo and "*dislodge the sediments of history*" [Khovanskaya et al. 2018] through ACI research and design.

The three new strategies we propose are:

- *Designing for disruption* involves challenging incumbent systems, norms and practices that go against animals' basic capabilities and which designers would like to address or change. These are often acts of design intended to raise awareness rather than solve specific problems. This is exemplified by acts of critical design such as the *RayFish Footwear* [RFF], a fictional footwear company that purported to craft 'bio-customised' shoes from the skin of stingrays, bio-engineered to customers' chosen designs. Behind the imaginary project was the Next Nature Network which created it to raise awareness of the way in which some animals are objectified to satisfy human appetites; to trigger a public debate on emerging biotechnologies and the products they may bring; and to question our consumptive relationship with animals [van Mensvoort 2012].
- *Designing for reconfiguration* involves re-defining design-related concepts and frameworks whose current anthropocentric definition legitimises the dismissal of animals' role in the design process or justifies design outcomes that discriminate against them. For example, Mancini and Lehtonen [2018] have contested notions of participatory design which assume shared understandings and goals among partakers, and which exclude, devalue and delegitimise the participatory contribution of agents who do not possess the capacity to verbally negotiate. Instead, the authors have proposed a participatory design model which accounts for the diversity of understandings and goals that multispecies partakers might have. Likewise, Paci et al. [2022] have challenged the assumption that privacy is an exclusively human concern, extending the concept's definition to animals and highlighting animal privacy as a design requirement for interactive systems.
- *Designing for pollination* involves enabling animal-centred values to penetrate socio-economic systems in which animals exist but which are not animal-centred. This might include developing animal-centred design frameworks, methods or applications within ACI projects, which can be applied beyond ACI research and then seeking opportunities to experiment with their application to address problems that arise within socio-economic systems where animals are subjects to various forms of oppression, in order to help those systems evolve towards animal justice. For example, Mancini and Nannoni [2022] have proposed a research ethics framework that extends principles of animal-centred research developed within ACI to all animal research,

aiming to stimulate a discussion on and influence the development of ethical standards for animal research that are more nuanced compared to existing ones and more considerate of animals' basic entitlements.

In addition to the above two strategies, we propose the following commitment:

- *Commitment to expanded empathy* – Within the design community, empathic design is commonly used to describe a process of getting closer to the lives and experiences of existing or future users and gaining a deep understanding of their experiences [Kouprie and Visser 2009]. While it is generally acknowledged that it is not possible to fully capture the perspective of another being (human or animal), researchers in the field see value in the act of trying. When it comes to animals, trying to view the world from their perspective is, for obvious reasons, harder. However, it may still have benefits. Applying techniques of empathic design within ACI might help designers gain a deeper and more holistic understanding of animals, greater respect and concern towards them, and increased motivation to act for them [Metcalf 2021]. Furthermore, it might help designers feel more compassionately [Kolko 2012] and appreciate that, while they are different from us in many ways, animals share with us the vulnerability to which their embodiment exposes them [Deckha 2015]. As with other aspects of political design, empathic design becomes political when we expand the circle of empathy to gain a more comprehensive understanding of the wider consequences of our design interventions and how these might affect different stakeholders, as well as how these are influenced by and influence the wider socio-economic forces within which ACI researchers and designers operate.

Table 2 summarises strategies and commitments that could foster ACI researchers' political engagement, including Dombrowski et al. [2016]'s six strategies and three commitments, as well as three additional strategies and one additional commitment that we propose considering the current status of animals in human society.

