Is There a Link Between Autism and the Capacity for Invention?

It is clear that our hominid ancestors could use simple stone tools. For example, *Homo habilis* and *Homo erectus*, who both lived 2 million years ago, used stone axes and hammers. And so could the Neanderthals who lived as recently as 40,000 years ago. But despite small changes in the design of their tools, for millions of years, there was little evidence for generative invention: the ability to invent in multiple ways, not just as a one-off. If we look at non-human species alive today, a lot of animals can use simple stone tools. Chimpanzees, for example, can use a rock as a hammer to crack a nut, and crows can drop a stone to raise the water level to be able to reach a worm. Both the behavior of other animals and our hominid ancestors can be parsimoniously explained as the result of associative learning, that is, forming an association between two items, A and B, with little sign of generative invention.



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But then, 70,000 to 100,000 years ago, when *Homo sapiens* was on the scene, the rate of inventions suddenly took off, and it's been unstoppable ever since. Suddenly, we see the capacity for generative invention, not just inventing once, but inventing non-stop. A cognitive revolution had occurred in the human brain.

What was this cognitive revolution? There were two new circuits in the human brain, the Empathy Circuit and the Systemizing Mechanism. The Systemizing Mechanism allowed humans to look for special patterns in the world, which I call "if-and- then" patterns. These are the basis of any system. If I take something, and I do something to it, then I get an outcome. The Systemizing Mechanism allowed us to analyze the world to find such patterns and confirm that they hold true. To do this, we repeat our observations over and over again. Once confirmed, we then can vary the mechanism by experimenting with the "if" or the "and". If we produce a new pattern, that is an invention. I borrow this terminology from the 19th century logician George Boole, who analyzed the structure of thought.

We can infer the existence of the Systemizing Mechanism in the modern human brain because 75,000 years ago, we see the first jewelry. If I make a hole in each shell, and thread a string through each hole, then the shells will form a necklace. And 71,000 years ago, we see the first bow and arrow. Again, the same "if-and-then" algorithm: If I attach an arrow to a stretch fiber, and release the tension in the fiber, then the arrow will fly.

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The earliest musical instrument, 40,000 years old.

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And 40,000 years ago, we see the earliest musical instrument that has ever been found: a flute made from a hollow bone. If I blow down the hollow bone and cover one hole, then I make a specific sound.

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But if I blow down the hollow bone and cover two holes, then I make a different sound. Our ancestor had invented a new, complex tool, a musical instrument, and a system of sounds we call music.

Around 40,000 years ago we see the first cave paintings, and by 25,000 years ago we see sculptures. By 12,000 years ago we see the invention of agriculture. If I take a tomato seed and I plant it in moist soil, then I get a tomato plant. The invention of agriculture transformed our <u>diet</u>, our health, and our lifestyles. And we are still inventing unstoppably today; a recent example being the invention of a vaccine. If I take the <u>genes</u> for <u>COVID</u>'s spike protein, and put them into a harmless virus, then I have a vaccine against COVID.

But let's go back to the first jewelry, 75,000 years ago, because the Systemizing Mechanism explains how we could make the jewelry, but the Empathy Circuit explains why we made it. We wear jewelry because we can imagine what someone else might think or feel—that they might think we are beautiful or of high status, or we make jewelry to give as a gift, because we can think that someone might feel happy. The evolution of empathy enabled a whole raft of complex social interactions, including deception and referential communication.

- What Is Autism?
- Take our Autism Test
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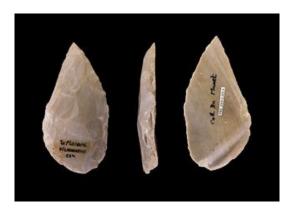
Human Origins Program, Smithsonian Institution, used with permission.

The earliest jewelry, 75,000 years old.

Source: Human Origins Program, Smithsonian Institution, used with permission.

Now, back to our big question: Is there a link between autism and invention? Anecdotally, many inventors show a high level of <u>autistic</u> traits. Thomas Edison, who famously invented the first electric lightbulb, invented non-stop. As a <u>teenager</u>, he was obsessed with Morse code, a system of patterns, and he even named his children Dot and Dash. His wife moved a mattress into his workshop so that he could carry on inventing and experiment day and night. Anecdotally, many autistic people have a talent at <u>pattern recognition</u> and systemizing. Today, Max Park, the world champion in the Rubik's Cube, a system of visual patterns, is autistic.

But anecdotes are not evidence. For *The Pattern Seekers*, we looked at 600,000 people in the general population and measured their autistic traits using the AQ, the Autism Spectrum Quotient. We found those who work in STEM (science, technology, engineering, and mathematics) on average have more autistic traits than those who do not. This shows a clear link between aptitude in understanding systems and higher levels of autistic traits. Those 600,000 people also took the Empathy Quotient and the Systemizing Quotient. We found that you can divide people into five brain types based on whether they lean more towards empathy or systemizing. Those who lean more towards empathy are Type E. Those who lean more towards systemizing are Type S. And those who are extreme Type S systemize non-stop, seeing patterns everywhere, but often struggle to understand other people's thoughts and feelings. We found more women are Type E, more men are Type S, and the majority of autistic people are Type S or extreme Type S. So more evidence of a link between autism and hyper-systemizing.



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Mousterian point. Place of discovery: Le Placard cave, Vilhonneur Charente, France.

Source: Didier Descouens (CC-BY-SA-4.0)/Wikimedia Commons

But is the link between autism and pattern-seeking genetic? We had the opportunity to work with the personal genomics company 23andMe, and found that the genetic variants associated with high systemizing overlap with the genetic variants associated with autism. So some of the genes that cause autism also cause talent in pattern recognition. This leads to a prediction: that autism might be more common in places like Silicon Valley. We went to the Dutch city of Eindhoven, where one-third of jobs are in IT and which is home to the Eindhoven University of Technology, much like MIT, and where the Philips Factory has been for over 100 years. We found autism rates were twice as high in Eindhoven compared to two other Dutch cities, Utrecht and Haarlem, matched for demographics. This is again consistent with a genetic link between autism in the child, and a talent in pattern-seeking among their parents.

So, we have evidence that the genes for autism have driven human invention. And yet, how are we as a society treating autistic people? The majority of autistic adults are unemployed and have high levels of poor mental health, likely the result of a lack of support or from being excluded from education and work. We owe autistic people a huge debt of gratitude for the role their genes have played in human progress, and we have a moral responsibility to ensure no group of individuals is deprived of their human rights to education, employment, and participation in society. It's time for a change. We can learn from the Israeli army, which has a special unit that only recruits autistic adults because of their aptitude to look at thousands of aerial photographs to look for unexpected patterns that might be a sign of terrorist activity. They are making sure autistic people are included and are playing their part in society.

It's time to embrace the concept of <u>neurodiversity</u>—the idea that brains come in many varieties—and none is better or worse than another; they are just different.

This post also appears in the Trinity College Cambridge magazine The Fountain.

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