The Physical Genuis

What do Wayne Gretsky, Yo-Yo Ma, and a brain surgeon named Charlie Wilson have in common?

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Early one recent morning, while the San Francisco fog was lifting from the surrounding hills, Charlie Wilson performed his two thousand nine hundred and eighty-seventh transsphenoidal resection of a pituitary tumor. The patient was a man in his sixties who had complained of impotence and obscured vision. Diagnostic imaging revealed a growth, eighteen millimetres in diameter, that had enveloped his pituitary gland and was compressing his optic nerve. He was anesthetized and covered in blue surgical drapes, and one of Wilson's neurosurgery residents—a tall, slender woman in her final year of training—"opened" the case, making a small incision in his upper gum, directly underneath his nose. She then tunnelled back through his nasal passages until she reached the pituitary, creating a cavity several inches deep and about one and a half centimetres in diameter.

Wilson entered the operating room quickly, walking stiffly, bent slightly at the waist. He is sixty-nine—a small, wiry man with heavily muscled arms. His hair is cut very close to his scalp, so that, as residents over the years have joked, he might better empathize with the shaved heads of his patients. He is part Cherokee Indian and has high, broad cheekbones and large ears, which stick out at almost forty-five-degree angles. He was wearing Nike cross-trainers, and surgical scrubs marked with the logo of the medical center he has dominated for the past thirty years—Moffitt Hospital, at the University of California, San Francisco. When he was busiest, in the nineteen-eighties, he would routinely do seven or eight brain surgeries in a row, starting at dawn and ending at dusk, lining up patients in adjoining operating rooms and striding from one to the other like a conquering general. On this particular day, he would do five, of which the transsphenoidal was the first, but the rituals would be the same. Wilson believes that neurosurgery is best conducted in silence, with a scrub nurse who can anticipate his every step, and a resident who does not have to be told what to do, only shown. There was no music in the O.R. To guard against unanticipated disturbances, the door was locked. Pagers were set to "buzz," not beep. The phone was put on "Do Not Disturb."

Wilson sat by the patient in what looked like a barber's chair, manipulating a surgical microscope with a foot pedal. In his left hand he wielded a tiny suction tube, which removed excess blood. In his right he held a series of instruments in steady alternation: Cloward elevator, Penfield No. 2, Cloward rongeur, Fulton rongeur, conchatome, Hardy dissector, Kurze scissors, and so on. He worked quickly, with no wasted motion. Through the microscope, the tumor looked like a piece of lobster flesh, white and fibrous. He removed the middle of it, exposing the pituitary underneath. Then he took a ring

curette—a long instrument with a circular scalpel perpendicular to the handle—and ran it lightly across the surface of the gland, peeling the tumor away as he did so.

It was, he would say later, like running a squeegee across a windshield, except that in this case the windshield was a surgical field one centimetre in diameter, flanked on either side by the carotid arteries, the principal sources of blood to the brain. If Wilson were to wander too far to the right or to the left and nick either artery, the patient might, in the neurosurgical shorthand, "stroke." If he were to push too far to the rear, he might damage any number of critical nerves. If he were not to probe aggressively, though, he might miss a bit of tumor and defeat the purpose of the procedure entirely. It was a delicate operation, which called for caution and confidence and the ability to distinguish between what was supposed to be there and what wasn't. Wilson never wavered. At one point, there was bleeding from the right side of the pituitary, which signalled to Wilson that a small piece of tumor was still just outside his field of vision, and so he gently slid the ring curette over, feeling with the instrument as if by his fingertips, navigating around the carotid, lifting out the remaining bit of tumor. In the hands of an ordinary neurosurgeon, the operation—down to that last bit of blindfolded acrobatics—might have taken several hours. It took Charlie Wilson twenty-five minutes.

Neurosurgery is generally thought to attract the most gifted and driven of medical-school graduates. Even in that rarefied world, however, there are surgeons who are superstars and surgeons who are merely very good. Charlie Wilson is one of the superstars. Those who have trained with him say that if you showed them a dozen videotapes of different neurosurgeons in action—with the camera focussed just on the hands of the surgeon and the movements of the instruments—they could pick Wilson out in an instant, the same way an old baseball hand could look at a dozen batters in silhouette and tell you which one was Willie Mays. Wilson has a distinctive fluidity and grace.

