Toby, a small Munsterlander, walks a metal wheel with eight spokes in search of a cannister that contains a T-shirt worn by someone who tested positive for the coronavirus. "Toby was, as he often is with studies, a little bit of a superstar—he picks it up super quickly," says To...

These sniffer dogs are learning to smell the coronavirus

Dogs can learn to smell low blood sugar, oncoming seizures, and certain cancers. At the University of Pennsylvania, they're now learning to smell the coronavirus, too.

BYJILLIAN KRAMER

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• 9 MIN READ

Tuukka likes to play Frisbee. Griz adores a squishy orange ball. Toby uses his leisure time to nap or bark at passing vehicles. But these otherwise ordinary mutts have an extraordinary ability: They are part of a pack of research dogs that can sniff out the distinctive scent of SARS-CoV-2, the virus that causes COVID-19.

As the disease swept the globe and scientists deployed tools such as polymerase chain reaction tests to detect the novel coronavirus in people, a team of researchers at the University of Pennsylvania's School of Veterinary Medicine worked to determine if dogs could also be trained to find infections.

The proof-of-concept study, published in April in the journal *PLOS ONE*, showed that the virus has an odor that trained dogs can identify in urine and saliva. Now, the researchers—with the help of Tuuka, Griz, Toby, Rico, and Roxie—are examining whether canines can sniff out coronavirus' scent in sweaty T-shirts.

If the dogs can accurately detect it on clothing, they could patrol places such as airports and stadiums to sniff out the virus in public settings.

"Our big question is, can we translate this into an operational usage?" asks Cynthia Otto, a senior author on the study and director of the University of Pennsylvania School of Veterinary Medicine Working Dog Center. "Can the dogs screen people? I think that's a potential benefit."

Cynthia Otto, director of the Working Dog Center, works with Rico, a German shepherd. Otto believes that dogs could one day be trained to screen people for COVID-19 at public spaces, such as airports or stadiums.

The smell of sweat

With a sense of smell thought to be 1,000 to 10,000 times better than ours, dogs today do all kinds of work. They can sniff out early signs of Parkinson's disease, diabetes, several types of cancer, oncoming epileptic seizures, and malaria, among other ailments. They assist search and rescue teams in the wake of natural disasters and serve as allies in military operations, smelling out hidden explosives. Some dogs partner with customs officials searching for contraband, from drugs to elephant ivory. They can track down poachers, patrol cargo ships for rats that might escape at distant harbors, and sniff out endangered and invasive species.

Penn researchers began trying to train the dogs to sniff out the novel coronavirus from urine and saliva samples in spring 2020. In November, they started training the dogs to do it with sweat. The process starts by presenting the dogs with positive samples, then rewarding them with treats. Once the dogs learn to associate the scent of the virus with a pleasurable experience, they are ready to start official trials.

Dogs trained to detect the virus in sweat could walk through lines of people and smell infections instantaneously.

The researchers place a series of sweaty T-shirts and distractors—clean clothing, shipping materials, or rubbing alcohol—all inside mesh-covered cannisters on the ends of an eight-spoke metal wheel. Only one cannister will contain a T-shirt worn by a person who tested positive for COVID-19 within 48 hours of wearing it. The dogs know to walk around the wheel until they detect that positive sample.

In the April study with urine and saliva samples, dogs could find the virus with 96 percent accuracy, Otto says. While the current study using sweaty T-shirts is ongoing, the canines have been remarkably successful at that too, she says.

Roxie is their fastest dog: She's walked the wheel and found the positive sample in as little as 12 seconds. Rico, a more pensive pup, takes about 23 seconds to identify the right shirt.

Left: Meghan Ramos, a sports medicine and rehabilitation resident at the Working Dog Center, swabs the inside of Tuukka's mouth as Essler, Tuukka's owner, holds on. Tuukka is new to scent work. "It was funny watching her struggle through it, because going from basic nos...

Right: Researchers take blood samples and mouth swabs before the start of the study to ensure the dogs had not contracted COVID-19.

Roxie, a high-strung yellow Labrador, plays before she begins an experiment. "She has to play before she does her study because she has too much energy," says Amritha Mallikarjun, a postdoctoral fellow at the Working Dog Center.

Sniffer dogs in the field

The dogs can detect the coronavirus by smelling its volatile organic compounds, the chemicals excreted through waste products such as urine, saliva, and sweat as humans' cells metabolize.

The compounds are "like the fingerprint of a disease," says Amritha Mallikarjun, a postdoctoral research fellow working on the current study. And while they're indistinguishable to human noses, dogs have a super-powered sense of smell: In addition to all those receptors, their nostrils connect to dozens of crisscrossing cavernous tunnels that allow scents to linger. "There's a lot of space in there for the air to turn around

and touch surfaces and get caught" by the canine's nose receptors, she says.

Similar studies have concluded or are underway in other parts of the world, including the U.K. and France. For example, after finding dogs could discriminate between sweat samples from people who had tested positive or negative for COVID-19, Dominique Grandjean, a veterinarian and professor at France's National Veterinary School of Alfort, tells *National Geographic* that he will begin to test whether canines can detect the variants of COVID-19. And dogs already have been deployed at Finland's Helsinki-Vantaa international airport to sniff out infected passengers.

Some proponents of COVID-19 detection dogs say that the animals could replace other COVID-19 mitigation efforts, such as PCR tests, which require a nasal or oral swab and can take days to process. Dogs trained to detect the virus in sweat could walk through lines of people and quickly smell infections without interruption, says Mallikarjun, and with minimal risk: Studies have shown that SARS-CoV-2 cannot be transmitted to people—or animals—through sweat.

