Chapter 5

Moshe Feldenkrais: Physicist, Black Belt, and Healer

Healing Serious Brain Problems Through Mental Awareness of Movement

Escaping with Two Suitcases

In June 1940 a young Jew escaped from Nazi-occupied Paris, just hours ahead of the approaching Gestapo. He was carrying two suitcases. They contained French scientific secrets and materials, including two liters of a newly discovered material, heavy water, which was essential for producing nuclear energy and weapons, as well as plans for an incendiary bomb. His task was to prevent them from falling into German hands and his hope was to reach England. He was stout, barrel-chested, about five foot four, extremely strong, and an athlete of some repute. A decade-old soccer knee injury made it hard for him to walk.

The man, Moshe Feldenkrais, just turned thirty-six, was a physicist who was completing his Ph.D. at the Sorbonne. He had worked on French atomic secrets in the laboratory of the young husband-and-wife team Frédéric and Irène Joliot-Curie. Several years before, in 1935, the couple had been jointly awarded the Nobel Prize for producing artificial radioactive elements. In March 1939 the lab was the first to split an atom of uranium, setting up a chain reaction that released immense amounts of energy that came to be called nuclear power. It was Feldenkrais who built the accelerator that generated the particles that bombarded the

atom. The same year Albert Einstein wrote to U.S. president Franklin D. Roosevelt that "through the work of Joliot in France," a new kind of bomb was possible; he warned that the Nazis were following this work and had begun to accumulate uranium.

A few days before his June 1940 escape, as the Nazis were marching into Paris, Feldenkrais noticed that for some strange reason his injured knee was acting up. It became swollen so badly he could barely get out of bed to go to work. True, the recent mental stress had been extreme, but he could not explain how an event occurring in the brain might cause his knee to swell. Within hours of the invasion, the Gestapo would come to search the Curie lab and force the entire staff to go down into the courtyard. Usually, in these circumstances, they would separate out the Jews and the Communists and cart them off to concentration camps. Frédéric told Feldenkrais that because he was a Jew, he would not be safe. Frédéric quickly got him papers from the French government.

With his two suitcases, Moshe and his wife, Yonah, began a desperate cross-country dash to find a ship to England. But as they drove from one port to the next, they found that either the port was closed or the last boat had left. The Nazi Luftwaffe was bombing the roads, which were crowded with desperate people fleeing for their lives in cars, because trains weren't running. Soon the roads were so damaged they were impassable. Moshe and Yonah began walking, but she had been born with a hip problem, and he had his bad knee. As she succumbed, he managed, by force of will, to push her in an abandoned wheelbarrow until they were able to join an Allied naval evacuation operation. It was commanded by a British officer, Ian Fleming, who later wrote the James Bond novels. Fleming put them aboard the HMS *Ettrick*, the last boat to escape occupied France. Because the ship was so crowded, Feldenkrais had to throw his suitcases onto a large pile of baggage, to be reclaimed on arrival.

When Feldenkrais and his wife arrived in England in the last week of June 1940, he searched for the suitcases but could find only one, which he turned over to the British Admiralty. But he now had a new problem: the name *Feldenkrais* sounded German. The British, fearing

the Nazis were planting spies among the refugees, detained him and put him in an internment camp on the Isle of Man.

One of Britain's key scientists, J. D. Bernal, had been charged with finding scientists to help in the war effort. He had once visited Joliot-Curie's lab and now discovered that Feldenkrais was being held. Bernal got him released to help the British deal with a new vulnerability: Nazi submarines were sinking British ships. In France, Feldenkrais had done important research on sonar, a kind of underwater radar that could be used to detect submarines. After the British sonar project stalled, Feldenkrais was recruited to work with a strange assortment of scientists in Fairlie, an isolated village on the west coast of Scotland. In a matter of days, he went from being a suspect alien to being a scientific officer of the Admiralty, working in British counterespionage. By day, he worked on top secret projects. At night, he taught his colleagues judo.

In Paris he had helped set up the Judo Club of France, was among the first Western black belts, and had written books on judo, which showed, using physics equations, how it was scientifically possible for a small person to throw a much larger one. Word of his expertise spread when a commander took his judo course and asked Feldenkrais to train his home guard platoon, then a battalion. He was soon training British paratroopers in hand-to-hand combat without a weapon as they prepared for D-Day.

Origins of the Feldenkrais Method

Feldenkrais had shown a preternatural independence of mind and willfulness from a young age. He was born in the small town of Slavuta, in what is present-day Ukraine, on May 6, 1904. In 1912 his family moved to Baranovichi, in what is today Belarus. For decades, Jews in the Russian Empire had been victims of government-sponsored pogroms, murderous attacks on Jewish villages. In 1917, in response to the plight of the Jews there and elsewhere, the British, who controlled Palestine, issued the Balfour Declaration, which said, "His Majesty's Government view with favour the establishment in Palestine of a national home for the Jewish people, and will use their best endeavours to facilitate the

achievement of the object." When Moshe was fourteen, he set out alone to walk from Belarus to Palestine. A pistol in his boot, a math text in his sack, and with no official documents or papers, he crossed marshes and endured temperatures of 40 degrees below as he traversed the Russian frontier in the winter of 1918–19. As he walked from village to village, other Jewish children, intrigued, joined him. At one point, to survive, they joined a traveling circus, where the acrobats taught Moshe tumbling and how to fall safely—skills he would one day perfect with his judo. By the time he reached Cracow, fifty children had joined the much-admired boy on his way to Palestine, then more, until over two hundred young people were following him. Eventually adults joined his children's march through central Europe to Italy and the Adriatic, where they boarded a boat. It arrived in Palestine in 1919, in late summer.

Like many new arrivals, Feldenkrais was penniless. He worked as a laborer and slept in a tent. In 1923 he began to attend high school and supported himself by tutoring children with whom other tutors had failed; he displayed an early aptitude for helping people overcome blocks in the learning process.

In the 1920s Arabs attacked Jewish villages and cities in British Mandate Palestine. Feldenkrais's cousin Fischel was among those killed. The Jews requested from the British either more protection or the right to arm themselves—and were refused. So young Feldenkrais began to study how to defend himself without a weapon. Arab attackers usually came at their opponents with knives, striking from above, and directing their thrusts to the neck or solar plexus. Many Jews were killed in these encounters. Feldenkrais tried to teach them to block a blow, then grab and twist the attacker's arm so that he dropped the knife. But his students were unable to resist the natural, anxious neurological reflex response of lifting their forearms up to protect their faces or turning their backs to the blow. So instead of fighting these spontaneous responses of the nervous system, Feldenkrais designed a block that used them. He now *insisted* that his students, when attacked, follow the instinctual tendency to block their faces, and he then sculpted that movement into a better block. He then photographed people being attacked from different angles and crafted blocks that molded their frightened,

spontaneous reactions into effective defenses. The method worked and would become a template for his future approach to the nervous system: work with it, not against it.

In 1929 he circulated *Jiu-Jitsu and Self-Defense,* in Hebrew, the first of his many books on unarmed combat. It became the first self-defense manual used to train the armed forces of the fledgling Jewish state. That was the year he injured his knee, and while recuperating, he became fascinated with mind-body medicine and the unconscious. He wrote two chapters for a book called *Autosuggestion,* which included a translation of Émile Coué's treatise on hypnosis. In 1930 he moved to Paris, where he completed a degree in engineering and began a Ph.D. in physics under Joliot-Curie.

One day in 1933 he heard that Jigoro Kano, the founder of judo, was in Paris for a lecture. Kano was a very small, frail person who had often been attacked by others when younger. Judo, a modification of jujitsu, trained its practitioners to use an opponent's own power to knock him off balance and throw him. Judo, which means "the gentle way," was also a holistic way of life, both physical and mental. Feldenkrais showed Kano his book on hand-to-hand combat.

"Where did you get this?" asked Kano, pointing to a picture of the block Feldenkrais had developed to use one's spontaneous, anxious nervous response to protect oneself.

"I developed it," Feldenkrais answered.

"I don't believe you," said Kano. So Feldenkrais asked Kano to attack him with a knife, and Kano did. The knife went flying.

Kano took the book and digested it over months. Then he told Feldenkrais he'd train him to be one of the elite students whose distinction was that when Kano threw them through the air, they could always land in a controlled way. Kano soon decided he had finally found the person to help popularize judo in Europe. Two years later Feldenkrais cofounded the Judo Club of France. To finance his Ph.D., he taught judo to Joliot-Curie and other physicists.

