No one is quite sure where creativity comes from, but that doesn't worry Allan Snyder. He says he knows how to turn it on at the flick of a switch. **Helen Phillips** investigates

The genius machine

"TAKING RISKS," says Allan Snyder, "that's one of the main things that drives me." All the more amazing, then, that so many people willingly don his specially designed headpiece so he can zap their brains with strong magnetic pulses in a bid to turn them, temporarily, into autistic savants.

Snyder, director of Australia's Centre for the Mind, wouldn't put it quite like that. He'd say he was switching off higher brain functions in an attempt to mimic certain symptoms of mental illness. But it boils down to the same thing. Snyder wanted to see whether he could turn everyman into Rain Man.

Why, you might ask, would he want to do that? Well, he explains, perhaps if he gets the conditions just right, his magnetic mind-zapper might act as a creativity machine, revealing an inner genius his subjects didn't even know they possessed.

Given Snyder's obvious eccentricity and self-confessed love of risk, you might be forgiven for running a mile rather than have him mess with your mind. But he is perfectly serious. Take a moment to look over his numerous awards and fellowships, his thriving research centres at the University of Sydney and the Australian National University in Canberra, not to mention his record of attracting the likes of the Dalai Lama and Nelson Mandela to his conferences, and you feel perhaps you ought to hear him out. Once he starts explaining himself, it becomes hard to see where eccentricity ends and creative genius begins. And maybe that's the point.

Madness has long been linked with creativity. Van Gogh, Edgar Allan Poe, Tchaikovsky and John Nash all trod a fine line between the two. But it wasn't psychotic or manic genius that got Snyder thinking. It was autistic savants – severely impaired people with one or more amazing mental skills, perhaps in drawing, music, sculpture or language. These talents are all the more striking because they often occur in people whose intelligence is otherwise very limited.

Despite popular belief, autism is seldom linked with amazing skills. For every autistic savant there are maybe 10 more people with autism who do not have a special skill. And roughly half of all savants are not autistic, but have some other form of mental illness, brain damage or retardation. But the fact that savants exist at all gave Snyder a bright idea. "My research is directed at the belief that you can switch on extraordinary skills by switching off part of the brain," he explains.

Psychologists have long been fascinated by savant skills. The orthodox view is that these "islands of genius" result from obsessive use of what little mental capacity is spared by the illness. But Snyder disagrees. He thinks we all have amazing skills, but they are concealed within our subconscious. Autism, he believes, causes some part of our brain's normal function to be lost, sometimes allowing the savant skills to shine through.

MICHAEL AMENDOLIA

Allan Snyder believes there are savant-like skills lurking in all of us

The main reason for thinking savant skills are hidden within everyone is that they can appear spontaneously after someone has suffered brain damage. One case in the literature, for example, documents how a child suddenly acquired spectacular calendar-calculating skills and an extraordinary memory for days, dates and music following an injury to the left side of the head at age 10. Another famous case is Alonzo Clemons, who developed a striking talent for animal sculpture following a childhood head injury.

Savants are also found among people with a rare neurodegenerative condition called frontotemporal dementia. In this disease, people – usually in their 50s – gradually lose their inhibitions and mental faculties as part of the brain beneath their temples withers away. Bruce Miller, a neurologist at the University of California, Los Angeles, who is an expert on the disease, has documented a handful of patients who developed artistic skills as their illness advanced. One patient with no prior interest in art took up drawing at the age of 53, producing vivid childhood scenes from memory (*Neurology*, vol 51, p 978).

The art produced by these people is distinctly savant-like, says Snyder, in that it consists of realistic scenes or memories rather than expressionistic or creative imagery. But what struck Snyder most was Miller's discovery that his patients all had damage in the same area of the brain, the left frontotemporal lobe. Previous studies have suggested that the majority of autistic savants have left-sided damage, and Miller himself has studied an autistic patient with damage in the left frontotemporal lobe. What's more, the people who became savants after a head injury also had damage on the left side.

One person who became a calendar-calculating savant after a head injury is now having his brain scanned in an attempt to pin down how his skills developed. But however it happened, the spontaneous and sudden appearance of remarkable mental abilities means they cannot be the result of training or obsessive practice, thinks Snyder. The skills must have been there to start with. "The people who possess these unusual skills do so because they have brain damage," he says. "Our theory is that the brain damage made them access something that we all have."