Table 2 - Design strategies and commitments for political engagement in ACI towards animal-centred design

DESIGN STRATEGIES AND COMMITMENT FOR POLITICAL ACI	
DESIGN STRATEGIES	
Originally proposed by Dombrowski et al. [2016] to foster political engagement in HCI and reinterpreted here to foster political engagement in ACI	<i>Designing for Transformation</i> of social justice towards the inclusion of animals
	<i>Designing for Recognition</i> of how policies and practices might impact animals
	<i>Designing for Reciprocity</i> of human and animal agency in society
	<i>Designing for Enablement</i> of animals' expression of volition and control
	<i>Designing for Distribution</i> of benefits and burdens among humans and animals
	<i>Designing for Accountability</i> of those who have power over animals
Proposed here to support political engagement in ACI given animals' current status in human society	<i>Designing for Disruption</i> of systems that go against animals' capabilities
	<i>Designing for Reconfiguration</i> of anthropocentric notions that exclude animals
	<i>Designing for Pollination</i> of systems with ACI's animal-centred values
DESIGN COMMITMENTS	
Reinterpreted from Dombrowski et al. [2016]	<i>Commitment to Conflict</i> as a constructive force for positive change
	<i>Commitment to Reflexivity</i> on own positionality and values and their influence
	<i>Commitment to Personal Ethics and Politics</i> on issues of animal justice
Proposed here for ACI	<i>Commitment to Expanded Empathy</i> to gain a deeper understanding of animals

7 CONCLUDING REMARKS

As we have discussed, interaction design is an essentially political activity, which shapes spaces and possibilities for action and which affects individuals and communities. As such, designing requires considering and negotiating priorities and power relations among designers, project stakeholders and the wider socio-economic systems within which designing takes place. When it comes to ACI, these considerations and negotiations become particularly challenging but all the more important. In fact, in a world that largely interacts with animals in a way that is not animal-centred, ACI's animal-centred perspective could itself be regarded as a strong political stance. Nevertheless, the community is yet to fully engage with the political dimension of ACI. Acknowledging the significant systemic challenges faced by ACI researchers, this paper aims to support their political engagement. To this end, we have proposed a notion of animal-centredness, and a series of design strategies and commitments that could help them design politically, or think politically about design, from an animal-centred perspective, whatever kind of interaction they might be designing for with whatever kind of stakeholder within whatever kind of setting.

The political dilemmas concerning ACI research, within and beyond specific projects, are not dissimilar to those faced by disciplines such as social anthropology when, in the '90s, anthropologists began to engage with issues related to the researchers' own positionality and to the effects of their anthropological writings on the subjects of their research and on broader social groups. As a result, they started dealing with moral and political questions arising when their published studies were read by different audiences [Brettell 1993] and with the complexity of the research's 'after-life' (for instance, how the research and the power bestowed onto researchers by their academic role could be used to legitimise political targets and agendas [Bilu 1998]). This ethical turn made anthropologists "*become more attentive to the reverberations of their fieldwork and particularly ethnographic writing in the lives and the social world of the people whom they study*" [Bilu 1998, p.136]. Similarly, it is essential for ACI researchers to ponder their positionality during research, how stakeholders perceive them, how they use design to interact with animals, what informs their decisions and designs, and what are the possible 'after-lives' of their designs, which might negatively affect animals or lead to a positive change for animals' lives.

Within disciplines such as landscape architecture, which deal with the organisation and management of territory and territorial resources that may be essential for the existence of different human and animal stakeholders, these political dilemmas are especially prominent, and issues of positionality and power require careful consideration from designers. Recently the debate around the political nature of the discipline has revolved not only around how the act of planning and designing a landscape is, in nature, political but also on how the design of the landscape may support (or hinder) political engagement by those experiencing it. For example, de Block and Vicenzotti [2018] argue that the turn to affect theory in landscape aesthetics, which advocates harmonization and continuity between the human and non-human, may reduce the emotional distance between subject (i.e. the individual) and object (i.e. the landscape) in the experience of design, and thus may result in a depoliticised, acritical participation of the observer instead of their political, potentially critical involvement. Similarly, ACI researchers and designers ought to consider not only their own political engagement but also how their work might drive other stakeholders' critical and political action.

Khovanskaya et al. [2018] remind us that, in order to create a more equitable future, designers need to take explicit sides and embrace the messy political work of building partnerships with disempowered groups, facilitating questioning and leveraging their skills to co-envision new futures and new designs. Because

interactive technology has the potential to enable animal agency in new ways, and to provide new insight into their capacities and experiences, ACI represents a real opportunity to reconfigure human-animal relations for a more equitable and more sustainable world, in which society includes nonhuman animals and social justice is open to them too. But, wherever they stand on the issue of multispecies justice, ACI researchers should not shy away from asking the hard questions and poking at the various boundaries of what is still a fundamentally anthropocentric society.