During his time in France, his knee problem became serious. On bad days, he was confined to bed, sometimes for weeks. He noticed that some days were better than others, and wondered why this should be

and why this physical problem was worse in times of mental stress. Clearly, the cause of his knee problem wasn't chiefly psychosomatic. His knee was injured so badly that his thigh muscle had nearly wasted away. Exams showed that his meniscus, the cartilage inside the knee, was severely torn, and the knee ligaments were completely destroyed. He finally saw a senior surgeon, who told him he couldn't possibly function without surgery. Feldenkrais asked, "Is there any likelihood that the operation will fail?" The surgeon answered, "Oh yes, it's about fifty-fifty," but even if the operation succeeded, his knee would always be stiff. Feldenkrais said, "Good-bye. I won't do it."

Then one day he had a strange experience. He went out alone, hopping on his good leg, slipped on an oily patch, and hurt his good leg. He struggled home, fearing he'd be completely immobile, went to bed, and fell into a deep sleep. When he awoke, he was surprised to find that he could stand on the leg with the injured knee: "I thought I was going insane. How could a leg with a knee that had prevented me standing on it for several months suddenly become usable and nearly painless?" His neuroscience reading helped him realize that his brain and nervous system were the cause of this seeming miracle. The acute trauma to Feldenkrais's "good leg" led his brain to inhibit the motor cortex brain maps for that leg to protect it from further injury should he move. But when one side of the brain is inhibited, often the other takes over its functions. The inhibition of the motor cortex maps for the good leg caused the motor cortex map of his damaged leg to "fire up" whatever muscle he had left, so it could be more useful. This experience taught him that his brain, not solely the physical condition of his knee, was in charge of his level of functioning.

Later, on duty in the antisubmarine program in Scotland, Feldenkrais was frequently on wet, slippery decks, and his knee was often swollen. He had no choice but to deal with his problem himself. He needed to discover what triggered his brain and knee on his "bad days."

He took note that while other mammals can walk moments after birth, humans learn such basic skills as walking over time. To Feldenkrais this meant that walking was "wired in" to the nervous system through experience and involved the creation of habits of movement—habits he was

now going to try to change. He began by developing a kinesthetic awareness of how he used and moved the knee. Kinesthetic awareness is a sensation that informs a person where his or her body and limbs are in space and what it feels like to move. Feldenkrais had learned, both from judo and from his neuroscience reading, that when a human stands, a group of muscles—the antigravity muscles of the back and the quadriceps—holds a person up.

Each person has habitual ways of standing that are partially learned. Every time he stands, he enacts these habits unconsciously. Since bad postural habits exacerbated Feldenkrais's problem knee on his bad days, he decided to observe himself lying down, so as to eliminate the action of gravity on his body and his need to use the antigravity muscles and the standing habits he had acquired. He spent many hours on his back, moving his knee ever so slowly, to see where the pain or restriction began, lifting his leg ever so slightly, many hundreds of times. He later told his student Mark Reese that he was observing himself "so that he could feel all the subtle subconscious connections between all parts of himself."

"No part of the body can be moved without all the others being affected," Feldenkrais wrote. This holistic insight would later distinguish his approach from other forms of bodywork. Since the bones, the muscles, and the connective tissue form a whole, it is impossible to move one part, however slightly, and not influence all the others. Extending an arm and raising a finger, by even the smallest amount, requires muscles in the forearm to contract, and other muscles in the back to stabilize those muscles, triggering reactions in the nervous system and the body that anticipate how this movement will subtly alter overall balance. All the muscles, under normal conditions, even when supposedly "relaxed," show some contraction, or "muscle tonus." (Muscle *tonus* is not the same as muscle *tone*. Muscle *tone* often colloquially refers to the defined look or visual definition of a muscle on a thin person. Muscle *tonus* is a medical term, referring exclusively to the general state of contraction of a muscle; and tonus can range from high levels of contraction to low.) Altering the tension in any single muscle affects the tension of the others. For example, contracting the biceps requires relaxing the triceps.

Using his kinesthetic awareness of tonus and breaking his walking down into minute movements, Feldenkrais could now go weeks without knee trouble. "I was far more absorbed in observing how I was doing a movement than I was interested in what that movement happened to be," he wrote, to describe his use of ongoing mental awareness of movement to give himself feedback, which would alter his functioning and his brain.

As he analyzed his gait he found that over the years he had made many adaptations to how he walked, and that these changes had made him forget some of the movements he could do before his injury, so his repertoire of movement had become restricted without his noticing. Thus many of his movement restrictions were caused not only by his physical limitations but also by his habits of movement and habits of mental perception. He had learned from Kano that judo was a form of mind-body education, because mind and body are always related. "I believe," Feldenkrais wrote, "that the unity of mind and body is an objective reality. They are not just parts somehow related to each other, but an indispensable whole while functioning."

This insight helped explain to Feldenkrais the mysterious fact that his knee had swollen up when the Nazis occupied Paris. For the third time, after the Russian pogroms and the attacks in Palestine, his life had been threatened because he was a Jew. His physical problem, he saw, could be made worse by mental stress. Terrifying experiences and memories could trigger nervous system, biochemical, and muscular reactions throughout his mind and body—even swelling in his knee.

During the war, he wrote a book that began as a meditation on the work of Freud, whom he greatly respected; unlike many clinicians of his time, Freud emphasized how the mind and the body always influence each other. But, Feldenkrais noted in *Body and Mature Behavior*, Freud's treatment, talk therapy, focused little on how anxiety or other emotions are expressed in posture and in the body, and Freud never suggested that analysts work on the body when treating mental problems. Feldenkrais believed that there were no purely psychic (i.e., mental) experiences: "The idea of two lives, somatic and psychic, has . . . outlived its usefulness." The brain is always embodied, and our subjective experience

always has a bodily component, just as all so-called bodily experiences have a mental component.

When the war ended, Feldenkrais learned that all but a few of his relatives had been murdered by the Nazis. Luckily, his parents and sister had survived. He finished his Ph.D. dissertation and graduated. But on returning to France he found that the Nazis, with the collusion of a French and a Japanese judo colleague, had written him out of the history of the judo club he had cofounded, again because he was a Jew. So he settled in London instead, pursued some inventions, wrote another book on judo, called *Higher Judo,* and began a book, *The Potent Self,* in which he developed his healing method, which he was now using to help fellow scientists and friends. As a physicist, he had met the greats: Albert Einstein, Niels Bohr, Enrico Fermi, and Werner Heisenberg. He was deeply torn: should he continue in nuclear physics or, given the wonderful results he was getting, pursue healing? He chose healing. His mother said half-jokingly, "He could have got a Nobel Prize in physics, and instead he became a masseur."

But his plans for staying put and pursuing his method were again interrupted. In 1948 the United Nations divided Palestine into two areas, one Jewish, to be called the State of Israel, and the other Arab, called Palestine. Within hours, six well-armed Arab nations attacked the Jewish state. A stream of Israeli scientists went to London and persuaded Feldenkrais to return, in 1951, to direct the Israeli Army's department of electronics, in top secret projects, which he did until 1953. Only then, at last, was he free to refine his life's work. In Israel he met a chemist, Avraham Baniel, who became a lifelong friend. Baniel persuaded Feldenkrais to come and give classes in his and his wife's apartment every Thursday night, saying "We can be a laboratory for you."

Core Principles

Over the course of mastering his knee problems and writing *Body and Mature Behavior,* and now seeing clients regularly, Feldenkrais refined the principles that formed the basis of his new methods. Most of them are related to facilitating what I have called the stage of neurodifferentiation (described in Chapter 3), one of the key stages of neuroplastic healing.

1. The mind programs the functioning of the brain. We are born with a limited number of "hardwired" reflexes, but the human being has the "longest apprenticeship" of all animals, during which learning takes place. "Homo sapiens," he wrote, "arrives with a tremendous part of his nervous mass left unpatterned, unconnected, so that each individual, depending on where he happens to be born, can organize his brain to fit the demands of his surroundings." As early as 1949, Feldenkrais wrote that the brain could form new neural paths to do so.* In 1981 he wrote, "The mind gradually develops and begins to program the functioning of the brain. My way of looking at the mind and body involves a subtle method of 'rewiring' the structure of the entire human being to be functionally well integrated, which means being able to do what the individual wants. Each individual has the choice to wire himself in a special way." When we have experience, he wrote, "the neural substrate [the neuronal connections in the brain] organizes itself." Feldenkrais often said, as his student David Zemach-Bersin points out, that when there is a neurological injury, plenty of brain matter usually remains to take over the damaged functions. Moshe Feldenkrais was one of the first neuroplasticians.

