GIFTED KIDS: WHAT RESEARCH SAYS ABOUT NURTURING GENIUS *page 40*

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NURTURING GENIUS

A decades-long study of exceptionally gifted children reveals what it takes to hone the world's sharpest minds

By Tom Clynes

ILLUSTRATION BY SONIA ROY

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On a summer day in 1968, psychology professor Julian Stanley met a brilliant but bored 12-year-old named Joseph Bates. The Baltimore student was so far ahead of his classmates in mathematics that his parents had arranged for him to take a computer science course at Johns Hopkins University, where Stanley taught. Even that wasn't enough. Having leapfrogged ahead of the adults in the class, the child kept himself busy by teaching the FORTRAN programming language to graduate students.

Unsure of what to do with Bates, his computer instructor introduced him to Stanley, a researcher well known for his work in psychometrics—the study of cognitive performance. To discover more about the young prodigy's talent, Stanley gave Bates a battery of tests that included the SAT college admissions exam.

Bates's score was well above the threshold for admission to Johns Hopkins, which prompted Stanley to search for a local high school that would let the child take advanced mathematics and science classes. When that plan failed, Stanley convinced a dean at Johns Hopkins to let Bates, then 13, enroll as an undergraduate.

Stanley would affectionately refer to Bates as "student zero" of his Study of Mathematically Precocious Youth (SMPY), which would transform how gifted children are identified and supported by the U.S. education system. As the longest-running longitudinal survey of intellectually talented children, SMPY has for 45 years tracked the careers and accomplishments of some 5,000 individuals, many of whom have gone on to become high-achieving scientists. The study's ever growing data set has generated more than 400 papers and several books and provided key insights into how to spot and develop talent in science, technology, engineering, mathematics (STEM), and beyond.

"What Julian wanted to know was, How do you find the kids with the highest potential for excellence in what we now call STEM, and how do you boost the chance that they'll reach that potential?" says Camilla Benbow, a protégé of Stanley's who is now dean of education and human development at Vanderbilt University. But Stanley was not interested in just studying bright children; he wanted to nurture their intellect and enhance the odds that they would change the world. His motto, he told his graduate students, was "no more dry bones methodology."

With the first SMPY recruits now at the peak of their careers, what has become clear is how much the precociously gifted outweigh the rest of society in their influence. Many of the innovators who are advancing science, technology and culture are those whose unique cognitive abilities were identified and supported in their early years through enrichment programs such as the Johns Hopkins Center for Talented Youth—which Stanley began in the 1980s as an adjunct to SMPY. At the start, both the study and the center were open to young adolescents who scored in the top 1 percent on university entrance exams. Pioneering mathematicians Terence Tao and Lenhard Ng were 1 percenters, as were Facebook's Mark Zuckerberg, Google co-founder Sergey Brin and musician Stefani Germanotta (Lady Gaga), who all passed through the Hopkins center.

"Whether we like it or not, these people really do control our society," says Jonathan Wai, a psychologist at the Duke Talent Identification Program, which collaborates with the Hopkins center. Wai combined data from 11 prospective and retrospective longitudinal studies, including SMPY, to demonstrate the correlation between early cognitive ability and adult achievement. "The kids who test in the top 1 percent tend to become our eminent scientists and academics, our Fortune 500 CEOs, and federal judges, senators and billionaires," he says.

FAST FACTS

HOW TO EDUCATE BRILLIANT KIDS

1. The Study of Mathematically Precocious Youth (SMPY) has been tracking outcomes of intellectually talented kids for 45 years, yielding more than 400 papers.
2. SMPY data strongly support grade skipping and other forms of acceleration.
3. Spatial ability is especially conducive to earning patents and securing advanced degrees.
4. While many Middle Eastern and East Asian countries have programs to identify and develop the talents of gifted kids, the U.S. and Europe tend to emphasize shoring up low achievers.

