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# Why Can Some Kids Handle Pressure While Others Fall Apart?

By PO BRONSON and ASHLEY MERRYMAN

Noah Muthler took his first state standardized test in third grade at the Spring Cove Elementary School in Roaring Spring, Pa. It was a miserable experience, said his mother, Kathleen Muthler. He was a good student in a program for gifted children. But, Muthler said, "he was crying in my arms the night before the test, saying: 'I'm not ready, Mom. They didn't teach us everything that will be on the test.' " In fourth grade, he was upset the whole week before the exam. "He manifests it physically," his mother said. "He got headaches and stomachaches. He would ask not to go to school." Not a good sleeper anyway, Noah would slip downstairs after an hour tossing in bed and ask his mom to lie down with him until he fell asleep. In fifth grade, the anxiety lasted a solid month before the test. "Even after the test, he couldn't let it go. He would wonder about questions he feared he misunderstood," Muthler said.

So this year, Muthler is opting Noah out of the Pennsylvania System of School Assessment, using a broad religious and ethical exemption. Just knowing he won't be taking the tests in March has put Noah in a better frame of mind about school. "The pressure is off his shoulders now," his mother said. When he doesn't grasp a concept immediately, he can talk it through without any panic. "He looks forward to science class and math class again," Muthler said. "He wants to be a chemical or nuclear engineer."

Muthler understands Noah's distress; more mysterious is why her son Jacob, who is in eighth grade, isn't the least bit unnerved by the same tests. He, too, is in the gifted program, but that seems to give him breezy confidence, not fear. "You would think he doesn't even care," Muthler marveled. "Noah has the panic and anxiety for both of them." Nevertheless, she will opt out Jacob from the tests, too, to be consistent.

Never before has the pressure to perform on high-stakes tests been so intense or meant so much for a child's academic future. As more school districts strive for accountability, standardized tests have proliferated. The pressure to do well on achievement tests for college is filtering its way down to lower grades, so that even third graders feel as if they are on trial. Students get the message that class work isn't what counts, and that the standardized exam is the truer measure. Sure, you did your homework and wrote a great

history report — but this test is going to find out how smart you *really* are. Critics argue that all this test-taking is churning out sleep-deprived, overworked, miserable children.

But some children actually do better under competitive, stressful circumstances. Why can Jacob thrive under pressure, while it undoes Noah? And how should that difference inform the way we think about high-stakes testing? An emerging field of research — and a pioneering study from Taiwan — has begun to offer some clues. Like any kind of human behavior, our response to competitive pressure is derived from a complex set of factors — how we were raised, our skills and experience, the hormones that we marinated in as fetuses. There is also a genetic component: One particular gene, referred to as the COMT gene, could to a large degree explain why one child is more prone to be a worrier, while another may be unflappable, or in the memorable phrasing of David Goldman, a geneticist at the National Institutes of Health, more of a warrior.

Understanding their propensity to become stressed and how to deal with it can help children compete. Stress turns out to be far more complicated than we've assumed, and far more under our control than we imagine. Unlike long-term stress, short-term stress can actually help people perform, and viewing it that way changes its effect. Even for those genetically predisposed to anxiety, the antidote isn't necessarily less competition — it's *more* competition. It just needs to be the right kind.

**Every May in Taiwan,** more than 200,000 ninth-grade children take the Basic Competency Test for Junior High School Students. This is not just any test. The scores will determine which high school the students are admitted to — or if they get into one at all. Only 39 percent of Taiwanese children make the cut, with the rest diverted to vocational schools or backup private schools. The test, in essence, determines the future for Taiwanese children.

The test is incredibly difficult; answering the multiple-choice questions requires knowledge of chemistry, physics, advanced algebra and geometry, and testing lasts for two days. "Many students go to cram school almost every night to study all the subjects on the test," says Chun-Yen Chang, director of the Science Education Center at National Taiwan Normal University. "Just one or two percentage points difference will drag you from the No. 1 high school in the local region down to No. 3 or 4."

In other words, the exam was a perfect, real world experiment for studying the effects of genetics on high-stakes competition. Chang and his research team took blood samples

from 779 students who had recently taken the Basic Competency Test in three regions of Taiwan. They matched each student's genotype to his or her test score.

The researchers were interested in a single gene, the COMT gene. This gene carries the assembly code for an enzyme that clears dopamine from the prefrontal cortex. That part of the brain is where we plan, make decisions, anticipate future consequences and resolve conflicts. "Dopamine changes the firing rate of neurons, speeding up the brain like a turbocharger," says Silvia Bunge, associate professor of psychology and neuroscience at the University of California, Berkeley. Our brains work best when dopamine is maintained at an optimal level. You don't want too much, or too little. By removing dopamine, the COMT enzyme helps regulate neural activity and maintain mental function.

