The Mind-Body Connection in Learning

By Ruth Palombo Weiss

Neuroscientists, educators, nutritionists, psychiatrists, geneticists, and yogis are examining the mind-body link to figure out how we learn.

In This Article: Brain-Based Research

- Our ability to generate new brain cells accounts for the brain's plasticity—its ability to continue to learn and update its database.
- Our minds and bodies work together to help us pay attention, solve problems, and remember solutions. Our physiological states support our mental efforts. Movement and exercise can enhance optimal learning states.
- Emotional peace and connectivity help ensure a continued state of mental acuity, not to mention mental longevity.

Our bodies don't exist to carry our heads around," says Dr. Candace Pert, author of *Molecules of Emotion* and research professor in the department of biophysics and physiology at Georgetown University School of Medicine, Washington, D.C. "Any thinking has the whole body participating."

Pert explains that each neuron in the human brain has hundreds of thousands of receptors. "Receptors are proteins, and these receptors literally vibrate and constantly change shape." She continues: "As more peptides were discovered in the brain, more were also found in other systems of the body. Therefore, the body-soul connection is actually physical. These receptors wax and wane depending on how much bombardment they get. They're in a constant state of loud chatter."

Pert adds that we make new, functional brain cells daily from birth to death. In fact, it's our ability to generate new brain cells that accounts for the brain's plasticity—its ability to continue to learn and update its database. Scientists generally agree that each human being has approximately 100 billion neurons, each of which has from 1,000 to 100,000 connections, all of which are constantly changing. Those numbers add up to more than the estimated number of stars in the universe. Electro-chemically, the human brain is the most complex mass of organic tissue known.

Information to and from neurons is transferred electrically via chemical neurotransmitters. The communications point is called the synapse, where information is transferred from one cell to another. Dendrites serve as the input mechanism, receiving information from one cell and transmitting the message to the cell body. The axon, which extends from the nucleus, conducts messages away from the cell body.

Dr. John Ratey, professor of psychiatry at Harvard Medical School and author of *A User's Guide to the Brain*, notes that neurons that fire together wire together. That's the basis of how we learn. When a cell makes enough proteins due to stimulus, it increases connections. Two natural brain chemicals, nerve growth factor (NGF) and brain-derived neurotropic factor (BDNF), facilitate the growth of neuronal connections between brain cells. Ratey calls those substances "Miracle Gro for the brain." They're released when the brain's cells are active, such as when we think or puzzle over something. Our brains are the ultimate adaptation organs. In new situations, the brain is hungry to learn to manage incoming information. The cortex is where all of the new learning takes place, in an area called the association matrix. The brain's large prefrontal cortex enables humans to adapt to changing environments. When we adapt, we make more growth factor, which continues to be produced as we learn new things.

"If you affect one area, many others are also affected," says Ratey. There's a continuous biofeedback loop in which our thoughts are influenced by our bodies and vice versa.

Another focus for research in the past 10 years has been the connection between the heart and brain. At San Diego-based HeartMath, president and COO Bruce Cryer and his teammates have gathered an impressive array of research about heart-brain connections. "The heart literally influences brain function in profound ways that have implications on decision making, mental clarity, communication skills, and overall effectiveness and productivity," says Cryer.

The first pathway he describes is a neurological communication. The heart has its own intrinsic nervous system whose role is so sophisticated that cardiologists call it the heart's "little brain." The second pathway is a biochemical communication. "We can now classify the heart as a hormonal gland. Many of the so-called brain chemicals are produced in places other than the brain," says Cryer. "Neurochemicals such as epinephrine, norepinephrine, and oxytocin are also produced in the heart—as is atrial peptide, a heart-produced hormone that has a balancing effect within the body."

Cryer defines the third pathway as the biophysical connection. The pulse is a powerful wave going throughout the body, and a continuous series of waves carries information from the heart all over the body, especially to the brain. Finally, there's an electromagnetic communication. Says Cryer, "The heart produces the strongest electrical signal in the body—60 percent stronger than the electrical output of the brain. If you think of the body as an

electrical grid, the heart is the main power station and the brain is a substation."

Even at rest, our hearts constantly vary in speed. Heartbeats occur in patterns that respond to emotional changes. For example, when we're feeling frustrated, the heart produces a chaotic rhythm that reaches the cortex and inhibits it. When that occurs, our reaction speed is delayed, our memory isn't as sharp, we may say things we don't mean or later regret, and we may lose physical coordination. Conversely, when we're calm, the heart beats in smoother rhythms, which can produce high-performance learning in which brain connections are made easier and faster.

Care and feeding of the brain

Ratey says that many of the fundamental tools for nurturing the brain are everyday matters. We all know that proper nutrition, exercise—physical and mental—and sufficient sleep help us remain sharp cognitively and steady emotionally. Spirituality, meditation, and pursuit of our passions can also enhance our mental acuity and longevity. By treating our physical bodies, intellect, and spirit well, we take advantage of the brain's great plasticity and our power to reconfigure our brains.

