

# Inside the Mind of a Savant

Kim Peek—the inspiration for *Rain Man*—possesses one of the most extraordinary memories ever recorded. Until we can explain his abilities, we cannot pretend to understand human cognition

By Darold A. Treffert and Daniel D. Christensen

When J. Langdon Down first described savant syndrome in 1887, coining its name and noting its association with astounding powers of memory, he cited a patient who could recite Edward Gibbon's *The Decline and Fall of the Roman Empire* verbatim. Since then, in almost all cases, savant memory has been linked to a specific domain, such as music, art or mathematics. But phenomenal memory is itself the skill in a 54-year-old man named Kim Peek. His friends call him "Kim-puter."

He can, indeed, pull a fact from his mental library as fast as a search engine can mine the Internet. Peek began memorizing books at the age of 18 months, as they were read to him. He has learned 9,000 books by heart so far. He reads a page in eight to 10 seconds and places the memorized book upside down on the shelf to signify that it is now on his mental "hard drive."

Peek's memory extends to at least 15 interests—among them, world and American history, sports, movies, geography, space programs, actors and actresses, the Bible, church history, literature, Shakespeare and classical music. He knows all the area codes and zip codes in the U.S., together with the television stations serving those locales. He learns the maps in the front of phone books and can provide MapQuest-like travel directions within any major U.S. city or between any pair of them. He can identify hundreds of classical compositions, tell when and where each was composed and first performed, give the name of the composer and many biographical details, and even discuss the formal and tonal components of the music. Most intriguing of all, he appears to be developing a new skill in middle life. Whereas before he could merely talk about music, for the past two years he has been learning to play it.

It is an amazing feat in light of his severe developmental problems—characteristics shared, in varying extents, by all savants. He walks with a sidelong gait, cannot button his



Kim Peek stands in front of an image of his brain.

Peek has **memorized 9,000 books** and can provide MapQuest-like directions between any major U.S. cities.

clothes, cannot manage the chores of daily life and has great difficulties with abstraction. Against these disabilities, his talents—which would be extraordinary in any person—shine all the brighter. An explanation of how Peek does what he does would provide better insight into why certain skills, including the ordinarily obscure skill of calendar calculating (always associated with massive memory), occur with such regularity among savants. Recently, when an interviewer offered that he had been born on March 31, 1956, Peek noted, in less than a second, that it was a Saturday on Easter weekend.

Imaging studies of Peek's brain thus far show considerable structural abnormality [see box on page 54]. These findings cannot yet be linked directly to any of his skills; that quest is just beginning. Newer imaging techniques that plot the brain's functions—rather than just its structure—should provide more insight, though. In the meantime, we believe it is worthwhile to document the remarkable things that Peek can do. People like him are not easily found, and savantism offers a unique window into the mind. If we cannot explain it, we cannot claim full understanding of how the brain functions.

### An Unusual Brain

Peek was born on November 11, 1951. He had an enlarged head, on the back of which was an

encephalocele, or baseball-size “blister,” which spontaneously resolved. But there were also other brain abnormalities, including a malformed cerebellum. One of us (Christensen) did the initial MRI brain scans on Peek in 1988 and has followed his progress ever since.

The cerebellar findings may account for Peek's problems with coordination and mobility. But more striking still is the absence of a corpus callosum, the sizable stalk of nerve tissue that normally connects the left and right halves of the brain. We do not know what to make of this defect, because, although it is rare, it is not always accompanied by functional disorders. Some people lack the structure without suffering from any detectable problems at all. Yet in people whose corpus callosum has been severed in adulthood, generally in an effort to prevent epileptic seizures from spreading from one hemisphere to the other, a characteristic “split-brain” syndrome arises in which the estranged hemispheres begin to work almost independently of each other.

It would seem that those born without a corpus callosum somehow develop back channels of communication between the hemispheres. Perhaps the resulting structures allow the two hemispheres to function, in certain respects, as one giant hemisphere, putting normally separate functions under the same roof, as it were. If so, then Peek may owe some of his talents to this particular abnormality. In any case, the fact that some people lacking a corpus callosum suffer no disabilities, whereas others have savant abilities, makes its purpose less clear than formerly thought. Neurologists joke that its only two certain functions are to propagate seizures and hold the brain together.