Daisy the cow has now arrived at the slaughterhouse. How should the facility's design lead her inside? Consistent with the design solutions proposed by animal welfare scientist Grandin [2013] to improve the humanness of slaughterhouses, the corridors leading to the entrance could meander in such a way that Daisy cannot see what happens to the cows in front of her. Surely, this would reduce the negative impact of the slaughtering process on her welfare by taking the dread out of her journey. But precluding her the knowledge of what is about to happen would deprive her of the opportunity to object and resist, which a direct view into the slaughterhouse could afford her. Then again, what would be the point of giving Daisy the opportunity to object if she has no chance to escape and her resistance might be repressed with violence? What if her act of resistance was given visibility beyond the closed doors of the slaughterhouse for prospective consumers of her produce to witness? Would Daisy's expression of resistance still be pointless, or might it lead to change for cows like her? What if, one day, upon detecting the signs of a cow's dread and dissent to entering the slaughterhouse, the barriers that contain her were to lift-up to set her free?

Would our readers design a cow-friendly slaughterhouse? More to the point, how might they decide what a cow-friendly slaughterhouse even is?

ACKNOWLEDGEMENTS

We thank the anonymous reviewers for their thoughtful engagement and helpful comments.

REFERENCES

- ACI2022, Nineth International Conference on Animal-Computer Interaction: www.aciconf.org (accessed 30.05.22)
- Alexander, J. (2014). Notes towards a definition of politics. *Philosophy* 89, 348, 273–300.
- Aspling, F. (2020). *Unleashing Animal-Computer Interaction: A Theoretical Investigation of the 'I' in ACI*. Stockholm University - Doctoral Dissertation.
- Bentham, J. (1823/1948). *An Introduction to the Principles of Morals and Legislation*. Hafner, New York.
- Bilu, Y. (1998). The Dialectics of Life, Story and Afterlife. In Liebes, T., Curran, J. (eds.) *Media, ritual, and identity*. Routledge, London and New York, 136-150.
- Blichitz, D. (2009). Moving beyond Arbitrariness: the Legal Personhood and Dignity of Non-Human Animals. *South African Journal of Human Rights*, 25, 38-72.
- Bradshaw, K. (2020). *Wildlife as Property Owners: A new Conception of Animal Rights*. University of Chicago Press.
- Brambell, F.W.R. (1965). *Report of the Technical Committee to Enquire into the Welfare of Animals Kept under Intensive Livestock Husbandry Systems*. Her Majesty's Stationery Office, London.
- Brettell, C.B. (1993). Introduction: Fieldwork, Text and Audience. In Brettell, C.B. (Ed.) *When They Read What We Write: The Politics of Ethnography*, Westport, CT: Bergin & Garvey, 1-24.
- Broom, D.M. (2011). A History of Animal Welfare Science. *Acta Biotheor.*, 59, 121-137.

