Brain Up Your TKD

How Neuroscience Can Help

By C. Alexander Simpkins, Ph.D. and Annellen M. Simpkins, Ph.D.

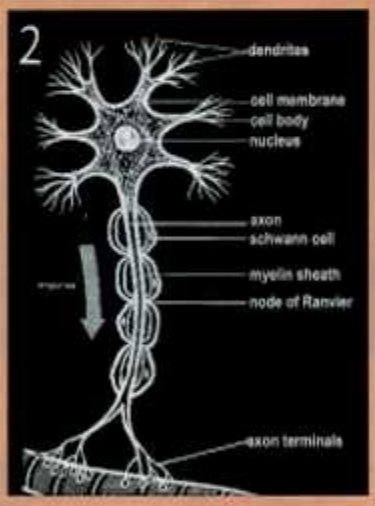
As a Tae Kwon Do practitioner, you are always trying to perfect what you do. You probably spend many hours working out, with the goal of making each technique the best it can be. But did you know that you could enlist your brain to help? Your brain is your best ally in learning well and developing excellent techniques.

Whenever you do anything, the brain gets involved. So when you practice, you are not just training your muscles, you are also training your brain. The brain directs an interconnected system of nerves, known as the nervous system, found all through the body (FIGURE 1). Many pathways allow signals to flow around in patterned ways, which is how the signals from the brain are communicated to the body, and information from the body is sent back to the brain. Applying understandings from neuroscience, you can take your practice to an even higher level!

Brain Plasticity

The brain is not as fixed and permanent as was previously believed. What you do, think, and feel changes your brain; and you can do it at any age. In fact, it is quite malleable, which is referred to as neuroplasticity.

The brain is made up of tiny cells called neurons. (FIGURE 2) Neuroplasticity begins at the synapses, the spaces between neurons. Like the Eastern principle that enlightenment is in emptiness, we find the amazing capacity of our brain to change in these empty synaptic spaces between neurons. When you do an action, such as throwing a kick, (FIGURE 3) certain neuronal connections are activated. If you keep kicking repeatedly, these connections are strengthened and learning at the neuronal level takes place. This learning process is known as long-term potentiation or LTP. Look at Donald Hebb's famous statement, "Neurons that fire together wire together," conversely, if you were to stop kicking for an extended time, those neuronal connections that were involved in kicking would weaken and could eventually stop being connected at all. This is known as long-term depression or LTD.



Brain Training Tip: When you work on performing your techniques, remember that you are training neurons to fire together. By attending to the precision of each move, you initiate the correct neuronal connections. Through repetition of the exact motion, you are in essence teaching your neurons to fire in a pattern. Thus, it is essential to strive for correct technique. If you keep doing a technique incorrectly, you form neural interconnections for doing it wrong. LTP may help to explain why bad habits are hard to break. So, when your instructor gives you a correction, take it seriously so that you can train your brain in the right way!

Using More of Your Brain

We know that Tae Kwon Do improves balance, teaches control of movement, enhances perception, and sharpens focus. Many different brain areas become involved in perfecting all of these components. Here are just a few of the brain areas that take part in the process.

Balance in Motion

When you first learn Tae Kwon Do, you are mastering physical skills involving positioning of the body, balance, and complex coordination of rapid alternating movements. Your cerebellum (FIGURE 4), that section in the back of your brain sometimes called "the little brain," gets involved. The cerebellum is activated whenever learning a new skill. It is also important in finding and keeping your balance while moving, a necessary Tae Kwon Do capacity.

Once you have learned the moves, the motor cortex activates to control planning and execution of your techniques (SEE FIGURE 4). You might recall that when you were first learning to punch, you struggled with coordinating both hands in a smooth push-pull motion, correctly snapping your hips to add power, while also trying to accurately place a powerfully focused punch. (FIGURE 5) Part of the challenge came from teaching your brain to coordinate many parts of its motor system together. The primary motor cortex located in the Frontal Lobe (FIGURE 6) coordinates the complex and subtle combination of movement skills. There is also a premotor cortex, which guides the trunk muscles, the seat of Tae Kwon Do power. And the supplementary motor area (SMA) helps to plan and coordinate complex motions, especially those involving two hands. So, whenever you perform the push-pull dynamic of punching, your SMA is activated. Tae Kwon Do practice orchestrates all these different parts of the brain and body together into a perfectly unified punch.

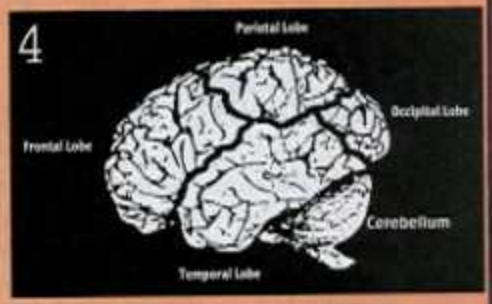
Brain Training Tip: Throw each kick, punch, and block like you mean it. Keep your attention directed to what you are doing and make an effort with every technique. Add emotional content through the limbic system (FIGURE 7), the emotional center of the brain, which connects to many different areas of the cortex. These deeper parts of the brain will be more fully involved, and as a result, your Tae Kwon Do will become more spirited and energized.