Here's the thing: There are two variants of the gene. One variant builds enzymes that *slowly* remove dopamine. The other variant builds enzymes that *rapidly* clear dopamine. We all carry the genes for one or the other, or a combination of the two.

In lab experiments, people have been given a variety of cognitive tasks — computerized puzzles and games, portions of I.Q. tests — and researchers have consistently found that, under normal conditions, those with slow-acting enzymes have a cognitive advantage. They have superior executive function and all it entails: they can reason, solve problems, orchestrate complex thought and better foresee consequences. They can concentrate better. This advantage appears to increase with the number of years of education.

The brains of the people with the other variant, meanwhile, are comparatively lackadaisical. The fast-acting enzymes remove too much dopamine, so the overall level is too low. The prefrontal cortex simply doesn't work as well.

On that score alone, having slow-acting enzymes sounds better. There seems to be a trade-off, however, to these slow enzymes, one triggered by stress. In the absence of stress, there is a cognitive advantage. But when under stress, the advantage goes away and in fact reverses itself.

"Stress floods the prefrontal cortex with dopamine," says Adele Diamond, professor of developmental cognitive neuroscience at the University of British Columbia. A little booster hit of dopamine is normally a good thing, but the big surge brought on by stress is too much for people with the slow-acting enzyme, which can't remove the dopamine fast

enough. “Much like flooding a car engine with too much gasoline, prefrontal-cortex function melts down,” Diamond says.

Other research has found that those with the slow-acting enzymes have higher I.Q.’ s, on average. One study of Beijing schoolchildren calculated the advantage to be 10 I.Q. points. But it was unclear if the cognitive advantages they had would stay with them when they were under stress outside the security of the lab environment.

The Taiwan study was the first to look at the COMT gene in a high-stakes, real-life setting. Would the I.Q. advantage hold up, or would the stress undermine performance?

It was the latter. The Taiwanese students with the slow-acting enzymes sank on the national exam. On average, they scored 8 percent lower than those with the fast-acting enzymes. It was as if some of the A students and B students traded places at test time.

“I am not against pressure. Actually, pressure is good [for] someone,” Chang commented. “But those who are more vulnerable to stress will be more disadvantaged.”

As of 2014, Taiwan will no longer require all students to take the Basic Competency Test, as the country moves to 12-year compulsory education. The system will no longer be built to weed out children, but to keep them all in school. But academically advanced students will still take some kind of entrance exam. And those elite students will still feel the pressure, which, it bears repeating, will hurt some but help others.

“The people who perform best in normal conditions may not be the same people who perform best under stress,” Diamond says. People born with the fast-acting enzymes “actually need the stress to perform their best.” To them, the everyday is underwhelming; it doesn’t excite them enough to stimulate the sharpness of mind of which they are capable. They benefit from that surge in dopamine — it raises the level up to optimal. They are like Superman emerging from the phone booth in times of crisis; their abilities to concentrate and solve problems go up.

**Some scholars have** suggested that we are all Warriors or Worriers. Those with fast-acting dopamine clearers are the Warriors, ready for threatening environments where maximum performance is required. Those with slow-acting dopamine clearers are the Worriers, capable of more complex planning. Over the course of evolution, both Warriors and Worriers were necessary for human tribes to survive.

In truth, because we all get one COMT gene from our father and one from our mother, about half of all people inherit one of each gene variation, so they have a mix of the enzymes and are somewhere in between the Warriors and the Worriers. About a quarter of people carry Warrior-only genes, and a quarter of people Worrier-only.

A number of research studies are looking at COMT, including several involving the American military. Researchers at Brown University have been studying COMT's connection to post-traumatic stress disorder in veterans of the wars in Iraq and Afghanistan. Quinn Kennedy, a research psychologist at the Naval Postgraduate School, is studying how the gene correlates with pilot performance. Douglas C. Johnson, a professor of psychiatry at the University of California, San Diego, is part of a consortium of researchers called the OptiBrain Center, where he is interested in COMT's role in combat performance and well-being.

While the studies are ongoing, the early results show those with Worrier-genes can still handle incredible stress — as long as they are well trained. Even some Navy SEALs have the Worrier genes, so you can literally be a Worrier-gene Warrior. In Kennedy's sample, almost a third of the expert pilots were Worriers — a larger proportion than in the general population.

Kennedy's work is particularly revealing. She puts pilots through a series of six flight-simulator tests, where pilots endure turbulence, oil-pressure problems, iced carburetors and crosswinds while landing. They are kept furiously busy, dialing to new frequencies, flying to new altitudes and headings and punching in transponder codes.

