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Clara Mancini's colleagues used to laugh when she talked about her work. Mancini studies interaction design: finding ways to improve our experience of interactive technologies. Should there be buttons? How many, how large, what colour? As gadget designers well know, little things can make a big difference.

But Mancini had shifted her focus to a new group of users. "It was very hard at the beginning," says Mancini. "People saw this as something not quite to be taken seriously, as something a little bit funny and cute." It all centred on her chosen demographic: dogs.

Dogs might chase cars or howl at the TV, but when would they ever need to interact with technology? "I imagined seeing my dog sitting at a keyboard trying to type," says Helen Sharp, a software engineer at the Open University,

UK, where Mancini is also based.

That image may seem bizarre at first, but it's actually not a bad approximation of the challenges many dogs face in performing the tasks we set them. "What changed my mind was hearing about the ways humans ask animals to interact with technology, and then reflecting on how difficult and stressful it must be for them," says Sharp.

We expect a lot from dogs. We have made them an integral part of our every day lives, and that creates a growing need for them to interact with technology. Assistance dogs, for example, are trained to operate light switches or raise an alarm if their diabetic owner collapses. "Dogs are already used in search and rescue, in medicine, as service animals, to help autistic kids and more," says Alper Bozkurt, an electrical and computer engineer at North

Lassie gets an upgrade

Crafting gadgets for animals to use could allow them to help us in ways we never dreamed of, says Rachel Nuwer

Carolina State University in Raleigh. He thinks technology can help rather than hinder. "We'll be able to make them even better at their jobs," he says.

But how do you design tech specifically for an animal? What are their needs? How will they best interact with man-made devices? As new research tackles these questions, we are learning how to help them help us better. What's more, insights from working with animals may expand our horizons when it comes to building interfaces for ourselves.

We have long been strapping gadgets to animals. Zoologists routinely attach GPS trackers to beasts of the land, air and sea to monitor their movements. The US military has even stuck sensing devices to dolphins and sea lions trained to detect underwater mines.

Crucially, however, none of this technology was designed with the animals' experience in mind. "As we know from the field of interaction design, users need to be involved in the design process so researchers can know what they really want," says Mancini. That's usually when the jokes begin. "People would say things like, 'How would you get informed consent from a tiger? If it doesn't bite your head off, does that mean it approves?'"

But those turn out to be good questions. How do you design devices for a user that can't tell you what it wants? Mancini's team decided to focus their work on dogs, since they are already thoroughly integrated into our lives. Looking at the animals' anatomy and behaviour is a good starting point.

Lights out

When Mancini began trials involving switching on the light, the dogs jumped time and time again for the switch, clumsily pawing at it but often failing to activate it. One expert trainer told her that she could count on dogs not being able to turn on the light even after several attempts. "Service dogs are struggling to do the tasks that are required of them," says Mancini. "For them, operating a tiny, fiddly light switch is very difficult."

Dogs cannot easily distinguish the colour red either, so red alarm buttons and lights don't register. Dogs also categorise objects by size more so than shape, and prefer to use their noses for precision tasks such as hitting a button or turning off a switch.

Taking that into account, the team designed dog-friendly buttons in different sizes and in high-contrast blue and yellow, each activated with the touch of a nose or the slap of a paw. When Mancini presented dogs with them, ➤

they were able to switch on the light on the first try. Such a simple change can make a dog's life a lot easier. "Imagine if you had to use a computer with really teeny-tiny keys and a tiny screen, and that every time you needed to turn on a light you had to jump," she says. "That would stress you very quickly."

In a second project, Mancini and graduate student Charlotte Robinson addressed the lack of any system for medical-assistance dogs to sound the alarm if their diabetic owner should suddenly collapse because their blood sugar has dropped abnormally low. The prototype

"Imagine if you had to jump every time you turned on a light. That would stress you"

alarm is a multicoloured rope that, when pulled with the mouth, sends a potentially lifesaving message to emergency services.

In July, Mancini and her colleagues exhibited their work at the Royal Society's Summer Science Exhibition in London. A couple of wheelchair-using visitors who brought along their service dogs were delighted when their companions figured out how to work Mancini's interfaces on the spot.

Well-designed devices can help dogs communicate in other ways. Mancini is also working with cancer-detecting dogs, trained to use their sense of smell. Normally, the dogs sit or lie down to indicate the presence of cancer cells in a breath or urine sample, for example, and return to their owners if the sample is negative. However, if dogs are unsure whether what they are sniffing is malignant, they sometimes turn to their owners for help, potentially biasing the evaluation. Like humans, dogs vary in their interpretation of evidence, with some animals more prone to giving false positives than others.

To get around this, Mancini and her colleagues designed a pressure plate that allows dogs to signal their degree of certainty according to how firmly they push on it. The devices are already being used by Medical Detection Dogs, a UK charity that trains dogs to do this work.

Others have gone further, designing what almost amounts to a doggy walkie-talkie. A team at the Georgia Institute of Technology in Atlanta, including Thad Starner, a key developer behind Google's Project Glass, are perfecting an interactive vest for service dogs as part of a project called FIDO – Facilitating Interactions for Dogs with Occupations. The

POKE TO PLAY

It's not all work and no play in designing interfaces for animals. Hanna Wirman at Hong Kong Polytechnic University has a background in video game design, but ditched human gamers in favour of orang-utans. In Indonesia, many young orang-utans are orphaned when their parents are killed during forest clearance for new oil-palm plantations, and may end up living in rescue centres. Wirman thinks games can enrich their lives.