Among the alumni of the Johns Hopkins Center for Talented Youth are (*left to right*) Facebook co-founder and CEO Mark Zuckerberg, Google co-founder Sergey Brin, musical star Stefani Germanotta (aka Lady Gaga) and prizewinning mathematician Terence Tao. They were admitted after scoring in the top 1 percent on college admission tests at a precocious age.

Such results contradict long-established ideas suggesting that expert performance is built mainly through practice—that anyone can get to the top with enough focused effort of the right kind. SMPY, in contrast, suggests that early cognitive ability has more effect on achievement than either deliberate practice or environmental factors such as socioeconomic status. The research emphasizes the importance of nurturing precocious children, at a time when the prevailing focus in the U.S. and other countries is on improving the performance of struggling students. At the same time, the work to identify and support academically talented students has raised troubling questions about the risks of labeling children and the shortfalls of talent searches and standardized tests as a means of identifying high-potential students, especially in poor and rural districts.

"With so much emphasis on predicting who will rise to the top, we run the risk of selling short the many kids who are missed by these tests," says Dona Matthews, a developmental psychologist in Toronto, who co-founded the Center for Gifted Studies and Education at Hunter College. "For those children who are tested, it does them no favors to call them 'gifted' or 'ungifted.' Either way, it can really undermine a child's motivation to learn."

A Study Begins

On a muggy August day, Benbow and her husband, psychologist David Lubinski, describe the origins of SMPY as they walk across the quadrangle at Vanderbilt. Benbow was a graduate student at Johns Hopkins when she met Stanley in a class he taught in 1976. Benbow and Lubinski, who have co-directed the study since Stanley's retirement, brought it to Vanderbilt in 1998. "In a sense, that brought Julian's research full circle because this is where he started his career as a professor," Benbow says as she nears the university's psychology laboratory, the first U.S. building dedicated to the field, dating to 1915.

Psychologist Julian Stanley didn't set out to just study bright children. He wanted to nurture their intellect and enhance the odds that they would change the world.

Stanley's interest in developing scientific talent had been piqued by one of the most famous longitudinal studies in psychology, Lewis Terman's Genetic Studies of Genius. Beginning in 1921, Terman selected teenage subjects on the basis of high IQ scores, then tracked and encouraged their careers. But to Terman's chagrin, his cohort produced only a few esteemed scientists. Among those rejected, because his IQ of 129 was too low to make the cut, was William Shockley, the Nobel Prize–winning co-inventor of the transistor. Physicist Luis Alvarez, another Nobel winner, was also rejected.

Stanley suspected that Terman would not have missed Shockley and Alvarez if he had had a reliable way to test them specifically on quantitative reasoning ability. So Stanley decided to try the Scholastic Aptitude Test (now simply the SAT). Although the test is intended for older students, Stanley hy-

DAVID RAMOS Getty Images (Zuckerberg); KIM KULISH Getty Images (Brin); ADRIANA M. BARRAZA age Fotostock (Lady Gaga); STEVE JENNINGS Getty Images (Tao)