One of the most difficult of all neurosurgical procedures is aneurysm repair, where the surgeon sets out to seal, with a tiny titanium clip, a bulge in the side of an artery caused by the weakening of its wall. If the aneurysm bursts in the process—because the clip is applied incorrectly, or the surgeon inadvertently punctures one of the tributary vessels or doesn't see something critical on the underside of the aneurysm—the patient stands a good chance of dying. Aneurysm repair is bomb disposal. Wilson made it look easy. "After he'd dissected the whole aneurysm out, and when he had control of all the feeding vessels, I'd see him grasp it and flip it back and forth, because he somehow *knew* that if it popped he would still be able to clip it," says Michon Morita, who trained with Wilson at U.C.S.F. in the early nineties and now practices in Honolulu. "Most people are afraid of aneurysms. He wasn't afraid of them at all. He was like a cat playing with a mouse."

There are thousands of people who have played in the National Hockey League over the years, but there has been only one Wayne Gretzky. Thousands of cellists play professionally all over the world, but very few will ever earn comparison with Yo-Yo Ma. People like Gretzky or Ma or Charlie Wilson all have an affinity for translating thought into action. They're what we might call physical geniuses. But what makes them so good at what they do?

The temptation is to treat physical genius in the same way that we treat intellectual genius—to think of it as something that can be ascribed to a single factor, a physical version of I.Q. When professional football coaches assess the year's crop of college prospects, they put them through drills designed to measure what they regard as athleticism: How high can you jump? How many pounds can you bench press? How fast can you sprint? The sum of the scores on these tests is considered predictive of athletic performance, and every year some college player's stock shoots up before draft day because it is suddenly discovered that he can run, say, 4.4 seconds in the forty-yard dash as opposed to 4.6 seconds. This much seems like common sense. The puzzling thing about physical genius, however, is that the closer you look at it the less it can be described by such cut-and-dried measures of athleticism.

Consider, for example, Tony Gwynn, who has been one of the best hitters in baseball over the past fifteen years. We would call him extraordinarily coördinated, by which we mean that in the course of several hundred milliseconds he can execute a series of perfectly synchronized muscular actions—the rotation of the shoulder, the movement of the arms, the shift of the hips—and can regulate the outcome of those actions so that his bat hits the ball with exactly the desired degree of force. These are abilities governed by specific neurological mechanisms. Timing, for example, appears to be controlled by the cerebellum. Richard Ivry, a psychologist at the University of California at Berkeley, has looked at patients who suffered cerebellar damage as a result of a stroke. He had them pronounce the sounds "bah," "pah," and "dah." The difference between the "b" sound and the "p" sound is primarily a matter of timing. "To make the 'b' sound, you put your lips together and as you open them you immediately vibrate the vocal chords," Ivry said. "For 'p' you open the lips thirty to forty milliseconds before the vocal cords vibrate." Stroke patients with cerebellar damage, Ivry found, make lots of "b"-"p" mistakes: "baby" comes out "paby." Their timing is off. But they don't have trouble with "p" and "d," because the timing of lips and vocal cords for those two sounds is exactly the same. The difference is simply in the configuration of your tongue. "You never hear them say 'dady' instead of 'baby,'" Ivry said.

Force regulation appears to be controlled by another area of the brain entirely, the basal ganglia. "I like to think of the basal ganglia as a gate to the motor system," Ivry said, although he cautioned that the work on force regulation is still a good deal more speculative than the work on timing. "At any point in time, I have a few actions that I'm thinking about, and the basal ganglia are monitoring all the potential ones, then choosing one. The question is: How quickly does that gate open up?" He devised a study in which subjects were asked to press on a lever with their index finger over and over again, with the same degree of force each time. Patients with Parkinson's disease, which is a degenerative condition affecting the basal ganglia, had relatively little trouble with the timing of that movement, but they had terrible difficulty controlling the force of the tapping. At one moment they were pressing too hard, and the next they weren't pressing hard enough. Their "gate" wasn't working properly.