2. A brain cannot think without motor function. Wrote Feldenkrais, "My fundamental contention is that the unity of mind and body is an objective reality, that these entities are not related to each other in one fashion or another, but are an inseparable whole. To put this more clearly: I contend that a brain could not think without motor functions."

Even thinking of making a movement triggers the movement, even if very subtly. When he got a pupil to simply imagine a movement, he noticed that the tonus in the relevant muscles increased. Imagining counting would trigger subtle movements in the throat's vocal apparatus. Some people can barely speak if their hands are confined. Every

* That neuroplastic point was already a theme in his *Body and Mature Behavior,* Chapter 5. In 1977 one of Feldenkrais's students, Eileen Bach-y-Rita, introduced him to her husband, the neuroplasticity pioneer Paul Bach-y-Rita (see Chapter 7). Feldenkrais read Paul Bach-y-Rita's work and actively began to integrate his concepts, which fit well with his own. In 2004 Bach-y-Rita developed a project to study Feldenkrais's results with head injuries but died before he could complete it. E. Bach-y-Rita Morgenstern, personal communication; also see her article "New Pathways in the Recovery from Brain Injury," *Somatics* (Spring/Summer 1981).

emotion affects facial muscles and posture. Anger shows in clenched fists and teeth; fear, in tightened flexors and abdominal muscles and in holding the breath; joy, in a lightening of the limbs and buoyancy. People may believe they can have a pure thought, but in a deeply relaxed state, Feldenkrais pointed out, they will observe that every thought leads to a change in their muscles.

Every time the brain is used, four components are triggered: motor movement, thought, sensation, and feeling. Under normal circumstances, we don't experience one without the other three.*

3. *Awareness of movement is the key to improving movement.* The sensory system, Feldenkrais pointed out, is intimately related to the movement system, not separate from it. Sensation's purpose is to orient, guide, help control, coordinate, and assess the success of a movement. The kinesthetic sense plays a key role in assessing the success of a movement and gives immediate sensory feedback about where the body and limbs are in space. Awareness of movement is the fundamental basis of Feldenkrais's method. He called his classes Awareness Through Movement lessons (or ATMs). It may seem "magical" to think that movement problems—especially in people with serious brain damage—can be radically changed simply by becoming more aware of the movement, but it seems magical only because science formerly thought of the body as a machine with parts, in which sensory functions are radically separated from motor functions.

This focus on self-awareness and monitoring of experience is based in part on Feldenkrais's exposure to the meditative aspect of Eastern martial arts, and it reveals him anticipating the current Western interest

*One of the hottest current theories in neuroscience, the motor theory of thought proposed by the neuroscientist Rodolfo Llinás, was anticipated by Feldenkrais. Llinás points out that nervous systems are not essential for life but are for complex movement. Plants don't need nervous systems because plants are not mobile. The link between movement and the nervous system, and the brain, becomes particularly clear in the simple sea squirt, called Ascidiacea. In early life, in its larval form, it moves around, like a tadpole, and has a primitive brainlike group of 300 nerve cells that receives sensory information from a primitive vestibular apparatus and a patch of skin. It eventually finds a stationary place in which to feed, and ceases to move for the rest of its life. No longer needing to move, it no longer needs a brain, and so it digests its own brain and primitive spinal cord, as well as its tail with its musculature. R. R. Llinás, *I of the Vortex: From Neurons to Self* (Cambridge, MA: MIT Press, 2001), p. 15.

in mindfulness meditation by about fifty years. Feldenkrais's insights have been reaffirmed by the neuroscientist Michael Merzenich, who showed that long-term neuroplastic change occurs most readily when a person or an animal pays close attention while learning. Merzenich did lab experiments in which he mapped animals' brains before and after different kinds of learning tasks. When the animals performed tasks for rewards automatically, without paying attention, their brain maps changed, but only temporarily.

4. Differentiation—making the smallest possible sensory distinctions between movements—builds brain maps. Newborns, Feldenkrais observed, often make very large, poorly differentiated movements based on primitive reflexes, using many muscles at once, such as reflexively extending their entire arms. They also cannot discriminate among their fingers. As they mature, they learn to make smaller, more precise individual movements. But the movements do not become precise until the child can use awareness to discern very small differences among them. Differentiation, Feldenkrais would show, would be key to helping many people with strokes, children with cerebral palsy, and even autism.

Feldenkrais found, repeatedly, that when a body part is injured, its representation in the mental map becomes smaller or disappears. He relied on the work of the Canadian neurosurgeon Wilder Penfield, who showed that the surface of the body is represented in the brain by a map. But the size of an individual body part in the brain map is proportional not to its actual size in the body but rather to how often and how precisely it is used. If the body part performs a simple function—the thigh, for example, mainly does one thing, moving the knee forward—the representation is small. But brain maps for the fingers, often used in precise ways, are huge. Feldenkrais understood that it is a use-it-or-lose-it brain, and that when parts are injured—and thus are not used often—their representation in the brain map decreases. By making very finely tuned—differentiated—movements of these parts and paying close attention while doing so, people experience them subjectively as becoming larger; they take up more of their mental maps, and lead to more refined brain maps.

5. Differentiation is easiest to make when the stimulus is smallest. In

Awareness Through Movement, Feldenkrais wrote, "If I raise an iron bar I shall not feel the difference if a fly either lights on it or leaves it. If, on the other hand I am holding a feather, I shall feel a distinct difference if the fly were to settle on it. The same applies to all the senses: hearing, sight, smell, taste, heat, and cold." If a sensory stimulus is very great (say, very loud music), we can notice a change in the level of that stimulus only if the change is quite significant. If the stimulus is small to begin with, then we can detect very small changes. (This phenomenon is called the Weber-Fechner law in physiology.) In his ATM classes, Feldenkrais instructed people to stimulate their senses with very tiny movements. These small stimuli radically increased their sensitivity, which ultimately translated into changes in their movements.

For example, Feldenkrais would ask people, as they lay on their backs, to tilt their heads very subtly up and down, about twenty times (or more), making the smallest possible movement—a hundredth of an inch—with as little effort as possible; they were to be aware only of the effect the movement had on the left side of the head, neck, shoulders, pelvis, and the rest of the left side of the body. Observing those changes will lead to decreased muscle tonus in the entire left side of the body (even though both sides of the body move when the head is tilted). This change happens because the awareness itself helps reorganize the motor cortex and the nervous system. If the person were to scan his body before and after the exercise, he would discover that, mentally, the left side's body image now feels lighter, also larger and longer and more relaxed, than the right side. (The cause is that the brain map for that side is now more differentiated and represents the body in finer detail. This technique of changing body tonus and brain maps is helpful because many movement problems often arise because areas of the body are not well represented in the brain maps.)

6. Slowness of movement is the key to awareness, and awareness is the key to learning. As Feldenkrais put it, "The delay between thought and action is the basis for awareness." If you leap too quickly, you can't look before you leap. He took this principle, of moving slowly in order to be more aware and learn better, directly from Eastern martial arts. People learning tai chi practice their movements at glacial speed, with

virtually no physical effort. In his early books on judo, such as *Practical Unarmed Combat,* Feldenkrais had emphasized the need to repeat actions very slowly and calmly and noted that hurried movements are bad for learning.

Slower movement leads to more subtle observation and map differentiation, so that more change is possible. Remember, when two sensory or motor events occur repeatedly and simultaneously in the brain, they become linked, because neurons that fire together wire together, and the brain maps for those actions merge. In *The Brain That Changes Itself,* I described how Merzenich discovered how subjects can lose differentiation in the brain, and he explained that "brain traps" occur when two actions are repeated simultaneously too often: their two brain maps, meant to be separate or differentiated, merge. He showed that when a monkey's fingers were sewn together and thus forced to move at the same time, the maps in the brain for those two fingers became fused.

Maps also fuse in everyday life. When a musician moves two fingers simultaneously often enough while playing an instrument, the maps for the two fingers sometimes fuse, and when the musician tries to move one finger alone, the other moves too. The maps for the two different fingers are now "dedifferentiated." The more intensely the musician tries to produce separate movements, the more he will move both fingers, strengthening the merged map. He's caught in a brain trap, and the harder he tries to get out of it, the deeper he gets into it, developing a condition called focal dystonia. We all are prone to less dramatic brain traps. Sitting at a computer, for example, we lift our shoulder unconsciously as we type. After a while we may find—as I did—that the shoulder is often up when it needn't be. Neck pain soon follows. One way to begin to deactivate the process is to learn to redifferentiate the muscles that elevate the shoulder from those involved in typing. This first requires awareness that the two actions are being done simultaneously.