Among recreational pilots with the lowest rating level — trained to fly only in daylight — those with Warrior genes performed best. But that changed with more experience. Among recreational pilots who had the next level of qualification — trained to fly at night using cockpit instruments — the Worriers far outperformed the Warriors. Their genetically blessed working memory and attention advantage kicked in. And their experience meant they didn't melt under the pressure of their genetic curse.

What this suggests, Kennedy says, is that, for Worriers, "through training, they can learn to manage the particular stress in the specific pilot training, even if it is not necessarily transferred over to other parts of their lives."

So while the single-shot stakes of a standardized exam is particularly ill suited for Worrier genotypes, this doesn't mean that they should be shielded from all challenge. In

fact, shielding them could be the worst response, depriving them of the chance to acclimate to recurring stressors. Johnson explains this as a form of stress inoculation: You tax them without overwhelming them. “And then allow for sufficient recovery,” he continued. Training, preparation and repetition defuse the Worrier’s curse.

**There are many** psychological and physiological reasons that long-term stress is harmful, but the science of elite performance has drawn a different conclusion about short-term stress. Studies that compare professionals with amateur competitors — whether concert pianists, male rugby or female volleyball players — show that professionals feel just as much anxiety as amateurs. The difference is in how they interpret their anxiety. The amateurs view it as detrimental, while the professionals tend to view stress as energizing. It gets them to focus.

A similar mental shift can also help students in test-taking situations. Jeremy Jamieson, assistant professor of social psychology at the University of Rochester, has done a series of experiments that reveal how the labeling of stress affects performance on academic testing.

The first experiment was at Harvard University with undergraduates who were studying for the Graduate Record Examination. Before taking a practice test, the students read a short note explaining that the study’s purpose was to examine the effects of stress on cognition. Half of the students, however, were also given a statement declaring that recent research suggests “people who feel anxious during a test might actually do better.” Therefore, if the students felt anxious during the practice test, it said, “you shouldn’t feel concerned. . . simply remind yourself that your arousal could be helping you do well.”

Just reading this statement significantly improved students’ performance. They scored 50 points higher in the quantitative section (out of a possible 800) than the control group on the practice test. Remarkable as that seemed, it is relatively easy to get a result in a lab. Would it affect their actual G.R.E. results? A couple of months later, the students turned in their real G.R.E. scores. Jamieson calculated that the group taught to see anxiety as beneficial in the lab experiment scored 65 points higher than the controls. In ongoing work, Jamieson is replicating the experiment with remedial math students at a Midwestern community college: after they were told to think of stress as beneficial, their grades improved.

At first blush, you might assume that the statement about anxiety being beneficial simply calmed the students, reducing their stress and allowing them to focus. But that was not the case. Jamieson's team took saliva samples of the students, both the day before the practice test to set a base line, and right after reading the lines about the new science — just moments before they started the first question. Jamieson had the saliva tested for biomarkers that show the level of activation of the body's sympathetic nervous system — our "fight or flight" response. The experimental group's stress levels were decidedly higher. The biological stress was real, but it had different physiological manifestations and had somehow been transformed into a positive force that drove performance.

If you went to an SAT testing site and could run physiological and neurological scans on the teenagers milling outside the door right before the exam, you would observe very different biomarkers from student to student. Those standing with shoulders hunched, or perhaps rubbing their hands, stamping their feet to get warm, might be approaching what Wendy Berry Mendes and colleagues call a "threat state." According to Mendes, an associate professor of psychology at the University of California, San Francisco, the hallmark of a threat state is vasoconstriction — a tightening of the smooth muscles that line every blood vessel in the body. Blood pressure rises; breathing gets shallow. Oxygenated blood levels drop, and energy supplies are reduced. Meanwhile, a rush of hormones amplifies activity in the brain's amygdala, making you more aware of risks and fearful of mistakes.

At that same test center, you might see students shoulders back, chest open, putting weight on their toes. They may be in a "challenge state." Hormones activate the brain's reward centers and suppress the fear networks, so the person is excited to start in on the test. In this state, decision making becomes automatic. The blood vessels and lungs dilate. In a different study of stress, Jamieson found that the people told to feel positive about being anxious had their blood flow increase by an average of more than half a liter per minute, with more oxygen and energy coursing throughout the body and brain. Some had up to two liters per minute extra.

Jamieson is frustrated that our culture has such a negative view of stress: "When people say, 'I'm stressed out,' it means, 'I'm not doing well.' It doesn't mean, 'I'm excited — I have increased oxygenated blood going to my brain."