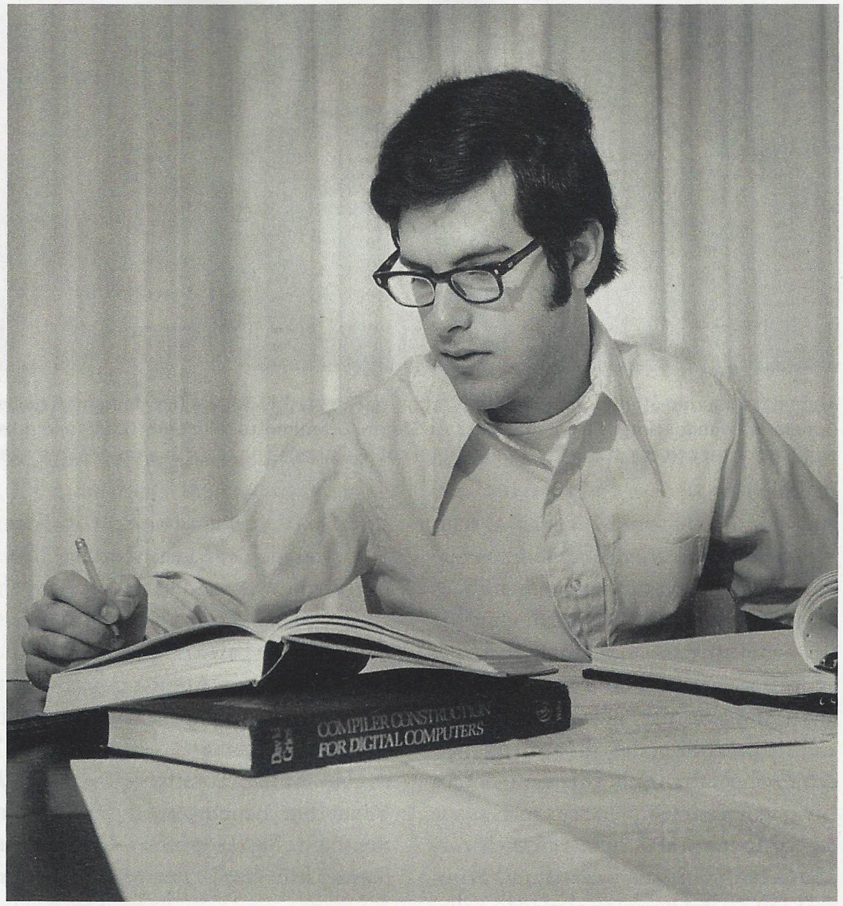
pothesized that it would be well suited to measuring the analytical reasoning abilities of elite younger students.

In March 1972 Stanley rounded up 450 bright 12- to 14-year-olds from the Baltimore area and gave them the mathematics part of the SAT. It was the first standardized academic "talent search." (Later, researchers included the verbal part and other assessments.)

"The first big surprise was how many adolescents could figure out math problems that they hadn't encountered in their course work," says developmental psychologist Daniel Keating, then a Ph.D. student at Johns Hopkins. "The second surprise was how many of these young kids scored well above the admissions cutoff for many elite universities."

Stanley had not envisioned SMPY as a multidecade longitudinal study. But after the first follow-up survey, five years later, Benbow proposed extending the study to track subjects through their lives, adding cohorts and including assessments of interests, preferences, and occupational and other life accomplishments. The study's first four cohorts range from the top 3 percent to the top 0.01 percent in their SAT scores. The SMPY team added a fifth cohort of the leading mathematics and science graduate students in 1992 to test the generalizability of the talent-search model for identifying scientific potential.

"I don't know of any other study in the world that has given us such a comprehensive look at exactly how and why STEM talent develops," says Christoph Perleth, a psychologist at the University of Rostock in Germany who studies intelligence and talent development.



Computer scientist Joseph Bates became "student zero" at age 12 in the Study of Mathematically Precocious Youth. Shown here about a year before earning a master's degree at 17, he went on become a pioneer in artificial intelligence.

The Predictive Power of Spatial Skills

As the data flowed in, it quickly became apparent that a one-size-fits-all approach to gifted education, and education in general, was inadequate.

"SMPY gave us the first large-sample basis for the field to move away from general intelligence toward assessments of specific cognitive abilities, interests and other factors," says Rena Subotnik, who directs the Center for Gifted Education Policy at the American Psychological Association in Washington, D.C.

In 1976 Stanley started to test his second cohort (a sample of 563 13-year-olds who scored in the top 0.5 percent on the SAT) on spatial ability—the capacity to understand and remember spatial relations between objects. Tests for spatial ability might include matching objects that are seen from different perspectives, determining which cross section will result when an object is cut in certain ways, or estimating water levels on tilted bottles of various shapes. Stan-

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ley was curious about whether spatial ability might better predict educational and occupational outcomes than could measures of quantitative and verbal reasoning on their own.

