

NEUROSCIENCE

Accidental Genius

A blow to the head can
sometimes unmask hidden
artistic or intellectual gifts

By Darold A. Treffert

Darold A. Treffert, a Wisconsin psychiatrist, met his first savant in 1962 and has done research on the syndrome ever since. He served as a consultant for the making of the movie *Rain Man* and maintains a Web page at www.savantsyndrome.com, hosted by the Wisconsin Medical Society.



A 10-year-old boy, Orlando Serrell, knocked unconscious one day by a baseball, discovered afterward that he could bring to mind the exact day of the week for any date after the accident and could remember the weather for each day since the trauma as well. He could also recall the most minute daily events.

Jason Padgett, the victim of a brutal mugging in 2002 that left him with a severe concussion, soon afterward began to see what he describes simply as “images.” He began to sketch them out on paper. When he showed his work to others, he learned that the repeating, self-similar patterns were fractals.

These two people have a remarkable condition known as acquired savant syndrome. In the more familiar savantism—made famous by the 1988 movie *Rain Man*—people are endowed from early in life with extraordinary but narrowly defined musical, artistic, mathematical, memory and mechanical skills that stand in contrast to their marked impairments in language, social interactions and other mental faculties overall. In *Rain Man*, for instance, actor Dustin Hoffman’s character, Raymond Babbitt, had stunning mathematical, calendar-calculating and other skills and a massive memory but also showed severe cog-

nitive and behavioral limitations from his underlying autism.

In acquired savant syndrome, in contrast, near-genius levels of artistic or intellectual skills show up after dementia, a severe blow to the head or another insult to the brain. Discovery of this unusual phenomenon raises the possibility that dormant potential in some artistic or intellectual realm—an “inner savant”—resides in each of us. If so, perhaps a way can be found to tap these buried abilities in the absence of disease or injury.

YOUR INNER SCULPTOR

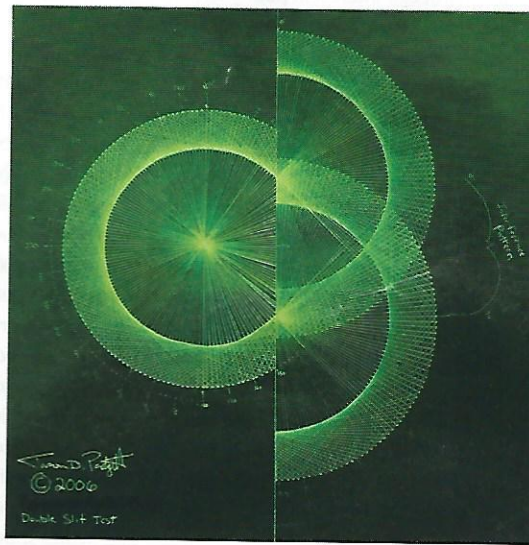
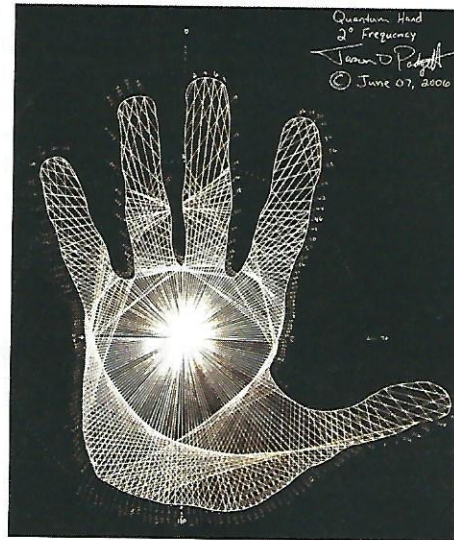
I HAVE STUDIED SAVANT SYNDROME for much of my career. Until the mid-1980s, I assumed it was present from birth—in other words, savant syndrome was a congenital condition. But then I attended the premier exhibition of exceptional sculptures made by Alonzo Clemons. As an infant, Clemons seemed to learn quickly.

IN BRIEF

Rain Man, the movie starring Dustin Hoffman, brought to popular attention the existence of savant syndrome—in which people with autism display exceptional intellectual or artistic gifts from birth.

