

Fox squirrels show long-term investment savvy when hoarding nuts

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Fox squirrels on the UC Berkeley campus make ideal research participants.

(Phys.org)—Researchers at the University of California, Berkeley, are gathering evidence this fall that the feisty fox squirrels scampering around campus are not just mindlessly foraging for food, but engaging in a long-term savings strategy. Humans could learn something about padding their nest eggs from squirrels' diversification efforts.

Of course, with squirrels, it's not about money, but about nuts.

"Think of them as little bankers depositing money and spreading it out in different funds, and doing some management of those funds," said Mikel Delgado, a doctoral student in psychology who heads the squirrel research team in the laboratory of UC Berkeley psychologist Lucia Jacobs.

The group has a Cal Squirrels website for which they adapted the Cal logo to promote their work: "We really think that campus squirrels are an ideal system to understand cognition in the wild, especially at Berkeley, with our year-round potential for field work," said Jacobs, a leading expert on squirrel cognition.

"To understand how their mind has evolved," she added, "you want to have a species that faces big [cognitive problems](#) – like making decisions about thousands of acorns and then remembering where you hid them three months ago—and still faces normal challenges, such as escaping from predators, outwitting your competitors and seducing those of the opposite sex –and most important, you need to watch them without disturbing their behavior."

Using the campus wilds as their animal behavior laboratory, Delgado and a dozen psychology undergraduates are tracking up to 70 fox squirrels to map their territories and study their "caching behavior," which refers to the system squirrels use to hoard and retrieve many kinds of nuts. The students mark their [study participants](#) by gently squirting fur dye on the squirrels' backs or sides.

"We're trying to find out what kinds of strategies they might be using to assess the quality of each nut and what kind of investment they want to make in it," said Delgado, whose research is funded by the National Science Foundation. "And we want to know how they remember where they hide all those nuts." A paper on her findings is forthcoming.

First found on the UC Berkeley campus in the 1930s, fox squirrels are non-native and distinguishable from the more rat-like eastern gray squirrels by their reddish hue, bushy tails and overall cuteness. They are diurnal creatures who don't hibernate and are prey for many animals, including foxes, coyotes, hawks, eagles and owls. They are not social animals, but loners. As for mating, "it's brief and involves a lot of

chasing, squeaking, biting and scrambling around trees," Delgado said.

In recent months, Delgado and her team have followed the bushy-tailed critters across creeks and meadows, hillsides and undergrowth. They've even given them names like Rocket, Flame and Dave. A favorite is Peter, a three-legged, tail-less female squirrel who hangs out in the Chancellor's Esplanade.

"Despite her disability, she's great at caching," said Delgado.

Among other things, campus squirrels eat acorns, pine nuts, walnuts, almonds and hazelnuts, not to mention the peanuts that research team members carry around in fanny packs. The animals hoard nuts because not all the trees on campus produce food year-round and, since squirrels don't hibernate, they need to stock up for the winter.

Typically, a fox squirrel will pick up a nut using its teeth and long-clawed hands, rotate it, shake its head a couple of times and either peel off the husk – if there is one – and eat it on the spot, or hop off to find a place to bury it, often traveling as far as 100 meters to hide it. The question is, what kinds of spatial cues do they use to find those nuts once they've buried them?

To track the nut-stashing activity, the student researchers are using GPS technology to record all the burials and, in the process, are creating an elaborate map showing every campus tree, building and even garbage can: "We've compiled a list of more than 1,000 locations where the nuts are buried," Delgado said of work carried out this past summer.

The research team is replicating the caching experiment on humans by timing students as they bury Easter eggs on campus and try to find them: "We're using humans as a model for squirrel behavior to ask questions that we can't ask squirrels," Delgado said.

In another experiment, the team looked at how squirrels respond to frustration and found it brings out their problem solving skills. The squirrels were trained to open boxes with their noses and then given several boxes to open. When they encountered a locked box, they showed frustration, but did not give up. Instead, they tried different tricks to open the box, such as pushing it, dragging it and biting it, displaying the building blocks of intelligence, Delgado said.

"They're clever and very persistent at solving problems," Delgado said.

Delgado is building on the research of her mentor Jacobs, who has found evidence that, when holding a nut in a shell, squirrels shake their heads to assess the quality of the nut, and that this "head-flicking behavior" increases when they plan to store the nut rather than eat it.

Jacobs was also the first to discover that squirrels remember the location of their own buried nuts more so than of nuts buried by other squirrels. Some scientists have hypothesized that squirrels use their sense of smell to find nuts, but Jacobs' research suggests that they're not just "sniffing around" but using other techniques to locate their own nuts.

"That is something we are trying to ascertain with the GPS data," Delgado said. "They may be using a combination of landmarks and memory to narrow down their search, and then using their sense of smell for a final bit of searching."

While Delgado hopes to crack the mystery of which cognitive navigation skills [squirrels](#) use to find their personal stashes, one thing's for sure: "They're saving for the future," she said, "and they're really smart about it."

Provided by University of California - Berkeley

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