# The Prodigy's Brother

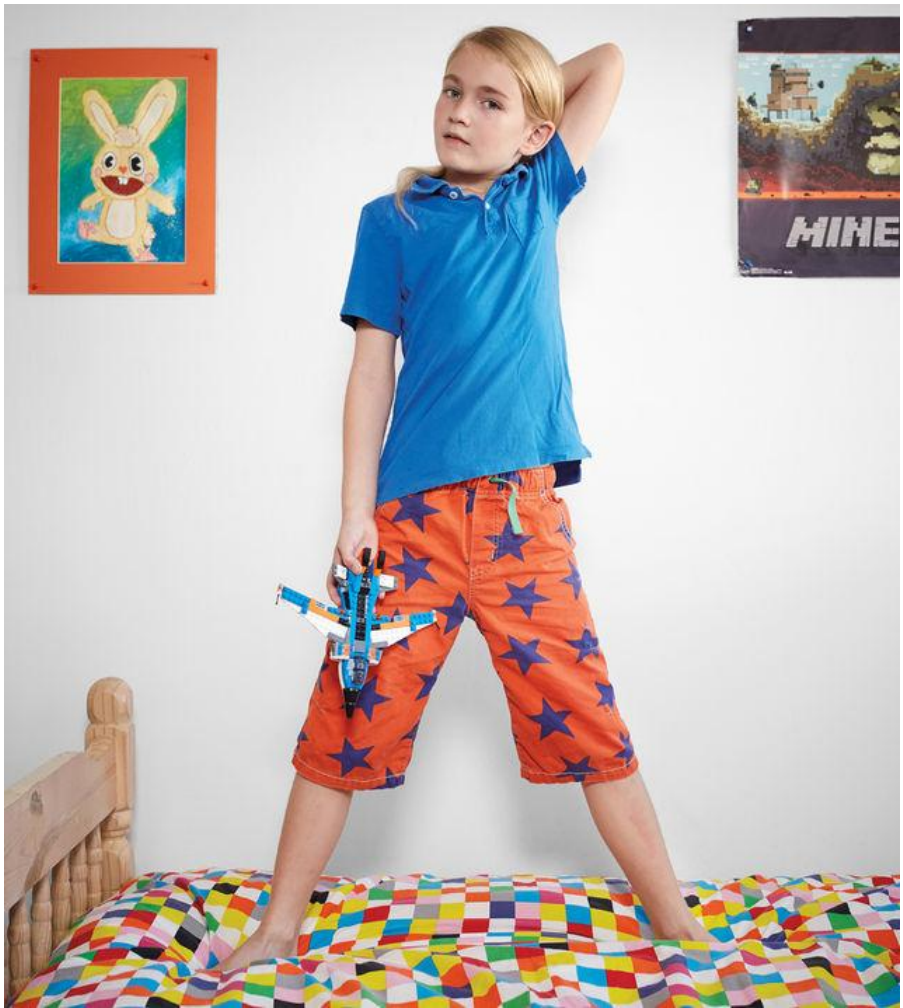
Discoveries about the genetic makeup of prodigies could provide crucial insights into the framework of autism, and new ways to treat it. Enter the Gilberts.

By Kimberly Stephens, published on March 8, 2016 - last reviewed on March 14, 2016

The best part of any disaster movie, as far as 10-year-old Griffin Gilbert is concerned, is the destruction scene. That's when you get the best view of the threatened cityscape—the Randy's Donuts sign careening through Los Angeles in 2012 or London on the cusp of annihilation in *Arctic Blast*—and Griffin has always had a thing for cities and landmarks.

Griffin grew up in the Las Vegas area. He began studying atlases when he was 4 and quickly memorized the world's countries and capitals. By kindergarten, he could draw a decent outline of each country's shape from memory and identify major cities by their skylines.

"I think it's the geometry," he says of his fascination with the world's landmarks. "Something about the buildings' shapes is just so unique."




