Training the brain to change the way we age, part 1: understanding neuroplasticity

Fitness and wellness professionals can help clients—and themselves—build mental 'muscle' for everyday life by adding brain games to physical movement

by Lawrence Biscontini, MA

This two-part article explores the brain and its functions and skills, factors that affect brain function, and practical ways to apply research on brain training. This first installment looks at brain functions and skills, as well as brain-training research. It also discusses some implications for translating research into practice. In the next issue of the Journal on Active Aging®, *the second installment will delve into factors that have a negative impact on brain function, general guidelines for neuroplasticity training, and different brain games.*

As we try to enhance the way we train the body to improve the way we age, including the brain in our approaches can make a huge difference. Research reveals that since the brain controls the body, and not the other way around, brain training can serve as the best point of departure for training. To be sure, the ways in which we train the body today abound, including sets, repetitions and overload. The good news is research now shows how a similar approach works for brain training as well.

Plasticity, the original term related to brain training, dates back to William James and his 1890 book, *Principles of Psychology.* More lately evolved to *neuroplasticity,* this concept refers to the brain's ability to reorganize and

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work a particular area of the brain (left side for math skills), but such activity does not constitute neuroplastic training for the purposes of this article. To train neuroplasticity, mental tasks must combine with physical movement.[9]

The body's movement does not have to be intense, to be sure. But for brain training, mental tasks must take place during some form of coordinated physical movement—for example, tapping toes while seated on the edge of a chair and working on Sudoku puzzles.

Anyone who has engaged in a moderately challenging brain skill while walking and talking will remember how much easier it becomes to stop and think. That's because stopping movement decreases the sensory input to the brain and allows it to concentrate on other processes, such as recalling a memory or finishing a complicated math skill. While limiting input may prove more comfortable at the time, we need to encourage the brain to function *simultaneously* with the body's needs, as required in life. Answering a caller's questions on a cellphone while walking across the street amidst heavy car traffic demands just such multitasking.

One caveat: Readers must choose and adapt the appropriate level of physical movement for clients to accompany any suggestions provided in this article. With brain training, intensity of movement is not the point. The body needs only to move.

Training brain and body: common examples

Introducing mental tasks to movement is possible while going about daily activities or doing more purposeful physical activity. Here are a couple of examples of combining mental and physical tasks to train neuroplasticity:

Conversation example

"What did you have for dinner last night?" seems an innocuous question between friends. The answer depends on one's ability to use a certain amount of memory. This task does not train the brain. However, if the friends asked each other to list *in reverse order* what they ate the previous night while they walked their pets on an evening stroll, the task *would* train neuroplasticity for two reasons. First, it would require the mind to work simultaneously as the body engaged in a movement skill. Second, and more specifically, the memory-recall and spatial skills of reverse order come from left-brain tasks.

Lunge example

In an example using a more traditional fitness-training movement, a client makes a list of fruits and vegetables while doing alternating forward lunges. Lunging forward with the left leg, the person says "broccoli," for example, followed by "pineapple" when lunging forward with the right leg. The process continues without stopping, with the individual naming a vegetable with each left-leg lunge and a fruit with each right-leg lunge. This task constitutes neuroplasticity training because the mind is working while the body engages. In addition, the problem-solving effort taxes the brain with right-brain tasks, while the physical movement coordination is a left-brain task.

Let's move now from discussing the left and right brain hemispheres and brain training, to look at the different parts of the brain and their functions.

Regions of the brain

Several key sections make up the brain. When these areas work in synchronicity in a moment of particular focus, it illustrates the work of the mind. The term *mind-body,* in its truest sense, comes from anything that originates in the brain as conscious movement with form, purpose, dedication and concentration. All training that uses the brain in this manner falls under a "mind-body" training umbrella.

The various sections of the brain serve different purposes. The *cerebrum,* the largest portion of the brain, contains sections in both the right and left brain hemispheres: the frontal, parietal, temporal and occipital lobes. These critical areas control the following complex brain functions:

- **frontal lobe:** elements such as creative thought, problem-solving (including decision-making), intellect, judgment, behavior, attention, abstract thinking, physical reaction, muscle movement, coordinated movement, smell and overall personality
- **parietal lobe:** comprehension, language, reading, internal stimuli, tactile sensation and sensory comprehension

- **temporal lobe:** auditory memories, speech, language and behavior
- **occipital lobe:** vision

The *cerebellum* sits at the back lower part of the brain. Particularly important for fitness instructors and trainers to understand, this area controls balance, posture, and coordination of motor skills and movements.