Follow-up surveys—at ages 18, 23, 33 and 48—backed up his hunch. A 2013 analysis found a correlation between the number of patents and peer-reviewed publications that people had produced and their earlier scores on SATs and spatial-ability tests. The SAT tests jointly accounted for about 11 percent of the variance; spatial ability accounted for an additional 7.6 percent.

The findings, which dovetail with those of other recent studies, suggest that spatial ability plays a major part in creativity and technical innovation. "I think it may be the largest known untapped source of human potential," says Lubinski, who adds that students who are only marginally impressive in mathematics or verbal ability but high in spatial ability often make exceptional engineers, architects and surgeons. "And yet no admissions directors I know of are looking at this, and it's generally overlooked in school-based assessments."

Although studies such as SMPY have given educators the ability to identify and support gifted youngsters, worldwide interest in this population is uneven. In the Middle East and East Asia, high-performing STEM students have received significant attention over the past decade. South Korea, Hong Kong and Singapore screen children for giftedness and steer high performers into innovative programs. In 2010 China launched a 10-year National Talent Development Plan to support and guide top students into science, technology and other high-demand fields.

In Europe and the U.S., support for research and educational programs for gifted children has ebbed, as the focus has moved more toward inclusion. England, for example, decided in 2010 to scrap the National Academy for Gifted and Talented Youth and redirected funds toward an effort to get more poor students into leading universities.

Lessons from the Fast Track

When Stanley began his work, the choices for bright children in the U.S. were limited, so he sought out environments in which early talent could blossom. "It was clear to Julian that it's not enough to identify potential; it has to be developed in appropriate ways if you're going to keep that flame well lit," says Linda Brody, who studied with Stanley and now runs a program at Johns Hopkins focused on counseling profoundly gifted children.

At first, the efforts were on a case-by-case basis. Parents of other bright children began to approach Stanley after hearing about his work with Bates, who thrived after entering university. By 17, he had earned bachelor's and master's degrees in computer science and was pursuing a doctorate at Cornell University. Later, as a professor at Carnegie Mellon University, he would become a pioneer in artificial intelligence.

"I was shy, and the social pressures of high school wouldn't have made it a good fit for me," says Bates, now 60. "But at college, with the other science and math nerds, I fit right in, even though I was much younger. I could grow up on the social side at my own rate and also on the intellectual side because the faster pace kept me interested in the content."

The SMPY data supported the idea of accelerating fast learners by allowing them to skip school grades. In a comparison of children who bypassed a grade with a control group of similarly smart children who did not, the grade skippers were 60 percent more likely to earn doctorates or patents and more than twice as likely to get a Ph.D. in a STEM field. Acceleration is common in SMPY's elite one-in-10,000 cohort, whose intellectual diversity and rapid pace of learning make them among the most challenging to educate. Advancing these students costs little or nothing and, in some cases, may save schools money, Lubinski says. "These kids often don't need anything innovative or novel," he says. "They just need earlier access to what's already available to older kids."

Many educators and parents continue to believe that acceleration is bad for children—that it will hurt them socially, push them out of childhood or create knowledge gaps. But education researchers generally agree that acceleration benefits the vast majority of gifted children socially and emotionally, as well as academically and professionally.

> As the data flowed in, it became apparent that a one-size-fits-all approach to gifted education, and education in general, was inadequate.

Skipping grades is not the only option. SMPY researchers say that even modest interventions—for example, access to challenging material such as college-level Advanced Placement courses—have a demonstrable effect. Among students with high ability, those who were given a richer density of advanced precollegiate educational opportunities in STEM went on to publish more academic papers, earn more patents and pursue higher-level careers than their equally smart peers who did not have these opportunities.

