Piecing Together Performance

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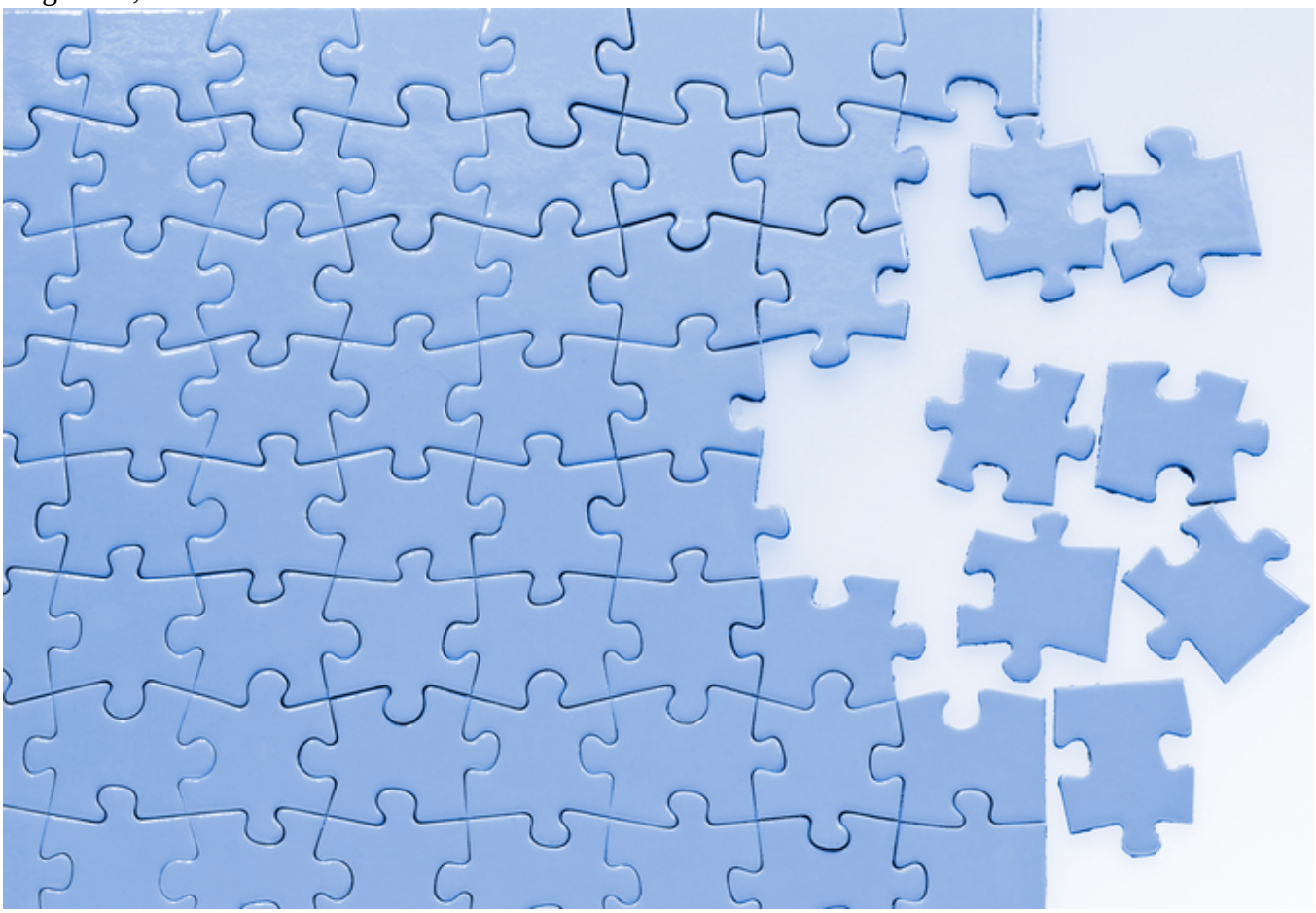

Of all the familiar characters who reemerge at the start of every school year, from jock to geek to teacher's pet, perhaps the most intriguing is the overachiever. We all know one when we see one: the student whose effort, either in the classroom or on the field, compensates for whatever talent might be lacking. In a sense, the label is a compliment. Overachievement requires, by definition, a tireless commitment to success. At the same time, it's a touch derisive. If overachievers had more academic or artistic ability to begin with, there would be no need to overdo it.

The roles of natural endowment and hard work in human performance are the focus of one of the oldest debates in behavioral science — and in society. A century ago, many linked genetics with genius. In the early 20th century, intensive practice became the leading explanation for success. By the 1990s, APS Fellow K. Anders Ericsson argued that elite achievement, with few exceptions, can be traced to a person's sustained, deliberate efforts toward a goal.

Ericsson and his colleagues found in a 1993 study that professional musicians had accumulated about 10,000 hours of deliberate practice over the course of a decade. The results became the basis of Ericsson's deliberate practice theory of elite performance, also called the 10,000 hour rule.

