Animal-computer interaction

Designing technology for and with animals

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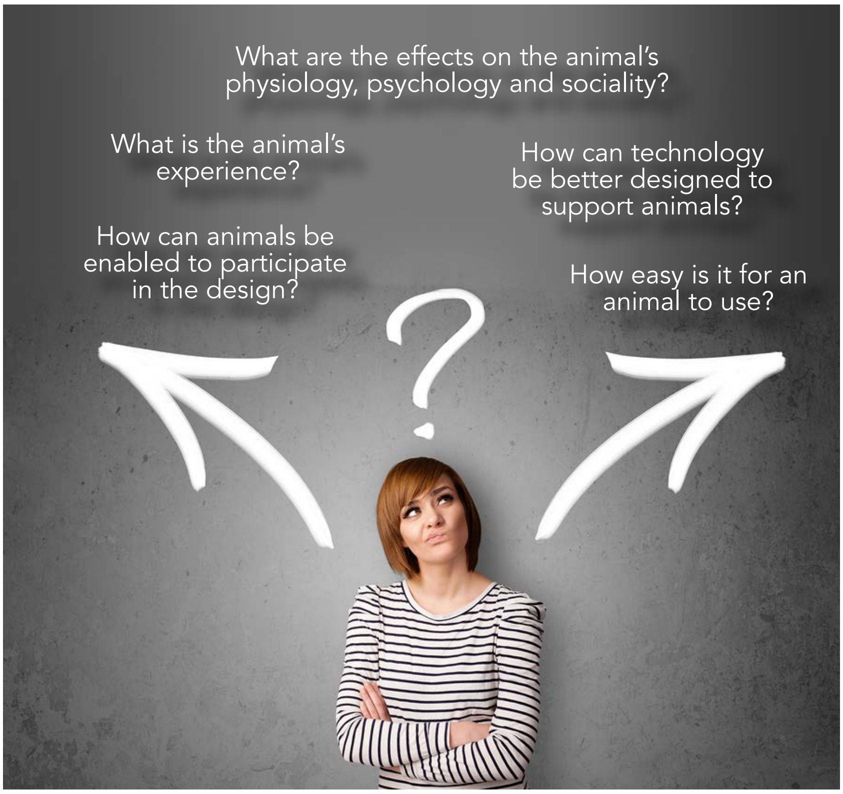
We live in a society where computing technology has become ubiquitous and interacting with computers no longer means using keyboard and mouse. Embedded in the fabric of our cities, workplaces, homes, vehicles, clothes and even bodies, 'smart' technologies now allow us to relate to the world around us, one another and even ourselves in unprecedented ways. These achievements have been driven by what interaction designers (those who research and design interactive technologies) call user-centred design.

Early uses of Animal Interactive Technology

However, we are not the only species to interact with technology. Being directly or indirectly involved in every aspect of human life, other animals have interacted with technology for a long time. For example, in the 1960s, bears were already wearing tracking devices in conservation studies; while mice and pigeons were operating switches and buttons in behavioural experiments. In the 1980s, great apes started using early touch-screen computers to learn human language in comparative cognition research, followed in the 1990s by dolphins who were given underwater keyboards for similar communication tasks. Meantime, thanks to advances in agricultural engineering, cows were being introduced to early robotic milking systems enabling them to milk themselves.

Sue Savage-Rumbaugh with the bonobo Kanzi, communicating by indicating icons on a lexigraph

In the early 2000s, interaction designers began to reflect on the interaction between animals and technology; they started asking questions about these technological interactions. Seeking answers to such questions is what we do at the Open University's Animal-Computer Interaction (ACI) Lab.



Developing technologies to better suit animals

To see how these questions can be addressed in practice, let us consider the case of working dogs. Dogs are incredibly adaptable and can be trained to do almost anything, including using some of the interactive technologies we have in our homes (e.g. washing machines, telephones, light switches). However, the interfaces of these technologies are designed for humans, not dogs.