Despite SMPY's many insights, researchers still have an incomplete picture of giftedness and achievement. "We don't know why, even at the high end, some people will do well and others won't," says Douglas Detterman, a psychologist who studies cognitive ability at Case Western Reserve University. "Intelligence won't account for all the differences between people; motivation, personality factors, how hard you work and other things are important."

Some insights have come from German studies that have a methodology similar to SMPY's. The Munich Longitudinal Study of Giftedness, which started tracking 26,000 gifted students in the mid-1980s, found that cognitive factors were the most predictive but that some personal traits—such as motivation, curiosity and ability to cope with stress—had a limited influence on performance. Environmental factors, such as family, school and peers, also had an impact.

The data from such intellectual-talent searches also contribute to knowledge of how people develop expertise in subjects. Some researchers and writers, notably psychologist K. Anders Ericsson of Florida State University and author Malcolm Gladwell, have popularized the idea of an ability threshold. This holds that for individuals beyond a certain IQ barrier (120 is often cited), concentrated practice time is much more important than additional intellectual abilities in acquiring expertise.

But data from SMPY and from the Duke talent program dispute that hypothesis. A study published in 2016 compared the outcomes of students in the top 1 percent of childhood intellectual ability with those in the top 0.01 percent. Whereas the first group gained advanced degrees at about 25 times the rate of the general population, the more elite students earned Ph.D.s at about 50 times the base rate.

But some of the work is controversial. In North America and Europe, some child development experts lament that much of the research on talent development is driven by the urge to predict who will rise to the top, and educators have expressed considerable unease about the concept of identifying and labeling a group of pupils as gifted or talented.

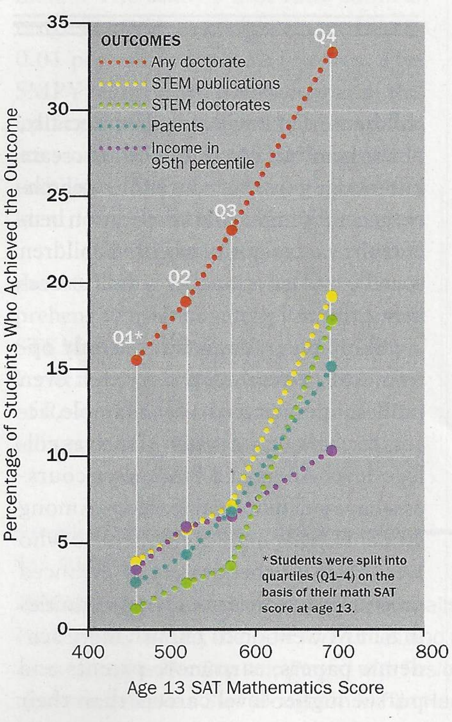
"A high test score tells you only that a person has high ability and is a good match for that particular test at that point in time," Matthews says. "A low test score tells you practically nothing," she says, because many factors can depress students' performance, including their cultural backgrounds and how comfortable they are with taking high-stakes tests. Matthews contends that when children who are near the high and low extremes of early achievement sense they are being assessed in terms of future success, it can damage their motivation to learn and can contribute to what Stanford University psychologist Carol S. Dweck calls a fixed mindset. It is far better, Dweck says, to encourage a growth mindset, in which children believe that brains and talent are merely a starting point and that abilities can be developed through hard work and continued intellectual risk-taking.

"Students focus on improvement instead of worrying about how smart they are and hungering for approval," Dweck explains. "They work hard to learn more and get smarter." Research by Dweck and her colleagues shows that students who learn with this mindset show greater motivation at school, get better marks and have higher test scores. Benbow agrees that standardized tests should not

There is an enduring misperception among educators that gifted kids are bright enough to succeed on their own and that we should focus more on low-performing students.

TOP OF THE CHARTS

Long-term studies of gifted students—those who scored in the top 1 percent as young adolescents on the math section of the SAT—reveal that the highest scorers (*upper quartile*) went on to outperform the rest by several measures.



