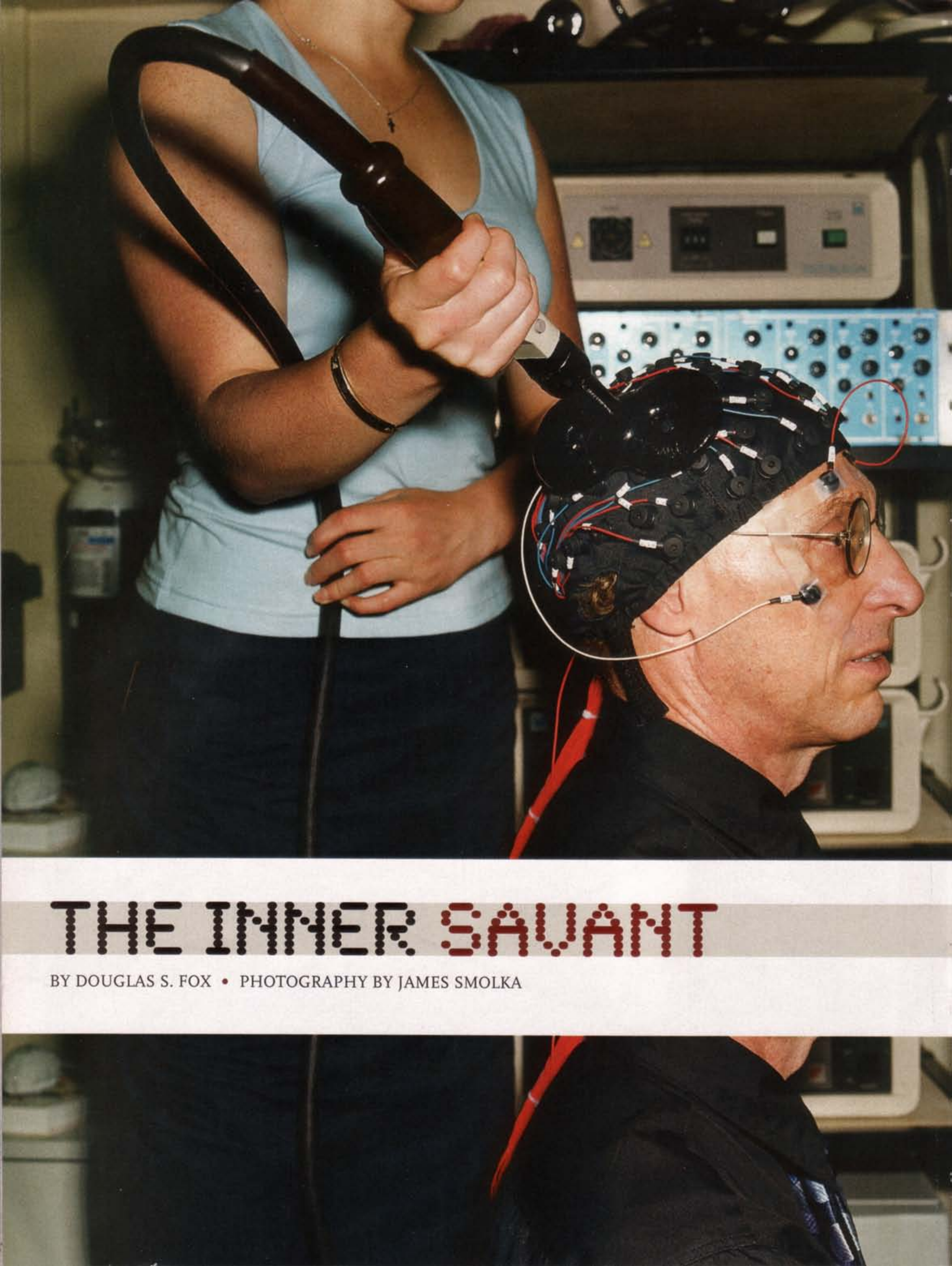


THE INNER SAVANT

BY DOUGLAS S. FOX • PHOTOGRAPHY BY JAMES SMOLKA

NADIA APPEARED HEALTHY

at birth, but by the time she was 2, her parents knew something was amiss. She avoided eye contact and didn't respond when her mother smiled or cooed. She didn't even seem to recognize her mother. At 6 months she still had not spoken a word. She was unusually clumsy and spent hours in repetitive play, such as tearing paper into strips. ¶ But at 3½, she picked up a pen and began to draw—not scribble, *draw*. Without any training, she created from memory sketches of galloping horses that only a trained adult could equal. Unlike the way most people might draw a horse, beginning with its outline, Nadia began with random details. First a hoof, then the horse's mane, then its harness. Only later did she lay down firm lines connecting these floating features. And when she did connect them, they were always in the correct position relative to one another. ¶ Nadia is an autistic savant, a rare condition marked by severe