Stroke victims and Parkinson's patients, of course, are people who have actually suffered neurological impairment. But Ivry and Steven Keele, of the University of Oregon,

suggest that in healthy people, too, there is probably a natural variation in the efficiency of these motor-control functions. They have done work on clumsy children, for example, that shows that what looks like a general lack of coördination can, in some cases, be broken down into either a basal-ganglia problem or a cerebellum problem. Clumsy kids are at one end of the coördination bell curve. "Maybe their neural connections or their branching isn't as well developed, or they don't have as many synaptic connections," Ivry suggests. And at the other end of the curve? That's where you find people like Tony Gwynn.

But being wonderfully coördinated isn't all there is to hitting. A ball thrown at eighty-nine miles per hour (which is a typical speed in the major leagues) takes roughly four hundred and sixty milliseconds to go from the pitcher's hand to home plate. Someone like Tony Gywnn, with all his finely tuned physiological hardware, takes about a hundred and sixty milliseconds to swing a bat. The decision about how to swing the bat, however, will take Gwynn between a hundred and ninety and four hundred and fifty milliseconds, depending on what the situation is and what he intends to do with the pitch. "Very good hitters base their decisions on past experience with certain pitchers, with the count, with the probabilities of certain types of pitches, with their own skills, and use very early cues in the pitcher's delivery to begin the swing," Janet Starkes, a professor of kinesiology at McMaster University, in Ontario, says.

What sets physical geniuses apart from other people, then, is not merely being able to do something but knowing what to do—their capacity to pick up on subtle patterns that others generally miss. This is what we mean when we say that great athletes have a "feel" for the game, or that they "see" the court or the field or the ice in a special way. Wayne Gretzky, in a 1981 game against the St. Louis Blues, stood behind the St. Louis goal, laid the puck across the blade of his stick, then bounced it off the back of the goalie in front of him and into the net. Gretzky's genius at that moment lay in seeing a scoring possibility where no one had seen one before. "People talk about skating, puck-handling, and shooting," Gretzky told an interviewer some years later, "but the whole sport is angles and caroms, forgetting the straight direction the puck is going, calculating where it will be diverted, factoring in all the interruptions." Neurosurgeons say that when the very best surgeons operate they always know where they are going, and they mean that the Charlie Wilsons of this world possess that same special feel—an ability to calculate the diversions and to factor in the interruptions when faced with a confusing mass of blood and tissue.

When Charlie Wilson came to U.C. San Francisco, in July of 1968, his first case concerned a woman who had just had a pituitary operation. The previous surgeon had done the one thing that surgeons are not supposed to do in pituitary surgery—tear one of the carotid arteries. Wilson was so dismayed by the outcome that he resolved he would teach himself how to do the transsphenoidal, which was then a relatively uncommon procedure. He carefully read the medical literature. He practiced on a few cadavers. He called a friend in Los Angeles who was an expert at the procedure, and had him come to San Francisco and perform two operations while Wilson watched. He flew to Paris to observe GerardGuiot, who was one of the great transsphenoidal surgeons at the time.

Then he flew home. It was the equivalent of someone preparing for a major-league tryout by watching the Yankees on television and hitting balls in an amusement-arcade batting cage. "Charlie went slowly," recalls Ernest Bates, a Bay-area neurosurgeon who scrubbed with Wilson on his first transsphenoidal, "but he knew the anatomy and, boom, he was there. I thought, My God, this was the first? You'd have thought he had done a hundred. Charlie has a skill that the rest of us just don't have."

This is the hard part about understanding physical genius, because the source of that special skill—that "feel"—is still something of a mystery. "Sometimes during the course of an operation, there'll be several possible ways of doing something, and I'll size them up and, without having any conscious reason, I'll just do one of them," Wilson told me. He speaks with a soft, slow drawl, a remnant of Neosho, Missouri, the little town where he grew up, and where his father was a pharmacist, who kept his store open from 7 a.m. to 11 p.m., seven days a week. Wilson has a plainspoken, unpretentious quality. When he talks about his extraordinary success as a surgeon, he gives the impression that he is talking about some abstract trait that he is neither responsible for nor completely able to understand. "It's sort of an invisible hand," he went on. "It begins almost to seem mystical. Sometimes a resident asks, 'Why did you do that?' and I say"—here Wilson gave a little shrug—"'Well, it just seemed like the right thing.'"