7. Reduce the effort whenever possible. The use of force is the opposite of awareness; learning does not take place when we are straining. The principle should not be *no pain, no gain.* Rather, it should be *if strain, no gain.* Feldenkrais thought the use of willpower (of which he obviously had plenty) was not helpful in developing awareness. Nor was any kind

of compulsive driven action, which increases muscle tonus throughout the body. Compulsive effort leads to mindless, automatic movement that becomes habitual and unresponsive to changing situations. Compulsion is the problem, not the solution. We can eliminate a lot of muscle tension in the body by using awareness to spot how we often, without intending to do so, tense and use muscles that are not necessary for that movement. He called these movements superfluous or "parasitic."

8. Errors are essential, and there is no right way to move, only better ways. Feldenkrais didn't correct errors or "fix" people. He emphasized: "Do not be serious, eager, avoiding any wrong move. The kind of learning that goes with Awareness through Movement is a source of pleasurable sensations, which lose their clarity if anything dims the pleasure of it all. . . . Errors cannot be avoided." To teach people to leave a problematic habit behind, he encouraged them to try random movements until they found one that worked better for them. Instead of correcting errors, he encouraged them to notice lack of flow in barely detectable movements. They learn, he insisted, from their own movements, not from him. In ATM lessons he encouraged pupils to set aside the critical faculty: "Don't *you* decide how to do the movement; let your *nervous system* decide. It has millions of years of experience." In a sense, he was asking his pupils to perform a psychoanalytic free association—using movement, instead of words—so that their own spontaneous movement solutions would emerge.

9. Random movements provide variation that leads to developmental breakthroughs. Monumental gains, Feldenkrais discovered, are made not by mechanical movement but by the opposite—random movements. Children learn to roll over, crawl, sit, and walk through experimentation. Most babies learn to roll over, for instance, when they follow something with their eyes that interests them, then follow it so far that, to their surprise, they roll over. They learn to roll over by accident, based on a random movement. Infants sometimes learn to sit up because they are trying to put their feet into their mouths, not because they want to sit. Learning to stand and walk are momentous breakthroughs that infants make without training. They learn by trial and error, when they are ready.

Years after Feldenkrais made this discovery, Dr. Esther Thelen, arguably the world's leading scientist of motor development, demonstrated that every child learns to walk *in a different way,* by trial and error, and not, as was thought, through a standard "hardwired program" applicable to all. Thelen revolutionized the scientific understanding of motor development, but when she discovered that Feldenkrais had said as much, she was "totally awed" by his clinical discoveries and told Feldenkrais's students, "I think that the science may seem rather crude compared to the kind of intuitive, hands-on, brain . . . knowledge you people have." She then trained as a Feldenkrais practitioner.

These insights contrast with the approach of many conventional physical therapies or the use of machines for rehabilitation, which generally give patients with "biomechanical problems" repetitive exercises, based on the assumption that there are *ideal* movements for lifting, walking, getting out of a chair, and so on. Feldenkrais hated it when his ATM classes were called exercises, because mechanical repetition of action was what got people into bad habits in the first place.

10. Even the smallest movement in one part of the body involves the entire body. In a person who is capable of effective, graceful, efficient movement, the entire body organizes itself, as a whole, to do the movement, no matter how small. Consider the following paradox. We can lift a finger with ease; we can reach out to shake a friend's hand or lift a glass with equal ease. When we unconsciously shrug our shoulders, as we speak, we do so with the same ease. Yet how can these movements all be of equal ease? A finger is much lighter than a hand and forearm, and a hand and forearm are lighter than the entire arm. They are of equal ease because, in practice, when done with grace, we use the entire body for each action. When the body is well organized, muscle tension is limited throughout, and the load for all the actions is shared across the muscles, skeleton, and connective tissue. Feldenkrais had learned from Kano that the great judo masters are always relaxed and that "in the correct act there is no muscle of the body which is contracted with greater intensity than the rest. . . . The sensation is of effortless action." The practitioner need not be stronger than his opponent as long as his body as a whole is more coordinated or, as he would later say, better "organized."

11. Many movement problems, and the pain that goes with them, are caused by learned habit, not by abnormal structure. Most conventional treatments assume that function is wholly dependent on the "underlying" bodily structure and its limitations. Feldenkrais discovered that his pupils' difficulties were caused as much by how their brains *learned* to adapt to their structural abnormalities as by the abnormalities themselves—and sometimes more so, as happened to him with his knee. His original adaptations to his knee initially helped him to get around somewhat, but he learned even better ones by creating a new way to walk—which served him well for the rest of his life, and he never needed surgery. There is always a brain component to a movement difficulty.

FELDENKRAIS FIRST TAUGHT PEOPLE TO use his principles the way judo was taught, in ATM group classes. Participants typically had various problems—sore necks, headaches, sciatica, herniated discs, frozen shoulders, postsurgical limps. Feldenkrais would get them to lie down on judo mats. The huge antigravity muscles (the extensors of the back and the thigh muscles) would relax, and all the habit patterns triggered by "fighting" gravity to stand up were eliminated. He got them to scan their bodies attentively, so they became aware of how they felt, and what parts of their bodies made contact with the mat. He often told them to pay attention to how they breathed. Often subjects hold their breath the moment they get into a movement difficulty.

Then he had them explore a minute movement on one side of the body for much of the lesson, sensing subtle differences in how they made each minute movement. It was at this point that Feldenkrais's knowledge of hypnosis and Émile Coué came into play; as he spoke, he gave almost hypnotic suggestions to encourage them to do the movement with least effort, with greatest ease, so that it felt very light. Typically he chose movements that were crucial at some point in early development, such as lifting the head, rolling over, crawling, or finding easy ways to come to a sitting position. "As a teacher I can accelerate your learning," he wrote, "by presenting the experience under the conditions in which the human brain learned in the first place." He might spend fifteen minutes getting his class to roll

their heads gently to one side and notice what they felt, how far they could roll them. Next, he would ask them only to imagine rolling their heads, and notice what they felt *throughout* their bodies. Often their muscles would contract, just at the thought of making the movement.

Then something odd would happen. Toward the end of the lesson, he asked them to close their eyes and scan their bodies again. The side they had worked on was generally closer to the mat and felt longer and larger. Their body images had changed, and they could roll their heads much farther. Tight muscles released. In the short time remaining, they switched to working on the other side and found that many of the gains made on the first side quickly transferred.

Feldenkrais would often ask pupils to spend most of the session focusing on the side of their body that was less distressed, discovering ways to move it with even greater ease. Then, pupils found it as though this awareness of how to move gracefully was spontaneously transferred to their distressed side. Feldenkrais sometimes said that the troubled parts of the body learned not from him, but from the side of the body that was moving comfortably.

If during a class a student found she had a restriction when she did a movement, she was only to notice it, not judge it negatively. She should not attempt to "push through" a restriction or "correct" an error. Instead, she was to explore different kinds of movements, to see which felt best, which seemed most efficient and graceful. "It is not a question of eliminating the error," Feldenkrais would say. "It is a question of learning." Thinking in terms of error and negative judgment puts the person's mind and body into a tense state that doesn't help learning. The pupil was to explore, and learn new ways to move, and in the process develop and reorganize the nervous systems and the brain, not fix them.

These classes were deeply relaxing, and people would get up from them noticing they had much less pain and a far greater range of movement. Soon people came to Feldenkrais for work with him, one on one, for help with their aching necks, knees, and backs, or for their postural and postsurgical movement problems. He began to have great success, using the same principles, one on one, gently moving their bodies on a table instead of telling them to do so.

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FUNCTIONAL INTEGRATION BECAME FELDENKRAIS'S TERM for a half hour spent, one on one, with a client on the table. The goal was for the pupil to become able to function well, regardless of any underlying structural problem, and for the mind and all the body's parts to find *a new integrated way* of *functioning* together. Hence the name "Functional Integration." Since he conceived of this method too as a form of "lessons," he called his clients "pupils." Unlike the ATMs, when he suggested various movements, these sessions were almost completely nonverbal, except at the beginning, when the pupil might tell him his or her problem.