- Byrne, C.A., Freil, L.E., Starner, T.E., Jackson, M.M. (2017). A Method to Evaluate Haptic Interfaces for Working Dogs, *Int. J. Hum. Comput. Stud.* 98, 196-207.
- Carpio, F., Jukan, A., Sanchez, A.I.M., Amla, N., Kemper, N. (2017). Beyond Production Indicators: A Novel Smart Farming Application and System for Animal Welfare. *ACI'17: Proceedings of the Fourth International Conference on Animal-Computer Interaction*, ACM DL, Art. 7, 1–11.
- Cheok, A. D., Tan, R. T. K. C., Peiris, R. L., Fernando, O. N. N., Soon, J. T. K., Wijesena, I. J. P., et al. (2011). Metazoa Ludens: Mixed-Reality Interaction and Play for Small Pets and Humans. *IEEE Trans. Syst. Man Cybern. A Syst. Hum.*, 41, 876–891.
- Chisik, Y., Mancini, C. (2019). P for Politics D for Dialogue: Reflections on Participatory Design with Children and Animals. *ACI'19: Proceedings of the Sixth International Conference on Animal-Computer Interaction*. ACM DL, Art. 15, 1-13.
- CIWF, Compassion in World Farming: www.ciwf.org.uk/farm-animals/cows/dairy-cows (accessed 30.05.22)
- DiSalvo, C. (2012). *Adversarial Design*. The MIT Press, Cambridge, Massachusetts.
- de Block, G., Vicenzotti, V. (2018). The effects of affect. A plea for distance between the human and non-human. *Journal of Landscape Architecture*, 13(2), 46–55.
- Deckha, M. (2015). Vulnerability, Equality and Animals. *Canadian Journal of Women and the Law*, 27(1), 47-71.
- Dombrowski, D., Harmon, E., and Fox, S. (2016). Social justice-oriented interaction design: Outlining key design strategies and commitments. *DIS'16: Proceedings of the 2016 International Conference on Designing Interactive Systems*. ACM Press, New York, 656-671.
- Dunayer, J. *Speciesism*. Ryce Publishing, Derwood, MD, 2004.
- Echterhoff, J.M., Haladjian, J., Brügge, B. (2018). Gait analysis in horse sports. *ACI'18: Proceedings of the Fifth International Conference on Animal-Computer Interaction*, ACM DL, Art. 3, 1-6.
- Freil, L., Byrne, C., Valentin, G., Zeagler, C., Roberts, D., Starner, T., Jackson, M. (2017). Canine-Centered Computing. *Foundations and Trends in Human-Computer Interaction*, 10(2), 1-82.
- French, F., Mancini, C., Sharp, H. (2020). More-than-Human-Aesthetics: Interactive Enrichment for Elephants. *DIS'20: Proceedings of the 2020 International Conference on Designing Interactive Systems*, ACM Press, New York, 1661-1672.
- French, F., Hirskey-Douglas, I., Vääätäjä, H., Pons, P., Karl, S., Chisik, Y., Nannoni, E., Zamansky, A., Mangat, M., Paci, P., Kasuga, H., Vilker, D. (2021). Ethics and Power Dynamics in Playful Technology for Animals. *Proceedings Academic Mindtrek 2021*, ACM Press, New York, 91-101.
- Grandin, T. (2013). Making Slaughterhouses More Humane for Cattle, Pigs, and Sheep. *Annu. Rev. Anim. Biosci.*, 1, 491-512.
- Grasswick, H. (2016). Strong Objectivity. In Wong, A., Wickramasinghe, M., Hoogland, R., Naples, N.A. (Eds.) *The Wiley Blackwell Encyclopedia of Gender and Sexuality Studies*.
- Grillaert, K., Camenzind, S. (2016). Unleashed Enthusiasm: Ethical Reflections on Harms, Benefits, and Animal-Centered Aims of ACI. *ACI'16: Proceedings of the Third International Conference on Animal-Computer Interaction*. ACM DL, Art. 9, 1-5.
- Haladjian, J., Hodaie, Z., Nüske, S., Brügge, B. (2017). Gait Anomaly Detection in Dairy Cattle. *ACI'17: Proceedings of the Fourth International Conference on Animal-Computer Interaction*, ACM DL, Art. 8, 1–8.
- Hankin, S.J. (2007). Not a Living Room Sofa: Changing the Legal Status of Companion Animals. *Rutgers Journal of Law & PublicPolicy*, 4 (2), 314-410.