There is a neurosurgeon at Columbia Presbyterian Center, in Manhattan, by the name of Don Quest, who served two tours in Vietnam flying A-1s off the U.S.S. Kitty Hawk. Quest sounds like the kind of person who bungee jumps on the weekend and has personalized license plates that read "Ace." In fact, he is a thoughtful, dapper man with a carefully trimmed mustache, who plays the trombone in his spare time and quite cheerfully describes himself as compulsive. "When I read the New York *Times*, I don't speed-read it,"Quest told me. "I read it carefully. I read everything. It drives my wife crazy." He was wearing a spotless physician's coat and a bow tie. "When I'm reading a novel—and there are so many novels I want to read—even if it's not very good I can't throw it away. I stick with it. It's quite frustrating, because I don't really have time for garbage." Quest talked about what it was like to repair a particularly tricky aneurysm compared to what it was like to land at night in rough seas and a heavy fog when you are running out of fuel and the lights are off on the carrier's landing strip, because the skies are full of enemy aircraft. "I think they are similar," he said, after some thought, and what he meant was that they were both exercises in a certain kind of exhaustive and meticulous preparation. "There is a checklist, before you take off, and this was drilled into us,"Quest said. "It's on the dashboard with all the things you need to do. People forget to put the hook down, and you can't land on an aircraft carrier if the hook isn't down. Or they don't put the wheels down. One of my friends, my roommate, landed at night on the aircraft carrier with the wheels up. Thank God, the hook caught, because his engine stopped. He would have gone in the water." Quest did not seem like the kind of person who would forget to put the wheels down. "Some people are much more compulsive than others, and it shows," he went on to say. "It shows in how well they do their landing on the aircraft carrier, how many times they screw up, or are on the wrong radio frequency, or get lost, or their ordinances aren't accurate in terms of dropping a bomb. The ones who are the best are the ones who are always very careful."

Quest isn’t saying that fine motor ability is irrelevant. One would expect him to perform extremely well on tests of the sort Ivry and Keele might devise. And, like Tony Gwynn, he’s probably an adept and swift decision maker. But these abilities, Quest is saying, are of little use if you don’t have the right sort of personality. Charles Bosk, a sociologist at the University of Pennsylvania, once conducted a set of interviews with young doctors who had either resigned or been fired from neurosurgery-training programs, in an effort to figure out what separated the unsuccessful surgeons from their successful counterparts. He concluded that, far more than technical skills or intelligence, what was necessary for success was the sort of attitude that Quest has—a practical-minded obsession with the possibility and the consequences of failure. "When I interviewed the surgeons who were fired, I used to leave the interview shaking," Bosk said. "I would hear these horrible stories about what they did wrong, but the thing was that they didn’t *know* that what they did was wrong. In my interviewing, I began to develop what I thought was an indicator of whether someone was going to be a good surgeon or not. It was a couple of simple questions: Have you ever made a mistake? And, if so, what was your worst mistake? The people who said, ‘Gee, I haven’t really had one,’ or, ‘I’ve had a couple of bad outcomes but they were due to things outside my control’—invariably those were the worst candidates. And the residents who said, ‘I make mistakes all the time. There was this horrible thing that happened just yesterday and here’s what it was.’ They were the best. They had the ability to rethink everything that they’d done and imagine how they might have done it differently."

What this attitude drives you to do is practice over and over again, until even the smallest imperfections are ironed out. After doing poorly in a tournament just prior to this year’s Wimbledon, Greg Rusedski, who is one of the top tennis players in the world, told reporters that he was going home to hit a thousand practice serves. One of the things that set Rusedski apart from lesser players, in other words, is that he is the kind of person who is willing to stand out in the summer sun, repeating the same physical movement again and again, in single-minded pursuit of some fractional improvement in his performance. Wayne Gretzky was the same way. He would frequently stay behind after practice, long after everyone had left, flipping pucks to a specific spot in the crease, or aiming shot after shot at the crossbar or the goal post.