Taking Flight: Griffin has a remarkable capacity for geographical, architectural, and anatomical facts. [And Minecraft] Photo by Mike McGregor

His parents, Gail Pubols, a stay-at-home mom and active school volunteer, and Gordon Gilbert, the manager of a high-end restaurant on the Bahamian island where the family now lives, always thought that Griffin was bright. At 2, he taught himself to read and began writing out

letters using sidewalk chalk. But they figured that all parents thought their children were smart. "We had no idea about babies," Gail recalls. "To us, whatever he did was normal."

Sue Abacherli, Griffin's kindergarten teacher, who has been in the field for 25 years, knew better. "We see what we call gifted kids and bright students and intelligent kids all the time, but Griffin was a step above," she says. "He was well-versed in geography and cultures and the economy of different places in the world and just such a vast variety of things that most 5- and 6-year-olds have no clue about."

When Griffin's first-grade teacher assigned a project on superheroes, he drew a picture of "Super Albania"—an outline of the country with a cape streaming behind it. He became engrossed with contemplating how the world could have been different if history had taken various detours—if Columbus hadn't come to America; if the United States hadn't entered World War II—and took to redrawing geopolitical boundaries accordingly on a three-by-five-foot dry-erase map. As a treat, he liked to have his parents drive him down the Las Vegas Strip so he could soak in the architectural details.

Griffin is profoundly gifted—many would call him a prodigy. Such children's accomplishments are often mind-blowing, and some, like Mozart and Picasso, go on to place among the greatest achievers in history. But how do they do it?

Joanne Ruthsatz is an assistant professor of psychology at the Ohio State University. She specializes in child prodigies, a field long neglected by scholars. She's also my mother, which has given me a unique vantage point on the world of extraordinary children, first as an observer of her work, then as a sounding board for her ideas, and now as co-author of academic papers and a book, *The Prodigy's Cousin*, stemming from her research.

Over the course of her career, she has worked with more than 30 child prodigies, the largest research sample of such children in the world. They include a 13-year-old catering sensation, a 12-year-old physicist fascinated by the fourth dimension, and a musician who could identify the violin by sight and sound at 18 months old.

Ruthsatz's interest was kindled while studying exceptional performers as a graduate student. She traveled to Louisiana to meet a 6-year-old musician who had never taken a formal lesson, but at 2 years of age had begun piecing together songs from the radio on a toy instrument. He performed often, and his uncanny abilities attracted widespread media attention. Ruthsatz gave him a battery of tests, including an IQ test and a music aptitude test, hoping that the results might offer a clue to his talents.

The 6-year-old did well on the tests, but nothing in the results leapt out as an obvious explanation for his abilities. And then Ruthsatz, the young musician, and his mother went to a Louisiana McDonald's. There they ran into the child's first cousin, a teenager with autism. Ruthsatz immediately wondered whether the cousin's autism might have some connection to the prodigy's talent.

"Prodigies were just kind of an anomaly that nobody really delved into because they didn't need any help," Ruthsatz says. But if prodigies had a hidden connection with autism, she thought, perhaps studying these extreme achievers could improve our understanding of autism and even pave the way for new and better therapies.

It was an unconventional idea. The 6-year-old musician wasn't autistic and didn't have the typical characteristics of the condition, like difficulty with communication or social situations. He demonstrated a profound passion for music that might qualify as a "fixated" interest, "abnormal in intensity or focus," another autistic trait, but that passion had catapulted him onto the national stage.

Since then, Ruthsatz has traveled the country identifying prodigies, listening to their stories, and testing their cognitive abilities. She has probed the foundation of their talents and discovered surprising differences among prodigies who specialize in different fields. Along the way, she's uncovered previously unrecognized attributes—like prodigies' acute empathy—and she recently launched an investigation of the genetic basis of extreme abilities.

Almost as soon as she began digging, the hidden connections between prodigy and autism were revealed. The most obvious was a family link: Many of the prodigies she encountered had close autistic relatives. The Gilberts see it in their own living room.

## Two Boys Diverge

Maybe it's something about the hair—long, shiny, and blond. Maybe it's the angelic expressions or the comparable height. But something about Griffin and Gage Gilbert often leads strangers to ask whether the brothers are twins, though they are actually just over two years apart. Their younger sister, Gibson, 6, has the same long hair and peaches-and-cream complexion; she's a dead ringer for both boys.