- Hirskyj-Douglas, I., Read, J.C. (2016). The Ethics of How to Work with Dogs in Animal Computer Interaction. Symposium on Animal-Computer Interaction. *Proceedings of Measuring Behaviour 2016*, Dublin University Press, 434–439.
- Hirskyj-Douglas, I., Read, J.C., Cassidy B. (2017). A Dog Centred Approach to the Analysis of Dogs' Interactions with Media on TV Screens, *Int. J. Hum. Comput. Stud.* 98, 208-220.
- Hirskyj-Douglas, I., Piitulainen, R. (2020). Developing Zoo Technology Requirements for White-Faced Saki Monkeys. *ACI'20: Proceedings of the Seventh International Conference on Animal-Computer Interaction*, ACM DL, Art. 3, 1-12.
- Hwang, J. (2013). *Living Among Pests – Designing the Biosynthetic City*. Next Nature Network.
<https://www.nextnature.net/story/2013/living-among-pests-designing-the-biosynthetic-city> (accessed 30.05.22)
- Khovanskaya, V., Dombrowski, L., Harmon, E., Korn, M., Light, A., Stewart, M., Voida, A. (2018). Designing Against the Status Quo. *ACM Interactions*, March-April 2018.
- Kolko, J. (2012). *Wicked Problems: Problems Worth Solving. A Handbook and a Call to Action*. Austin Center for Design.
- Koupric, M., & Visser, F.S. (2009). A Framework for Empathy in Design: Stepping into and out of the User's Life. *Journal of Engineering Design*, 20(5), 437–448.
- Jackson, M.M., Zeagler, C., Valentin, G., Martin, A., Martin, V., Delawalla, A., et al. (2013). FIDO-Facilitating Interactions for Dogs with Occupations: Wearable Dog-Activated Interfaces. *ISWC '13: Proceedings of the 2013 International Symposium on Wearable Computers*, ACM Press, New York, 81–88.
- Lawson, S., Kirman, B., Linehan, C. (2016). Power, Participation and the Dog Internet. In Special Topic on Frameworks for ACI: Animal Stakeholders in the Design Process. *ACM Interactions*, 13(4), 37–41.
- Lötter, H. (2011). *Poverty, Ethics and Justice*. University of Wales Press.
- Löwgren, J. and Stolterman, E. (2004). *Thoughtful Interaction Design: A Design Perspective on Information Technology*. The MIT Press, Cambridge, MA.
- Majikes, J., Brugarolas, R., Winters, M., Yuschak, S., Mealin, S., Walker, K., Yang, P., Bozkurt, A., Sherman, B., Roberts, D.L. (2017). Balancing Noise Sensitivity, Response Latency, and Posture Accuracy for a Computer-Assisted Canine Posture Training System, *Int. J. Hum. Comput. Stud.* 98, 179-195.
- Mancini, C. (2011). Animal-Computer Interaction (ACI): a Manifesto. *ACM Interactions*, 18(4), 69-73.
- Mancini, C. (2017). Towards an Animal-Centred Ethics for Animal–Computer Interaction. *Int. J. Hum. Comput. Stud.* 98, 221–233.
- Mancini, C., Li, S., O'Connor, G., Valencia, J., Edwards, D., and McCain, H. (2016). Towards Multispecies Interaction Environments: Extending Accessibility to Canine Users. *ACI2016: Proceedings of the Third International Conference on Animal-Computer Interaction*, ACM DL, Art. 8, 1-10.
- Mancini, C., Lehtonen, J. (2018). The Emerging Nature of Participation in Multispecies Interaction Design. *Proceedings of the 2018 International Conference on Designing Interactive Systems*, ACM Press, New York, 907–918.
- Mancini, C., Nannoni, E. (2022). Relevance, Impartiality, Welfare and Consent: Principles of an Animal-Centered Research Ethics. *Frontiers in Animal Science*, 3:800186.
- Mancini, C., Metcalfe, D., Hirsch-Matsioulas, O. (2022). Justice by Design: The Case for Equitable and Inclusive Smart Cities for Animal Dwellers. In Heitlinger, S., Foth, M., Clarke, R. (Eds.) *Designing More-than-Human Smart Cities: Beyond Sustainability, Towards Cohabitation*. Oxford University Press. (to appear)
- Makinde, A., Islam, M.M., Scott, S.D. (2019). Opportunities for ACI in PLF: Applying Animal- and User- Centred Design to Precision Livestock Farming. *ACI'19: Proceedings of the Sixth International Conference on Animal-Computer Interaction*, ACM DL, Art. 13, 1–6.