And Charlie Wilson? In his first few years as a professor at U.C.S.F., he would disappear at the end of the day into a special laboratory to practice his craft on rats: isolating, cutting, and then sewing up their tiny blood vessels, and sometimes operating on a single rat two or three times. He would construct an artificial aneurysm using a vein graft on the side of a rat artery, then manipulate the aneurysm the same way he would in a human being, toughening its base with a gentle coagulating current—and return two or three days later to see how successful his work had been. Wilson sees surgery as akin to a military campaign. Training with him is like boot camp. He goes to bed somewhere around eleven at night and rises at 4:30 a.m. For years, he ran upward of eighty miles a week, competing in marathons and hundred-mile ultra-marathons. He quit only after he had a hip replacement and two knee surgeries and found himself operating in a cast. Then he took up rowing. On his days in the operating room, at the height of his career, Wilson would run his morning ten or twelve miles, conduct medical rounds, operate steadily until

six or seven in the evening, and, in between, see patients, attend meetings, and work on what now totals six hundred academic articles. One of his former residents says, with a laugh, that when he was on Wilson's rotation he developed a persistent spasm of his upper eyelid and it did not go away until he moved on to train with someone else. Julian Hoff, the chairman of neurosurgery at the University of Michigan and a longtime friend of Wilson's, says, "The way he would communicate with people in the office is that he would have a little piece of paper and he would put your name with an arrow next to it, and two words saying what he wanted you to do." Once, when a new head of nursing at U.C.S.F. wanted to start rotating nursing teams in neurosurgery, instead of letting Wilson work with the same team every day, he stopped operating for a week in protest. New nurses, he explained, would mean more mistakes—not fatal mistakes but irregularities in the flow of his operating room, such as someone's handing him the wrong instrument, or handing him an instrument with the blade up instead of down, or even just a certain hesitation, because to Wilson the perfect operation requires a particular grace and rhythm. "In every way, it is analogous to the routine of a concert pianist," he says. "If you were going to do a concert and you didn't practice for a week, someone would notice that, just as I notice if one of my scrub nurses has been off for a week. There is that fraction-of-a-second difference in the way she reacts."

"Wilson has a certain way of positioning the arm of the retractor blade"—an instrument used to hold brain tissue in place—"so that the back end of the retractor doesn't stick up at all and he won't accidentally bump into it," Michon Morita told me. "Every once in a while, though, I'd see him when he didn't quite put it in the position he wanted to, and bumped it, which caused a little bit of hemorrhage on the brain surface. It wasn't harming the patient, and it was nothing he couldn't handle. But I'd hear 'That was stupid,' and I'd immediately ask myself, What did I do wrong? Then I'd realize he was chastising himself. Most people would say that if there was no harm done to the patient it was no big deal. But he wants to be perfect in everything, and when that perfection is broken he gets frustrated."

This kind of obsessive preparation does two things. It creates consistency. Practice is what enables Greg Rusedski to hit a serve at a hundred and twenty-five miles per hour again and again. It's what enables a pianist to play Chopin's double-thirds Étude at full speed, striking every key with precisely calibrated force. More important, practice changes the *way* a task is perceived. A chess master, for example, can look at a game in progress for a few seconds and then perfectly reconstruct that same position on a blank chessboard. That's not because chess masters have great memories (they don't have the same knack when faced with a random arrangement of pieces) but because hours and hours of chess playing have enabled them to do what psychologists call "chunking." Chunking is based on the fact that we store familiar sequences—like our telephone number or our bank-machine password—in long-term memory as a single unit, or chunk. If I told you a number you'd never heard before, though, you would be able to store it only in short-term memory, one digit at a time, and if I asked you to repeat it back to me you might be able to remember only a few of those digits—maybe the first two or the last three. By contrast, when the chess masters see the board from a real game, they are able

to break the board down into a handful of chunks—two or three clusters of pieces in positions that they have encountered before.