Feldenkrais would begin by positioning the pupil on the table in the posture that created maximum comfort, relaxation, support, and sense of safety to lower bodily tension. Often people habitually "hold" parts of their body tight without being consciously aware of doing so. To reduce strain or muscle tension in the lower back, he would place a small roller under the head, or knees, or elsewhere on the body. Whenever there is the slightest strain in the body, muscle tonus increases, making it harder for a person to detect the subtle movement differentiations essential for improvement, and to learn new movements. When the pupil was comfortable, and his muscle tension was as low as it could be, Feldenkrais believed the brain was most available for learning.

Feldenkrais would sit beside the pupil and begin communicating, by touch, with the pupil's nervous system. He began with small movements, so that the observing mind and brain would begin to make differentiations. This was touching not to impose on but to communicate with the brain. If the person's body moved, he would move with it, responsively, never using more force in his movements than necessary. He did not knead the muscles or press hard, as in massage or in an authoritarian manipulation of the joints. He would rarely work directly on a painful area; that approach only increased muscle tension. Thus he might start working on a part of the body farthest from where the pupil thought the problem was, often on the opposite side. He might begin to gently move a toe, far from a painful upper body part. If he felt a

restriction, he would *never* force it. What he discovered was that the brain would sense this relaxation in the toe, and the person would become immersed in that image of relaxed movement, which would soon generalize, so that that entire side of the body relaxed.

Feldenkrais's approach differs from some conventional body therapies in terms of method and goals, insofar as they focus on specific parts of the body and hence are "local" in orientation. For instance, some forms of physiotherapy will use exercise machines, to engage specific body parts to move through stretching and strengthening. These approaches, often extremely valuable, are arguably more inclined to treat the body as though it were made up of individual parts and are therefore more mechanical in orientation. They may prescribe particular protocols for particular problem areas. Feldenkrais claimed, "I have no stereotyped technique to apply ready-made to everyone; this is against the principles of my theory. I search and, if possible, find a major difficulty which can be detected at each session and which may, if worked upon, soften and be partially removed. I . . . go slowly and progressively through every function of the body."

Feldenkrais's reputation grew. A friend of Avraham Baniel's, Aharon Katzir, a scientist who made major contributions to neuroplasticity, took a great interest in Feldenkrais's work. He passed the information on to the Israeli prime minister David Ben-Gurion, and in 1957 Feldenkrais took Ben-Gurion on as his pupil. The seventy-one-year-old Ben-Gurion suffered from sciatica and low-back pain so severe he could barely rise to speak in Parliament. After some lessons, Ben-Gurion was able to leap up onto tanks to give speeches to the troops. Since Feldenkrais's house was near the sea, Ben-Gurion, before turning to matters of state, would go for a morning swim, then see Feldenkrais for his lessons. Once, Feldenkrais had him stand on his head. A photo of the elderly prime minister on his head on a Tel Aviv beach was used in an election and seen all over the world. Soon Feldenkrais was traveling and giving Functional Integration lessons worldwide, including to pupils such as the violinist Yehudi Menuhin and the British film director Peter Brook.

As Feldenkrais worked with more pupils, he discovered that his way, as he called it, of "dancing with the brain" could improve many

conditions in which serious brain damage had occurred—such as stroke, cerebral palsy, severe nerve damage, multiple sclerosis, some kinds of spinal cord injuries, learning disorders, and even cases where parts of the brain were missing.

Detective Work: Figuring Out a Stroke

Feldenkrais was frequently invited to Switzerland. On one visit, he met a woman in her sixties, Nora, who had had a stroke on the left side of her brain. His book about her treatment is his most detailed account of his technique.

In a stroke, a blood clot, or a bleed, cuts off blood supply to the neurons, and they die. In Nora's case, her speech was slow and slurred, her body stiff. She wasn't paralyzed, but her muscles were spastic on one side. Spastic muscles are muscles that have too much tonus and are too quick to contract. Spasticity—related to the word *spasm*—is thought to occur when the neurons in the brain that inhibit muscle contraction are damaged. This leaves only the excitatory neurons firing, and so there is too much muscle tension. It's a classic sign of a poorly modulated nervous system.

A year after the stroke, Nora's speech had improved, but she couldn't read a word or write her own name. After two years she still required around-the-clock monitoring, because she'd often go out and be unable to find her way home. She was deeply depressed about her lost mental functions.

Feldenkrais first met her three years into her illness and had no idea of how he would approach her problem. Every stroke with cognitive problems is unique, and figuring out exactly which brain function is damaged often requires the skill of a detective. He understood that reading is not natural—the learning process requires wiring together many different brain functions. He also understood that when a stroke affects a neuronal network that processes a function, it does not mean the entire network is damaged: "When a skill cannot be performed as before, only some of the cells which were essential to the skill performance do not function." It was often possible to recruit other neurons

and to teach them to differentiate "to perform the skill, though usually in a different manner."

Feldenkrais could give Nora only a few lessons before returning to Israel, so her family decided, because she was making no progress with conventional treatment, that she should go to Israel to work with him.

In his early work with Nora, Feldenkrais was trying to find out *why* she couldn't read and write. He also wondered about her body awareness and orientation: she kept bumping into things; when she tried to sit on a chair, she often sat on the edge of the seat; when she left his room, which had several doors, she often chose the wrong one. At the end of one half-hour lesson, he put her shoes, which she had taken off for the lesson, in front of her feet, with the toes facing her, without telling her why. She looked very confused, couldn't put them on, couldn't tell her right shoe from the left, and fumbled for five or six minutes. This mistake told him that her brain damage was preventing her from telling left from right, which would also interfere with her ability to read. He would have to deal with the left-right problem first because children must learn to differentiate left from right long before they can learn to read.

But before he could address Nora's orientation problem, he had to quiet her noisy, hyperexcited brain, which he knew was a problem because when he lifted her limbs, he couldn't bend them—they had excess muscle tension. He corrected the problem by having her lie on her back; he put supportive wooden rollers covered with sponge under the nape of her neck and the backs of her knees. This reduced the muscle tonus of her spastic body. Then as he gently moved her head back and forth, his touch lighter and lighter, her body relaxed, settling her brain and nervous system so that she would be in a state of heightened awareness. With so little stimulus coming into her brain, it would be easy for her to differentiate small sensory differences and learn. Next he simply touched her right ear and said, playfully, "This is the right ear."

As she lay on her back, she saw there was a couch to the right of the table she was on. He touched her shoulder and said, "This is the right shoulder." He went down her right side, touching her this way for several days running. He never used the word *left* or touched the left side. In a following session, he had her lie on her stomach, and again he

touched her right side. But she was confused, because she equated "right" with the way the room looked when she was on her back, with a couch facing her "right" side. Now that she was on her stomach, the "right" side was away from the couch. (We forget that as children we must learn this distinction.) He spent a number of sessions teaching her to learn where her right side was when she was in different positions. It was his genius to realize that a concept as seemingly simple as orientation was actually complex.

Then he took her a step further and had her cross her right leg over her left. She did so, but now she thought her left leg was her right leg, because it was now on the same side as the right. It took them two months of such lessons to experiment with the different right and left positions, until she could understand left and right in all their complexity. All the while her brain was forming a new map of body awareness of left and right. Sometimes she would relapse between lessons, and he'd have to start at the beginning, but slowly the relapses became less frequent.

Only now was he ready to introduce text. Nora said she couldn't "see" the words. He sent her to an ophthalmologist, who said her eyes were fine, confirming that the reading problem was in her brain, not in her eyes. Feldenkrais gave her a book with very large print. She trembled. He handed her a pair of glasses, but she fumbled. She did not know how to orient them to put them on her face. "I was annoyed with myself," he wrote, "for not having realized that even the transfer from body awareness to external objects needs training"; a baby, grabbing its parent's glasses and trying to put them on, has the same trouble. So he trained her to orient the glasses properly to her head so the left lens was over her left eye and the right lens was over the right eye.

Because she said she could not see, Feldenkrais, instead of asking her to read (which might stress her), simply told her to look at the pages, close her eyes, and say whatever words came to mind—in Freudian free association. After she finished looking, he searched the pages he had shown her and found that all the words she had said were on the left-hand side of the page, near the bottom, usually the last three words in the line. He said, "I was exhilarated. She did read words but did not know where she read them."

