A Genius Within

Tall, lean, and mildly eccentric, Professor Allan Snyder never takes off his black leather cap, even inside a restaurant. He is a professor from Australia, a Fellow of the Royal Society of London, who smiles like a wizard and speaks like a wild New York teenager.

He has a surprising present for you — a wonderful gift, indeed. If you visit his laboratory, he will put an electromagnetic brain-stimulating device on your head that will turn you into a genius. This is the magic of the 21st century.

Sounds too good to be true? Well, some people say that ideas in science must be crazy enough to be true.

The gist of Professor Snyder's idea can be briefly summarized as follows:

1. *Autistic savants without any learning skills sometimes show amazing talent.*
2. *This is because autistic savants somehow have direct access to raw or lower-level algorithms of the brain.*
3. *Healthy adults, on the other hand, are denied this access.*
4. *By electromagnetically stimulating the left side of the brain, however, healthy adults might be able to gain this access.*
5. *In a word, you have a "genius" hiding inside your brain.*

So, Professor Snyder claims that autistic savants reveal the secret of how our inner brain works, and that we can mimic this savant effect by electromagnetic stimulation.

Some day in the near future, you might be able to experience the world of a genius via a portable "genius machine," or what Professor Snyder calls a "thinking cap."

Learning and Creativity — Accelerated by Suppressing or Circumventing Certain Brain Regions

Allan Snyder is the director of the Centre for the Mind, a joint venture between two prestigious Australian universities, the Australian National University and the University of Sydney. He holds the 150th Anniversary Chair of Science and the Mind at the University of Sydney, and the Peter Karmel Chair of Science and the Mind at the Australian National University. He is also a fellow of the Royal Society of London.

Allan Snyder is a graduate of the Massachusetts Institute of Technology (MIT), Harvard University, and University College London. Previously, he was a Guggenheim fellow at the Yale University School of Medicine and a Royal Society guest research fellow at the Physiological Laboratory, Cambridge University, England.

Allan Snyder received the 2001 Marconi International Prize — "the world's foremost prize in communications" — in New York City, and the 2001 Clifford Patterson Prize of the Royal Society in London.

Champion Mindsets

Let me begin by putting learning into perspective. Ultimately, I care about learning to be creative, to make leaps. I make the distinction

between holding something up and saying "learn that," and being truly creative. We care about learning to be creative. After all, any company or corporation — I'm particularly interested in corporate creativity — is only as good as its next big idea; and creativity is the driving force that incubates these big ideas.

So, we need scientific ways to identify creative individuals in order to assemble innovation teams, for example. At the Centre for the Mind, we have developed a unique measure called the "creativity quotient" (CQ), which generates a creativity profile for each and every person in a corporation. However, I'm not going to talk about that today; I'm just bringing it up as background.

We also need strategies to nurture creativity, starting from the earliest of ages. We have developed a program at the Centre called "Any Kid can be a Champion" that does just that, but I'm not going to talk about that today either. Instead, I will talk briefly about my book *What Makes a Champion!* [a] during this lecture.

A person's creativity does not depend on how fast or how much he or she learns. Indeed, studies have shown that child prodigies, who learn faster than anybody else, rarely amount to anything (although there are some exceptions, like Mozart). On the other hand, all of the Nobel laureates and fellows of the Royal Society of London — I just happen to have my hands on that because I am a fellow — scored very average grades in school. This is astonishing: Nobel laureates and fellows of the Royal Society of London were very average students. In other words, if your children are doing great in school, then they will probably not become brilliant scientists.

This is nothing to agree about. This is a fact. I haven't said anything interesting. I'm just talking about facts. I really mean it.

What is really important is learning how to struggle, how to recover from adversity, and how to adapt. Nothing is more important than daring to take risks and to confront conventional wisdom. If you just learn automatically like a prodigy does, you will never learn how to struggle.

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[a] Snyder A (ed.), *What Makes a Champion!* Penguin, Australia, 2002.

I was a lousy student, and I was ashamed of it (although I have to admit that I wasn't so lousy that I could not get into Harvard). I think things came hard to me, so I had to learn how to struggle. This is what I call the "champion mindset": being able and willing to take risks, confront conventional wisdom, and face adversity.