Gibson is a pretty typical kid. She said her first word at 10 months, began reading at the same time as her classmates, engages easily with other kids, and loves *Frozen*, Jenga, and swimming.

The middle child, Gage, 8, is a near-constant whirl of motion. During our Skype sessions, he zipped around the room, a blur of purposeful energy—at school, he dashed around with a globe; at home, he had to be rescued from a ledge.

Gage is autistic. With the help of a full-time aide, he attends the same school as his siblings. He can handle some daily living skills, like heating a hot dog in the microwave, but his communication is functional rather than conversational and he's prone to wandering off. He occasionally clenches up when he's anxious or excited and makes a gasping noise to calm himself.

At first, Gage's development mirrored Griffin's. Both boys were hyperactive and slow to talk. Both could become deeply engrossed in whatever activity they were pursuing, even as toddlers. But their development diverged after age 2. Griffin's speech took off. As the months ticked by after Gage's second birthday, he didn't produce a word.

His parents began entering phrases like "toddler not talking" into search engines. One of the first things to pop up was an autism checklist. A disconcerting number of items applied to Gage: He wasn't speaking or gesturing; he could jump in his crib for hours, which certainly seemed like a repetitive movement; he had so little eye contact that Gail sometimes called him her "shifty-eyed little guy." When Gail and Gordon took Gage to a neurologist for an evaluation, he was diagnosed with autism.

"I felt like the wind was knocked out of me," Gail says. "We didn't know what that would mean for Gage's opportunities in life."

Two boys who had once seemed so similar were suddenly on starkly different paths, neither of which was familiar to their parents. Gage began receiving speech therapy and occupational therapy and was later enrolled in a program for autistic children. He finally said "Mommy" and "Daddy" during a therapy session when he was, as Gail recorded, three years, seven months, two weeks, and six days old. His speech improved gradually after that but remained fairly limited.

Despite the differences in their formal educational trajectories, it was never obvious to Gail and Gordon that Griffin and Gage were all that different. To them, it has long been clear that Gage has profound abilities of his own.

"A Rage to Master": Gage has a lot in common with prodigies, including a prodigious memory, consuming interests, and extraordinary attention to detail. Photo by Mike McGregor

## The Secret Speller

Gail and Gordon call them "sixth-sense moments"—the incidents that completely upend their assumptions about Gage's abilities. The first occurred when Gordon discovered "Pixap Toy

Sotry" spelled out in an assortment of puzzle pieces and felt letters. Gordon asked Griffin, who loved to write out words, if he had done it. He insisted that he had not.

Gordon thought Griffin must be joking. After all, Gibson was just an infant, and Gage, then two-and-a-half, still hadn't said his first word. Though Gage often spent time paging through books, the idea that he had taught himself to spell was absurd. "It was almost like, Who's messing with us? Are the neighbors coming in and doing puzzles?" Gordon recalls.

But more and more puzzle-piece words began appearing throughout the house: "Nick Jr." "Old Navy." "PBSkids.org." "DVD now." Gail and Gordon noticed that the words seemed closely aligned with Gage's interests. They eventually realized that Gage, though seemingly still nonverbal, was the mystery speller.

"It was very surprising and very promising at the same time," Gordon says. "What else is going on in there?"

Over the next few years, Gail and Gordon discovered that Gage had an uncanny sense of direction and could navigate to favorite places, like Chuck E. Cheese or a children's play gym, even from unfamiliar starting points. They found him plugging the credits of a favorite cartoon into Google Translate by memory—and then studying the credits in French, Italian, Hungarian, and Korean. He soon began editing compilations of commercials in other languages and tried to stream TV in Portuguese.

When Gage was in second grade, a friend in a special education master's program asked Gail and Gordon if she could give him an assessment test. Afterward, she asked them if they knew that Gage could multiply single-digit figures. They had no idea. Then the friend made the task harder, and Gage solved a series of double-digit multiplication problems in his head. "Everybody is pretty amazed by him because outwardly he really appears to be quite disabled," Gail says. "But he shows people every day that his brain is just incredible."