In "The Game of Our Lives," a classic account of the 1980-81 season of the Edmonton Oilers hockey team, Peter Gzowski argues that one of the principal explanations for the particular genius of Wayne Gretzky was that he was hockey's greatest chunker. Gretzky, who holds nearly every scoring record in professional hockey, baffled many observers because he seemed to reverse the normal laws of hockey. Most great offensive players prefer to keep the rest of the action on the ice behind them—to try to make the act of scoring be just about themselves and the goalie. Gretzky liked to keep the action in front of him. He would set up by the side of the rink, or behind the opposing team's net, so that the eleven other players on the ice were in full view, and then slide the perfect pass to the perfect spot. He made hockey look easy, even as he was playing in a way that made it more complicated. Gzowski says that Gretzky could do that because, like master chess players, he wasn't seeing all eleven other players individually; he was seeing only chunks. Here is Gzowski's conclusion after talking to Gretzky about a game he once played against the Montreal Canadiens. It could as easily serve as an explanation for Charlie Wilson's twenty-five-minute transsphenoidal resection:

What Gretzky perceives on a hockey rink is, in a curious way, more simple than what a less accomplished player perceives. He sees not so much a set of moving players as a number of situations. . . . Moving in on the Montreal blueline, as he was able to recall while he watched a videotape of himself, he was aware of the position of all the other players on the ice. The pattern they formed was, to him, one fact, and he reacted to that fact. When he sends a pass to what to the rest of us appears an empty space on the ice, and when a teammate magically appears in that space to collect the puck, he has in reality simply summoned up from his bank account of knowledge the fact that in a particular situation, someone is likely to be in a particular spot, and if he is not there now he will be there presently.

For a time, early in his career, Charlie Wilson became obsessed with tennis. He took lessons from Rod Laver. He joined three tennis clubs, so he could be absolutely assured of having court time whenever he wanted it. He had his own ball machine, and would go out early in the morning, before anyone else was on the court, and hit bucket after bucket of balls. He was in great shape. He could play any number of sets. He had a serve that he says was a beauty, a great backhand, and—as he put it—"a very expensive" forehand. But Wilson never turned into the kind of tennis player he wanted to be. Julian Hoff recalls, "There was this guy in the neurosurgery department, John Adams, who was a former tennis champion. An older guy. Arthritic. Rickety. Looked terrible. Charlie decided that he had to beat John Adams. But he never could. It drove him crazy."

It is easy to understand Wilson's frustration. He was a superb athlete—as a teen-ager he had been an excellent basketball player, and he attended college on a football scholarship—and a surgeon who could make life-or-death decisions in a split second. And yet, for all his focus and determination, he could not respond effectively to an old man shuffling toward the ball twenty feet across the net from him. "A good player knows

where the ball is going," Wilson says. "He anticipates it. He is there. I just wasn't." What Wilson is describing is a failure not of skill or of resolve but of the least understood element of physical genius—imagination. For some reason, he could not make the game come alive in his mind.

When psychologists study people who are expert at motor tasks, they find that almost all of them use their imaginations in a very particular and sophisticated way. Jack Nicklaus, for instance, has said that he has never taken a swing that he didn't first mentally rehearse, frame by frame. Yo-Yo Ma told me that he remembers riding on a bus, at the age of seven, and solving a difficult musical problem by visualizing himself playing the piece on the cello. Robert Spetzler, who trained with Wilson and is widely considered to be the heir to Wilson's mantle, says that when he gets into uncharted territory in an operation he feels himself transferring his mental image of what ought to happen onto the surgical field. Charlie Wilson talks about going running in the morning and reviewing each of the day's operations in his head—visualizing the entire procedure and each potential outcome in advance. "It was a virtual rehearsal," he says, "so when I was actually doing the operation, it was as if I were doing it for the second time." Once, he says, he had finished a case and taken off his gloves and was walking down the hall away from the operating room when he suddenly stopped, because he realized that the tape he had been playing in his head didn't match the operation that had unfolded before his eyes. "I was correlating everything—what I saw, what I expected, what the X-rays said. And I just realized that I had not pursued one particular thing. So I turned around, scrubbed, and went back in, and, sure enough, there was a little remnant of tumor that was just around the corner. It would have been a disaster."

