Excerpt from *Humans With Amazing Senses*

When bats go out to hunt, they send out sonar signals at such high frequencies and in such rapid bursts that they can hear the signals bounce off mosquitoes in midair. They then zero in on the insects like laser-guided missiles. Dolphins use the same technique to find their dinners. It's called echolocation, a technique that uses sound to identify objects by the echoes they produce.

Fourteen-year-old Ben Underwood of Sacramento, Calif., is one of the few people known to use echolocation as a primary means of navigating the world on land. There's not even a hint of light reaching his brain. His eyes are artificial, but his brain has adapted to allow him to appraise his environment. He makes a "clicking" sound to communicate with objects and people around him.

Scientists have discovered that in the brains of the blind, the visual cortex has not become useless, as they once believed. When blind people use another sense—touch or hearing, for example—to substitute for sight, the brain's visual cortex becomes active, even though no images reach it from the optic nerve. Echolocation creates its own images.

"I can hear that wall behind you over there. I can hear right there—the radio, and the fan," Ben says.

Ben says every object in his life talks to him in ways that no one else can hear or understand.

Forty-year-old Daniel Kish of Long Beach, Calif., also uses echolocation, and has become an expert on it, founding the World Access for the Blind, an organization that teaches others how to echolocate. Kish leads other blind people on mountain biking tours and hikes in the wilderness, visualizing and describing the picturesque sights around him through echolocating.

Clicking to Do Anything

If you listen closely to Ben or Kish, you can hear how they find their way. Ben says he can distinguish where the curbs are as he cruises his neighborhood streets.

He can find the pole and the backboard on a basketball goal, and tell which is which by the distinctive echo each makes. Even though he can't see the goal he's aiming for, he can sink a basket. Ben doesn't remember how or when he began clicking, but he's developed his abilities to such an extent that aside from echolocation, he can rapidly discriminate the sounds in video games.

Ben lost his sight when he was 2. He was diagnosed with cancer in both eyes, and when chemotherapy failed, his mother, Aquanetta Gordon, was left with one option: For her son to live, both his eyes had to be surgically removed.

Gordon remembers her son after the operation.

"He woke up and he said, 'Mom, I can't see anymore, I can't see anymore.' And I took his hands and I put them on my face and I said, 'Baby, yes, you can see.' I said, 'You can see with your hands.' And then I put my hand on his nose and I said, 'You smell me? You can see with your nose and your ears. . . . You can't use your eyes anymore, but you have your hands and your nose and your ears.'"

In a house already filled with three other children, Ben's mother decided not to treat his blindness as a handicap. In school, Ben recognizes his classmates by their voices. With the help of Braille books and a talking laptop computer, Ben attends the same classes as sighted students.

Rich Mental Images, Without Visual Elements

Like Ben, Kish also lost his eyesight to cancer at age 1. He was raised to believe he could do pretty much anything, and he discovered clicking by accident as a child.

"I have mental images that are very rich, very complex. They simply do not possess the visual element," Kish says.

In retrieving those pictures, Kish varies the pace and volume of his clicks as he walks along; and what he can tell you about an object's qualities is sometimes astonishingly thorough.

If bats can distinguish prey as small as mosquitoes with echolocation, and some dolphins can detect small targets a hundred yards away, what are the ultimate capabilities of human beings like Ben and Kish?

Peter Scheifele, who studies hearing and sound production in animals and people at the University of Connecticut, analyzed samples of the clicks that Ben and Kish make.

"Ben clicks, looks to me like once every half second, whereas a dolphin is actually making 900 clicks per second. And the bat is even faster than that," Scheifele says.

The bottom line: Human beings send out sounds at much slower rates and lower frequencies, so the objects people can picture with echolocation must be much larger than the ones bats and dolphins can find.