As the doors to the test center open, the line between challenge and threat is thin. Probably nothing induces a threat state more than feeling you can't make any mistakes.

Threat physiology can be activated with the sense of being judged, or anything that triggers the fear of disappointing others. As a student opens his test booklet, threat can flare when he sees a subject he has recently learned but hasn't mastered. Or when he sees a problem he has no idea how to solve.

**Armando Rodriguez graduated** last spring from Bright Star Secondary Charter Academy in Los Angeles, but he is waiting until next fall to start college. He is not taking a gap year to figure out what he wants to do with his life. He's recuperating from knee surgery for a bone condition, spending his days in physical therapy. And what does he miss about being out of school? Competing.

"It's an adrenaline rush — like no other thing." He misses being happy when he wins. He even misses losing. "At least it was a feeling you got," he said. "It made you want to be better, the next time." Without a competitive goal, he feels a little adrift. He finds himself mentally competing with other physical-therapy patients.

Rodriguez recorded a 3.86 G.P.A. his senior year of high school and was a defender for the school soccer team. The knee injury happened during a stint on the school's football team: his doctor had warned that it was too risky to play, but "I just had to try," he said. He used to constantly challenge his friends on quiz grades; it's how they made schoolwork fun.

But when he took the SAT last year, he experienced a different sensation. "My heart was racing," he said. "I had butterflies." Occasionally, he'd look up from his exam to see everyone else working on their own tests: they seemed to be concentrating so hard and answering questions faster than he was. "What if they're doing way better than me?" immediately led to the thought, "These people are smarter than me. All the good schools are going to want them, and not me." Within seconds, he arrived at the worst possible outcome: his hopes of a good college would be gone.

It might seem surprising that the same student can experience competition in such different ways. But this points to what researchers think is the difference between competition that challenges and competition that threatens.

Taking a standardized test is a competition in which the only thing anyone cares about is the final score. No one says, "I didn't do that well, but it was still worth doing, because I learned so much math from all the months of studying." Nobody has ever come out of an SAT test saying, "Well, I won't get into the college I wanted, but that's O.K. because I

made a lot of new friends at the Kaplan center." Standardized tests lack the side benefits of competing that normally buffer children's anxiety. When you sign your child up for the swim team, he may really want to finish first, but there are many other reasons to be in the pool, even if he finishes last.

High-stakes academic testing isn't going away. Nor should competition among students. In fact several scholars have concluded that what students need is more academic competition, but modeled on the kinds children enjoy.

David and Christi Bergin, professors of educational and developmental psychology at the University of Missouri, have begun a pilot study of junior high school students participating in math competitions. They have observed that, within a few weeks, students were tackling more complex problems than they would even at the end of a yearlong class. Some were even doing college-level math. That was true even for students who didn't like math before joining the team and were forced into it by their parents. Knowing they were going up against other teams in front of an audience, the children took ownership over the material. They became excited about discovering ever more advanced concepts, having realized each new fact was another weapon in their intellectual arsenal.

In-class spelling bees. Science fairs. Chess teams. "The performance is highly motivating," David Bergin says. Even if a child knows her science project won't win the science fair, she still gets that moment to perform. That moment can be stressful and invigorating and scary, but if the child handles it well, it feels like a victory.

"Children benefit from competition they have prepared for intensely, especially when viewed as an opportunity to gain recognition for their efforts and improve for the next time," says Rena Subotnik, a psychologist at the American Psychological Association. Subotnik notes that scholastic competitions can raise the social status of academic work as well as that of the contestants. Competitions like these are certainly not without stress, but the pressure comes in predictable ebbs and flows, broken up by moments of fun and excitement.

Maybe the best thing about academic competitions is that they benefit both Warriors and Worriers equally. The Warriors get the thrilling intensity their minds are suited for, where they can shine. The Worriers get the gradual stress inoculation they need, so that one day

they can do more than just tolerate stress — they can embrace it. And through the cycle of preparation, performance and recovery, what they learn becomes ingrained.

It may be difficult to believe, as Jamieson advises, that stress can benefit your performance. We can read it, and we can talk about it, but it's the sort of thing that needs to be practiced, perhaps for years, before it can become a deeply held conviction.

It turns out that Armando Rodriguez was accepted at five colleges. He rallied that day on the SAT. It wasn't his best score — he did better the second time around — but it was not as bad as he feared. Rodriguez had never heard of Jeremy Jamieson. He had never read, or ever been told, that intense stress could be harnessed to perform his best. But he understood it and drew strength from it. In the middle of his downward spiral of panic, he realized something: "I'm in a competition. This is a competition. I've got to beat them."

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