Other structures of the brain containing glands comprise the limbic system. The *amygdala* helps the body respond to emotions, memories and fear. Its small shape resembles a raw almond, and the word itself means "almond" in Greek (ΑΜΥΓΔΑΛΑ).

The *hippocampus* allows learning and memory of emotions, specifically converting temporary memories into permanent memories, which can be stored within the brain. The hippocampus also helps people analyze and remember spatial relationships, allowing for accurate movements.

The *hypothalamus* region controls mood, thirst, hunger and temperature. It also contains glands that control the hormonal processes throughout the body. Making healthy decisions about food amounts involves the frontal lobe's decision-making properties, but understanding the true feelings of physical hunger involves the hypothalamus.

The *thalamus,* located in the center of the brain, controls attention span and pain sensing, as well as the input of constant sensations moving in and out of the brain.

Finally, the origins of life function reside in the *brain stem,* including our heartbeat, blood pressure and breathing. Perhaps most importantly, this section connects all the aforementioned sections of the brain with the rest of the body through the spinal cord.

The brain in action: the pizza example

A practical example can help to simplify the regions of the brain above and how they work. The following comments about pizza illustrate the brain in action:

- "I remember the first time I had pizza at a lovely outside square in Rome" reflects the hippocampus (emotional memories).
- "I'm hungry for thin-crust pizza" uses the hypothalamus (hunger).
- "I remembered that in Italian, the word *pizza* stays the same—'la pizza'" uses the temporal lobe (memories of sound, language skills).
- "In a general sense, I love all kinds of thick and thin crust vegetable pizza" comes from the parietal lobe (abstract thinking).
- "I searched on the Internet to find out where to buy authentic pizza in my zip code" uses the parietal lobe (reading and research skills).
- "I'm going to walk to the pizzeria to order some pizza takeaway" reflects the frontal lobe (decision-making and physical movement).
- "When I come to the restaurant, I choose the kind of pizza I want from the menu" uses the occipital lobe (vision).
- "I'm now eating my pizza, savoring each slice as I bring it to my mouth" uses the cerebellum (coordinated movements).

Just as we can favor certain muscles and muscle groups with physical training, so, too, we can favor certain brain functions and brain games. Some people prefer left-brain mathematical puzzles; others prefer right-brain crossword puzzles. It proves necessary, then, to include brain games using all different brain areas to offer well-rounded training.

This article installment includes an activity called "Phone Number Games with a friend" on page 42. In these games, 2 participants recite digits in a variety of ways while continuing a movement pattern, which challenges memory, spatial skills, problem-solving, and more. The next article installment will feature brain games that use conversation and vision as pathways to neuroplasticity training.

Efforts build mental 'muscle'

Engaging in simple right and left brain games during movement does not involve learning a new way to train the body. We can merely add an extra layer of "brain games" to what we, and our clients, already do. Yes, we may feel strange, frustrated and even uncomfortable when we first introduce these games

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Resources

Internet

Brain Awareness Week (The Dana Alliance): Tips and Resources
Downloadable materials include "Staying Sharp" and "BAW Favorites" puzzle series
www.dana.org/BAW/content.aspx?id=44679

The Brainwaves Center: Puzzles and Self-Tests
www.brainwaves.com/puzzles_selfTests.html

SharpBrains: Brain Teasers
http://sharpbrains.com/brainteasers/brain-games-and-teasers-top-50

Print

Doidge, N. (2007). *The Brain That Changes Itself: Stories of Personal Triumph from the Frontiers of Brain Science.* New York, NY: Viking

Eckmann, T. (2013). *101 Brain Boosters.* Monterrey, CA: Healthy Learning

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into familiar activities, such as going for a walk or working out. In our effort to build mental "muscle," though, it may help to remember that brain training can prove just as important as traditional movement to our overall health, aging and success.