The Harvard University psychologist Stephen Kosslyn has shown that this power to visualize consists of at least four separate abilities, working in combination. The first is the ability to generate an image—to take something out of long-term memory and reconstruct it on demand. The second is what he calls "image inspection," which is the ability to take that mental picture and draw inferences from it. The third is "image maintenance," the ability to hold that picture steady. And the fourth is "image transformation," which is the ability to take that image and manipulate it. If I asked you whether a frog had a tail, for example, you would summon up a picture of a frog from your long-term memory (image generation), hold it steady in your mind (image maintenance), rotate the frog around until you see his backside (image transformation), and then look to see if there was a tail there (image inspection). These four abilities are highly variable. Kosslyn once gave a group of people a list of thirteen tasks, each designed to test a different aspect of visualization, and the results were all over the map. You could be very good at generation and maintenance, for example, without being good at transformation, or you could be good at transformation without necessarily being adept at inspection and maintenance. Some of the correlations, in fact, were negative, meaning that sometimes being good at one of those four things meant that you were likely to be bad at another. Bennett Stein, a former chairman of neurosurgery at Columbia Presbyterian Center, says that one of the reasons some neurosurgery residents fail in their training is that they are incapable of making the transition between the way a particular problem is depicted in an X-ray or an M.R.I., and how the problem looks when they

encounter it in real life. These are people whose capacities for mental imaging simply do not match what's required for dealing with the complexities of brain surgery. Perhaps these people can generate an image but are unable to transform it in precisely the way that is necessary to be a great surgeon; or perhaps they can transform the image but they cannot maintain it. The same may have been true for Charlie Wilson and tennis. Somehow, his particular configuration of imaging abilities did not fit with the demands of the sport. When he stopped playing the game, he says, he didn't miss it, and that's not surprising. Tennis never quite got inside his head. Neurosurgery, of course, is another matter.

"Certain aneurysms at the base of the brain are surrounded by very important blood vessels and nerves, and the typical neurosurgeon will make that dissection with a set of micro-instruments that are curved, each with a blunt end," Craig Yorke, who trained with Wilson and now practices neurosurgery in Topeka, recalls. "The neurosurgeon will sneak up on them. Charlie would call for a No. 11 blade, which is a thin, very low-profile scalpel, and would just cut down to where the aneurysm was. He would be there in a quarter of the time." The speed and the audacity of Wilson's maneuvers, Yorke said, would sometimes leave him breathless. "Do you know about Gestalt psychology?" he continued. "If I look at a particular field—tumor or aneurysm—I will see the gestalt after I've worked on it for a little while. He would just glance at it and see it. It's a conceptual, a spatial thing. His use of the No. 11 blade depended on his ability to construct a gestalt of the surgical field first. If just anybody had held up the eleven blade in that way it might have been a catastrophe. He could do it because he had the picture of the whole anatomy in his head when he picked up the instrument."

If you think of physical genius as a pyramid, with, at the bottom, the raw components of coördination, and, above that, the practice that perfects those particular movements, then this faculty of imagination is the top layer. This is what separates the physical genius from those who are merely very good. Michael Jordan and Karl Malone, his longtime rival, did not differ so much in their athletic ability or in how obsessively they practiced. The difference between them is that Jordan could always generate a million different scenarios by which his team could win, some of which were chunks stored in long-term memory, others of which were flights of fancy that came to him, figuratively and literally, in midair. Jordan twice won championships in the face of unexpected adversity: once, a case of the flu, and, the second time, a back injury to his teammate Scottie Pippen, and he seemed to thrive on these obstacles, in a way Karl Malone never could.