- Mellor, D.J., Beausoleil, N.J., Littlewood, K.E., McLean, A.N., McGreevy, P.D., Jones, B., Wilkins, C. (2020). The 2020 Five Domains Model: Including Human–Animal Interactions in Assessments of Animal Welfare. *Animals*, 10, 1870.
- Menaker, T., Monteny, J., De Beeck, L.O., Zamansky, A. (2022). Clustering for Automated Exploratory Pattern Discovery in Animal Behavioral Data. *Frontiers in Veterinary Science*, 9:884437
- Metcalfe, D. (2022). Empathic Multispecies Design – Using Empathy to Design with Animal Perspectives in Mind. In Goldschmidt, G., Tarazi, E. (Eds.) *DTRS13 - Expanding the frontiers of design: A blessing or a curse?* DesignTech, Faculty of Architecture & Town Planning Technion – Israel Institute of Technology, 382-391.
- Mills, C. (2009). Rawls on Race/Race in Rawls. *The Southern Journal of Philosophy*, 47, 161-184.
- Nelson, J.K., Shih, P.C. (2017). CompanionViz: Mediated Platform for Gauging Canine Health and Enhancing Human-Pet Interactions, *Int. J. Hum. Comput. Stud.* 98, 169-178.
- North, S. (2016). Do Androids Dream of Electric Steeds? The Allure of Horse-Computer Interaction. *ACM Interactions*, March-April 2016.
- Nussbaum, M.C. (2006). *Frontiers of Justice: Disability, Nationality, Species Membership*. The Belknap Press of Harvard University Press, Cambridge, MA.
- Obrenović, Z. (2014). Design as Political Activity: Borrowing from Classical Political Theories. *ACM Interactions*, November-December 2015.
- Paci, P., Mancini, C., Nuseibeh, B. (2022). The Case for Animal Privacy in the Design of Technologically Supported Environments. *Frontiers in Veterinary Science*, 8:784794.
- Paci, P., Mancini, C., Price, B. (2019). Wearer-Centered Design for Animal Biotelemetry: Implementation and Wearability Test of a Prototype. *ISWC'19: Proceedings of the 23rd International Symposium on Wearable Computing*. ACM Press, New York, 177-185.
- Pons, P., Carrion-Plaza, A., Jaen, J. (2019). Remote Interspecies Interactions: Improving Humans and Animals' Wellbeing through Mobile Playful Spaces. *Pervasive and Mobile Computing*, 52, 113-130.
- Rachels, J. (1990). *Created from Animals: the Moral Implications of Darwinism*. Oxford University Press, New York.
- Rault, J.L., Webber, S., Carter, M. (2015). Cross-Disciplinary Perspectives on Animal Welfare Science and Animal-computer Interaction. *ACE'15: Proceedings of the 12th International Conference on Advances in Computer Entertainment Technology*, ACM DL, Art. 56, 1-5.
- Rawls, J. (1972). *A Theory of Justice*. Harvard University Press, Cambridge, MA.
- Rawls, J. (2001). *Justice as Fairness: a Restatement*. Harvard University Press, Cambridge, MA.
- RFF, RayFish Footware: www.rayfish.com (accessed 30.05.22)
- Ritvo, S., Allison, R. (2014). Challenges Related to Nonhuman Animal Computer Interaction: Usability and 'Liking'. *ACE'14: Proceedings of the First International Congress on Animal Human-Computer Interaction*, ACM DL, Art. 4, 1-7.
- Robinson, C., Mancini, C., van der Linden, J., Guest, C., Harris, R. (2014). Canine-Centered Interface Design: Supporting the Work of Diabetes Alert Dogs. *CHI'14: Proceedings of the SIGCHI International Conference on Human Factors in Computing Systems*, ACM Press, New York, 3757–3766.
- Ruge, L., Cox, E., Mancini, C., Luck, R. (2018). User-Centered Design Approaches to Measuring Canine Behavior: Tail Wagging as a Measure of User Experience. *ACI'18: Proceedings of the Fifth International Conference on Animal-Computer Interaction*, ACM DL, Art. 1, 1-12.
- Ruge, L., Mancini, C. (2022). An Ethics Toolkit to Support Animal-Centered Research and Design. *Frontiers in Veterinary Science*, 9:891493.