Problems with human buttons and switches	Solutions
too small and fiddly for a dog's finger-less paws	large (up to 20 × 20 cm), so they are easy to target; activated by a soft touch, so dogs can use either their paw or nose to activate them
typically positioned too high for dogs	either wired or wireless, so they can easily be positioned where they are most accessible for a particular dog
often use colours such as red and green, which dogs cannot see	they are either blue or yellow, colours which dogs can see well
and they come in many different shapes but similar sizes, which dogs don't easily distinguish between.	they have the same square shape but come in different sizes, which is how dogs prefer to categorise objects.

All this makes it difficult for dogs not only to physically interact with our domestic interfaces, but even to understand how different controls might map onto different functions.

Dog friendly buttons

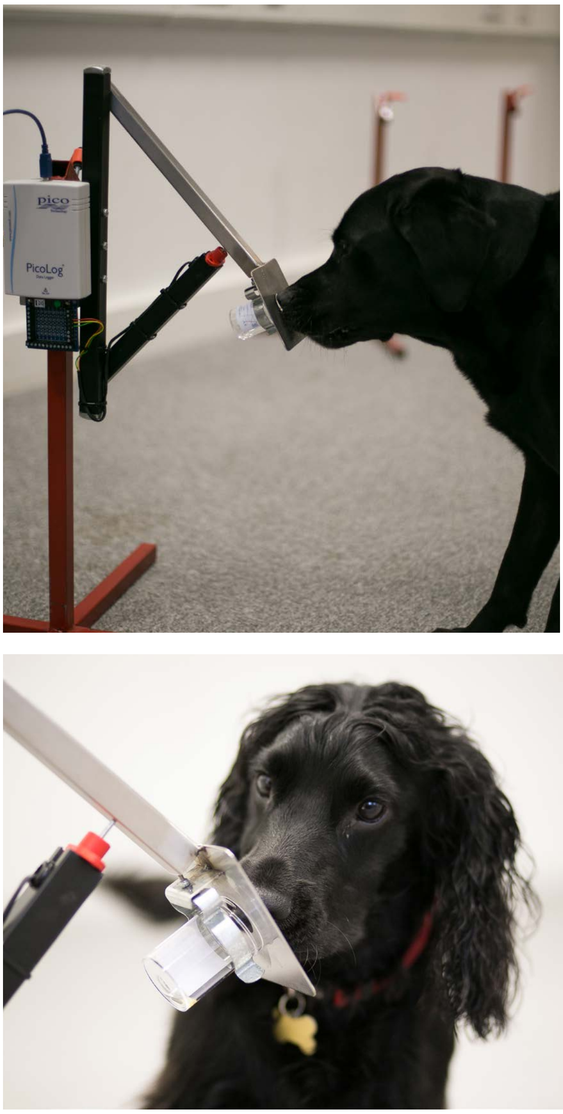
We have been working with the charity Dogs for the Disabled to re-think the way in which our domestic controls are designed, and have developed a suite of dog-friendly buttons for the home or office. The Open University has decided to install them in one of its buildings to make life easier for the assistance dogs who frequent our campus, and for their humans.

Case study: Cancer detection by dogs

In collaboration with the charity Medical Detection Dogs we are developing technology that can help cancer detection dogs. The charity trains dogs to sniff the smell of cancer cells in biological samples such as urine, sweat or breath, and to signal back to their trainer whether they find cancer cells in a sample they are sniffing. The trainers need to be sure to interpret correctly what the dog has found, so they teach the dogs to communicate with them using conventional signals, for example sitting down in front of samples that contain cancer cells.

This signalling system has two limitations. Firstly, it allows the dogs to say, "Yes, there is something here," or "No, there is nothing here," but not to express nuances in between. Secondly, even though that helps the trainers, using conventional signals is not natural for the dogs, so sometimes they don't perform the signals as expected, leaving the trainers in doubt as to what they might be saying.

To address these limitations, we have developed an 'electronic rig' which holds the sample sniffed by the dogs and uses a pressure sensor to measure the interaction of the dog's nose with the sample.



