Animal-Computer Interaction: Animals as Co-Designers of Multispecies Technologically Supported Ecosystems

RESEARCH NOTE ON MY JOURNEY OF CO-DESIGN WITH OTHER ANIMALS

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Interactive technology has become integral part of daily life for nonhuman as well as human animals. In fact, interactive technology targeted to nonhuman animals has been in existence for the best part of a century, including biotelemetry devices fitted on free-living bears during environmental studies, operant interfaces used to train laboratory pigeons in behavioural experiments, or robotic milking systems for farmed cows introduced to optimise dairy production processes. Concomitantly, for decades, dogs have been trained to operate human interfaces, such as light switches or washing machines, to carry out tasks on behalf of their assisted humans. Recently, a host of computing-enabled devices such as tracking collars or teleconferencing systems have appeared on the pet market promising owners to help them better care for and communicate with their cats and dogs.

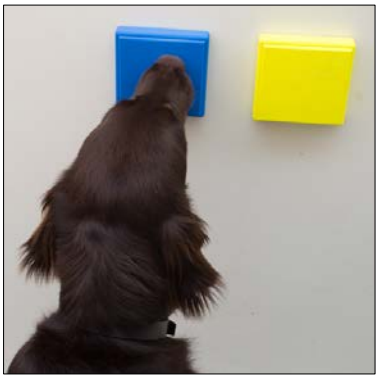
But how do technological interactions take into account and affect the capabilities, activities, experience and welfare of affected animals? To what extent do their requirements inform the design of technologies they interact with? Do these technologies reflect their perspective? Can animals shape the processes through which such technologies are developed? This kind of questions have for decades underpinned the development of Human-Computer Interaction and, more recently, Interaction Design. However, since humans are not the only species coming into contact with technologized environments, and since humans and other animals are inextricably entangled through shared practices and environments, there is a strong case for extending the remit of interaction design to include more-than-human species.

Convinced that addressing many societal challenges and interaction design problems would require thinking outside the 'human box', in 2011 I wrote an Animal-Computer Interaction (ACI) Manifesto [9], calling for the development of a discipline that would expand the boundaries of interaction design beyond humans. Concomitantly, I founded the Animal-Computer Interaction Laboratory at The Open University, whose aim is to "*advance the art and science of designing animal-centred interactive systems for a participatory multispecies society*" [1] by:

- Understanding the interaction between animals and computing technology within the contexts in which animals habitually live, are active, and socialise with members of their own or other species, including humans.
- Informing the development of interactive technology to: a) improve animals' life quality or expectancy by facilitating the fulfilment of their physiological and psychological needs; b) support animals in their activities and functions in which they are involved, by minimising any negative effects and maximising any positive effects of those functions on the animals' life expectancy and quality; c) foster intra-species and inter-species relations by enabling communication and promoting understanding between parties.
- Developing user-centred approaches, including theories and methods, to inform the design of technology intended for animals, regarding animal users as legitimate stakeholders and design contributors throughout all the phases of the design process and beyond.

The ACI Lab's research program comprises a series of applied projects, which tackle a variety of everyday life problems from a range of theoretical and methodological perspectives, in order to advance ACI as a discipline while endeavouring to make a difference in the real world. These projects explore some of the design, methodological and ethical challenges, and innovation opportunities, that arise when extending the boundaries of interaction design beyond humans. In this regard, I am particularly interested in sensemaking related to interaction (among humans and other animals; between humans and other animals; between - humans and other - animals and technology); I am interested in the semiotic processes that underpin multispecies sensemaking, and how interaction design processes and outcomes could support sensemaking and, in turn, multispecies activities and social interactions.

Accordingly, one of our early ACI studies investigated the use of tracking collars with companion dogs and how GPS devices that are designed to provide humans with information about their dogs end up changing the behaviour of both humans and dogs, and thus the interaction between them [7]. We found that humans made sense of the technology at an abstract level, based on symbolic and iconic signs (i.e. interpreting the moving dot that represented their dogs in relation to the map appearing on their phone); instead, dogs made sense of (and responded to) the technology at a physical level, based on indexical signs (i.e. interpreting how the collar was used within the context of daily human-dog practices and interactions). Our findings suggested that dogs attempt to attribute meaning and respond to technological artefacts, just as they do with other objects and events in their environment, in order to make predictions and optimise their engagement with their surroundings. It seems to me that this capacity for sensemaking both underpins and demonstrates animals' capacity for participatory engagement in both social and production processes. But how can we support such sensemaking and engagement capacity and how can we make sense of animals' productive contributions?