- Sadetzki, Y., Hirsch-Matsioulas, O. (2021). Leashing the City: Dog-Leash-Human Entanglements and the Urban Space. *ACI'21: Proceedings of the Eight International Conference on Animal-Computer Interaction*, ACM DL, Art. 1, 1-7.
- Sen, A. (2009). *The Idea of Justice*. Penguin Books, London.
- Singer, P. (1980). Animals and the Value of Life. In Regan, T. (Ed.) *Matters of Live and Death: New Introductory Essays on Moral Philosophy*. Random House, New York, 28-66.
- Stamp Dawkins, M. (2012). *Why Animals Matter: Animal Consciousness, Animal Welfare and Human Well-Being*. Oxford University Press, New York.
- Sunstein, C.R. (2005). Introduction: What are Animal Rights? In Sunstein, C. R., & Nussbaum, M. C. (Eds.) *Animal Rights: Current Debates and New Directions*. Oxford University Press, 3-15
- UN, United Nations - Universal Declaration of Human Rights: <https://www.un.org/en/about-us/universal-declaration-of-human-rights> (accessed 10.08.22)
- Vääätäjä, H., Pesonen, E. (2013). *Ethical Issues and Guidelines When Conducting HCI Studies With Animals*. *CHI EA '13: CHI '13 Extended Abstracts on Human Factors in Computing Systems*, ACM Press, New York, 2159–2168.
- Vääätäjä, H. (2014). Animal Welfare as a Design Goal in Technology Mediated Human-Animal Interaction. *ACE'14: Proceedings of the First International Congress on Animal Human-Computer Interaction*, ACM DL, Art. 6, 1-8.
- van der Linden, D. (2021). Interspecies Information Systems. *Requirements Engineering*, 26, 535–56.
- van der Linden, D, Zamansky, A. (2017). Agile with Animals: Towards a Development Method. *Proceedings of IEEE 25th International Requirements Engineering Conference Workshops (REW)*, 423–426.
- van der Vleuten, R., Spikman, B., Kazemi, S. (2018). Crowded Cities - Crowbar. *CrowdedCities*. <https://www.crowdedcities.com/> (accessed 10.08.22)
- van Mensvoort, K. (2012). *The Rise and Fall of Rayfish Footwear*. Next Nature Network. <https://nextnature.net/magazine/story/2012/the-rise-and-fall-of-rayfish-footwear> (accessed 30.05.22)
- van Weeghel, E., Bram, B., Spoelstra, S., and Peter, W.G. (2016). Involving the Animal as a Contributor in Design to Overcome Animal Welfare Related Trade-offs: the Dust Bath Unit as an Example. *Biosyst. Eng.*, 145, 76–92.
- Wallis, L.J., Range, F., Kubinyi, E., Chapagain, D., Serra, J., Huber, L. (2017). Utilising Dog-Computer Interactions to Provide Mental Stimulation in Dogs Especially During Ageing. *ACI'17: Proceedings of the Fourth International Conference on Animal-Computer Interaction*, ACM DL, Art.1, 1-12.
- Wagner, K., Seitner, D., Barth, K., Palme, R., Futschik, A., Waiblinger, S. (2015). Effects of Mother Versus Artificial Rearing During the First 12 Weeks of Life on Challenge Responses of Dairy Cows. *Applied Animal Behaviour Sci.*, 164, 1–11.
- Webber, S., Cobb, M.L., Coe, J. (2022). Welfare through Competence: A Framework for Animal-Centric Technology Design. *Frontiers in Veterinary Science*, 9:885973.
- Westerlaken, M. (2020). *Imagining Multispecies Worlds*. Malmö University - Doctoral Dissertation.
- Westerlaken, M., Gualeni, S. (2016). Becoming with: Towards the Inclusion of Animals as Participants in Design Processes. *ACI'16: Proceedings of the Third International Conference on Animal-Computer Interaction*, ACM DL, Art. 1, 1-10.
- Wise, S. (2000). *Rattling the Cage: Toward Legal Rights for Animals*. Perseus Books, Cambridge MA.
- Wise, S.M. (1999). Animal Thing to Animal Person--Thoughts on Time, Place, and Theories. *Animal Law*, 5, 61-68.