What Makes a Champion! deals precisely with this concept. I arranged for Nelson Mandela and a group of 50–60 extraordinary people to be together, and we had a 3-day conference about this. What I discovered was that creativity is an act of rebellion. To be creative, you have to confront conventional wisdom; you have to break with convention. If you are not willing to be subversive, you will not be creative. After all, something is considered a breakthrough only when it is subversive.

The hallmark of someone who has this champion mindset, as I call it, is that they abhor being just average or ordinary. Now, that's surprising. When I started out, I thought that to be extraordinary or truly creative, one would be driven by the need to be successful or by the fear of being a failure. However, this is not the case. Champions are not by nature driven to succeed, neither are they driven by a fear of failure; they simply do not want to be ordinary. They want to differentiate themselves from the rest of the pack, and not always consciously. Becoming a champion is not a conscious decision that you can simply choose to do: if it is conscious, then you have probably destroyed any hope of ever achieving it.

So, my take-home message on this little preamble is that we should not encourage children to be like everyone else (this message really drives home the debate over Asian versus Western learning). Instead, we should nurture their uniqueness. If you want children to have this special ingredient that we call supercreativity, then you have to encourage them to be subversive in order to convert conventional wisdom.

Now, there are a lot of families and individuals that I could talk about and use as examples, but I'm going to just briefly talk about me and my family. I take no credit for anything about me — my parents, as you will see, must take credit, and in a extraordinary way. I come

from a family of three boys, and each of us has won major international prizes in different fields. I have no idea why this is so. I can, however, tell you that my parents constantly told us to nurture our uniqueness: "Each of you has something to give, whatever it may be," they would say.

You are all unique. By definition, no one else is like you, and so each of you has something that is different from everyone else. Therefore, if you develop that, then you will, by definition, have this extraordinary thing. So wham! Celebrate that!

Mindsets

Now, I'd like to talk about something that was the subject of an article I wrote in *Nature*.[b]

In my opinion, the major challenge for the future is to have devices that help amplify a person's creativity. I've told you what I think creativity is, but I'm more interested in constructing devices that amplify a person's creative learning ability: devices that allow you to realize your true genius, your true creative capacities. Ultimately, my dream is to have a learning machine — a real "thinking cap."

The bottleneck to creative learning — as opposed to just learning, which you usually do in school (e.g. rote memory) — is failing to recognize that there is something new to learn in the first place. The bottleneck to learning is not that people have trouble learning (I've already told you that prodigies don't amount to anything), but rather that most people look at something and don't recognize there's something to learn. This is profoundly important, and is backed up by neuroscience and psychology. In fact, I'm going to back it up right now.

Unlike infants, we as adults do not see the world through a literal interpretation of our senses. Instead, we see it through our "mindsets": our knowledge which has been accumulated through past experiences.

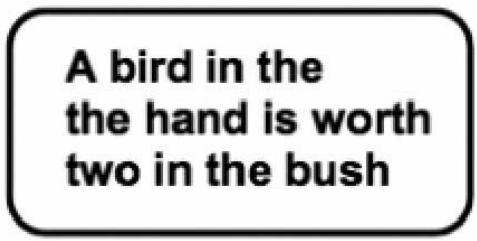
[b] Snyder AW, Barlow H, "Human vision: revealing the artist's touch," *Nature* **31**: 117–118, 1988.

Now think about that. How can we join the dots up in a different way if, every time you look at the dots, you impose something you already know? I like this metaphor because I don't think there's any better way other than this beautiful metaphor to describe all the information I'm about to give you.

Our brains impose meaning on sensory information. They present us with a coherent picture or the best hypothesis, when in reality there is always ambiguity. In other words, we are designed to be experts. We are wired to maneuver rapidly in a familiar environment. However, this comes at the cost of prejudice, the cost of making assumptions. It is a tremendous evolutionary advantage to have mindsets or concepts, but they incur large costs when it comes to making breakthroughs.

Compelling evidence comes from illusions. For example, we all make an implicit presumption that light comes from above. Our visual system is wired to assume that light comes from above. If light comes from below, we make terrible mistakes, such as concave turning to convex.

As another example, we often read what we know, not what is really there. Read this:



Most people who read this miss the double "the." Oliver Sacks read it 25 times in my office, and got so angry that he left the room! You read what you know.