## A Shared Focus

That Griffin and Gage's personalities and abilities connect and crisscross so strikingly is no coincidence. Child prodigies tend to have a few specific traits. Though they don't all have astronomical IQ scores, each has an extraordinary working memory. Most score in the 99.9th percentile on the working memory subtest of the Stanford-Binet Intelligence Scale. They have excellent attention to detail and a tendency toward passionate, all-consuming interests that Ellen Winner, chair of the psychology department at Boston College, has described as "a rage to master." These same traits are also commonly present in autism.

The truly extreme nature of both boys' memories is obvious. Griffin has a steel grip on the names, shapes, and skylines of cities, states, and countries around the world. Gage frequently commits the credits of movies and TV shows to memory and types them out without error.

The same goes for attention to detail: When Gail made Griffin a body-shaped Rice Krispies cake including most of the major organs for his anatomy-themed ninth birthday, he immediately

pointed out that the spleen and the kidneys were missing and insisted that they be added. Gage has a similarly fine-tuned perception for intricate routes, even unfamiliar ones. Both boys have the "rage to master" as well: For Griffin, geography, architecture, and anatomy. For Gage, languages, books, television, and visual images.

The idea that there are strengths associated with autism is not new. As far back as 1943, Leo Kanner, one of the scientists usually credited with first identifying autism as an independent condition, remarked upon his patients' "phenomenal" memories and "good cognitive potentialities." The high rate of autism among savants—individuals like the artist Richard Wawro who have both a spike in ability and an impairment or disability—is well-established. According to the savant expert Darold Treffert, 75 percent of congenital savants are autistic.

But here's the thing: Unlike most savants, the young people we consider prodigies typically don't have autism. It's partially for this reason that while there have been studies of autism and high IQ, and even autism and extreme talent, child prodigy-specific research had long been treated as distinct from autism and savant work. It's only in recent years that these fields have begun to converge around the nascent realization that a link with autism may be a surprising answer to the mystery of prodigies' abilities. Ruthsatz believes the striking commonalities between Griffin and Gage (and other child prodigies and their autistic relatives), coupled with the particular differences between them, could be a key to advancing our understanding of autism.

A Mindful Big Brother: "I dream that he will be able to do whatever he wants to do," Griffin wrote about Gage (right).

## A Back Door Opens

Ruthsatz has expanded her research to focus not just on the behavioral and cognitive profiles of prodigies but on their DNA as well. With a team of researchers at Ohio State, she has pursued genetic links between prodigy and autism. In searching for genes inherited by both prodigies and autists, a region on chromosome 1, known as 1p31-q21, emerged as statistically significant. A gene or genes in that area appear to be tied to both groups.

That study was based on a small

sample. The genes at play need to be more specifically identified, and the results confirmed. But the team believes that the locus on chromosome 1 may explain one of the strengths that prodigies and autists often share, such as astounding working memory or attention to detail.

This early finding also raises an intriguing question: If prodigies and autistic individuals share a specific DNA variation, what can we then learn from the genetic differences between them?

In many autism studies, researchers compare the genes of an autistic child with those of a nonautistic sibling. But comparing Gage's and Griffin's DNA, rather than Gage's and Gibson's, should be far more revealing. The genetic differences between prodigies and close autistic relatives could offer a unique window into the genes most directly tied to the social and communication challenges of autism—and open a back door into the condition's genetic architecture.

A similar line of thought has swept through other medical research in recent years. Scientists have made breakthroughs in areas like HIV and heart disease not by studying those who have the conditions but those who don't—in particular, individuals who appear to be at high risk but never develop symptoms. Some people, it turns out, have genes that make them at least partially resistant. The specifics behind that genetic resistance can sometimes act as a blueprint for developing treatments for those not born with the particular genetic quirk.

The current picture of autism's genetics is complex and heterogeneous. Scientists have found genes that contribute to some instances of autism, yet even the most prevalent are thought to contribute to only a small percentage of cases.