The brain is the hungriest organ we have, and eating is the most powerful stimulant that can affect it. Brains are glucose sponges, consuming 25 percent of all of the glucose (and oxygen) we absorb. Glucose is the brain's sole fuel, yet it's stored elsewhere in the body. We need a steady supply of glucose throughout the day, which requires eating complex carbohydrates, fats, and proteins—not just a morning coffee and donut. Pert asserts that *when* we eat is as important as *what* we eat. Our biggest food intake should be at the midday meal, as is the practice in every nonindustrial culture and used to be in America. Eating the main meal at midday allows plenty of time for the food to be digested before we retire. Says Pert, "It also means that the molecules of nutrition will be carried to sites in the mind and body where they'll reinforce conscious, vigorous, waking activity rather than be deposited as fat, which happens more readily when we eat late."

Light, or lack of it, also affects the brain's circadian rhythms. We have chromo-sensitive cells all over our bodies, not just through the face and eyes, notes Pert. When we have adequate sunlight throughout the year, we do appreciably better.

If you want to help your body and brain, be active. Research has proven that just by taking a brisk walk, you can reduce the risk of heart attack, hip fracture, diabetes, and colon cancer and lower your weight and blood pressure. Dozens of scientific studies have shown that sustained aerobic and anaerobic exercise increase the flow of blood to the brain. Certain endorphins—naturally occurring substances that decrease pain and induce a sense of well-being—rise when we engage in prolonged, strenuous exercise such as jogging.

> Increasingly, brain research indicates that physical movement affects thought.

Gessner Geyer, president of Brainergy, says, "In essence, we are kinesthetic learners. Learning isn't all in our heads, and our brains don't sit disembodied in a bucket. Our minds and bodies work together to help us pay attention, solve problems, and remember solutions. Our physiological states support our mental efforts. Movement and exercise can enhance optimal learning states. When we stand up to stretch our legs after a long bout of mental exertion, our bodies are being asked to help freshen our minds."

Exercise such as dance, martial arts, hatha yoga, tai chi, basketball, and gymnastics involve learning a series of complex movements while coordinating one's balance. Those types of exercise have been proven to generate a greater number of connections between neurons.

"The physiological effects of physical activity are compelling," says Geyer. "They include increased cerebral blood flow and oxygen to the brain; the development of capillaries, which permit collateral circulation; the release of dopamine and serotonin, two essential neurotransmitters that help sustain attention and the ability to concentrate; and the increase of BDFN, which facilitates neuroplasticity—the ability of the brain to continue to grow and change throughout our life span."

Says Ratey, "New research indicates that these kinds of exercise also affect the basal ganglia and corpus callosum, sharpening memory and increasing the capacity to master new information. Maintaining memory and repairing weakened brain connections depend on stimulation. To improve our brains, we have to move our bodies, take action, get going.

"The reason is that the primary motor cortex, basal ganglia, and cerebellum, which coordinate physical movement, also coordinate the movement of thought. Just as they order the physical [motions] needed for moving, they order the sequence of thoughts needed for thinking. Fundamental motions such as walking and running trigger the most deeply ingrained neural firing patterns in these brain regions."

Geyer also points to a number of longitudinal studies on "successful aging" as further reason to keep our bodies moving. One study of nearly 2,000 70- to 74-year-olds—sponsored by the MacArthur foundation and conducted by teaching hospitals at Harvard, Johns Hopkins, and Duke universities—sought to discover which factors might contribute to a person's mental acuity in late adulthood. The findings point to these nongenetic factors that promote "optimal cognitive aging":

- a sustained regimen of ongoing mental activity
- a high expiratory flow rate that comes from aerobic exercise
- participation in some sort of anaerobic activity such as gardening or lifting
- a high degree of self-efficacy, a sense of personal control over life's daily challenges.

Mental gymnastics

Moving our bodies, however, isn't enough. It has been documented that a variety of mental exercises—such as doing crossword puzzles, learning a new skill or language, or playing chess or backgammon—can strengthen and renew neural connections, thereby keeping the brain flexible and resilient. Even the simple task of brushing one's teeth with one's nondominant hand can increase connections between our axons and dendrites. The best news is that studies show our brains remain resilient and capable of making new connections throughout our lives. If we continue to challenge our brains, they will remain fit just like our muscles, hearts, and lungs. Challenging ourselves mentally keeps our synaptic pathways alive. The good news is that we *can* teach old dogs new tricks.