Imagine two people looking at the same cloud formation. The portrait painter sees a face of dignity, whereas the ultrasound sonographer sees a

diseased gallbladder. You see what you know. As yet, the cloud is neither a portrait nor a diseased gallbladder, but you see what you know.

Look at this:

Most people in time see a Dalmatian. Now, how could you ever see a dog if you didn't already have a mindset for Dalmatians? You cannot tell that there is a dog there unless you already have a template or mindset for a dog.

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Debate

Steels: Is it a dog or a structure?

Snyder: Well, most people see a Dalmatian.

Steels: Yes, I know what your point is. You cannot see a dog if you didn't have the mindset of a dog. What I'm saying is that it must be a dog — there has to be some kind of coherence that gives rise to the concept.

Snyder: That's an interesting concept. When you look at the cloud and you see a portrait, is there some coherence in the portrait? I claim that

there isn't. In fact, the way I see it, you walk around the world projecting what you know on everything.

Steels: I don't agree.

Snyder: Oh good, good. Let me try to go on, yeah. I'm glad you don't agree. If I were preaching something that you agreed with, what good would that be!

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Now, the interesting thing is that when I showed this same diagram to a South African person, he didn't see a Dalmatian. Instead, he saw a hyena — a different animal — looking in a different direction. So, you see what you know. The South African was familiar with hyenas, so he saw a hyena; he never saw a Dalmatian. He had great trouble shifting his interpretation from a hyena to a Dalmatian. In fact, I had to show him pictures of real Dalmatians to get him to change his mind.

There's no doubt that we see what we know, and that we are often blind to alternative interpretations. We are blinded by our mindsets. We are prejudiced to know our life by our past experiences. This is extremely difficult to overcome.

Over the years, I've shown this picture to thousands of people, with very interesting outcomes. Each person sees a different thing, depending on the person's background; ornithologists see birds, for instance. I cannot think of anybody who has offered more than one interpretation.

The story is even more intriguing. Recent evidence in *Science* shows that the sensory system itself falsifies the signal. In other words, when the executive brain gets an idea, it commands the lower levels to falsify the idea to conform to the executive decision. The executive brain subconsciously makes an interpretation of something and, before you know it, the sensory information is demanded to conform to it (I can give you the references, but it's not my work). So, amazingly, the mind tells the lower sensory levels to lie. I think this is profound.

So, what does this mean? I'm arguing that this is a consequence of the brain having mindsets. Mindsets are good things, by the way; don't get me wrong. They allow us to maneuver fast and be experts for most of our lives. If you have a stomachache and go to the doctor, the doctor could be right in saying, "Ah, we have to be very careful about this. It could be

aliens running around in your stomach." However, when it comes to creative science, this is not good.

What are mindsets? They are collections of sensory details that characterize familiar objects, or objects in the most general sense. Mindsets are embodiments of the familiar.

So, to sum up: our brains see the world through mindsets — mental templates, if you like, of the world derived from past experiences. While templates are very good expertise, they also blind us to novelty. Therefore, the bottleneck to learning is actually failing to recognize that something is new. We see what we know; we see only the whole, not the parts.

What is the neurobiological mechanism that prevents us from seeing the world literally? Well, prior to the formation of a mindset, while we are still in infancy, I believe that we are aware of the lower-level sensory information pouring into our brains. However, once a mindset or concept is formed, whether it is learning how to drive a car or something else, we are no longer aware of the lower-level sensory information.

This is just a simple conceptual model showing that you are aware of all the details before you have a mindset:

Lower-level sensory information
↓
Executive (conscious) awareness

However, once you have developed a mindset or concept, you see only the label. You see the big picture, not the details.

Lower-level sensory information
↓
Concepts
↓
Executive (conscious) awareness

For example, we are not consciously aware of how our brains derive the shape of an object from the subtle shading around its surface. If I give you a ball and ask you to draw a ball, you will not be able to draw a ball

unless you have prior experience or teaching. Because the ball is the ball, because of the subtle shading around the ball, and because your brain is an expert about seeing, you do not see the details. Your brain just says as it should: "Ball." You are aware of the ball as a whole (i.e. on the level of the label), but not in terms of the details that attribute to make up the label.

The Best of Both Worlds? Case Studies of Autistic Children

How can we circumvent our mindsets when the concept is an intrinsic part of our makeup? Surprisingly, it takes insights from damaged brains — abnormal minds — to answer this question.