SOURCES: "HOW TO RAISE A GENIUS: LESSONS FROM A 45-YEAR STUDY OF SUPER-SMART CHILDREN," BY TOM CLYNES, IN *NATURE*, VOL. 537; SEPTEMBER 8, 2016; "BEYOND THE THRESHOLD HYPOTHESIS: EVEN AMONG THE GIFTED AND TOP MATH/SCIENCE GRADUATE STUDENTS, COGNITIVE ABILITIES, VOCATIONAL INTERESTS, AND LIFESTYLE PREFERENCES MATTER FOR CAREER

Summer enrichment: Fifth and sixth graders collaborate on a health research project at a Duke Talent Identification Program at Southwestern University in Texas (*left*). Middle and high school students count bacteria in a petri dish for a genetics course at the Johns Hopkins Center for Talented Youth (*right*).

IVAN ROSS *Duke Talent Identification Program (left)*; JOHNS HOPKINS CENTER FOR TALENTED YOUTH *(right)*

be used to limit students' options but rather to develop learning and teaching strategies appropriate to children's abilities, which allow students at every level to reach their potential.

This year Benbow and Lubinski plan to launch a midlife survey of the profoundly gifted cohort (the one in 10,000), with an emphasis on career achievements and life satisfaction, and to resurvey their 1992 sample of graduate students at leading U.S. universities. The forthcoming studies may further erode the enduring misperception that gifted children are bright enough to succeed on their own, without much help.

"The education community is still resistant to this message," says David Geary, a cognitive developmental psychologist at the University of Missouri who specializes in mathematical learning. "There's a general belief that kids who have advantages, cognitive or otherwise, shouldn't be given extra encouragement, that we should focus more on lower-performing kids."

Although gifted-education specialists herald the expansion of talent-development options in the U.S., the benefits have mostly been limited so far to students who are at the top of both the talent and socioeconomic curves. "We know how to identify these kids, and we know how to help them," Lubinski observes. "And yet we're missing a lot of the smartest kids in the country."

As Lubinski and Benbow walk through the quadrangle, the clock strikes noon, releasing packs of enthusiastic adolescents racing toward the dining hall. Many are participants in the Vanderbilt Programs for Talented Youth, summer enrichment courses in which gifted students spend three weeks gorging themselves on a year's worth of mathematics, science or literature. Others are participants in Vanderbilt's sports camps.

"They're just developing different talents," says Lubinski, a former high school and college wrestler. "But our society has been much more encouraging of athletic talents than we are of intellectual talents." And yet these gifted students, the "mathletes" of the world, can shape the future. "When you look at the issues facing society now—whether it's health care, climate change, terrorism, energy—these are the kids who have the most potential to solve these problems," Lubinski says. "These are the kids we'd do well to bet on." **M**

MORE TO EXPLORE

- **Creativity and Technical Innovation: Spatial Ability's Unique Role.** Harrison J. Kell et al. in *Psychological Science,* Vol. 24, No. 9, pages 1831–1836; September 2013.
- **Beyond Intelligence: Secrets for Raising Happily Productive Kids.** Dona Matthews and Joanne Foster. Anansi, 2014.
- **Experts Are Born, Then Made: Combining Prospective and Retrospective Longitudinal Data Shows That Cognitive Ability Matters.** Jonathan Wai in *Intelligence,* Vol. 45, pages 74–80; July–August 2014.
- **Life Paths and Accomplishments of Mathematically Precocious Males and Females Four Decades Later.** David Lubinski et al. in *Psychological Science,* Vol. 25, No. 12, pages 2217–2232; December 2014.
- **From Terman to Today: A Century of Findings on Intellectual Precocity.** David Lubinski in *Review of Educational Research.* Published online October 27, 2016.

From Our Archives

- **The Secret to Raising Smart Kids.** Carol S. Dweck; December 2007/January 2008.
- **Coaching the Gifted Child.** Christian Fischer; August/September 2008.