Theory guides us in one respect. Peek's brain shows abnormalities in the left hemisphere, a pattern found in many savants. What is more, left hemisphere damage has been invoked as an explanation of why males are much more likely than females to display not only savantism but also dyslexia, stuttering, delayed speech, and autism. Also supporting the role of left hemisphere damage are the many reported cases of “acquired savant syndrome,” in which older children and adults suddenly develop savant skills after damage to the left hemisphere.

What does all this evidence imply? One possibility is that when the left hemisphere cannot

#### FAST FACTS

#### Peek's Peaks

**1>>** Savants possess great skills. Kim Peek cannot button his shirt but knows all U.S. zip codes and can recite music he heard only once 40 years ago.

**2>>** Peek's brain is missing a corpus callosum, which connects the hemispheres. This abnormality and others evoke a key question: In development, does the brain compensate for damage or does damage simply allow latent abilities to emerge?

**3>>** Rote learning eventually developed into associative thinking for Peek, with creativity that has helped him engage the wider world. A savant's skills should never be dismissed but should be cultivated for the person's intellectual and social advancement.

ETHAN HILL (preceding pages)

function properly, the right hemisphere compensates by developing new skills, perhaps by recruiting brain tissue normally earmarked for other purposes. Another possibility is that injury to the left hemisphere merely unveils skills that had been latent in the right hemisphere all along, a phenomenon some have called a release from the “tyranny” of the dominant left hemisphere.

Peek underwent psychological testing in 1988. His overall IQ score was 87, but the verbal and performance subtests varied greatly, with some scores falling in the superior range of intelligence and others in the mentally retarded range. The psychological report concluded, therefore, that “Kim’s IQ classification is not a valid description of his intellectual ability.” The “general intelligence” versus “multiple intelligences” debate rages on in psychology. We believe that Peek’s case argues for the latter point of view.

Peek’s overall diagnosis was “developmental disorder not otherwise specified,” with no diagnosis of autistic disorder. Indeed, although autism is more commonly linked with savantism than is any other single disorder, only about half of all savants are autistic. In contrast with autistic people, Peek is outgoing and quite personable. One thing that does seem necessary for the full development of savant skills is a strong interest in the subject matter in question.

### Memory and Music

In Peek’s case, all the interests began in rote memorization but later progressed to something more. Although Peek generally has a limited capacity for abstract or conceptual thinking—he cannot, for example, explain many commonplace proverbs—he does comprehend much of the material he has committed to memory. This degree of comprehension is unusual among savants. Down himself coined the interesting phrase “verbal adhesion” to describe the savant’s ability to remember huge quantities of words without comprehension. Sarah Parker, a graduate student in psychology at the University of Pennsylvania, in a description of a savant named Gordon stated it more colorfully when she noted that “owning a kiln of bricks does not make one a mason.” Peek not only owns a large kiln of bricks, he has also become a strikingly creative and versatile word mason within his chosen areas of expertise.

Sometimes his answers are quite concrete and literal. Once when asked by his father in a restaurant to “lower his voice,” Peek merely slid lower into his chair, thus lowering his voice box. In other cases, his answers can seem quite ingenious. In



one of his talks he answered a question about Abraham Lincoln’s Gettysburg Address by responding, “Will’s house, 227 North West Front Street. But he stayed there only one night—he gave the speech the next day.” Peek intended no joke, but when his questioner laughed, he saw the point; since then, he has purposely recycled the story with humorous intent and effect.

Peek does have the power to make clever connections. He once attended a Shakespeare festival sponsored by a philanthropist known by the initials O.C., whose laryngitis threatened to keep him from acknowledging a testimonial. Peek—a fan of Shakespeare, and like him, an incorrigible punster—quipped, “O.C., can you say?”

Such creative use of material that had originally been memorized by rote can be seen as the verbal equivalent of a musician’s improvisation. Like the musician, Peek thinks quickly, so quickly that it can be difficult to keep up with his intri-

Peek reads a page in eight to 10 seconds, learning it by heart as he goes. His mental library of 9,000 books includes encyclopedic coverage of everything from Shakespeare to musical composers to the maps of all major U.S. cities.