Acquired savantism is an alternative form of the condition in which a person develops the ability to paint, play music or do mental calculations after experiencing some form of brain injury.

An inner savant may exist in most people if the proper brain circuits are activated or switched off through electrical stimulation technologies or even through focused practice of a particular skill.



GEOMETER: Padgett began to produce drawings like the ones at the right when a mugging that caused a concussion unlocked math, physics and artistic capabilities that the college dropout never knew he had.

At about age three, however, a fall resulted in a brain injury, slowing his cognitive development precipitously and leaving him with a serious intellectual disability, including limited vocabulary and speech. But afterward, he developed a spectacular skill for sculpting using whatever materials were handy—even shortening from the kitchen. With his new talent came a growing fascination with animals. For example, he could look at a photograph of a horse in a magazine and then sculpt a three-dimensional replica in less than half an hour, each muscle and tendon reproduced in exacting detail.

Clemons sparked my interest in acquired savant syndrome, and I looked for reports of it in the medical literature but found only a few instances. In 1923 psychologist Blanche M. Minogue described the appearance of extraordinary musical abilities in a three-year-old following a bout of meningitis. In 1980 T. L. Brink, another psychologist, reported on a nine-year-old boy in whom superior mechanical skills appeared after a bullet wound to his

left brain. In his case, he was able to dismantle, reassemble and modify multigear bicycles and invented a punching bag that could simulate the bobbing and weaving of a live opponent.

These sparse reports in the years before 1980 reflected the condition's rarity: a concussion or stroke does not usually enhance cognitive or creative capacity. I then decided to collect descriptions of such cases. By 2010 I had assembled a worldwide registry of 319 known savants, of whom only 32 had the acquired form.

Among the reports entered in my registry was work done by neurologist Bruce Miller, now at the University of California, San Francisco, and his colleagues. In 1996 Miller began compiling the first of 12 cases of people who had a disorder known as frontotemporal dementia (FTD). These elderly patients demonstrated musical or artistic skills for the first time, sometimes at prodigious levels, after their diagnosis. Frontotemporal dementia differs from Alzheimer's dementia in that the degenerative process

affects only the frontal lobes and not wider areas of the brain.

FTD often targets the left anterior temporal area of the brain and the orbitofrontal cortex. Both regions normally inhibit activity in the visual system at the back of the brain, which is involved in processing incoming signals from the eyes. The disease seems to foster a newfound artistic sensibility by turning off inhibitory signals from the front of the brain. The releasing

of the brakes allows the brain to process sight and sound in new ways. It unleashes artistic or other creative sensibilities even though damage to the frontal lobes may lead to the inappropriate behaviors that characterize the disorder. "FTD is an unexpected window into the artistic process," Miller says.

Further work implies that accidental genius results from diminished activity in some brain areas that is combined with a

counterbalancing intensification in others. More specifically, it involves a set of events I call the three R's that occur after the brain is damaged—most often after the left hemisphere is stricken, similar to what happened with Miller's FTD cases. The process begins with "recruitment," a rise in electrical activity in still intact cortical tissue, often in the right hemisphere. Then the brain circuitry undergoes "rewiring" to establish newly formed connections between regions that were not previously linked. Next comes "release" of dormant capacity as a result of increased access to the newly connected brain areas.

An experiment done by Richard Chi and Allan Snyder, both then at the Center for the Mind at the University of Sydney, has used a relatively new technology to provide some evidence that these brain changes account for the acquired savant skills. Using transcranial direct-current stimulation (tDCS), these researchers induced savantlike abilities in human volunteers. The technique generates a polarized electric current to diminish activity in a part of the left hemisphere involved with sensory input, memory, language and other brain processes while increasing activity in the right hemisphere (the right anterior temporal lobe).

The investigators then asked study participants to solve the challenging "nine-dot" puzzle either with or without tDCS—a task that requires the creativity to search for a solution in an unconventional way. Participants had to connect three rows of three dots using four straight lines without lifting a pen or retracing lines. None of them could solve it before stimulation, and when 29 subjects were exposed to "sham" stimulation—electrodes emplaced without any current to test for placebo effects—they were still at a loss. With the current switched on, however, some 40 percent—14 of 33 participants—worked their way through the puzzle successfully.