But what might that be? Psychologists have long known that a large proportion of brain activity occurs without our knowledge, and that only a small amount ever reaches our conscious awareness. Snyder's version of this model is that your unconscious brain extracts all the raw sensory details about the world around you – the tones and pitches, lines, light and shadow. This information is far more than we can deal with, he believes. But it is where we experience the world "as it really is".

Except most people never see this version of events. Our unconscious mind takes the flood of information and simplifies and ▶

categorises it into manageable and useful packages. Where it sees lines and patterns of dark and shade, our conscious mind might know it is a horse. We know that, because our brain has learned all about horses, has experienced what makes something a horse rather than a dog or a table, and has formed a concept and a mental image. It's a very efficient way for our minds to work. It allows us to spot things quickly, to name them and communicate the ideas. The mind also learns how these things might behave, so that we can make predictions about the world and devise rules about how to act appropriately. Snyder calls these various ways of extracting meaning from the raw data "mindsets".

In Snyder's view, what savants lack is mindsets. They experience only raw sensory information, and their precise drawings are a reflection of that. The reason most people can't draw like that is because their mindsets get in the way. Once the brain forms a concept, it inhibits the conscious mind from becoming aware of the details that created that concept in the first place. So instead of drawing what you see, you draw what you know.

Snyder and his colleague John Mitchell first went public with this idea about five years ago, only to be met with widespread scepticism (*New Scientist*, 9 October 1999, p 30). So they began trying to prove it, which is where the magnetic brain-zapper comes in.

It sounds drastic, but using magnetic pulses to switch brain activity off is routinely used in neurology departments and hospitals. Called transcranial magnetic stimulation, or TMS, it is used as a research tool to test for side effects of brain surgery, and to work out the function of parts of the brain. The idea is simple: place a strong magnetic field on your scalp and you halt electrical activity in the nearby part of your brain, just as placing a fridge magnet on a computer can stop the hard drive from working (see Graphic, right).

Snyder and his colleagues decided to focus TMS on Miller's area – the left frontotemporal lobe – in the hope that temporary and reversible damage to it would let savant skills shine through. Last year they tried it out, first on Snyder himself, then on 11 volunteers under experimental conditions. And late last year he published the initial results (*Journal of Integrative Neuroscience*, vol 2, p 149).

MICHAEL AMENDOLIA

Savant skills are often seen in people with damage to a lobe on the left side of the brain. So Snyder decided to switch this lobe off (right) and see what happened

First the downside. Only four of the 11 volunteers responded to TMS. This, however, isn't all that unusual, says Niels Birbaumer from the Institute for Medical Psychology and Behavioural Neurobiology at the University of Tübingen in Germany. "In some people you get an effect, in some not, and in any case the effect is not very strong and that's typical for TMS results," he says. No one really knows why this is, but it probably has something to do with the fact that brain organisation varies widely from person to person.

In the four people who responded, however, TMS had some notable effects, Snyder says. First he looked at the subjects' drawing style before, during and after a 15-minute bout of TMS. He asked them to draw people from memory after briefly showing them photos, and animals from their imagination. It's hard to say that TMS made the subjects better at drawing, but it did seem to change their style (see Graphic, below). You might say the drawings were more natural. The effects lasted for 45 minutes or so, suggesting either that the TMS had some lingering effects, or that subjects learned a new way to do things. Three of the four people who responded also reported altered states of consciousness, saying they became more aware of detail. Other subjects said they felt slightly high.