Their abilities could also be used to create and program mechanical noses, electronic devices that would work similarly to breathalyzers to scan people and identify COVID-19, she adds.
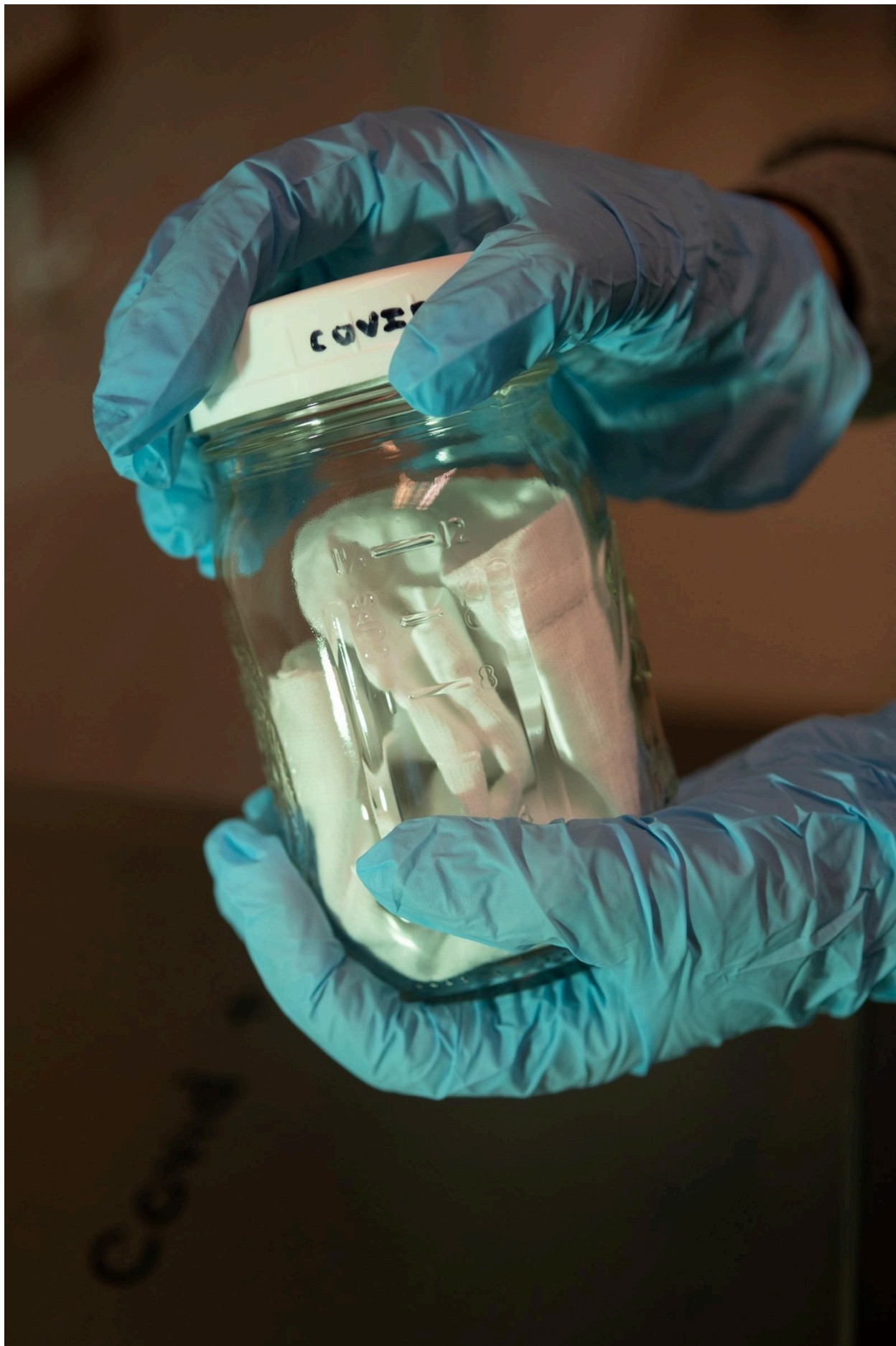
Left: Tuukka, a mix of German shepherd, husky, and border collie, practices her virus detection skills at the wheel.

Right: Researchers collected T-shirts for the study from volunteers across the country. The volunteers must wear the plain white T-shirts overnight and submit the results of a recent COVID-19 test—or a copy of their vaccination certificate—with their shirt.

But others say it's too soon to know how dogs will fit into the fight against the pandemic. "I think there certainly is potential there," says Anna Durbin, a professor of international health at Johns Hopkins Bloomberg School of Public Health. She says that trained dogs could be used to complement other efforts. For example, they could provide an initial screening that a laboratory test could later confirm, allowing a potentially infected person to take immediate precautions.

These sniffer dogs can't be just any dogs, either. "A lot of people are excited about having COVID-19 detection dogs," Otto says, "but we need to be thinking about the *right* dog for that job—a dog that's going to be reliable and also not get bored with it."

Alexandra Horowitz, a dog cognition specialist at Barnard College who is not involved with the study, says that the dogs that are most successful in this type of smell work are those that are very motivated to work for a reward, and will "do whatever is asked of them to get that reward."

That's certainly Griz, the researchers agree, who works tirelessly for his unique treat: that orange squishy ball. "He just loves it," says Mallikarjun. "He likes to squash it, and he's very happy."