How can a person suddenly perform so much better at the flip of a switch? Because these instant savants—and congenital and acquired savants as well—"know things" innately they were never taught. Clemons, the sculptor, had no formal training in art but knew instinctively how to produce an ar-

CASE HISTORIES

The Ultimate Eureka Moments

Acquired savantism has given people the ability to pursue poetry, music and instantaneous mental calculations. A few cases from a registry of savants follow.

The late Tommy McHugh was a 51-year-old builder in Liverpool, England, without any particular interest in poetry or painting. After suffering in 2001 a hemorrhage in the lining of the skull that damaged the frontal area of his brain, he suddenly began to fill notebooks with poems and to spend much of his time painting and sculpting. Physicians attributed this new talent to "relative disinhibition," which frees up the ability to evoke unusual word juxtapositions or imagery. McHugh has had exhibits in the U.K., and his story has been chronicled in a number of television documentaries.

Orlando Serrell, mentioned earlier, who began doing calendar calculations as a boy after being knocked out by a baseball, can determine the day of the week for any day since the injury occurred. He also recalls the weather every day since his injury. Now at 44, the Virginia man is still able to calendar-calculate, but his memory skills have advanced so that he can remember the minutest details of each day's activities—a condition known as hyperthymestic memory. Brain scans at Columbia University Medical Center have confirmed that Serrell engages in unconscious calculating—and his skill is not based on memorizing the calendar.

Derek Amato was a 40-year-old corporate trainer in Colorado with no special interest or skill in music. In 2006 he dove into the shallow end of a swimming pool, sustaining a severe concussion and losing some hearing in one ear. Following his hospital discharge, he was inexplicably drawn to the piano, which he had never touched before. He began to see black-and-white spots that he was able to transpose from his head into notes on the piano. He now makes his living composing, performing and recording.

Tony Cicoria, an orthopedic surgeon from New York, was talking on the telephone in 1994 when he was struck by lightning. Presumed to be in cardiac arrest, he was resuscitated by a nurse who was waiting to use the phone. For a week or two he had some mild memory problems. Those eventually subsided, and he resumed his orthopedic surgery practice full-time with no residual effects from the lightning strike. But one thing had changed. He developed a consuming obsession with classical music. Before the incident, he thought of himself as mainly a "rocker." But his newfound obsession morphed into a desire to play classical music as well. Shortly after his injury, he heard music in a dream. The tune stuck with him, resonating in his head whether he was awake or asleep. Finally, he decided to transcribe the earworm into a 26-page concert piano piece called *Fantasia: The Lightning Sonata*, op. 1.

Jason Padgett, who developed a passion for math, physics and drawing geometric shapes after he sustained a concussion following an assault, still runs three futon stores in Washington State. He now calls the injury, mentioned earlier, a "rare gift." Before the mugging, Padgett described himself as being among the "math-averse." Now the former college dropout takes higher-level math courses to fully understand the geometric figures that are his obsession, and he has written a popular book about his experiences.

—D.A.T.

mature, the frame for the sculpture, to enable his pieces to show horses in motion.

One plausible explanation for the hidden talents that emerge in savant syndrome—whether early in life or induced by injury—is that these reservoirs of skill and knowledge must be inherited in some way. We do not start life with a blank slate that subsequently gets inscribed through education and other life experiences. The brain may come loaded with a set of innate predispositions for processing what it sees or for understanding the “rules” of music, art or mathematics. Savants can tap into that inherited knowledge far better than the average person can.

THE GENIUS SWITCH

KNOWING THAT THESE TALENTS can emerge even later in life raises the question of whether everyone has the capacity to become a savant—and whether it might be possible to do so without facing the travails of brain injury or dementia.