Nora had told Feldenkrais, "I cannot see," not "I cannot read." He was beginning to understand what she meant. He took a straw and put one end between her lips and the other end between her fingertips, positioned over a word in a book. He wanted to make a direct link between the mouth, which speaks, and the eyes, which see. She could see the word at the end of the straw but couldn't yet read it. But after about twenty practice trials, she spontaneously started to say the word at the end of the straw—much the way children, when they learn to read, often point out each word with their fingers. Nora was reading. Feldenkrais often sat beside Nora to her left. He put his right hand under her left arm, on her wrist, to help her hold the book. With his other hand, he helped her hold the straw between her lips. In this way, he could feel the slightest change in her body, the slightest halt in her breathing, the second it occurred. When it did, he knew that it was time for him to stop moving the straw, until her nervous system could reorganize. "It was a kind of symbiosis of the two bodies—I felt any change in her mood, and she felt my determined, peaceful, noncoercive power. I did not rush her, but would read the words out loud the instant I felt her stiffen with anxiety and lose grip. Gradually I had to read less often."

One of Feldenkrais's most important ways of helping a damaged brain learn was to use his own body to sense, match, and identify with the nervous system of his pupil. Touch was always important to him because he believed that when his nervous system connected with the other person's, they formed one system, "a new ensemble . . . a new entity. . . . Both the touched and the toucher feel what they sense through the connecting hands, even if they do not understand and do not know what is being done. The touched person becomes aware of what the touching person feels and, without understanding, alters his configuration to conform to what he senses is wanted from him. When touching I seek nothing from the person I touch; I only feel what the touched person needs . . . whether he knows it or not, and what I can do at that moment to make the person feel better."

The idea of two nervous systems in symbiosis he describes as resembling a dance, where one partner learns by following the other, without any formal instruction. Such "dancing," like any kind of dancing, is

about communication between two people. When Feldenkrais touched a pupil, he was often communicating nonverbal hints of what her body might be able to do when he moved it, allowing her to sense new variations of movement that her restricted limbs might be capable of. This is especially important with older pupils, who, as they age, have repeated the same movement habits over and over, which neuroplastically reinforces these patterns; by neglecting other patterns, they lose the circuitry for them, in the use-it-or-lose-it brain. Feldenkrais was able to remind pupils of movements they once had but had lost.

After three months, he taught Nora to hold a pen and write using other ingenious techniques. She continued to improve, and the lessons ended, and she returned to Switzerland.

One year later, on a visit to Switzerland, Feldenkrais spotted Nora walking near the railway station in Zurich. She looked confident. When they spoke, he was delighted to find that the teacher-pupil relationship was over, replaced by the ordinary ease of two friends bumping into each other.

When Feldenkrais agreed to work with Nora, he was not overwhelmed by the fact that she had lost brain structure, because he knew her brain was plastic; he couldn't know what her limits might be before trying patiently to teach her to re-create her orientation, then to read and write, as one might teach a child. The key to her progress was his recognizing which brain function was missing, then teaching her to make sensory differentiations. As her mind—her awareness—noticed these differences, they were wired into her brain maps, and she became ready to make even finer differentiations.

There is great beauty in the image of these two elderly people, Feldenkrais, about seventy, sitting by Nora's side, the one teaching the other how to read, their nervous systems so intertwined and attuned, he learning, as he would write, as much as she. But Feldenkrais was very careful about the words he used to describe what he did with Nora. It was not, he said, a "recovery." "Recovery is not the right word," he wrote, "since the part of the motor cortex where writing is organized and directed was not in a state to perform as before. The better word is

'recreating' a writing ability." Because the brain map circuits originally involved in reading and writing were damaged by her stroke, those functions had to be taken over by other neurons. He didn't call what he did with Nora a "cure," even though many would have. He preferred the term *improvement*. "'Improvement,'" he wrote, "is a gradual bettering which has no limit. 'Cure' is a return to the previously enjoyed state of activity which need not have been excellent or even good." Such improvements would be dramatic in children born with brain damage who had never had "good functioning" in the first place.

Helping Children

As Feldenkrais had more experience with stroke patients, he started to see children with cerebral palsy, many of whom had had a stroke in utero or suffered a lack of oxygen to the brain during birth. Often they were unable to control their tongues and lips in order to speak. Like adults who have had strokes, children with cerebral palsy often develop rigid or "spastic" limbs, with so much muscle tension that they become too rigid to move normally or at all.

In children, rigidity creates a serious problem. At birth, we do not have finely developed, differentiated brain maps that allow us to sense and make fine individual movements. A healthy newborn will put his fist in his mouth to suck, and the entire, undifferentiated brain map for the hand fires to process the sensation and the move. As time passes, he will differentiate out a few fingers from that hand and suck them, and then perhaps the thumb alone. As he plays with his hands, his brain map for the hand is differentiating, forming separate areas for each finger to sense and move. But a child with cerebral palsy, with a spastic limb or body, can't make fine, separate movements; his limbs are too rigid. Often his hand forms a tight fist, so he can't even begin brain map development and differentiation into separate areas for each movement.

Another symptom often seen in a child with cerebral palsy is that he can't get his heels onto the ground when standing, or is held in a standing position by an adult, because muscle contractions in his calves pull

his heels up. Consequently, his Achilles tendons are always tense. Other such children are knock-kneed: the muscles inside the thighs, the adductors, are so tight that they pull their knees together. Both conditions can be very painful.

Mainstream medical treatment prescribes surgery for such cases. The surgeon cuts and lengthens the Achilles tendon. Or sometimes Botox injections are used to paralyze the muscle and release the tension. But the muscle contractions continue, so operations or injections have to be repeated. For knock-kneed children, the adductor is cut to relieve the pressure. But neither of these well-meaning but drastic approaches addresses the underlying problem, because it is the brain that is firing the signal to contract the muscles. And the procedures leave the child with abnormal body mechanics—for life. Other medical approaches involve various stretching exercises, reasoning that the muscles and connective tissue get shortened and lock into place—which is true. Yet these stretches are often painful and also don't address the fact that *it is the brain* "telling" the muscles to tighten.

Feldenkrais saw spasticity as caused not only by the initial damage to the brain but also by the brain's problem in regulating sensation and motor activity, because it wasn't getting differentiated input. Thus the brain didn't "know" when to turn off the firing of the motor cortex.

Once when Feldenkrais was teaching a workshop in Toronto, he saw a little boy with cerebral palsy. Ephram couldn't walk normally, needed a wheeled walker, and was very spastic and stiff. Because his heels didn't touch the floor, he walked on his toes. But his most urgent problem was that his knees were locked together, inseparable. A surgeon had scheduled an operation to cut his adductors to pry his knees apart.

Feldenkrais started to work on the toe walking. With Ephram lying down, Feldenkrais made tiny movements on the boy's feet, then his legs, to help him differentiate the brain maps for these limbs. In a very short time, the boy began to relax and breathe more easily. Feldenkrais was sending messages to Ephram's brain, using the sensory neurons of his feet and legs. This input allowed his brain to distinguish his toes and

their muscles, the calf and thigh muscles, and all the movements they could make. Only when the brain could make these distinctions could it begin to properly regulate the firing of his motor system neurons and his muscle tonus.

In a Functional Integration lesson, if Feldenkrais felt the person had a muscle that was "holding" and too tight, he would often do for the person what the disturbed nervous system was overdoing. One of his astute practitioners, Carl Ginsburg, described how often Feldenkrais, rather than trying to get a pupil to stop "holding" himself tight, would do the holding for him. "Feldenkrais's understanding of habit led him not to oppose this activity but to support it by taking over the activity directly. Feldenkrais found that once they got that support most pupils just let go of the habitual action."*

Feldenkrais was able to get Ephram to cross one knee over the other, putting them even closer together than they had been. By putting the close knees even closer, Feldenkrais was doing what the boy's disturbed nervous system was "overdoing"—teaching his nervous system that it didn't need to work so hard. In a few minutes, Ephram's spastic thigh muscles released without Feldenkrais's using force. Now that the knees were a bit separated, he put his fist between them and asked the boy to squeeze the fist with the muscles on the insides of his thighs. Then Ephram completely relaxed his muscles, and his knees completely opened. "See how much easier it is to have your knees open?" Feldenkrais said. "To close them requires work." Feldenkrais had used Ephram's body to program the brain. A 2006 study of thirty-three subjects showed that Awareness Through Movement classes can also lengthen muscles,

*I experienced this "support" when one of Feldenkrais's earliest American followers, David Zemach-Bersin, gave me a Functional Integration lesson. I had got into the habit of automatically raising my right shoulder while typing, putting strain on my neck, leading to pain and restriction. In the lesson, Zemach-Bersin gently lifted my shoulder toward my neck, "supporting" it in the higher position, using his nervous system to take over the task my nervous system had assigned itself. In a minute or so, I felt massive relief of the restriction and pain. This idea, of dealing with the force of a contracting muscle not by opposing it but by going with it, derives from judo principles. In judo, one doesn't overpower the opponent's force but rather uses it to steer, topple, or throw the opponent.

as much as stretching can, an approach athletes might want to think about.*

A Girl Missing Part of Her Brain

Feldenkrais's approach can radically change the life even of people who were born missing huge parts of the brain, by facilitating differentiation in the remaining brain areas. Elizabeth, whom I interviewed, was born missing a third of her cerebellum, a part of the brain that helps to coordinate and control the timing of movement, thought, balance, and attention. Without the cerebellum, a person has difficulty controlling all these mental functions. The cerebellum, which means "little brain" in Latin, is about the size of a peach and is tucked under the cerebral hemispheres, toward the back of the brain. Although it occupies only about 10 percent of the brain's volume, it contains almost 80 percent of the brain's neurons. The technical name for Elizabeth's condition is *cerebellar hypoplasia,* and there was no treatment known to change the course of the illness.