ARE YOU CAPABLE OF MULTIPLYING 147,631,789 BY 23,674 IN YOUR HEAD, INSTANTLY? PHYSICIST ALLAN SNYDER SAYS YOU PROBABLY CAN, BASED ON HIS NEW THEORY ABOUT THE ORIGIN OF THE EXTRAORDINARY SKILLS OF AUTISTIC SAVANTS

LEFT: Allan Snyder, director of the Center for the Mind in Sydney, Australia, thinks temporarily inhibiting neural activity through a technique called transcranial magnetic stimulation could lead to creative breakthroughs.

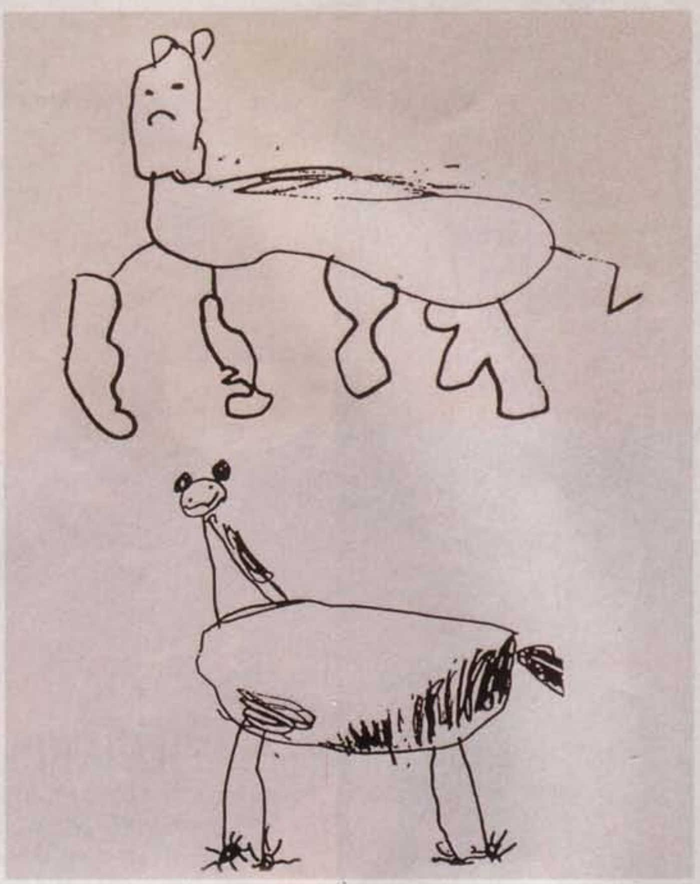
mental and social deficits but also by a mysterious talent that appears spontaneously—usually before age 6.

Sometimes the ability of a savant is so striking, it eventually makes news. The most famous savant was a man called Joseph, the individual Dustin Hoffman drew upon for his character in the 1988 movie *Rain Man*. Joseph could immediately answer this question: "What number times what number gives 1,234,567,890?" His answer was "Nine times 137,174,210." Another savant could double 8,388,628 up to 24 times within several seconds, yielding the sum 140,737,488,355,328. A 6-year-old savant named Trevor listened to his older brother play the piano one day, then climbed onto the piano stool himself and played it better. A savant named Eric could find what he called the "sweet spot" in a room full of speakers playing music, the spot where sound waves from the different sources hit his ears at exactly the same time.

Most researchers have offered a simple explanation for these extraordinary gifts: compulsive learning. But Allan Snyder, a vision researcher and award-winning physicist who is director of the Center for the Mind at the University of Sydney and the Australian National University, has advanced a new explanation of such talents. "Each of us has the innate capacity for savantlike skills," says Snyder, "but that mental machinery is unconscious in most people."

Savants, he believes, can tap into the human mind's remarkable processing abilities. Even something as simple as seeing, he explains, requires phenomenally complex information processing. When a person looks at an object, for example, the brain immediately estimates an object's distance by calculating the subtle differences between the two images on each retina (computers programmed to do this require extreme memory and speed). During the process of face recognition, the brain analyzes countless details, such as the texture of skin and the shape of the eyes, jawbone, and lips. Most people are not aware of these calculations. In savants, says Snyder, the top layer of mental processing—conceptual thinking, making conclusions—is somehow stripped away. Without it, savants can access a startling capacity for recalling endless detail or for performing lightning-quick calculations. Snyder's theory has a radical conclusion of its own: He believes it may be possible someday to create technologies that will allow any nonautistic person to exploit these abilities.