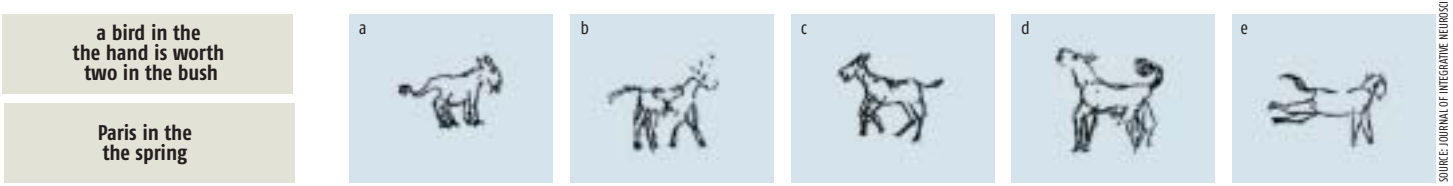
Snyder also wanted a more objective test, so he asked his subjects to proofread phrases with a non-obvious mistake. Without TMS everybody missed the errors, but with TMS two subjects were more likely to see them. One improved from zero to a 70 per cent success rate, the other from zero to 50 per cent. Snyder claims that this is evidence that TMS makes the subjects see the world the way it really is. "Like autistic savants, they are much more literal," he says.

Snyder is also working on a set of tests for mathematical skills, looking at prime number generation and calendar-calculating skills, and also musical skills.

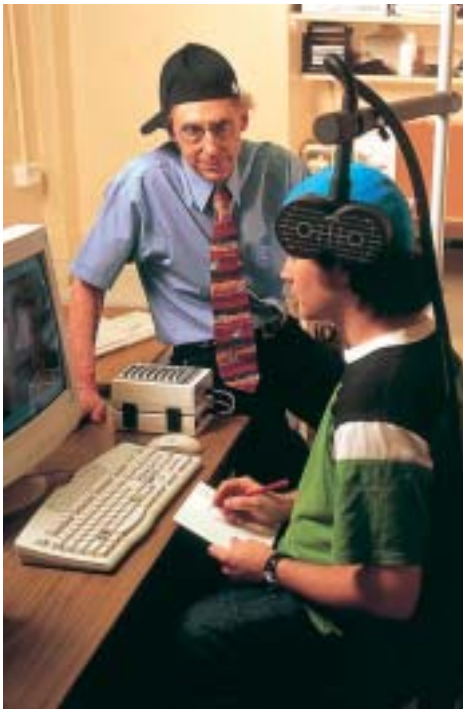
Other researchers have results that back Snyder up. Psychologist Robyn Young and her colleagues at Flinders University in Adelaide, South Australia, initially sceptical of Snyder's theory, looked at a wider range of skills under TMS. She asked volunteers to recall lists of names, addresses and telephone numbers, reproduce pictures they had been shown for just a short time, judge musical pitches as

BRAIN BOOSTER

Shutting off the left frontotemporal lobe with a TMS machine can improve your eye for detail (left) and also subtly alter your drawing style (right). Are these glimmers of savant-like skills in all of us?

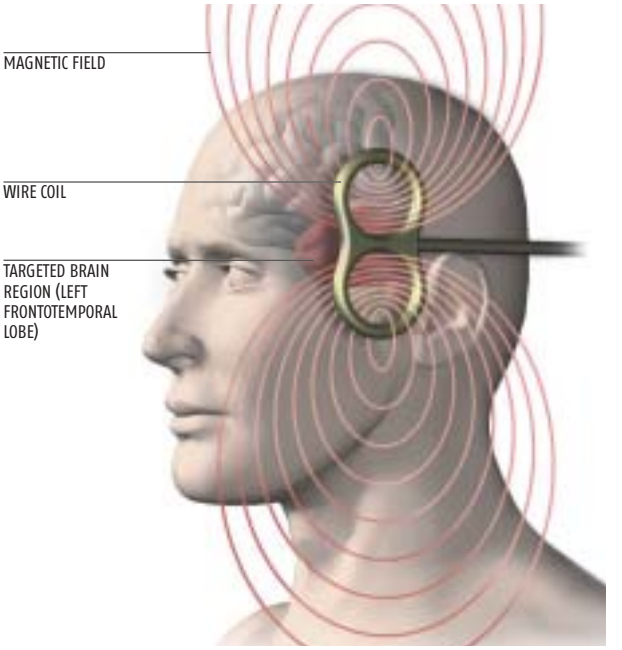


SOURCE: JOURNAL OF INTEGRATIVE NEUROSCIENCE, *vol 2, p149*



TURN ON, TUNE OUT

A TMS machine consists of a coil of copper wire inside a paddle-shaped casing. Passing an electric current through the coil induces an intense magnetic field around it. If you place the paddle on someone's scalp the magnetic field penetrates about 2 cm into their skull, inducing an electric field in the brain tissue beneath. Depending on the strength of the field, the shape of the coil and the rate of the electrical pulses (anything from a single one to 50 per second) this either activates, slows down or jams normal signalling in that part of the brain