Curiously, some brain-impaired individuals who suffer from infantile autism are the very opposite of us. They see only the parts, and do not tend to see the whole.

Let me remind you what our ultimate goal here is: we want to make a creativity machine that can accelerate creative learning. To do this, we must — at least momentarily — be literal, free from prior interpretations. Thus, I'm looking at autistic children to try to understand why they can see the world literally. In other words, could we have the best of both worlds? Could we have our mindsets for one moment, and then switch them off the next to see the dots as they are, to see the world literally?

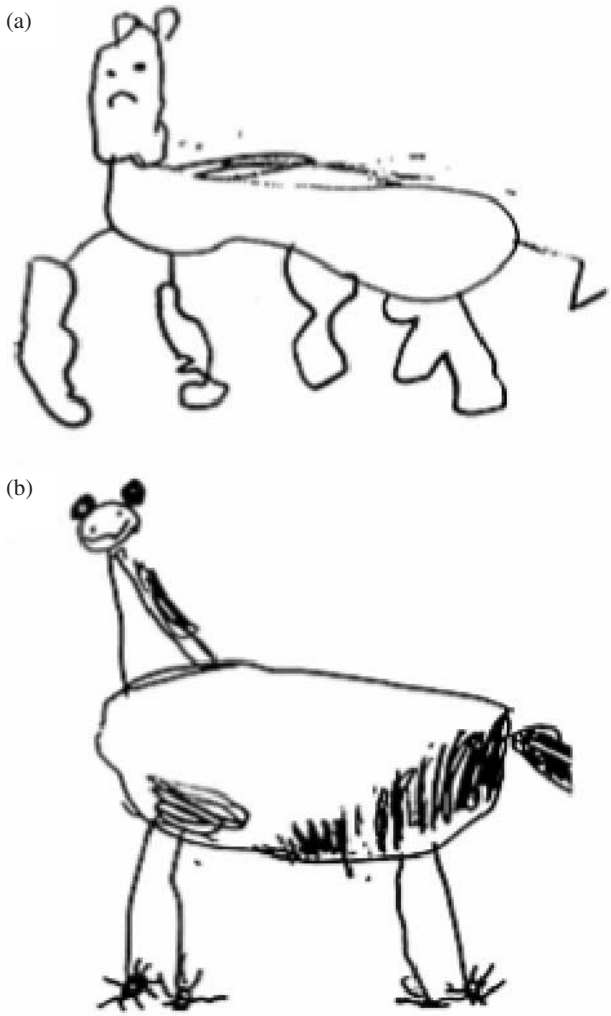
I'm trying to make a creativity machine. I'm trying to make you, at least momentarily, literal so that you can see the world the way it is. You can see everything without prejudice, so to speak.

How can you do that? Well, there are several interesting ways. One is by trickery. For example, if you want to draw, you can get rid of the meaning of what you see by turning the drawing upside down or by looking at the drawing one piece at a time. However, tricks like these have their limitations.

Another way to bypass mindsets is by brute force. This involves turning the mindset off by turning off part of the brain. A perfectly safe way of doing this is via transcranial magnetic stimulation (TMS), in which the left temporal lobe is shut off. Why the left temporal lobe? Because autistic children tend to have damaged left temporal lobes, especially the ones that are literal.

So, I mimic the behavior of autistic children by turning off the left temporal lobe with magnetic pulses. Magnetic pulses are known to shut off local parts of the brain.

Here is a normal 4-year-old child (with an IQ of 40) who draws like caricature, drawing not what is seen, but what is known.