THE ORIGINS OF AUTISM ARE THOUGHT TO LIE IN EARLY BRAIN development. During the first three years of life, the brain grows at a tremendous rate. In autistic children, neurons seem to connect haphazardly, causing widespread abnormalities, especially in the cerebellum, which integrates thinking and movement, and the limbic region, which integrates experience with specific emotions. Abnormalities in these regions seem to stunt interest in the environment and in social interaction. Autistic children have narrowed fields of attention and a poor ability to recognize faces. They are more likely to view a face, for example, as individual components rather than as a whole. Imaging studies have shown that when autistic children see a familiar face, their pattern of brain activation is different from that of normal children.



DRAWINGS BY NORMAL 4-YEAR-OLDS

When 4-year-old children draw a horse, they typically choose to establish its contour and familiar features such as head, eyes, legs, and tail. Allan Snyder believes that these kids draw on a concept of the horse to re-create it rather than recalling the precise physical details, as savants do.

That narrowed focus may explain the autistic child's ability to concentrate endlessly on a single repetitive activity, such as rocking in a chair or watching clothes tumble in a dryer. Only one out of 10 autistic children show special skills.

In a 1999 paper, Snyder and his colleague John Mitchell challenged the compulsive-practice explanation for savant abilities, arguing that the same skills are biologically latent in all of us. "Everyone in the world was skeptical," says Vilayanur Ramachandran, director of the Center for Brain and Cognition at the University of California at San Diego. "Snyder deserves credit for making it clear that savant abilities might be extremely important for understanding aspects of human nature and creativity."

SNYDER'S OFFICE AT THE UNIVERSITY OF SYDNEY IS IN A GOTHIC BUILDING, complete with pointed towers and notched battlements. Inside, Nadia's drawings of horses adorn the walls; artwork by other savants hangs in nearby rooms.

Snyder's interest in autism evolved from his studies of light and vision. Trained as a physicist, he spent several years studying fiber optics and how light beams can guide their own path.

A DRAWING BY A 3-YEAR-OLD SAVANT

A 3-year-old child named Nadia became famous for her ability to sketch spectacularly detailed horses and riders from memory. Savants like Nadia show the ability to perform unusual feats of illustration or calculation when they are younger than 6. Snyder wants to figure out how they do it.

At one time he was interested in studying the natural fiber optics in insects' eyes. The question that carried him from vision research to autism had to do with what happens after light hits the human retina: How are the incoming signals transformed into data that is ultimately processed as images in the brain? Snyder was fascinated by the processing power required to accomplish such a feat.

During a sabbatical to Cambridge in 1987, Snyder devoured Ramachandran's careful studies of perception and optical illusions. One showed how the brain derives an object's three-dimensional shape: Falling light creates a shadow pattern on the object, and by interpreting the shading, the brain grasps the object's shape. "You're not aware how your mind comes to those conclusions," says Snyder. "When you look at a ball, you don't know why you see it as a ball and not a circle. The reason is your brain is extracting the shape from the subtle shading around the ball's surface." Every brain possesses that innate ability, yet only artists can do it backward, using shading to portray volume.

"Then," says Snyder, speaking slowly for emphasis, "I asked the question that put me on a 10-year quest"—how can we bypass the mind's conceptual thinking and gain conscious access to the raw, uninterpreted information of our basic perceptions? Can we shed the assumptions built into our visual processing system?

IF SOMEONE CAN BECOME AN INSTANT SAVANT, SNYDER WONDERED, DOESN'T THAT SUGGEST WE ALL HAVE SAVANTLIKE POTENTIAL LOCKED AWAY IN OUR BRAINS?

A few years later, he read about Nadia and other savant artists in Oliver Sacks's *The Man Who Mistook His Wife for a Hat and Other Clinical Tales*. As he sat in his Sydney apartment one afternoon with the book in hand, an idea surfaced. Perhaps someone like Nadia who lacked the ability to organize sensory input into concepts might provide a window into the fundamental features of perception.