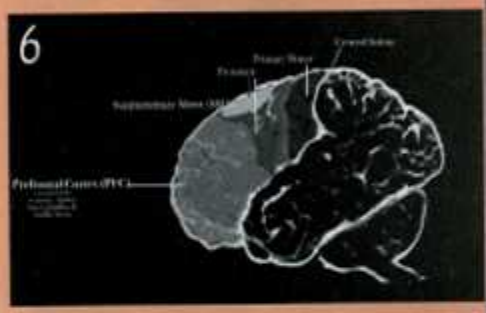
Sparring Skills

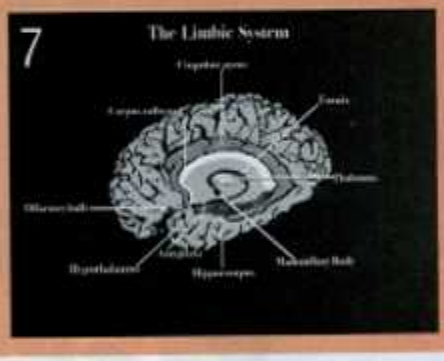
The strategy and planning skills you develop for sparring activate the prefrontal cortex in the frontal lobe (See FIGURE 6). For example, knowing how to create an opening such as kicking high to draw the opponent's block up and then throwing in a middle target kick for a score, (FIGURE 8, 9) involves what

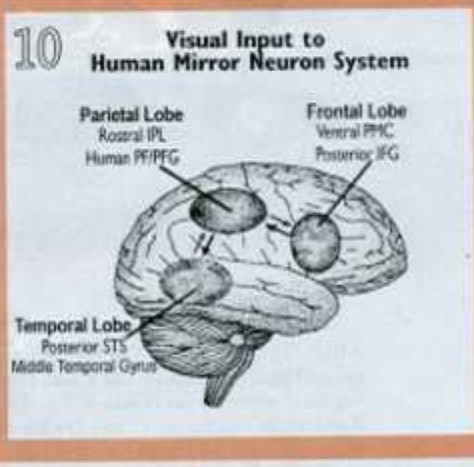
is known as executive functioning, regulated in the prefrontal cortex. Executive functions include planning, higher-level decision-making, sequencing, and goal directed behavior. These executive skills are essential for successful sparring.

When you spar, you are alerted to the movements of the opponent. Skilled black belts have an uncanny sixth sense about what the opponent will do next. One recent theory is that some specialized neurons in the brain, known as mirror neurons, (FIGURE 10) activate when you move, but they also activate when you observe movement in other people. These neurons are located in the motor









area and in the parietal lobe, and are involved in understanding and empathizing with the intentions and actions of others. So, you can literally *feel* the opponent's movements like you feel your own movements.

Knowing and Doing: Declarative and Procedural Processing

Learning and memory engage two separate but interacting brain systems, each with its own neural counterparts. One system is conscious, declarative, using words and concepts. When you are first learning a new form, you engage the declarative learning and memory system. You think about what each technique is, the meaning, and the moves in sequence. Once you know your form well you may find yourself able to flow through the moves without having to think about them. Implicit learning, from a second learning system that relies on the procedural memory, comes into play. Mastery in the martial arts is seen in the sensitive movements of a master, a blur of powerful, precise techniques, performed without need of planning or thought. Here you see the procedural brain system in action, beyond deliberate thought—just movement itself.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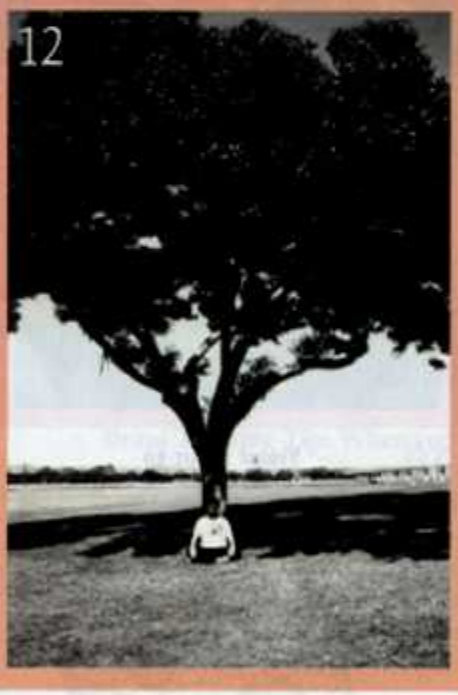
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Focus

Absolute focus, where mind and body move as one, is at the highest level of achievement in Tae Kwon Do. This is developed over time, moving from conscious and deliberate attention to unconscious absorption in the movement procedure, bringing the whole mind-brain-body together as a system, such as when breaking wood (FIGURE 11). One of the traditional ways to develop the qualities of focus is through meditation, a method of mindfully holding attention on what you do while you do it. The legendary founder of martial arts, Bodhidharma was also the legendary founder of Zen meditation, and so the martial arts are often considered a form of moving meditation (FIGURE 12).

A great deal of research has been devoted to understanding how meditation affects the brain. Many different research projects have found that meditators are highly attentive while also remaining deeply relaxed. So meditation is neither simply a typical calm state nor is it a typical alert state. Rather, it enhances alertness and relaxation simultaneously, a useful combination of skills for martial artists!

Brain Training Tip: Sit down and close your eyes. Observe a breath, beginning with bringing the air in through your nose. Feel the air in the nasal passages and then follow the sensation as the air travels down into your lungs. Concentrate on the movement in your chest and diaphragm as the air enters. Follow the air as it moves out. Feel the sensation of air pushing out as it leaves your nose. Follow the air as it moves in and out, with fresh interest. Each moment is distinct, different from the past moment, and unique, open to new potentials. And so, every breath is completely new and worthy of full attention.

When you feel focused, perform a form. Maintain this full attention with every move. Practice this meditation regularly. Being able to be calm and alert simultaneously will improve your skills.

The brain is a complex organ. For the purposes of this article, we have presented a simplified account of its structures and functions. Future research will add more to the understanding of Tae Kwon Do and the brain. Meanwhile, rest assured that correct practice of Tae Kwon Do is a healthy activity! So, keep working out and in time, with the mind, brain, and body working as one, you will surely improve. TKD

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