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Sit. Stay. Parse. Good Girl!

By NICHOLAS WADE

Chaser, a border collie who lives in Spartanburg, S.C., has the largest vocabulary of any known dog. She knows 1,022 nouns, a record that displays unexpected depths of the canine mind and may help explain how children acquire language.

Chaser belongs to John W. Pilley, a psychologist who taught for 30 years at Wofford College, a liberal arts institution in Spartanburg. In 2004, after he had retired, he read a report in Science about Rico, a border collie whose German owners had taught him to recognize 200 items, mostly toys and balls. Dr. Pilley decided to repeat the experiment using a technique he had developed for teaching dogs, and he describes [his findings](#) in the current issue of the journal Behavioural Processes.

He bought Chaser as a puppy in 2004 from a local breeder and started to train her for four to five hours a day. He would show her an object, say its name up to 40 times, then hide it and ask her to find it, while repeating the name all the time. She was taught one or two new names a day, with monthly revisions and reinforcement for any names she had forgotten.

Border collies are working dogs. They have a reputation for smartness, and they are highly motivated. They are bred to herd sheep indefatigably all day long. Absent that task, they must be given something else to do or they go stir crazy.

Chaser proved to be a diligent student. Unlike human children, she seems to love her drills and tests and is always asking for more. "She still demands four to five hours a day," Dr. Pilley said. "I'm 82, and I have to go to bed to get away from her."

One of Dr. Pilley's goals was to see if he could teach Chaser a larger vocabulary than Rico acquired. But that vocabulary is based on physical objects that must be given a name the dog can recognize. Dr. Pilley found himself visiting [Salvation Army](#) stores and buying up sackfuls of used children's toys to serve as vocabulary items.

It was hard to remember all the names Chaser had to learn, so he wrote the name on each toy with indelible marker. In three years, Chaser's vocabulary included 800 cloth animals, 116

balls, 26 Frisbees and a medley of plastic items.

Children pick up about 10 new words a day until, by the time they leave high school, they know around 60,000 words. Chaser learned words more slowly but faced a harder task: Each sound was new and she had nothing to relate it to, whereas children learn words in a context that makes them easier to remember. For example, knives, forks and spoons are found together.

Dr. Pilley does not know how large a vocabulary Chaser could have mastered. When she reached 1,000 items, he grew tired of teaching words and moved to more interesting topics like grammar.

One of the questions raised by the Rico study was that of what was going through the dog's mind when he was asked to fetch something. Did he think of his toys as items labeled fetch-ball, fetch-Frisbee, fetch-doll, or did he understand the word "fetch" separately from its object, as people do?

Dr. Pilley addressed the question by teaching Chaser three different actions: pawing, nosing and taking an object. She was then presented with three of her toys and correctly pawed, nosed or fetched each one depending on the command given to her. "That experiment demonstrates conclusively that Chaser understood that the verb had a meaning," Dr. Pilley said.

The 1,022 words in Chaser's vocabulary are all proper nouns. Dr. Pilley also found that Chaser could be trained to recognize categories, in other words common nouns. She correctly follows the command "Fetch a Frisbee" or "Fetch a ball." She can also learn by exclusion, as children do. If she is asked to fetch a new toy with a word she does not know, she will pick it out from ones that are familiar.

Haunting almost every interaction between people and animals is the ghost of Clever Hans, a German horse that in the early 1900s would tap out answers to arithmetic problems with his hoof. The psychologist Oskar Pfungst discovered that Hans would get the answer right only if the questioner also knew the answer. He then showed that the horse could detect minute movements of the questioner's head and body. Since viewers would tense as Hans approached the right number of taps, and relax when he reached it, the horse knew exactly when to stop.

People project their expectations onto animals, particularly dogs, and can easily convince themselves the animal is achieving some humanlike feat when in fact it is simply reading cues unconsciously given by its master. Even though researchers are well aware of this pitfall, interpreting animal behavior is particularly tricky. In the current issue of *Animal Behaviour*, a leading journal, two previous experiments with dogs have been found wanting.

In one report, researchers say they failed to confirm an experiment showing that dogs would

yawn contagiously when people yawn. **Another report** knocks down an earlier finding that dogs can distinguish between rational and irrational acts.

The danger of Clever Hans effects may be particularly acute with border collies because they are bred for the ability to pay close attention to the shepherd. Dogs that ignore their master or the sheep do not become parents, a fierce selective pressure on the breed's behavior. "Watch a collie work with a sheepherder and you will come away amazed how small a gesture the person can do to communicate with his dog," said Alexandra Horowitz, a dog behavior expert at **Barnard College** and author of "**Inside of a Dog**."

Juliane Kaminski, a member of the research team that tested Rico, was well aware of the Clever Hans effect. So she arranged for the dog to be given instructions in one room and to select toys from another, making it impossible for the experimenter to give Rico unwitting cues. Dr. Kaminski works at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany.

Dr. Pilley took the same precaution in testing Chaser. He submitted an article describing his experiments to *Science*, but the journal rejected it. Dr. Pilley said that the journal's advisers had made valid criticisms, which he proceeded to address. He and his co-author, Alliston K. Reid of Wofford College, then submitted a revised article to *Behavioural Processes*. Dr. Horowitz, who was one of *Science*'s advisers in the review of Dr. Pilley's report, said of the new article that "the experimental design looks pretty good." Dr. Kaminski, too, regards the experiment as properly done. "I think the methodology the authors use here is absolutely sufficient to control for Clever Hans," she said.

The learning of words by Rico and Chaser may have some bearing on how children acquire language, because children could be building on the same neural mechanisms. Dr. Pilley and Dr. Reid conclude that their experiments "provide clear evidence that Chaser acquired referential understanding of nouns, an ability normally attributed to children."

But the experiment's relevance to language is likely to be a matter of dispute. Chaser learns to link sounds to objects by brute repetition, which is not how children learn words. And she learns her words as proper nouns, which are specific labels for things, rather than as abstract concepts like the common nouns picked up by children. Dr. Kaminski said she would not go as far as saying that Chaser's accomplishments are a step toward language. They show that the dog can combine words for different actions with words for objects. A step toward syntax, she said, would be to show that changing the order of words alters the meaning that Chaser ascribes to them.

Dr. Pilley says he is working on just that point. "We're trying to teach some elementary

grammar to our dog," he said. "How far we'll be able to go we don't know, but we think we are on the frontier."

His goal is to develop methods that will help increase communication between people and dogs. "We are interested in teaching Chaser a receptive, rudimentary language," he said.

A [Nova episode](#) on animal intelligence, in which Chaser stars, will be broadcast on Feb. 9.

As with other animals for which prodigious feats of cognition have been reported, like Alex the gray parrot or Kanzi the bonobo, it is hard to place Chaser's and Rico's abilities in context. If their achievements are within the general capacity of their species, why have many other instances not been reported? If, on the other hand, their achievements are unique, then either the researchers have lucked out in finding an Einstein of the species, or there could be something wrong with the experiments like a Clever Hans effect.

Dr. Pilley said that most border collies, with special training, "could be pretty close to where Chaser is." When he told Chaser's dog breeder of the experiment, "he wasn't surprised about the dog's ability, just that I had had the patience to teach her," Dr. Pilley said.

Dr. Horowitz agreed: "It is not necessarily Chaser or Rico who is exceptional; it is the attention that is lavished on them," she said.