Snyder's theory began with art, but he came to believe that all savant skills, whether in music, calculation, math, or spatial relationships, derive from a lightning-fast processor in the brain that divides things—time, space, or an object—into equal parts. Dividing time might allow a savant child to know the exact time when he's awakened, and it might help Eric find the sweet spot by allowing him to sense millisecond differences in the sounds hitting his right and left ears. Dividing space might allow Nadia to place a disembodied hoof and mane on a page precisely where they belong. It might also allow two savant twins to instantaneously count matches spilled on the floor (one said "111"; the other said "37, 37, 37"). Meanwhile, splitting numbers might allow math savants to factor 10-digit numbers or easily identify large prime numbers—which are impossible to split.

Compulsive practice might enhance these skills over time, but Snyder contends that practice alone cannot explain the phenomenon. As evidence, he cites rare cases of sudden-onset savantism. Orlando Serrell, for example, was hit on the head by a baseball at the age of 10. A few months later, he began recalling an endless barrage of license-plate numbers, song lyrics, and weather reports.

If someone can become an instant savant, Snyder thought, doesn't that suggest we all have the potential locked away in our brains? "Snyder's ideas sound very New Age. This is why people are skeptical," says Ramachandran. "But I have a more open mind than many of my colleagues simply because I've seen [sudden-onset cases] happen."

Bruce Miller, a neurologist at the University of California at San Francisco, has seen similar transformations in patients with frontotemporal dementia, a degenerative brain disease that strikes people in their fifties and sixties. Some of these patients, he says, spontaneously develop both interest and skill in art and music. Brain-imaging studies have shown that most patients with frontotemporal dementia who develop skills

THERE ARE REPORTS OF TWINS WHO COULD CALCULATE

have abnormally low blood flow or low metabolic activity in their left temporal lobe. Because language abilities are concentrated in the left side of the brain, these people gradually lose the ability to speak, read, and write. They also lose face recognition. Meanwhile, the right side of the brain, which supports visual and spatial processing, is better preserved.

"They really do lose the linguistic meaning of things," says Miller, who believes Snyder's ideas about latent abilities complement his own observations about frontotemporal dementia. "There's a loss of higher-order processing that goes on in the anterior temporal lobe." In particular, frontotemporal dementia damages the ventral stream, a brain region that is associated with naming objects. Patients with damage in this area can't name what they're looking at, but they can often paint it beautifully. Miller has also seen physiological similarities in the brains of autistic savants and patients with frontotemporal dementia. When he performed brain-imaging studies on an autistic savant artist who started drawing horses at 18 months, he saw abnormalities similar to those of artists with frontotemporal dementia: decreased blood flow and slowed neuronal firing in the left temporal lobe.

ONE BLUSTERY, RAINY MORNING I DROVE TO MANSFIELD, A small farm town 180 miles northeast of Melbourne. I was heading to a day clinic for autistic adults, where I hoped to meet a savant. The three-hour drive pitched and rolled through hills, occasionally cutting through dense eucalyptus forests punctuated with yellow koala-crossing signs. From time to time, I saw large, white-crested parrots; in one spot, a flock of a thousand or more in flight wheeled about like a galaxy.

I finally spotted my destination: Acorn Outdoor Ornaments. Within this one-story house, autistic adults learn how to live independently. They also create inexpensive lawn decorations, like the cement dwarf I see on the roof.

Joan Curtis, a physician who runs Acorn and a related follow-up program, explained that while true savants are rare, many people with autism have significant talents. Nurturing their gifts, she said, helps draw them into social interaction. Guy was one of the participants I met at Acorn. Although he was uncomfortable shaking my hand, all things electronic fascinated him, and he questioned me intently about my tape recorder.

Every horizontal surface in Guy's room was covered with his creations. One was an electric fan with a metal alligator mouth on the front that opened and closed as it rotated from side to side. On another fan a metal fisherman raised and lowered his pole with each revolution. And then I saw the sheep. Viewed from the left, it was covered in wool. Viewed from the right, it was a skeleton, which I learned Guy had assembled without any help. Guy didn't say much about himself. He cannot read nor do arithmetic, but he has built an electric dog that barks, pants, wags its tail, and urinates.

During my visit, another Acorn participant, Tim, blew into the room like a surprise guest on *The Tonight Show.* He was in a hurry to leave again, but asked me my birthday—July 15, 1970.

"Born on a Wednesday, eh?" he responded nonchalantly—and correctly.

"How did you do that?" I asked.

"I did it well," he replied.

"But how?" I asked.