Initially, she spent many hours observing what the orang-utans do when left in small cages with hardly any outside stimulus. She noticed that poking one another with sticks was a recurring game. Back in the lab, she created a plate with holes of various sizes, and sensor-containing sticks that could be poked into the holes, causing the plate to emit various sounds. "It's a music game," says Wirman, who will soon return to Indonesia to test it.

She needs to be quick, though. At the age of about 2½, orang-utans suddenly acquire new urges. "At that age, all they are interested in is exploring their sexuality," she says. The orang-utans she observed will already have outgrown her toy, so Wirman is switching to another

sanctuary that houses younger animals. "It was either move the project to another centre or start developing sex games for orang-utans," she says. "But that would have taken things into a weird kind of direction."

BOREDOM BUSTERS

Elephants, too, might benefit from high-tech toys. Fiona French at the London Metropolitan University is designing gaming devices for them. The project will explore how auditory signals – something that elephants naturally use to communicate – can be incorporated into a kind of video game to enhance their well-being. As well as alleviating boredom in captivity, French thinks games could facilitate our communication with animals.

Michelle Westerlaken at Malmö University in Sweden, who has designed iPad games for cats, believes that video games can amuse bored pets. But she also thinks that games could be a key tool for working out what animals actually prefer when it comes to using gadgets (see main story). "Play is a free activity – you cannot force an animal to play," she says. "So it's a suitable starting point for figuring out how to design things for animals."



CRAIG DINGLE/GETTY

researchers consulted experts who work with police and military dogs about the tasks their animals perform and the types of clothing or gear that the dogs typically wear on the job. They then created several different sensors based on dogs' ability to bite, tug, nose-tap and grip things with their mouths. "The dogs know how to use FIDO vests for accomplishing a variety of tasks, just like a human knows how to use a cellphone," says Melody Jackson, the project director.

FIDO allows dogs to communicate specific messages to owners or handlers in a variety of situations. A service dog, for example, can alert its hearing-impaired owner if a tornado siren goes off or the doorbell rings. A rescue dog that locates a lost child could stay with them and call for help by activating a GPS-tagged sensor, rather than running back to its handler. And a bomb-detecting sniffer dog could indicate what type of explosive it has found, and where, then get clear of the area. "FIDO is a game changer for working dog teams," Jackson says. "These highly trained dogs have information that currently they have no way to impart to their handlers."

Give the dog a phone

The FIDO vests contain nine sensors, each of which conveys a different message. Vibrating motors inside the vest can be used to give dogs commands remotely. The researchers tested various breeds, including border collies, golden retrievers, pit bulls, Labradors and even Jackson's own little papillon. "We haven't encountered a single dog yet that could not activate all of the sensors," Jackson says.

Jackson designs the gear to ensure the dogs can operate it as easily as possible. "Would you design a button for a cellphone that had to be bitten to operate it? Of course not, because we humans have fingers and thumbs," she says. "Likewise, we wouldn't expect a dog to be able to operate a button on a cellphone designed for humans." They also recently began collaborating with Georgia Tech's K9 bomb sniffer-dog unit. The ensuing trials taught them that they needed to make the vests waterproof. "The first time we tested it, the dog went straight into a lake," Jackson says.

Bozkurt, who is working on a smart harness that will let dogs collect and transmit data from disaster zones, thinks such gadgets are just the start. "We'll find new applications for how these animals can help us," he says. He says that giving dogs the ability to communicate better will help with tasks from disease detection and crime prevention to



FIDO

assisting people with autism or traumatic brain injuries.

One new application involves teaming dogs with drones. Anna Gergely at Eötvös Loránd University in Budapest, Hungary, is working on a project called Swarmix, which trains dogs to interact with drones in search-and-rescue. The aim is to help rescue dogs find survivors as quickly as possible, the idea being that dogs can move much quicker than a human handler, while drones can gather a bird's-eye view of the scene. If the drone detects a victim, it will guide the dog to the spot.

Gergely is learning how to get dogs to work with robots rather than humans or other animals. She put food in a sealed box, which the dogs tried and failed to open. She then introduced a remote-controlled car that opened the box, allowing the dogs to get at the food. Eventually, the dogs began responding to the car as if it were a human handler. Finally, she began using drones in place of the cars. Although the dogs had trouble following high-speed Swinglet drones, they adapted well to slower Quadcopters.

Because they are easy to train, dogs are the obvious starting point. But technology could also provide distraction for farm animals kept in cages for their entire lives or bored zoo animals (see "Poke to play"). Jackson imagines that horses could be another good candidate. "Certainly technology could be used to inform riders if their position is correct, of how much

"Working dogs currently have information they can't impart to their handlers"

Roll over, Rover: the FIDO smart jacket lets service dogs communicate with their handlers

pressure they have on the reins and where their weight rests," she says.

Ultimately, though, such envelope-pushing work with animals could teach us new things about our own interaction with technology. Are screens the best we can do? Discarding some of our assumptions could lead to new interfaces – ones based on tactile feedback, for example. Coming up with new ways to interact with technology could also help us build devices for pre-verbal infants or the cognitively impaired. Researchers have experimented with different interfaces for tablets used by orang-utans and bonobos, for example, and their insights could improve interfaces for children with dyslexia or poor vision. More generally, tech designers have to come up with new ways to get user feedback when the user is an animal – using biometric measures or behavioural studies, for example. Similar techniques could equally be used to evaluate technology intended to be used by people who have difficulty communicating.

For now, Gergely is already seeing ways technology enhances people's relationships with their animals. The owner of a dog that recently took part in one of her robot-interaction trials warned Gergely that the dog was stupid. But the dog ended up doing better than others that had been fully trained. The owner was overjoyed and enrolled her dog in training school. "Now they take walks and have fun together," Gergely says. "In that dog's life, at least, there was a big change." ■

Rachel Nuwer is a writer based in New York