Lawrence Biscontini, MA, has been involved in brain training since an eye operation in 1972 left him without sight for several months in recovery. As an Advisory Board Member for the International Council on Active Aging®, and as an "active ager" himself, Biscontini dedicates a great deal of time to making practical the most recent research on keeping our brains as young and sharp as possible. He copresented the workshop "Training neuroplasticity: current research for training the active older adult" at the ICAA Conference 2014, in Orlando, Florida. Biscontini neither supports nor endorses any sources of brain games. He can be reached at www.findlawrence.com.

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Phone Number Games with a friend

Part 1
Two people get into a "holding pattern" of movement. This activity can range from simple seated marching to more involved patterns such as standing marching, grapevines and squats.

One person is Friend A; the other is Friend 1. Dividing and labeling "friends" in this unexpected way unites left and right brain skills from the start. In addition to the individuals having to stay alert to remember these unique partner names, such labels also work to keep every game positive: Each partner is first in the alphabet or number system.

To begin the Phone Number Games, Friend A tells Friend 1 the last 4 digits of his/her phone number. The 2 individuals then play the following brain games as both partners continue to move (for example, marching in place or walking around the block).

Friend 1 recites the digits in the same forward order, and then:

- recites the digits backwards
- adds the digits, two at a time, and sums a grand total
- spells each digit forwards
- spells each digit backwards

Now, change roles! Repeat the above for up to 5 minutes per partner, as appropriate. Either partner may request assistance and "collaboratively problem solve" with the other person when needed.

Part 2
After about 10 minutes of Part 1, Friend A and Friend 1 start completely different movement skills (for example, standing in place and each making figure 8s with the hands while keeping the palms together in a folded-hands-in-prayer gesture, all fingers pointing forward away from the body, instead of towards the sky).

The 2 partners repeat the above Phone Number Games, adding the first 3 digits of the phone number to the existing 4, to play with a total of 7 digits. They continue with this method until they can execute some or all of the games.

To progress in the session or in future sessions, the partners then add the area code (for a total of 10 digits) and repeat playing all the games as above. Whenever tempted to pause to think, Friend A and Friend 1 should encourage each other to "keep moving, and keep thinking," reminding themselves of the 2 simultaneous keys for neuroplasticity training.

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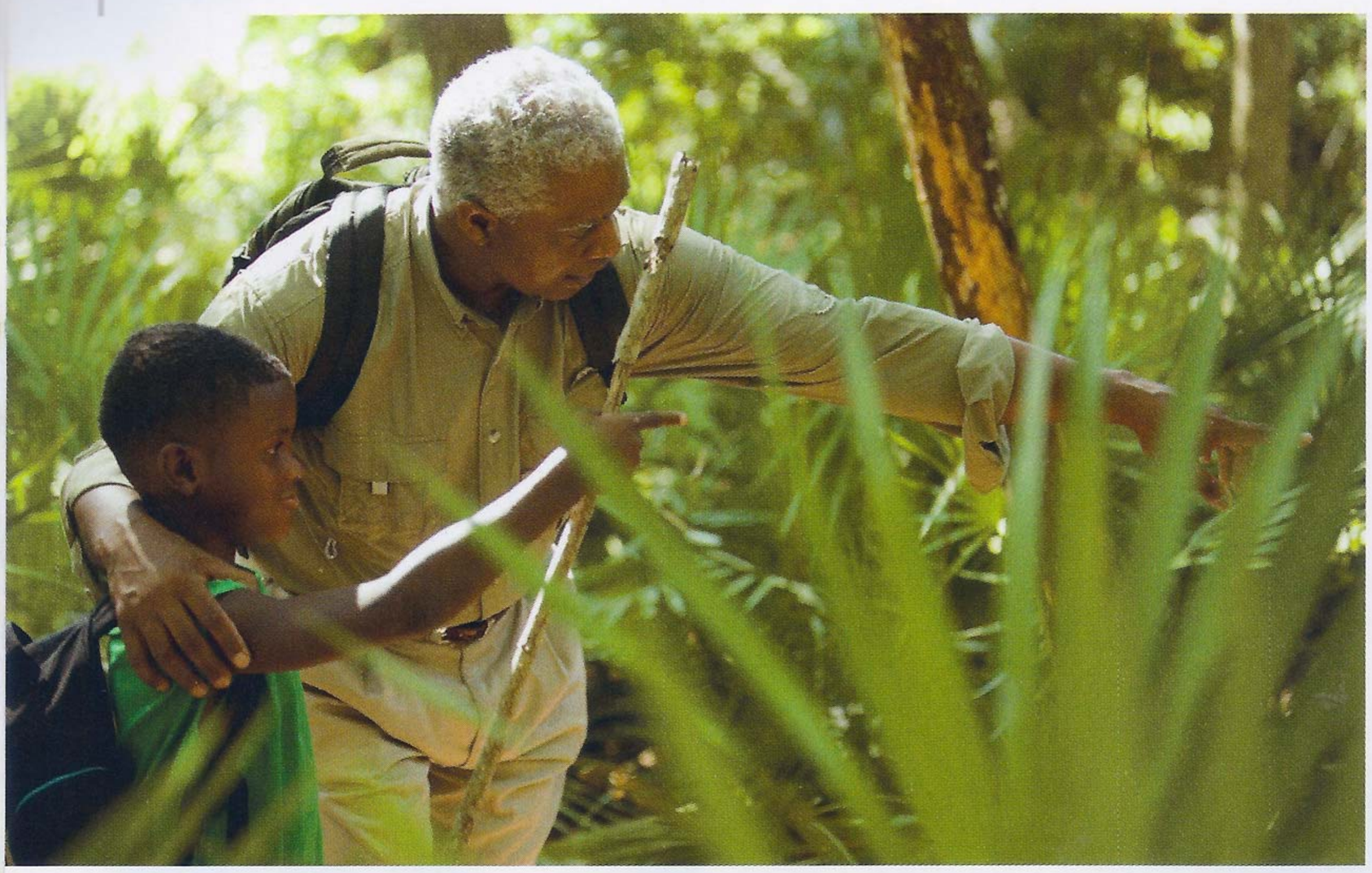