The pressure-sensing electronic rig used in cancer detection

We are finding that the pressure the dogs exert on the plates behind which the sample is secured varies depending on its content, so we can use the pressure recorded to interpret the dogs' reaction to a sample and whether they think that the sample is positive, negative, or somewhere in between. This allows the dogs to communicate with their trainer – so to speak – In their own terms, in a way that is both more subtle and spontaneous.

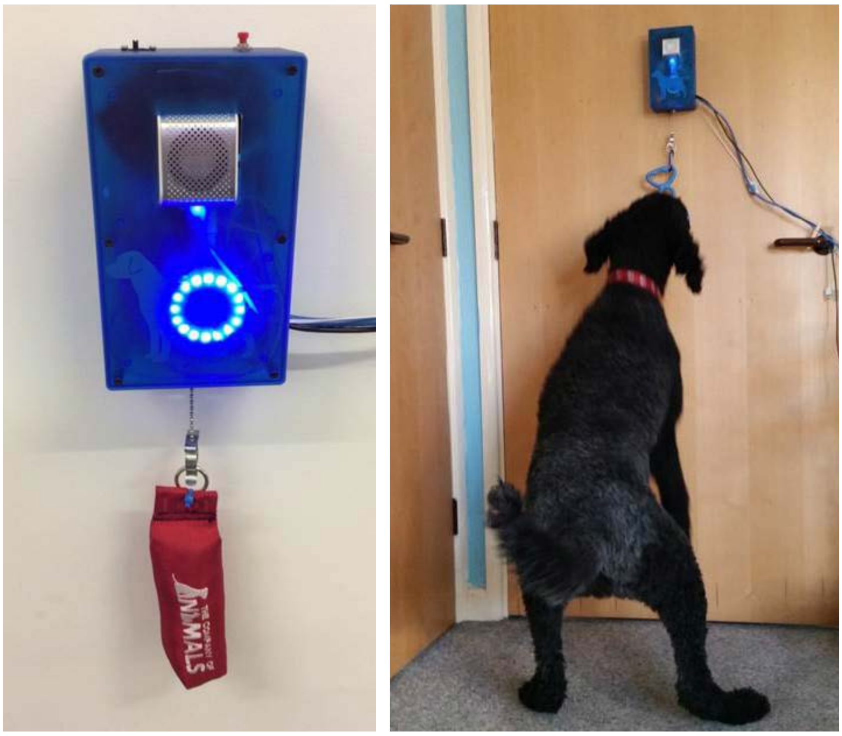
Asking the animals

To ensure that our technology can really support animals, we cannot just design *for* them, we also have to design *with* them. But how can we enable animals to participate in the design process? At our ACI Lab we have tried a combination of methods.

Firstly, it is very important to try to understand as much as possible about an animal's physiology, psychology and sociality; we do this by taking advice from animal scientists (e.g. colleagues at the University of Lincoln) and by talking with those who work with the animals (e.g. their trainers), and by closely observing the animals during their normal activities; this gives us an idea of what they generally like or dislike. Secondly, we seek feedback from the animals on specific designs through 'rapid prototyping': we prototype variations of a design in rapid succession and offer them to the animals under various conditions so they can show us their preferences.

Developing an alarm for medical alert dogs

Charlotte Robinson, a PhD student at the ACI Lab, is developing an alarm to enable medical alert dogs to call for help when their human becomes temporarily incapacitated due to a medical condition such as diabetes. When, during a training session, the human pretended to pass out, the dog refused to leave her side to trigger the alarm that was mounted on a wall far away; he would only trigger the alarm if, to do so, he didn't need to lose sight of his human, which suggested that perhaps the alarm needed to be located on the person rather than on a wall.



The canine alarm (left), and how it is activated by a dog

Animals will let us know what they want, but to be able to do so they need to be free to make choices, and even to choose whether or not to engage with a prototype or with us. In other words, user-centred design is not just about giving animals more control over their environment by designing technology for them; it is just as much about giving them control over the design process by adopting research methods that enable them to express their preferences and autonomy, even when they choose not to engage. I think this is the difference between research done 'on' animals and research done 'with' animals, which is what ACI is all about.

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