When she was in the womb, her mother felt there might be a problem, because Elizabeth hardly moved. When Elizabeth was born, she didn't move her eyes. They flickered and were not properly aligned, gazing in different directions. At one month, they rarely tracked objects. Her parents were terrified she might not see normally. As she developed,

* Feldenkrais said he wanted not flexible bodies but flexible brains (which would create flexible bodies). His colleague Ida Rolf often helped people with body tensions, spasticities, and postural problems. Rolf stretched the connective tissue (fascia) to free up a person's range of motion, based on the assumption that fascial layers often get stuck together, causing "adhesions." Feldenkrais practitioners, on the other hand, claimed that it was the brain that caused the restriction. Robert Schleip, head of the Fascia Research Group at Ulm University, in Germany, and an enthusiastic "Rolfer," set up a small study. He and his colleagues examined patients with restrictions of the muscles and fascia while they were undergoing general anesthesia. The hypothesis was that if the restrictions are caused by the brain, then when the brain is partially turned off in anesthesia, the restrictions should cease. Indeed, the researchers found that "most of the previously detected restrictions appear to be significantly improved (if not absent) during the conditions of anesthesia. It seemed that what had been perceived as mechanical tissue fixation may at least be partially due to neuromuscular regulation." R. Schleip, "Fascia as an Organ of Communication," in R. Schleip et al., eds., *Fascia: The Tensional Network of the Human Body* (Edinburgh: Churchill Livingstone, 2012), p. 78.

it was clear she had a problem with her muscle tonus. At times she was very floppy, meaning she had too little or no muscle tension, but at other times she had too much tension and was "spastic," making no exploratory, voluntary movements. She received conventional physiotherapy and occupational therapy, but the treatments were painful for her.

When Elizabeth was four months old, the chief pediatric neurologist at a major urban medical center tested the electrical activity of her brain. He told her parents that "her brain had not developed since birth, and there was no reason to believe that her brain would develop." Most such children show persistent deficits, and it was believed the cerebellum shows limited plasticity. The doctor also told her parents that her condition was much like cerebral palsy, and he predicted that she would never be able to sit up, would be incontinent, and would have to be institutionalized. Her mother later recalled, "I remember he said, 'The best we could hope for would be profound retardation.'" Elizabeth's physicians were accurately describing their experience with such children who had conventional treatment—the only kind they knew about.

Still, her parents sought help. One day, a friend, an orthopedic surgeon, who knew of Feldenkrais's work, said, "This guy can do things that no one else can." When they heard that Feldenkrais was coming from Israel to a town near them to train practitioners—one of his major activities in the 1970s—they got an appointment.

When Feldenkrais met Elizabeth for the first time, she was thirteen months old and unable to creep or crawl. (Creeping, which usually precedes crawling, means scooting along on the stomach.) She could make only a single, voluntary movement: rolling over on one side. At her first Functional Integration lesson, she couldn't stop crying. She had had many sessions with therapists, who had tried to get her to do things she was not ready to do developmentally. For instance, many therapists had tried to sit her up, over and over, and had failed. If the children's bodies are spastic, these movements hurt them—hence the crying.

According to Feldenkrais, these attempts to leapfrog through development are a huge error because no one ever learned to walk by walking. Other skills have to be in place for a child to walk—skills adults don't think about or remember learning, such as the ability to arch the

back and lift the head. Only when all these pieces are in place will a child learn to walk, spontaneously. Feldenkrais saw that Elizabeth couldn't lie comfortably on her belly, and when she was on her belly, she couldn't lift her head at all.

He noticed her entire left side was in complete spasm, making her limbs rigid. Her neck was very tight, causing her pain. The fact that Elizabeth's entire left side was spastic indicated that her brain map for that side was undifferentiated, instead of having hundreds of areas for processing different types of movements.

Feldenkrais touched her, ever so gently, on her Achilles tendon, and she was so tormented he knew he first had to do something to resolve that pain: he would have to settle her brain because otherwise it would not be available for learning.

"After Moshe examined her," her father remembers, "he said to me, 'She has a problem and I can help her.' He was not bashful. My wife asked him to explain, and he proceeded to take our daughter's foot at the ankle and bend it back, and he took my finger, and he said, 'Touch this,' so that I could feel the knot of muscle, and he said, 'She can't creep, because it hurts her to bend her leg. If we soften that up, you will see she can bend her leg. And as we do this—soften her muscles—her whole demeanor will change.' And it happened as he explained—a day or two after that, she was creeping." Soon she was crawling.

THE NEXT TIME FELDENKRAIS SAW Elizabeth, one of his young pupils, Anat Baniel, a clinical psychologist and the daughter of his close friend Avraham, happened to be there. Feldenkrais asked Baniel if she'd mind holding Elizabeth throughout the lesson. He gently touched her, to begin teaching her to differentiate very simple movements. Elizabeth became intrigued, attentive, happy.

Feldenkrais gently held her head and pulled it up and forward, very slowly and gently, to lengthen her spine. Usually, he had found this movement caused a natural arching of the back and led the pelvis to roll forward—a reaction that happens normally when a person is standing. Often, when working with children with cerebral palsy and

others who couldn't walk, he would use this technique to engage the pelvis, so it would reflexively roll. But when he tried it on Elizabeth, Baniel felt no movement. Her pelvis was inert in Baniel's lap. So Baniel decided that when Feldenkrais pulled, she would gently roll Elizabeth's pelvis.

Suddenly there was movement throughout Elizabeth's spastic, locked, inert spine and body. They gently moved her spine again and again. Next, they tried subtle variations of the movement.

At the end of the session, Baniel gave Elizabeth back to her father. Usually in his arms Elizabeth would plop down on him, not able to control her head. But this time she arched her back, threw her head back, then brought herself forward, again and again, facing her father. The subtle movements of the neck and spine that Feldenkrais and Baniel had done had awakened the idea of this movement and wired it into her brain. Now Elizabeth was moving the large muscles of her spine and back voluntarily, delighted with movement.

Yet there was still much to worry about: Elizabeth was profoundly disabled and carried a horrendous diagnosis. Feldenkrais could see that Elizabeth's parents were clearly concerned about her future. He usually didn't say a great deal on these occasions. But he judged a brain not by where a child was in her development but by whether, given stimulation appropriate to that stage of development, the child could learn. "She's a clever girl," he said. "She will dance at her wedding."

Feldenkrais returned to Israel. Over the next few years, her parents heroically and tirelessly did, and put up with, whatever it took to get Elizabeth to see him. They brought her to see him in hotel rooms whenever he came to the United States or Canada, and went to Israel three times, for two to four weeks of daily visits to Feldenkrais's office. In between these intensive visits, Elizabeth consolidated her gains with everyday activities.

When Feldenkrais was seventy-seven years old, he fell ill while traveling in a small town in Switzerland. He lost consciousness, and physicians discovered that he was bleeding inside his skull. A slow leak of blood had built up in the dura (the layer of connective tissue that surrounds the brain) and in the brain itself, putting pressure on it,

endangering it. Unfortunately the only neurosurgeon in the town was traveling that weekend, so surgery to relieve the pressure caused by his "subdural bleed" was delayed.

Feldenkrais's colleagues concluded that his many injuries from all the throws, falls, and concussions in judo had made him vulnerable to the subdural bleed. He recovered in France, but perhaps because surgery was delayed, he suffered some brain damage. But soon he was once again giving Functional Integration lessons. And sensing that his time was limited, he continued to teach as much as he could, hoping to transmit his latest findings.

Back in Israel, he had a stroke, which affected his speech. His students gave their master daily Functional Integration lessons. Now in his late seventies and ill, he directed more and more of the children who came to him to Baniel. Baniel gradually took over Elizabeth's care, flying in for three-week periods, giving her daily lessons. Elizabeth saw her on and off for years, and her progress quickened.