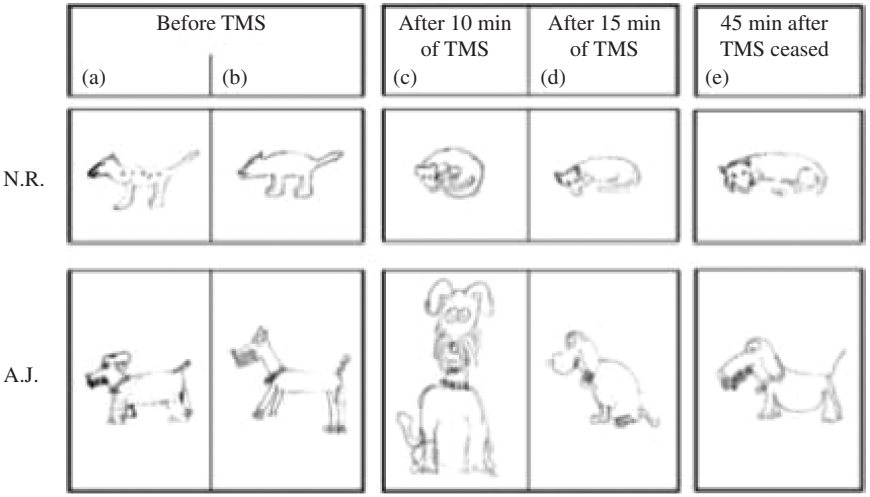
Representative drawings of normal children, each at age 4 years 2 months (Emma and Teneal, parents on campus preschool, Australian National University).

Here is an autistic 3-year-old girl who, by the way, cannot recognize her own mother and the nurse, cannot tie her own shoelaces, cannot speak a single language, and never drew before in her life; yet, she starts drawing literally what she sees. She draws, to me, like the master himself, Da Vinci (who spent years mastering the techniques of drawing). This really challenges the notion that certain things take years of experience, that we obviously see things based on mere mimicry of what is already in our brain.

Autistic child's drawing at about 3½ years (Selfe 1977)[c]

I've also taken perfectly normal 20-year-old students to see how they draw both before and after TMS. Before I gave them magnetic stimulation, they drew what I would expect: outlines. Then, after 10 minutes of magnetic pulse stimulation to the left temporal lobes, they were much more realistic. Forty-five minutes later, they went back to normal.

[c] Selfe L, *Nadia: A Case of Extraordinary Drawing Ability in an Autistic Child*, Academic Press, London, 1977.



Effect of transcranial magnetic stimulation (TMS) on drawing ability in two participants. The figure illustrates a dog drawn from memory by participants N.R. and A.J. (a, b) Practice session before the application of TMS; (c) during TMS; (d) immediately after TMS; and (e) 45 minutes after TMS ceased.

After undergoing TMS, the students completely changed their schema, their way of looking at life. They became literal. This is quite amazing.

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Discussion

Poeppel: About the 3-year-old artistic girl, did you confirm the presence of impairment in her left temporal lobe?

Snyder: Yes, she had left temporal thin lobe impairment.

Poeppel: Have you tried your method on yourself?

Snyder: Ah yes, I have.

Poeppel: And what was the result?

Snyder: Oh look, I'm a bad subject because I know what I want, and I can't block out knowing what I want. I perform well, but no one wants to

believe that I do because I wanted it to work to begin with. So, I'm not a good subject.

Poeppel: What did you experience, for example, in terms of colors and senses?

Snyder: I didn't experience colors, but I had a more conscious awareness of detail. It's subtle. This is not a profound switch. It works in about 45% to 60% of our test subjects. Why it doesn't work in the rest, no one knows.

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Thinking Cap: A Perspective

At the Centre, we have made people literal by using these procedures. I think the world should be interested in learning the ways to circumvent mindsets. For instance, you can engage a person in electroencephalogram (EEG)-assisted neurofeedback by identifying the literal, nonconscious brain states.

I'm not going to tell you exactly how the Centre identifies these states because that is confidential. I can, however, tell you two general conceptual procedures we have used to do this. One way is by looking at the EEG of autistic students or individuals, who are usually literal when doing tasks. The other way is to look at the EEG of normal people when they become literal after being magnetically stimulated. Through these two types of procedures, you can identify literal brain states.

In conclusion, I emphasize that the bottleneck to creative learning is, surprisingly, not knowing what to learn. The bottleneck to creative learning is actually not being aware of what is new. We need — just for a moment — to be literal, to see the dots the way they are. This can be achieved via EEG neurofeedback using a "thinking cap," which can be wireless and which interacts with both the computer and the person wearing the headband.

I see this as the next big technological leap that will accelerate creative learning. It is a totally unique way of seeing the world differently. Among

the many devices I have thought up, the "thinking cap" is tailor-made for this particular learning workshop. Thank you.

Further Reading

Snyder A (ed.), *What Makes a Champion!* Penguin, Australia, 2002.