As a result, there are major limits on autism treatments. The standard course includes various types of therapy, but the only two approved drugs target irritability, not the core symptoms of autism.

Scientists have made some headway using an animal model of the condition. For example, researchers recently reported developing a compound that reduced repetitive behaviors in mice with autism-like symptoms. A trial of the compound in a human cell line revealed that it had the desired effect on the targeted genes. "This is the kind of profile we like to see," says Tom Burris, the chair of pharmacological and physiological science at St. Louis University and an author of the study. But he estimates that it would take at least a couple of years to optimize the drug and begin human clinical trials, and the team hasn't yet investigated whether it has any effect on the social and communication facets of autism.

While there has been much research into the genetic roots of autism, comparing autistic individuals' genes with those of child prodigies is a novel approach. Ruthsatz has begun a new phase of this research with a team at McGill University in Canada. The scientists are searching for *de novo* mutations (those present in the offspring but not the mother or the father) tied to the prodigies' abilities.

Her theory is that the work could lead to the discovery that prodigies have a beneficial mutation that protects them from the challenges typically associated with autism. "One possible

explanation for the child prodigies' lack of deficits," Ruthsatz wrote in a paper for the journal *Intelligence*, "is that, while the child prodigies have a form of autism, a biological modifier suppresses many of the typical signs of autism but leaves attention to detail—a quality that actually enhances their prodigiousness—undiminished or even enhanced."

If such a modifier exists—and can be identified—the implications could be significant. "If we can find a mutation that is keeping the prodigies from having the daily living problems, then we could have better medicine for autism," she says, while acknowledging that any mutation her team discovers may not prove relevant to autism or may matter in only a minority of cases.

Worthy of Attention: Gail [holding Griffin] and Gordon [holding Gibson] focus on the positives in Gage's condition. Photo by Mike McGregor

## Brotherly Bonds

Island life has been an adjustment for the Gilbert family. "It's like living in a painting," Gail says, but the power is unreliable, their home frequently loses Internet service, and chocolate is expensive. The children's school, however, is an island perk—an inclusive space where Gail and Gordon have found it easier for both Gage and Griffin to assimilate than back in Nevada.

Griffin's intellect continues to manifest in intriguing and amusing ways. He inhales Khan Academy videos on biology and physics and cracks jokes about noble gases and right triangles.

During a recent car ride, he rattled through demographic information about obesity. He compares the shape of his food to different countries (recent chicken nuggets resembled Macedonia and Kyrgyzstan) and crafted the Cyprus buffer zone out of popcorn. On a sick day, he passed the time watching a video about Mersenne prime numbers.

It can be hard for him to find common ground with peers who don't share his fascination with the Burj Khalifa and Saint Basil's Cathedral. But he's comfortable talking to adults, and he still Skypes and plays Minecraft with members of "the Hive," Las Vegas-area friends from his old gifted program. "Griffin's going to need a little extra juice" to stay stimulated in and out of school, Gordon acknowledges, and the family is looking into accelerated online learning programs.

Gage is doing particularly well in math and Spanish. His parents believe he has memorized the flags of the world, he's developed a strong interest in swimming, and he has a support system, including his full-time aide, dedicated to his full participation in school.

Gail and Gordon are proud of Gage's achievements and are firm believers in his potential. But they still worry whether the son they describe as "high needs" will ever be able to live independently. "Autism doesn't mean he can't be successful in whatever he does," Gail says, "but I don't want anyone to ever think that we cured him, or that he was autistic when he was little and now he's not."

Gail and Gordon see participating in the research as a way to contribute to work that improves understanding of autism, emphasizes its positive aspects, and might even make life a little easier for Gage and others down the road.

"There's so much emphasis on the negative aspects of the neurological condition, but we want to see the positive aspects brought to light as well," Gordon says. "I think seeing that linkage between these very, very prodigious individuals and those who are higher need is important."