### (The Authors)

**DAROLD A. TREFFERT** and **DANIEL D. CHRISTENSEN** have long been fascinated by savantism. Treffert, a psychiatrist in Wisconsin, has done research on autism and savant syndrome since 1962, the year he first met a savant. He was consultant to the movie *Rain Man* and is author of *Extraordinary People: Understanding Savant Syndrome*. Christensen is clinical professor of psychiatry, clinical professor of neurology and adjunct professor of pharmacology at the University of Utah Medical School.

cate associations. Often he seems two or three steps ahead of his audiences in his responses.

A rather startling new dimension to Peek's savant skills has recently surfaced. In 2002 he met April Greenan, professor of music at the University of Utah. With her help, he soon began to play the piano and to enhance his discussion of compositions by playing passages from them, demonstrating on the keyboard many of the pieces he recalled from his massive mental library. Peek also has remarkable long-term memory of pitch, remembering the original pitch level of each composition.

He readily identifies the timbre of any instrumental passage. For example, he presented the

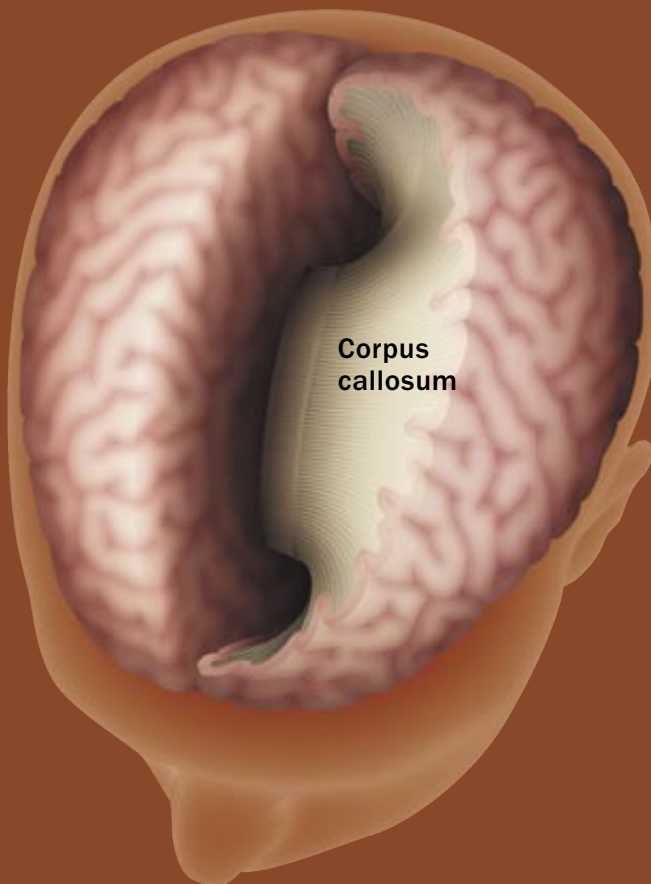
opening of Bedrich Smetana's orchestral tone poem *The Moldau* by reducing the flute and clarinet parts to an arpeggiated figure in his left hand on the piano. And he explained that the oboes and bassoons enter with the primary theme, which he then reduced to pitches played singly and then in thirds by his right hand (the left-hand figure continuing as it does in the score). His comprehension of musical styles is demonstrated in his ability to identify composers of pieces he had not previously heard by assessing the piece's musical style and deducing who that composer might be.

Though Peek is still physically awkward, his manual dexterity is increasing. When seated at the piano, he may play the piece he wishes to dis-

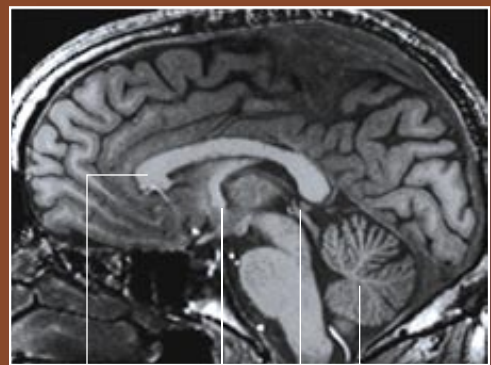
## A Missing Connection?