But recent studies show that practice alone can't account for individual differences in success, and as surely as the seasons loop back to autumn, performance researchers are once again recognizing the importance of innate abilities to achievement in the arts, sciences, and competitive games.

In a 2011 issue of *Current Directions in Psychological Science*, APS Fellow David Hambrick, of Michigan State University, and Elizabeth Meinz, from Southern Illinois University Edwardsville, reviewed many of these studies and found that general cognitive skills that are substantially heritable set expert musicians, scientific thinkers, chess players, and other top-tier achievers apart from others.

"In my opinion, the deliberate practice view has gone about as far as it can go," says Hambrick, who spent a summer working with Ericsson some years back. "But it seems clear to me that there's something else."

The Best of the Best

It takes but a quick glance at the list of Nobel prize winners to suspect that some people are born with an edge toward scientific achievement. Nine immediate relatives have earned the award in a field of science like physics or medicine, including six father-son pairings (such as the Bohrs) and a mother-daughter tandem (the Curies). Because extremely few scientists win the Nobel no matter how distinguished their careers, the odds of finding so many laureate relatives "would seem infinitely miniscule" unless elite scientific talent was at least partly heritable, wrote APS Fellow Dean Keith Simonton in a 2008 issue of *Archives of General Psychology*.

Still, many scholars suggest that natural abilities, such as general intelligence, can influence performance only up to a certain point. After that, factors such as hard work, which are less constrained by genetics, take over. This idea, known as the "threshold" hypothesis, has recently gained a good bit of popular acceptance. In *Outliers*, journalist Malcolm Gladwell supports this position, noting that the link between success and intelligence disappears beyond an IQ of around 120. Above that, he writes, "having additional IQ points doesn't seem to translate into any measurable real-world advantage."

Recently, a team of research psychologists from Vanderbilt University, including APS Fellows David Lubinski and Camilla Benbow, examined the threshold hypothesis as it applies to achievement in the STEM fields of science, technology, engineering, and math. Using a longitudinal study of precocious adolescents, the Lubinski and Benbow group targeted roughly 2,500 13-year-olds who scored in the top 1 percent for their age on the math section of the SAT. The researchers then analyzed what those youths had achieved in STEM fields some 25 years later.

Even within the top 1 percent of young science minds, those in the highest quartile (say, the 99.9th percentile) went on to accomplish measurably greater things than those in the lowest quartile (say, the 99.1st). The findings, originally reported in *Psychological Science* in 2007 and 2008, were summarized in a 2010 issue of *Current Directions* that more or less falsified the "threshold" hypothesis. Generally speaking, the researchers concluded that bright as all these students were, each seemed to benefit from being just a little brighter.

The performance differences were clear across a variety of careers. The top of the top were more than twice as likely to earn doctorate degrees than the bottom of the top, and individuals in the very top were

18 times more likely to earn a doctorate in a STEM field. Academics aren't for everyone, of course, but the top quartile were also six times more likely than the bottom to produce a patent and were three times more likely to have an income in the 95th percentile. Whether the goal was to become a professor, inventor, or tech-firm employee, natural ability seemed to enhance it.

"Measured cognitive abilities definitely have an impact. They can't really be dismissed, in terms of what effects they have on people's performance," says Kimberley Ferriman Robertson of Vanderbilt, lead author on the *Current Directions* paper. "Persistence and motivation are definitely important — it's not to say they're not — but there's more to it than that."

If anyone should fit the description of a natural talent, it's Wolfgang Amadeus Mozart. The idea that young Mozart, who was composing symphonies at age eight, didn't distinguish himself from his peers until he'd practiced for a decade didn't sit right with psychological scientist Joanne Ruthsatz. She reanalyzed Ericsson's data from the 1993 study and found that top violinists had begun to distance themselves well before they'd put in 10,000 hours. From the age of eight onwards, for instance, they won two-thirds of their competitions. Compare that to the "good" students, who only won about half the time, and the lowest group, who won about a fifth of the time.

Ruthsatz's team fashioned a study to see what other factors might contribute to great artistic performance. The researchers gathered young players from three levels of achievement: high-school band members, university music majors, and conservatory musicians. They administered tests of basic and music-specific intelligence, each designed to measure innate abilities.

Those two factors together accounted for more of the achievement difference than practice alone, Ruthsatz and colleagues reported in a 2008 issue of Intelligence. The findings suggest that high performers distinguish themselves on all three variables — general abilities, task-specific abilities, and work ethic — what Ruthsatz calls the Summation Theory.

"One thing that was interesting was the individual in the musical institute with the lowest IQ had the most practice time," says Ruthsatz, who's now at The Ohio State University at Mansfield. "You can make up for it. There are many ways to get to heaven. But the further down one [variable] is, the more you need the other. To take that equation and say all you need is practice, that's just not true."

Working Memory Matters

There's no doubt that practice is a key ingredient for success. But if deliberate practice alone is not sufficient to carry a person to the height of their performance, then what elements allow some people to excel above others?