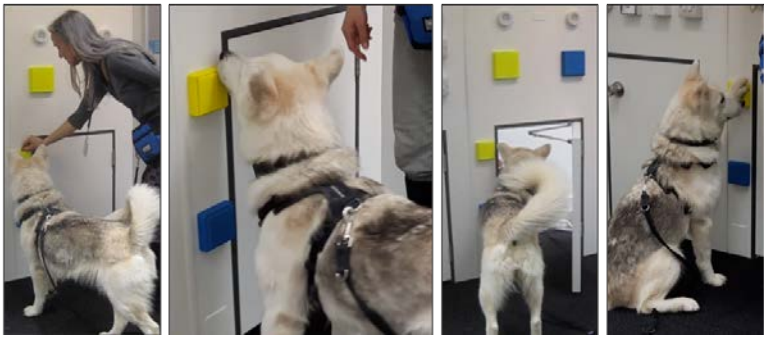


I had the opportunity to explore these questions during a project about *more-than-human participatory research*, led by the University of Edinburgh, for which the ACI Lab hosted a workshop about *co-designing with dogs* [2] with the participation of Dogs for the Disabled (now Dogs for Good), a UK Charity that trains dogs to carry out daily tasks for people with disabilities (e.g. operating light switches, traffic lights, elevators or doors). In spite of their fundamental social role, mobility assistance dogs have to work in environments that are inconsistent with their evolutionary characteristics, facing challenges that for human workers would be deemed unacceptable. The Dog-Smart Homes project started as a collaboration between the ACI Lab and Dogs for Good aiming to develop canine-centred ambient interfaces and multispecies interactive environments *accessible* to dogs [6].

A key concern of this ongoing research is understanding to what extent interaction design principles, which we rely upon when designing interactive systems for humans, could be applied when designing for other animals, to design environments they can make sense of and interact with [6]. Our empirical findings so far suggest that some principles might be fundamental, as they pertain to indexical sensemaking: *perceivability* is a prerequisite of sensemaking, *consistency* is essential for the emergence of sensemaking, *feedback* and *affordance* (or feedforward) are instrumental for enabling sensemaking during interaction. Other principles may be less relevant: *mapping* and *constraints* both presuppose the capacity for symbolic or iconic abstraction that other animals may not share. Arguably, interactive environments that are informed by fundamental design principles in conformity with their sensory, cognitive and physical characteristics are more likely to

enable animals to operate in such environments and participate in the practices that said environments support. But how do we know when what we design conforms to the requirements of the animals we *design for*? Even more fundamentally, how can we enable animals to express what they might require?

Indeed, another key concern of my research is the problem of *designing with* animals and enabling them to express what they want. I had the opportunity to explore this issue with ACI doctoral students: for example, Robinson applied ethnographic techniques combined with rapid prototyping and preference testing to involve medical alert dogs in the design of a canine alarm they could use to call for help in an emergency [11]; French took a 'research through design' approach to design playful enrichment for captive elephants by offering interactive artefacts to the elephants and allowing their responses to inform the artefacts' development [3]; Paci adapted ethological techniques to improve the objectivity of their interpretation of cats' responses to wearing tracking collars, in order to develop a wearer-centred framework for the design of animal biotelemetry [10]. Some have argued that none of these approaches enable animals to truly participate in the design process, due to interspecies differences and communication barriers, and consequent power asymmetries between humans and other animals; while others have argued that the only way to really know what animals want is to let them engage with artefacts and environments entirely on their own terms. However, it seems to me that these positions either assume anthropomorphic notions of participation (which result in anthropocentric notions of participation and participatory practices) or fail to recognise that participation is necessarily enabled through interaction, even though the interaction necessarily takes place within limitations. Such notions do not seem to account for the fact that animals are capable of *semiotic engagement* (as discussed above), of *volitional engagement* (they have evolved the capacity to pursue what is relevant to them to stay alive and well) and of *choice-full engagement* (they make choices to attain what they want), 'engagement' being the keyword.



To explore these issues more in detail, together with a colleague, I recently enrolled the help of my dog Zena to examine what happens during training sessions in which she learnt to operate various door-opening and light-switching prototype controls designed to fit with canine sensory, cognitive and physical characteristics [4]. What we found highlights how, even within the limitations of structured procedures, such as training, dogs are capable of expressing preferences for different designs and even of suggesting alternatives, through a co-production process underpinned by each party's semiotic, volitional and choice-full engagement. Despret calls this process *attunement* [12] and Haraway describes it as *making with* [13]. Haraway stresses how 'making with' is always a situated process, in which specific individuals, set-ups and contexts do *matter*; it is a *messy*, uncertain, open- ended process, in which opportunities can only be discovered by embracing its limitations. Indeed, the interaction design process is arguably highly adapted to dealing with such limitations, accounted for by the iterative nature of its cycles, whose function is precisely to unravel the layers of complexity characterizing interaction design problems. In this respect, interaction design can be seen as a process of incremental orientation towards an optimal final outcome that may never be reached, but that can be approximated. Thus, attending to the process by carefully crafting spaces and procedures that foster the emergence of participatory engagement is arguably more important than any interim design outcome. In this regard, we

suggested that (multispecies) participatory spaces could be defined along the following dimensions, the specifics of which *matter* when crafting such spaces [4]:

- *biological salience* relates to volition; settings and procedures need to offer participants something of what each of them really want; this does not need to be the same for all but it does need to be salient for each.
- *signal reliability* relates to semiosis; timing and consistency are key to signal reliability, which in turn is key to enable participants to form associations between events and make (their own) sense of the context in which they operate.
- *engagement options* relate to choice; they are essential to express volition and thus influence the design process; options cannot and should not be unlimited, but should be sufficient to orientate the design process through successive iterations.
- *contingiency variation* pertains to all the above dimensions; for example, varying a reward saliency can help explore thresholds of comfort; varying signal reliability can help explore thresholds of difficulty; and varying options can help explore interaction possibilities.

Crafting participatory research spaces that facilitate sensemaking, the expression of volition and choice is essential to conducting animal-centred research that is biologically relevant and beneficial for animal participants and implies an ethical as well as a methodological commitment. Such commitment involves adopting procedures that prioritise the participants' interests and welfare; it also involves garnering the participants' *mediated consent* (through their guardians) and - crucially - their *contingent consent* (i.e. the animals' willingness to engage in the here and now) [5]. This latter form of consent, of course, requires that research set-ups enable animal participants to assess (make sense as to) whether the conditions exist for them to want to engage and to choose whether to actually engage. How to achieve this kind of transparency for animal participants in interaction design research set-ups is another question that I am very interested in exploring.

Reframing participation in this way could help us move beyond anthropomorphic participatory models, and consequent anthropocentric participatory discourses and practices, which demand powers of abstract thinking and communication only accessible to (some) humans, and which delegitimize, dismiss, disqualify, and ultimately exclude those who do not possess such capabilities. It could help us move towards participatory models that are more inclusive and resilient to diversity, thus facilitate the emergence of incrementally co-produced multispecies environments.

Both human and nonhuman animals have a lot to gain from such a shift in perspective [14] and I am interested in exploring paradigms for human systems that may derive from enabling animals to drive the research and design process. For example, the project Interfaces for Bio Detection Dogs is a collaboration with Medical Detection Dogs, a UK Charity that trains dogs to detect and signal the presence of cancer cells in biological samples; the project aims to support the dogs' work by enabling them to signal through an indexical communication system that measures their spontaneous interaction with the samples, instead of requiring them to use symbolic signalling conventions for human convenience [7]. Could such an indexical approach be useful to design systems for humans too? Imagine a doctor who is examining the CT scans of a patient, looking for signs of cancer and using her touch and gestures to sort the scans. Even 'natural' touch-screen and gestural interfaces are based on conventional, albeit well grounded, signals, whereby the system copes with deviations from the convention by effectively neutralizing them. An *indexical interaction model* which capitalized on deviations, instead of neutralizing them, might be desirable for humans as well as dogs; this could be so particularly for tasks in which such deviations might be honest indicators of stimulus responses that express implicit knowledge, which might be critically important to capture.

In conclusion, it seems to me that humans have much to learn and much to gain by endeavoring to include more-than-human animals as co-designers in the co-production of technologized ecosystems. At the same time, it is humans' responsibility to develop practices which appropriately account for the contribution of more-than-human agencies to the design process, to enable the co-production of technologically supported multispecies ecosystems that represent all those who live in and sustain them.

BIOGRAPGY

Dr Clara Mancini is a Senior Lecturer in Interaction Design at The Open University's School of Computing and Communications. She is the founder and head of The Open University's Animal–Computer Interaction Lab, whose mission is to advance the art and science of designing animal-centred interactive systems for a participatory multispecies society. Clara is interested in the design, methodological and ethical challenges, and innovation opportunities, presented by ACI, and is committed to demonstrating ACI's potential to contribute to animal and human wellbeing, social inclusion, interspecies cooperation and environmental restoration. Clara has been principal investigator on a number of ACI projects and has supervised a range of ACI doctoral research, including ubiquitous and ambient interfaces for mobility assistance and medical detection dogs, interactive enrichment for captive elephants, and wearable animal biotelemetry. Her work has been published in the leading interaction design and ubiquitous computing venues, and she has lectured and given keynotes on ACI at national and international events. Clara was general chair for the ACI2016 and ACI2017 international conferences, in co-operation with the Association for Computing Machinery and Minding Animals International. She was lead guest editor for the first ACI Special Issue, in the International Journal of Human-Computer Studies.

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