TODAY ELIZABETH IS IN HER thirties and has two graduate degrees. She's petite, at five feet tall, and has a sweet voice. She walks, moving so easily that an observer would never know she had once been destined to end up immobile, in an institution, severely mentally retarded—at best. "Moshe," she tells me, "said to my dad, 'When she is eighteen, nobody is going to know that anything happened.' And he was dead on." She remembers "tidbits" of those visits to Israel, "and I sort of remember Moshe, the white hair, the blue shirt, and how smoky it was in there"—Feldenkrais smoked during lessons—"him whispering things into my ear, calming me down."

Her two graduate degrees are from major universities: she earned a master's in Near Eastern Judaic studies; then wanting something practical, she did a master's in social work and got her license. She still has some residual symptoms of the cerebellar hypoplasia. She has a mild learning disorder with numbers, and so math and science are difficult. But other than that, she enjoys learning and being intellectual, and she became a voracious reader—all of Shakespeare, most of Tolstoy, and

many other classics. Today she runs a small business and is happily married.

And yes, she danced at her wedding.

Creating Speech

Over five years I followed a dozen of Baniel's "pupils," children with special needs, all with serious brain problems, and I witnessed much extraordinary progress at her center in San Rafael, California. Baniel has accumulated vast experience with challenging cases of brain and nervous system damage in children—children with strokes, Down syndrome, autism and speech delay, movement problems called apraxias, cerebral palsy, and nerve injuries.

I watched Baniel work with another girl born missing a portion of her cerebellum, who couldn't speak. When her mother was seventeen weeks pregnant, an ultrasound showed that an entire section of the fetus's cerebellum, called the vermis, was missing, and the remainder had an abnormal, disorganized shape. The consulting neurologist said that if she lived, she would likely be autistic and unable to walk. I'll call her "Hope." When Hope came to see Baniel, she was two years and four months old. She couldn't move, sit, or hold her head or body up; her eyes were crossed, and she couldn't track moving objects. She wasn't socially engaged and didn't vocalize. Traditional physical therapy was painful for her and didn't help.

"The first time she came to Anat," says her father, "she learned to crawl within ten days." Baniel got her speaking by doing gentle movements that might seem to have nothing to do with speech—touching her feet and lower back, wiggling her knees, moving her pelvis and spine and ribs. Speaking can occur only if the brain can control the breath (which it does by coordinating the movement of the diaphragm, ribs, spine, and abdominal muscles) as well as the mouth, lips, and tongue. Baniel babbled playfully so Hope would realize that there was no "expectation" for her to speak words. (This was the opposite of speech therapy, which had given her exercises and drills to repeat properly formulated, comprehensible words, and which had made her anxious, because she was not developmentally ready for that. Baniel calls it

"practicing failure," because "children learn their experience; they don't necessarily learn what we intend them to.") Instead, using play, she turned on Hope's "learning switch" and helped her realize that any sound she made, however imperfect, could produce communication. Throughout the session, Hope was all giggles, occasionally saying "No!" After four sessions, Hope was babbling constantly and squealing with laughter. Today she is seven and a half and speaks in short sentences.

Hope had had no vision in her left visual field. Baniel also helped her to begin tracking objects and to see on the left side by working on the body as a whole. Interestingly, this work on eye tracking also affected the prescription of Hope's glasses. It went from plus eight to minus one. Eventually she became able to function without glasses.*

Another child I saw on multiple occasions I'll call "Sydney." Immediately after his birth, he had to spend time in the neonatal intensive care unit, where he was infected with bacterial meningitis. A CT scan showed he had a stroke, caused by the infection. In addition to destroying brain tissue, meningitis can lead to severe swelling and blockages in the flow of the cerebrospinal fluid that bathes the brain. As the fluid builds up, pressure mounts and the entire head enlarges, sometimes to almost twice the size—a condition called hydrocephalus. To save Sydney's life, a neurosurgeon put in a shunt to relieve the pressure, but the shunt failed, and he needed a second surgery.

When Sydney was first brought to Baniel's center at five months, he was completely spastic. He couldn't roll over. As with many people with strokes, his fists were tightly contracted, and his arm was bent up against his chest, immovable. "It was so tight and powerful that if you tried to move it quickly," says Baniel, "you'd break his arm." His parents were told he'd never walk. He couldn't turn his head to one side, a condition called torticollis. But at the end of his first session, he opened both hands. He made progress with each visit, eventually learning to roll over and back. Baniel told his parents, "The same brain that learned to roll over, and sit up, is going to talk."

* Hope had crossed eyes, and such children are often sent to have their eye muscles surgically cut, to align them—an approach that, according to Baniel, guarantees a cosmetic result, but their eyes will never work properly. Feldenkrais's work has helped many such children avoid surgery.

With his lessons, Sydney started walking at twenty-seven months. Realizing he could learn, even though his speech was still delayed, his parents took the unusual step of exposing him to three languages. (Along with English, his mother spoke to him in Italian, then sent him to Italian immersion; a Spanish caretaker spoke Spanish.)

In the first couple of years, at their most frequent, Sydney's sessions at Anat's center were four to five times a week, thirty minutes each. Baniel has found that concentrating lessons together often achieves more results than spacing them out.

When Sydney was five years old, he was getting only a few lessons a year. He was still a bit less active than most children his age, and his running was rigid. Today at nine he is very engaged. The boy who wasn't supposed to be able to walk or speak now runs around and is fluent in three languages—reading and writing English, Spanish, and Italian!*

Unconfined Until the End

In 1977, Feldenkrais set up an organization, now called the Feldenkrais Guild of North America, which today accredits training programs and certifies practitioners of his method. It is affiliated with the International Feldenkrais Federation, which represents certified practitioners throughout the world who have completed an in-depth, experiential hands-on training.

Throughout his adult life, Feldenkrais believed that genetics is only one factor determining the limits of intelligence. Much of the most important learning we do, he believed, is outside the classroom, from learning to walk (and defy gravity) to learning physics as he did (mostly in the Joliot-Curies' laboratory), to learning judo. Lifelong learning ran in his family. He was proud that his frail, eighty-four-year-old mother was able to learn to lift him and use judo to throw him. He joked with some other martial artists that the throw looked "completely fake because it is

* Baniel now calls her approach the Anat Baniel Method, and it has evolved from her original work with Feldenkrais and her own subsequent practice. Other practitioners trained in the Feldenkrais method also specialize in children as well as in strokes, athletes, musicians, dancers, anxiety (the subject of Feldenkrais's first book), spinal cord problems, back problems, chronic pain, and multiple sclerosis. Of course, many are generalists.

just unbelievable. . . . When she saw that people could do Judo throws and lifts, she said, 'I can do it,' and it took her about ten minutes and she learned to do it."

One of the most important things Feldenkrais took from Kano and judo was the understanding of reversibility: actions, to be intelligent, must be performed in such a way that, at any given moment, they can be stopped or reversed—turned in the opposite direction. The secret was never to move—or live—compulsively. (Living or performing actions compulsively is the opposite of doing them in a differentiated way. The compulsive action, unlike the differentiated one, is always done the same way, and ironically, because so much mental effort is used, it is often performed mechanically, with little awareness.)

He wrote in *Higher Judo,* "It is bad in Judo to try for anything with such determination as not to be able to change your mind if necessary." In judo as in life, we must never be locked in—to a habit, a way of thinking, or an attitude—and even when we think we are locked in, we often are not. In judo, even when one is pinned down on the ground by an opponent, he wrote, "one should always remember the words 'immobilization' and 'holding' do not describe the actual state of affairs—they convey the idea of finality and fixity that do not exist in action. An immobilization is dynamic and constantly changing all the time. The opponent generally frees himself as soon as you stop forestalling and checking his next move."

ONE DIRECTION CANNOT BE REVERSED: living beings move relentlessly toward death. That we do so, we cannot change; but how we do so, we can. We can approach with or without awareness. Feldenkrais was very ill and dying when Avraham Baniel came to visit him in 1984 for the last time in his Tel Aviv apartment. He noticed that Feldenkrais seemed to be listening to himself, his own body, as though listening to another. Knowing his friend's curiosity, and that his friend's attachment to life was very strong, Avraham asked him, "Moshe, how do you feel?"

Feldenkrais's face was swollen, and yet he seemed, to Avraham, to be smiling in his mind.

He answered slowly, "I am waiting to listen to my next breath."