In a recent study published in *Intelligence*, Ruthsatz examined modern child prodigies. While each of the prodigies had a moderately elevated level of intelligence, their IQ scores were not consistently on the extreme end of the spectrum. What were consistently extraordinary, however, were their working memory scores. Each child had results that placed them in the 99th percentile.

Other researchers have also caught on to the idea that working memory could define the boundaries of talent. In a study of poker by Meinz and Hambrick published earlier this year, 155 participants were

tested on poker knowledge (which can be acquired through practice) and working memory (which is largely heritable). They then tested performance on two critical elements of Texas Hold'Em play: remembering hands and evaluating their odds. Poker knowledge indeed predicted performance, but working-memory capacity (WMC) "may limit the ultimate level of performance achieved," Meinz, Hambrick, and colleagues report in the *Journal of Applied Research in Memory and Cognition*.

Working memory also contributes to another trait that many elite performers share: laserlike focus. APS Fellow Randall W. Engle, a professor of psychology at the Georgia Institute of Technology and Editor of *Current Directions in Psychological Science*, has devoted much of his career to studying the connection between working memory and executive attention, or the ability to focus on certain information in the face of distraction.

Engle and his colleagues conducted a 2004 study in which participants were categorized according to their WMC. Then they used an eye movement task, called an antisaccade task, to test the participants' ability to control their attention. A computer screen presented the participants with two boxes. They were asked to move their gaze toward either the box that flickered or the nonflickering box. Though it seems simple, this task is like asking someone to ignore their peripheral vision when crossing the street. After all, any movement they spot out of the corner of their eyes could be a jogger or it could be truck about to run them over.

When participants were asked to direct their gaze to the nonflickering box, low-WMC individuals were more likely to make mistakes than high-WMC individuals. In a separate study, which focused on the cocktail party effect, or people's ability to focus on relevant information despite being bombarded with irrelevant information, researchers supported Engle's conclusions when they found that low-WMC individuals had a harder time filtering out irrelevant information. Therefore, superior WMC may not only give elite performers an edge when it comes to retaining information, but may also sharpen their focus.

Personality Influences Performance

Certain aspects of personality have been connected to high performance. Among the personality traits in the Big Five model, multiple studies have found that conscientiousness is linked to performance. Conscientious people tend to be thorough, organized, and have a great deal of self-control. Conscientiousness has also been shown to predict stronger goal setting and self-efficacy.

Elite performers also tend to have a lot of endurance when it comes to achieving their goals. They don't give up easily. This is a quality that University of Pennsylvania psychological scientist Angela Duckworth calls grit. "We define grit as perseverance and passion for long-term goals," wrote Duckworth and colleagues in a 2007 study published in the *Journal of Personality and Social Psychology*. "Grit entails working strenuously toward challenges, maintaining effort and interest over years despite failure, adversity, and plateaus in progress."

To quantify grit, the researchers developed a self-report questionnaire that they called the Grit Scale. The items they chose for their scale were based on exploratory interviews with high-achieving lawyers, businesspeople, academics, and other professionals. Ultimately, the 12 items they chose were designed to test two factors: consistency of interests and perseverance of effort. Using the scale, they found that

more educated adults had higher grit scores than less educated adults. The results also suggested that grit increases with age. Another study of undergraduate students found that the individuals with the highest grit scores also had the highest GPAs.

The Whole Package

Researchers are still exploring whether enhancing these specific cognitive elements can help people achieve their best performance. Engle, for example, has found that working-memory training can help people improve their performance on a specific task, but they often have difficulty transferring that training to a new task (see “Boosting Brain Power Through a Mind-Body Connection,” Page 17). Yet even if individuals train ridiculously hard, there is one obstacle that they can’t overcome: a bias toward natural talent.

Something in the subtle factors that indicate natural talent appeals to us. Recently, Chia-Jung Tsay and APS Past President Mahzarin R. Banaji of Harvard University conducted a series of tests that compared views toward musicians who were either naturally talented or extremely hard-working. A panel of professional musicians, recruited as judges, claimed to place more value on effortful training than innate ability. When they evaluated performances, however, the same judges considered “the natural” to be more talented. In their 2011 article in the Journal of Experimental Psychology, Tsay and Banaji concluded that the tests “show a bias favoring naturals over strivers even when the achievement is equal.”

“It’s a hard thing to swallow, that intelligence makes a difference,” says Ruthsatz. “I’m not going to say that environment doesn’t play into it. It does. But you’re dealt a hand, and there’s only so much you can do with your hand.”

Ultimately what’s needed, Hambrick says, are theories that integrate multiple variables rather than ones that “reject, out of hand, a whole class of factors.” Some will be specific to a certain art, science, or game. Others, like general intelligence and working memory, will represent a basic platform of potential performance. Whatever formula emerges stands to be pretty complicated — not so different, in that way, from our response to an overachiever.

This version includes updates made after the print edition.