"Some subjects reported altered states of consciousness, saying they became more aware of detail. Other subjects said they felt slightly high"

higher, lower or the same as a test pitch, and spot the primes in a long list of numbers. Five out of her 17 subjects showed some improvements. These were not miraculous, she says, though one person, strikingly, improved across the board. She hopes to have her findings accepted for publication soon.

If Snyder and his team are right and we all have hidden, savant-like skills, he suggests some interesting implications. He predicts that TMS could grant us, at least temporarily, access to savant-like skills such as perfect pitch, improved memory or the ability to learn a new language without an accent. Snyder's favourite idea, however, is that he could use a TMS machine as a "thinking cap" to boost creativity.

This is quite a claim. Psychologists cannot agree what creativity is nor where it comes from, but the one thing they would all agree on is that savant skills are anything but. They might look creative but are really just an elaborate form of copying, says John Geake, who studies creativity at Oxford Brooks University in the UK. A savant pianist might reproduce an entire piece having heard it only once, but would be unable to compose or improvise. A savant artist, meanwhile, might draw a building in accurate detail from memory but the drawing would lack interpretation or originality.

Snyder doesn't dispute this. "It's clear that savant skills are pure mimicry," he says, "almost the opposite of creation." But he argues that there is a link between savantism and creativity. Being creative, he explains, is all about linking seemingly disparate ideas in a new way. Perhaps, then, a brief look at the world as a savant sees it, shorn of mindsets, would help you make such links. Savants routinely operate without mindsets, so cannot use the experience creatively. But if a normal person could dip in and out of the savant's world, it might be a different story.

It's an idea Snyder and his team have only just launched into the world of neuroscience (*Journal of Integrative Neuroscience*, vol 3, p 19). And the initial responses are, perhaps not surprisingly, a little sceptical. Birbaumer, though generally agreeing with Snyder that our subconscious brain has a lot in common with autistic savants, does not buy his theory about creativity. "It's speculative and far-fetched," he says. It's quite a leap from showing glimmers of savant-like skills within us all to placing them at the heart of a grand theory of creativity – especially as Snyder has not yet shown that TMS can deliver a creative boost.

One major objection is that there are other theories about creativity, long developed in the psychological literature, which Snyder is ignoring. Brain-imaging work, for example, has shown that the hippocampus, a memory structure deep in the brain, is active at that moment of insight when people solve riddles (*Hippocampus*, vol 13, p 316). This is not a brain area that Snyder has considered important, nor is it accessible to TMS because it lies too deep. What is more, Geake, along with Peter Hansen and others at the University of Oxford, has suggested that creativity relies heavily on mindsets. They found that a large working memory correlates with increased creativity. The more information you can juggle the more likely you are to make creative connections.

But other established ideas seem to chime with Snyder's view. Jordon Peterson, a psychologist at the University of Toronto, Ontario, says that creativity comes when people break out of their perceptual habits and see a new way of doing things. Psychologists talk about us having "frames" or perceptions about the world, echoing Snyder's mindsets. Although Peterson has different ideas to Snyder about how people form a new view, he agrees that creative people can switch between frames and make new ones more readily.

And the well-established link between mental illness and creativity makes sense in Snyder's view of things too. Perhaps certain mental illnesses are caused by inadvertent access to our normally subconscious view of the world, he suggests. Losing access to your conceptual mind may cause many problems, but a side effect might be an insightful glimpse of the world as it really is.

There may be a multitude of existing theories about what makes a brain creative. But none of them has yet been proved. Without testing, who can say what is at the heart of creativity: memory capacity, specialisations in brain areas, differences in thinking style?

Not everyone will be convinced by Snyder's idea about what makes a mind creative. But it's brave and original, and he has come up with something that can be tested. It might be completely crazy. But then again, it might just be the most amazingly creative insight. ●

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