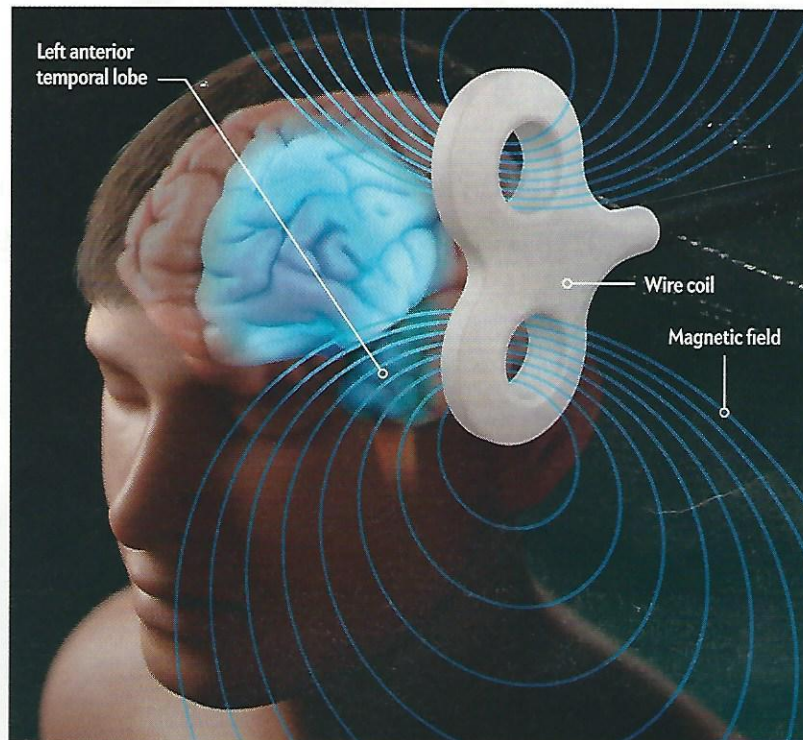
Another way to unleash buried brilliance would be to apply tDCS—or a related technology called repetitive transcranial magnetic stimulation—also a form of “thinking cap” that would toggle brain regions on and off to potentially augment a person’s creative capacity. A technological solution may not be an absolute prerequisite, however. Meditation or simple adherence to assiduous practice of an artistic skill may suffice to allow us to switch on the more creative right side of the brain and thus explore undiscovered artistic capabilities.

As investigators understand the brain better, they may find other ways of determining what happens when brain circuits are turned up or down. Diffusion tensor imaging (DTI) and diffusion tensor tracking (DTT), which pinpoint connections among neurons (“fiber tracking”), are better suited than earlier methods for revealing the intricacies of the wiring inside a person’s head, enabling researchers to correlate brain activity to the sudden appearance of skills. These more precise technologies can provide three-dimensional images of the fibers that tie together brain cells.

One challenge to uncovering the neurobiology underlying savantism has been the difficulty of observing brains as they carry out creative tasks that require movement. Not only is it hard to sculpt or play a piano inside an MRI machine, but any movement compromises image acuity. A newer technique—near-infrared spectroscopy (NIRS)—would sidestep such problems by replacing bulky machines with a comfortable skullcap that measures the amount of oxygen in blood flowing through the brain’s blood vessels and relays the information to image-processing software. Even more promising is a recently developed helmet that uses another imaging method—positron-emission

Instant Savant

A technology called repetitive transcranial magnetic stimulation can temporarily unleash savantlike abilities and offers a way to investigate how those abilities arise. When a coil placed over the left temple delivers a pulsed magnetic field through the skull, the field apparently turns off brain circuits in the left temporal area that process words and other information. Right-brain circuits dedicated to spatial tasks take on a more expansive role in mental processing. In some cases, subjects exposed to the magnetic fields were better able to guess the quantity of a large collection of objects.



tomography (PET)—for monitoring when a person is sitting, standing or even exercising.

Such studies are worth pursuing. Acquired savantism provides strong evidence that a deep well of brain potential resides within us all. The challenge now is to find the best ways to tap into our inner savant—that little bit of Rain Man—while keeping the rest of our mental faculties intact. ■

MORE TO EXPLORE

Savant-Like Skills Exposed in Normal People by Suppressing the Left Fronto-Temporal Lobe. Allan W. Snyder et al. in *Journal of Integrated Neuroscience*, Vol. 2, No. 2, pages 149-158; December 2003.

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