rewire itself in response to experiences and stimuli.[1,2] Recent research supports training the brain (neuroplasticity training) as if it were a muscle, applying similar fitness concepts of adaptation, sets, repetitions, timed performance, and specificity.[3,4] Other research tells us about the importance of neuroplastic training *combined* with physical movement skills, to strengthen, improve and even change some brain regions.[5,6] Training the brain's different capacities may also help individuals manage anger, fear and depression.[7] It may further serve as a viable complement—and sometimes alternative—to interventions with brain medication.[8]

This two-part article sheds light on brain-training research. It includes affordable tips that we, as fitness and wellness professionals, can use to add neuroplasticity training into everyday life, as we train both our clients and ourselves to age "smart."

The brain hemispheres

Many brain specialists have written on the complicated nature of the right and left brain hemispheres and their importance. For this article, the most important concepts to focus on include brain games that tax not only the left and right sides and the different areas of the brain working *individually,* but also the independent sections working *collectively.*

Let's start with a look at what the left and right brain hemispheres do. The left side mostly controls speech, language, math and analytical skills, memories of names and words, and motor skills on the right side of the body. Conversely, the right side mostly controls creative skills (including problem-solving), emotions, memories of images such as faces, spatial zones, patterns of details, and motor skills on the left side of the body. An approach of right-and-left-brain training draws upon mental tasks that require the different sides of the brain to undulate (fluctuate between hemispheres). Mental tasks alone are not enough, however, for neuroplasticity training.

The body must move

Executing any type of brain skill—doing Sudoku puzzles while comfortably seated in a lounge chair, for example—may

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Brain Awareness Week highlights brain research

Every year Brain Awareness Week engages hundreds of thousands of people through exhibits, activities, lectures and efforts organized by campaign partners. The Dana Alliance for Brain Initiatives launched the global campaign in 1996 to educate the public about the brain and the promise of brain research. In March 2015, the initiative celebrated 20 years of public outreach. The Dana Alliance supported a number of free public events, including "Staying Sharp," a panel on memory, brain health, and healthy brain aging, held March 17 at the New York University Langone Medical Center. AARP and the NYU Langone Center on Cognitive Neurology collaborated with the alliance to present this discussion.

A New York-based nonprofit organization of 350 eminent neuroscientists, The Dana Alliance is dedicated to advancing public awareness about the progress and benefits of brain research. Its partners in Brain Awareness Week include the Society of Neuroscience, universities, museums, patient advocacy groups, K-12 schools, and others. Those interested in participating in next year's Brain Awareness Week and/or learning more about brain research will find accessible educational resources, downloadable graphics, publications and general information on the campaign website, www.dana.org/BAW.