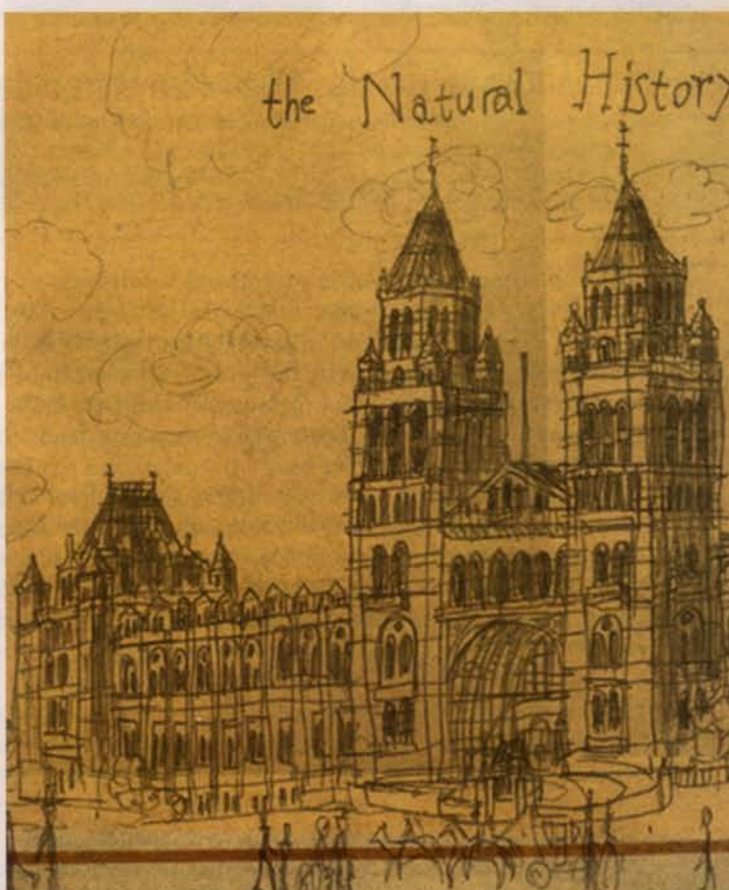
"*Very* well," he replied, with obvious pleasure. Then he was out the door and gone.

HOW DO CALENDAR SAVANTS DO IT? SEVERAL YEARS AGO TIMOTHY Rickard, a cognitive psychologist at the University of California at San Diego, evaluated a 40-year-old man with a mental age of 5 who could assign a day of the week to a date with 70 percent accuracy. Because the man was blind from birth, he couldn't study calendars or even imagine calendars. He couldn't do simple arithmetic either, so he couldn't use a mathematical algorithm. But he could only do dates falling within his lifetime, which suggests that he used memory.

He could, however, do some arithmetic, such as answer this question: If today is Wednesday, what day is two days from now? Rickard suspects that memorizing 2,000 dates and us-

DRAWING BY A SAVANT CHILD

As a child, Stephen Wiltshire did not communicate with the world except through drawing. At 10, he sketched London's Natural History Museum from memory. He is now, at 27, an accomplished artist.