**K**im Peek's brain (*bottom right*) differs from typical brains (*diagram and top right*) in several ways. Peek's brain and head are very large, each in the 99th percentile. Most striking is the complete absence of the corpus callosum, which normally connects the left and right hemispheres. Missing, too, are the anterior and posterior

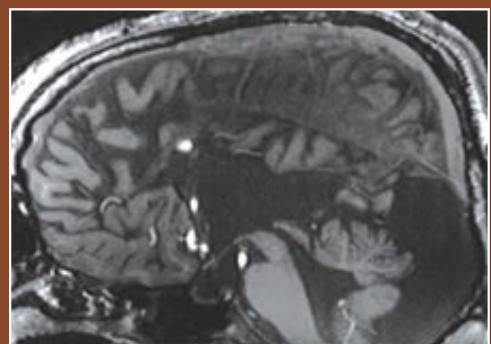
commissures, which also link the hemispheres. The cerebellum, responsible for certain motor functions, is smaller than usual and malformed, with fluid occupying much of the surrounding space; this may explain some of Peek's difficulties with coordination. What role these abnormalities play in his mental abilities is being investigated.



Normal brain



Kim Peek's brain



SARA CHEN (illustration); PRATIK MUKHERJEE AND DONNA R. ROBERTS University of California, San Francisco (MRI scans)

cuss, sing the passage of interest or describe the music verbally, shifting seamlessly from one mode to another. Peek pays attention to rhythm as well, lightly tapping the beat on his chest with his right hand or, when playing, tapping his right foot.

Greenan, a Mozart scholar, makes these observations: “Kim’s ability to recall every detail of a composition he has heard—in many cases only once and more than 40 years ago—is astonishing. The connections he draws between and weaves through compositions, composer’s lives, historical events, movie soundtracks and thousands of facts stored in his database reveal enormous intellectual capacity.” She even compares him to Mozart, who also had an enlarged head, a fascination with numbers and uneven social skills. She wonders whether Peek might even learn to compose.

### Life after *Rain Man*

It is not surprising that Peek’s prodigious memory caught the attention of writer Barry Morrow at a chance meeting in 1984 and inspired him to write the screenplay for *Rain Man*, whose main character, Raymond Babbitt, is a savant played by Dustin Hoffman. The movie is purely fictional and does not tell Peek’s life story, even in outline. But in one remarkably prescient scene, Raymond instantly computes square roots in his head, and his brother, Charlie, remarks, “He ought to work for NASA or something.” For Peek, such a collaboration might well happen.

NASA has proposed to make a high-resolution 3-D anatomical model of Peek’s brain architecture. Richard Boyle, director of the NASA BioVIS Technology Center, describes the project as part of a larger effort to fuse image data from as wide a range of brains as possible. The data, both static and functional, should enable investigators to identify changes in the brain that accompany thought and behavior. NASA hopes that this detailed model will enable physicians to improve their ability to interpret output from far less capable ultrasound imaging systems, which are the only kind that can now be carried into space to monitor astronauts.

The filming of *Rain Man* and the movie’s subsequent success was a turning point in Peek’s life. Before then, he had been reclusive, retreating to his room when company came; afterward, the confidence he gained from his contacts with the filmmakers, together with the celebrity provided by the movie’s success, inspired him and his father, Fran Peek, to share Kim’s talents with many audiences. They became enthusiastic emissaries for people with disabilities, and they have shared their story with more than 2.6 million people.



We believe that Peek’s transformation has general applicability. Much of what scientists know about health comes from the study of pathologies, and certainly much of what will be learned about normal memory will come from studying unusual memory. In the meantime, we draw some practical conclusions for the care of persons with special needs who have some savant skill. We recommend that family and other caregivers “train the talent,” rather than dismissing such skills as frivolous, as a means for the savant to connect with other people and mitigate the effects of the disability. It is not an easy path, because disability and limitations still require a great deal of dedication, patience and hard work—as Peek’s father, by his example, so convincingly demonstrates.

Further exploration of savant syndrome will provide both scientific insights and stories of immense human interest. Kim Peek provides ample evidence of both. **M**

**Piano playing is Peek’s most recently acquired skill, one at which he is becoming increasingly adept despite having poor coordination. Music professor April Greenan (seated) and Peek’s father, Fran, have encouraged his efforts.**

### (Further Reading)

- ◆ **The Real Rain Man.** Fran Peek. Harkness Publishing Consultants, 1996.
- ◆ **Extraordinary People: Understanding Savant Syndrome.** Updated edition. Darold A. Treffert. iUniverse, Inc., 2006.
- ◆ **www.savantsyndrome.com**, a Web site maintained by the Wisconsin Medical Society.