Science is a long game; the DNA research Ruthsatz is pursuing is still in the early stages. In the meantime, it's the way their kids treat each other that gives Gail and Gordon the most peace of mind. Gibson often keeps an eye out for Gage, grabs his hand if he looks as if he might wander off, and tries to engage him in games. And when Griffin was given an assignment to write about the person who most inspired him, he chose Gage:

"I dream that my brother will one day have a wife and kids, a job that he loves, and a house, and it won't matter at all that he is autistic. I dream that he will be able to travel if he wants to, to see places like Paris, Sydney, and Tokyo. I dream that he will be able to do whatever he wants to do, and that I will get to do these things with him."

## What Can Prodigies Teach Us About Our Own Brains?

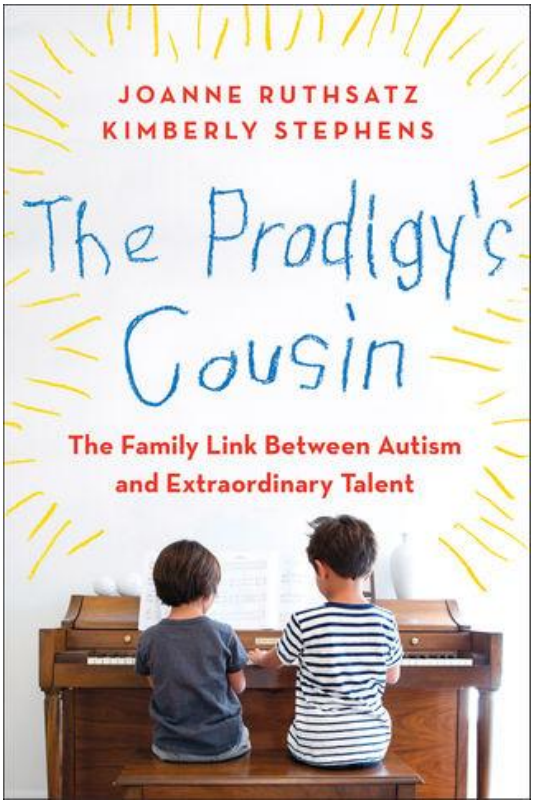
Some of history's greatest artists and scientists have been prodigies. At 13, German musician and composer Fanny Mendelssohn (sister of Felix) played the 24 preludes and fugues in the first book of Bach's *The Well-Tempered Clavier* from memory. A young Mozart reportedly heard

Gregorio Allegri's *Miserere*, music closely guarded by the church, performed at the Sistine Chapel and then wrote down the entire, complicated piece. Galileo used spatial visualization to develop the idea that objects of different weights fall through space at the same rate. And as a youth, Picasso generated rich object imagery in his mind's eye then recreated it in his art.

Prodigies share a common foundation—an extreme working memory, focused attention to detail, and a startling ability to lock in on an activity with single-minded focus. But beyond these bedrock traits, they have unique cognitive profiles that vary by their area of expertise, finds Ohio State researcher Joanne Ruthsatz. On the Stanford-Binet Intelligence Scale, music prodigies have the most extreme working memories, while math and science prodigies excel at spatial visualization, the ability to picture an object's movement through space and its physical transformation. Art prodigies, though, have relatively poor spatial visualization—a tendency researchers tie to rich object visualization, the ability to picture an object's color, shape, and size in vibrant detail.

Most of our interests, and potentially our professions, are shaped by our underlying cognitive abilities. Ruthsatz and researchers at Case Western Reserve University are exploring whether college students studying music, art, and math have the same spikes in ability as their prodigy counterparts—a possible explanation for why some of us feel called toward certain fields even though we aren't really sure why.

It might also mean that intelligence subtesting holds far more information than just a score, possibly suggesting the type of work and activities for which we are (very broadly speaking) suited. Huge working memory? Maybe you've got the chops to be a musician. Excellent visual-spatial score? Perhaps science will appeal.




"If the pattern holds, it says that we're all predisposed to certain fields of expertise or career paths," Ruthsatz says.

***Kimberly Stephens is a journalist, an attorney, and the co-author, with Joanne Ruthsatz, Ph.D., of* The Prodigy's Cousin: The Family Link Between Autism and Extraordinary Talent (link is external).**