Yo-Yo Ma says that only once, early in his career, did he try for a technically perfect performance. "I was seventeen," he told me. "I spent a year working on it. I was playing a Brahms sonata at the 92nd Street Y. I remember working really hard at it, and in the middle of the performance I thought, I'm bored. It would have been nothing for me to get up from the stage and walk away. That's when I decided I would always opt for expression over perfection." It isn't that Ma doesn't achieve perfection; it's that he finds striving for perfection to be banal. He says that he sometimes welcomes it when he breaks a string, because that is precisely the kind of thing (like illness or an injury to a teammate) that you cannot prepare for—that you haven't chunked and, like some robot,

stored neatly in long-term memory. The most successful performers improvise. They create, in Ma's words, "something living." Ma says he spends ninety per cent of his time "looking at the score, figuring it out—who's saying this, who wrote this and why," letting his mind wander, and only ten per cent on the instrument itself. Like Jordan, his genius originates principally in his imagination. If he spent less time dreaming and more time playing, he would be Karl Malone.

Here is the source of the physical genius's motivation. After all, what is this sensation—this feeling of having what you do fit perfectly into the dimensions of your imagination—but the purest form of pleasure? Tony Gwynn and Wayne Gretzky and Charlie Wilson and all the other physical geniuses are driven to greatness because they have found something so compelling that they cannot put it aside. Perhaps this explains why a great many top neurosurgeons are also highly musical. Robert Spetzler, Wilson's protégé, seriously considered a career as a concert pianist. Craig Yorke made his début as a violinist at sixteen with the Boston Pops. Quest, of course, plays the trombone. As for Wilson, he is a cellist and, when he was a student in New Orleans, he would play jazz piano at Pat O'Brien's, in the French Quarter. Music is one of the few vocations that offer a kind of sensory and cognitive immersion similar to surgery:the engagement of hand and eye, the challenge of sustained performance, the combination of mind and motion—

all of it animated by the full force of the imagination. Once, in an E-mail describing his special training sessions on rats, Wilson wrote that he worked on them for two years and "then trailed off when I finally figured that I was doing it for fun, not for practice." For fun! When someone chooses to end a twelve-hour day alone in a laboratory, inducing aneurysms in the arteries of rats, we might call that behavior obsessive. But that is an uncharitable word. A better explanation is that, for some mysterious and wonderful reason, Wilson finds the act of surgery irresistible, in the way that musicians find pleasure in the sounds they produce on their instruments, or in the way TonyGwynn gets a thrill every time he strokes a ball cleanly through the infield. Before he was two years old, it is said, Wayne Gretzky watched hockey games on television, enraptured, and slid his stockinged feet on the linoleum in imitation of the players, then cried when the game was over, because he could not understand how something so sublime should have to come to an end. This was long before Gretzky was any good at the game itself, or was skilled in any of its aspects, or could create even the smallest of chunks. But what he had was what the physical genius must have before any of the other layers of expertise fall into place: he had stumbled onto the one thing that, on some profound aesthetic level, made him happy.

Charlie Wilson says that only once in his career has he allowed himself to become emotionally attached to a patient—attached to the point where the patient's death felt like that of a family member. "It was this beautiful girl who had a spinal tumor," he told me. "She was always bringing me cookies. It was a malignant tumor. She became a paraplegic, and then she got married." Wilson was talking softly and slowly. "It just tore me up. I couldn't help myself. I remember operating on her and crying, right there in the O.R." Charlie Wilson is a man who, when he operates, does not permit music or extraneous talking or the noise of beepers or phones, who is attuned to even the slightest

hesitation on the part of his scrub nurse, who admits, in his entire life, to just one day of depression, and who has the audacity and the control to take a No. 11 blade and slice down—just like that—to the basilar artery. But she was young, and it was tragic, and there was nothing he could do, and he has a daughter, too, so perhaps it touched a chord. He was sitting, as he talked, in his office at Moffitt Hospital with his Nike cross-trainers and surgical scrubs, thinking back to a moment when all certitude and composure escaped him. His performance on the day he operated on the girl's spinal tumor must have been compromised by his grief, he admitted. But what did it matter? This was not a procedure that required great judgment or technical mastery. "It was an ugly operation," he said, pronouncing the word "ugly" with a special distaste. "Maybe that was part of it." Of course, it was. Charlie Wilson is one of the world's great neurosurgeons because he can find some beauty in what he does—even in the midst of terrible illness. There was nothing beautiful there. "This lovely, lovely girl." He looked away. "Such a heart."