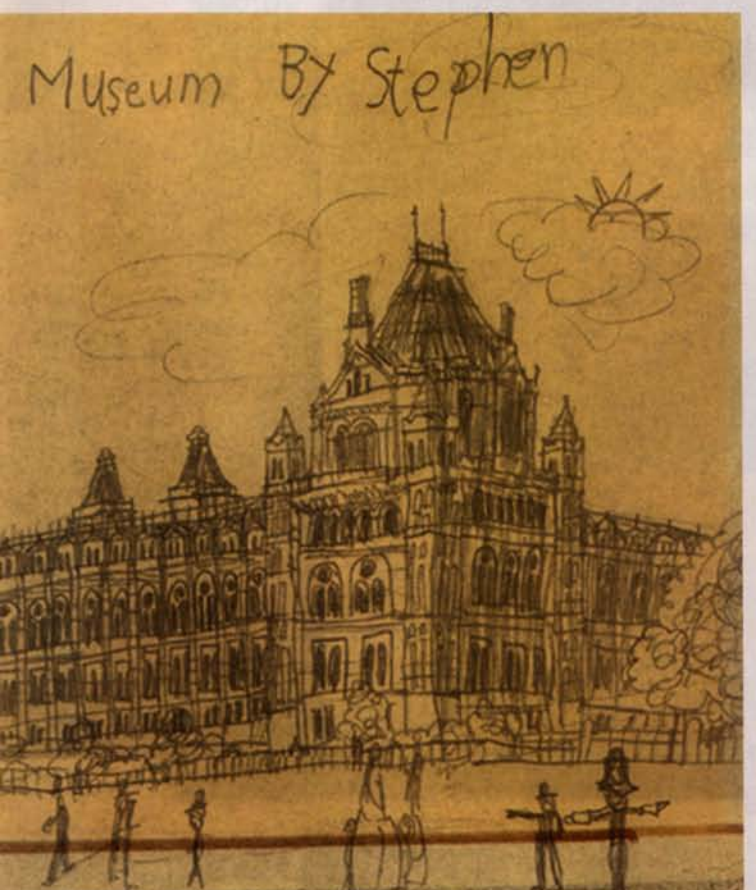


ing such arithmetic would allow 70 percent accuracy. "That doesn't reduce it to a trivial skill, but it's not inconceivable that someone could acquire this performance with a lot of effort," he says. It's especially plausible given the single-minded drive with which autistics pursue interests.

Yet Tim, the savant at Acorn, can calculate dates as far back as 1900, as well as into the future. And there are reports of twins who could calculate dates 40,000 years in the past or future. Still, practice may be part of it. Robyn Young, an autism researcher at Flinders University in Adelaide, Australia, says some calendar savants study perpetual calendars several days a week (there are only 14 different calendar configurations; perpetual calendars cross-reference them to years).

But even if savants practice, they may still tap into that universal ability Snyder has proposed. Here it helps to consider art savants. That Nadia began drawings with minor features rather than overall outlines suggests that she tended to perceive individual details more prominently than she did the whole—or the concept—of what she was drawing. Other savant artists draw the same way.

Autistic children differ from nonautistic children in another way. Normal kids find it frustrating to copy a picture containing a visual illusion, such as M. C. Escher's drawing in which water flows uphill. Autistic children don't. That fits with Snyder's idea that they're recording what they see without interpretation and reproducing it with ease in their own drawings.



Even accomplished artists sometimes employ strategies to shake up their preconceptions about what they're seeing. Guy Diehl is not a savant, but he is known for his series of crystal-clear still lifes of stacked books, drafting implements, and fruit. When Diehl finds that he's hit a sticking point on a painting, for example, he may actually view it in a mirror or upside down. "It reveals things you otherwise wouldn't see, because you're seeing it differently," he says. "You're almost seeing it for the first time again."

Diehl showed me how art students use this technique to learn to draw. He put a pair of scissors on a table and told me to draw the negative space around the scissors, not the scissors themselves. The result: I felt I was drawing individual lines, not an object, and my drawing wasn't half bad, either.

Drawing exercises are one way of coaxing conceptual machinery to take five, but Snyder is pursuing a more direct method. He has suggested that a technique called transcranial magnetic stimulation, which uses magnetic fields to disrupt neuronal firing, could knock out a normal person's conceptual brain machinery, temporarily rendering him savantlike.

Young and her colleague Michael Ridding of the University of Adelaide tried it. Using transcranial magnetic stimulation on 17 volunteers, they inhibited neural activity in the frontotemporal area. This language and concept-supporting brain region is affected in patients with frontotemporal dementia and in the art savant whom Miller studied. In this altered state, the volunteers performed savantlike tasks—horse drawing, calendar calculating, and multiplying.

Five of the 17 volunteers improved—not to savant levels, but no one expected that, because savants practice. Furthermore, transcranial magnetic stimulation isn't a precise tool for targeting brain regions. But the five volunteers who improved were those in whom separate neurological assessments indicated that the frontotemporal area was successfully targeted. "Obviously I don't think the idea is so outlandish anymore," says Young. "I think it is a plausible hypothesis. It always was, but I didn't expect we'd actually find the things we did."

Snyder himself is experimenting with grander ideas. "We want to enhance conceptual abilities," he says, "and on the other hand remove them and enhance objectivity." He imagines a combination of training and hardware that might, for example, help an engineer get past a sticking point on a design project by offering a fresh angle on the problem. One method would involve learning to monitor one's own brain waves. By watching one's own brain waves during drawing exercises, Snyder imagines it may be possible to learn to control them in a way that shuts down their concept-making machinery—even the left temporal lobe itself.

Even if further research never fully reveals why savants have extraordinary skills, we may at least learn from their potential. Snyder is optimistic. "I envisage the day," he says, "when the way to get out of a [mental rut] is you pick up this thing—those of us with jobs that demand a certain type of creativity—and you stimulate your brain. I'm very serious about this." ☒