Meditation and prayer, practiced throughout the world for tens of thousands of years, can also induce a state of relaxation, which proves mentally and physically beneficial. Dr. Herbert Benson of the Mind-Body Medical Institute at Harvard Medical School has conducted dozens of studies on the efficacy of meditation. "The relaxation response comprises an assortment of physiological changes: a decrease below resting levels in oxygen consumption, heart rate, breathing rate, and muscle tension—plus a decrease in blood pressure in some people and a shift from normal waking brain wave patterns to a pattern in which slower brain waves predominate," he says. "Instead of feeling like a cork bobbing on the sea, regular practice of the relaxation response leads to a sense that emotions—and the physiological reactions that go with them—can be brought under your control."

Ratey explains what happens physiologically when the body reacts to meditation or other altered state of consciousness: "Sympathetic nervous system activity decreases and metabolism slows down. The brain's own electrical activity also changes. Instead of supporting a decentralized storm of signals, a large number of brain neurons fire in a pleasing synchrony. Finding our individual synchrony in life is equally important to a healthy brain. It's crucial to letting our talents blossom and important for getting us away from the addictive behaviors that abound in life."

Emotional peace and connectivity help ensure a continued state of mental acuity, not to mention mental longevity. Says Pert, "Recent technological innovations have allowed us to examine the molecular basis of the emotions, and to begin to understand how the molecules of our emotions share intimate connections with, and are indeed inseparable from, our physiology.

"We must take responsibility for the way we feel. The notion that others can make us feel good or bad is untrue. Consciously or, more frequently, unconsciously, we choose how we feel at every single moment. The external world is in so many ways a mirror of our beliefs and expectations. Why we feel the way we feel is the result of the symphony and harmony of our own molecules of emotion that affect every aspect of our physiology, producing blissful good health or miserable disease."

Obviously, if we engage in activities that give us a sense of accomplishment, control, and purpose, we feel validated and glad to be alive; our brains and bodies are nourished. Therefore, we should follow our passions while they're hot. If we can engage our hearts, energy, minds, and sense of wonder and joy throughout our lives, we're not only richer, but also our brains will continue to stay plastic and create more interconnections.

Move, breathe, laugh

Geyer suggests several strategies for enhancing the brain-body connection in classroom situations. From years of schooling and conditioning at the office, most of us have been trained to sit and think. So, it's important to get people up out of their seats moving, breathing, and laughing. "I frequently begin with a vigorous breath-and-brain lateralization exercise that requires concentration and rapid movement," says Geyer. Some people giggle or are embarrassed at first, but these types of exercises signal a change in the group's interaction and gets energy flowing."

Geyer emphasizes that such exercises require the trainer's verbal acknowledgement that they require a humorous, intrepid spirit. As long as participants see that the trainer is there to help them connect with their own sources of energy and mental clarity and to assure that they have fun doing it, they're typically willing

to challenge themselves and attempt novel activities. Geyer always assumes an attitude of let's jump in and give ourselves a physical experience, noting that it's important to laugh and keep it light.

Geyer suggests that participants roll their heads and shrug their shoulders slowly at the beginning of a session and asks them to "cleanse their mental palettes of the day's extraneous concerns." In that way, participants can mentally clear away a time and space in which everyone in the group can focus and adjust their concentration to reestablish mental health and rejuvenation through physical exercise and group activity. He then might ask participants to perform a series of mind-body tasks in small groups. The tasks require movement, problem solving, and communication skills. Two are passing a hula hoop from person to person while the group stands in a circle with hands connected or signaling silently to line up according to birthplace from east to west. Geyer also uses a task he calls "stretch your perceptual thinking," in which he asks the group to duplicate a complex geometric pattern in three dimensions using large elastic bands. The exercise demands observation, mental rotation, communication, movement, and visual verification.

Geyer also relies on his training as a certified instructor of kundalini yoga. "Breath, movement, and thought are much more closely linked than most of us realize," he says. "Conscious, regulated breathing is a powerful tool for transforming one's mental state. Quite often, a three-minute breath exercise can change group interaction more effectively than a 30-minute presentation on organizational behavior." At the beginning of a session, Geyer often asks the audience to forget their embarrassment as they engage in a "baboon-like" breathing exercise in which they inhale and exhale in a rapid pulsing rhythm.

Ratey says, "It has become obvious that we can actually change our brains. By altering the external environment of our surroundings or the internal environment of our bodies, we can take better advantage of our strengths and amend our weaknesses. The possibilities for change are bounded only by our imagination, our willingness to assess our brains accurately through self-reflection, and our commitment to do some hard work." TD

More Reading

- *Ageless Body, Timeless Mind,* by Deepak Chopra (Harmony Books, 1993)
- *Mind-Body Medicine: How to Use Your Mind for Better Health,* Daniel Goleman and Joel Gurin, editors (Consumer Report's Books, 1993)
- *Molecules of Emotion,* by Candace Pert (Scribner, 1997)
- *A User's Guide to the Brain,* by John J. Ratey (Pantheon Books, 2001)
- *Why Zebras Don't Get Ulcers,* by Robert Sapolsky (W. H. Freeman & Company, 1994)

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