

Protecting the Aging Brain

by [Cody Sipe, PhD](#) on Oct 12, 2017

Research confirms that exercise and a healthy lifestyle are crucial to preserving cognitive functions and potentially staving off dementia.

Study after study shows that physical activity, diet and other lifestyle factors keep the brain healthy as we age—contrary to the popular notion that cognitive function inevitably declines in the later years of life.

Admittedly, Alzheimer’s disease and other dementias pose serious health risks. Alzheimer’s is the fifth leading cause of death for Americans over 65, and the threat keeps rising: In the next decades, the number of cases worldwide is expected to nearly triple, from 46.8 million in 2015 to 131.5 million in 2050 (Alzheimer’s Association 2017; ADI 2015). And another 15%–20% of older adults are diagnosed with mild cognitive impairment (MCI), according to the Alzheimer’s Association.

But this doesn’t mean brain power must wane as we age. Far from it, in fact. “The lights may be on, but the voltage is low,” say the authors of the book *Successful Aging* (Dell 1998), which debunks popular myths that senility, confusion, memory loss, “senior moments” and worse are normal parts of growing older (Rowe & Kahn 1999).

The research overwhelmingly suggests that cognitive function in old age reflects how people live: Nutrition, stress, environment, physical activity, relationships and even individual views on aging play a role. And recent advances in neuroscience suggest that aging adults retain the ability to improve their neural networks and cognitive function—a concept scientists call **neuroplasticity**.

All these points underscore why trainers working with older people need a comprehensive approach that includes exercises for maintaining or improving cognitive function. This approach requires

- learning proven strategies for preventing dementia and optimizing brain function;
- understanding the influence of the most important cognitive functions;
- using exercise to improve cognitive function and functional longevity; and
- sampling exercises you can begin using with your older clients today.

Let’s walk through each of these.

The Basics of Dementia Prevention

Dementia is an umbrella term for multiple cognitive impairments whose symptoms include memory loss, poor judgment, communication difficulties and personality changes. Alzheimer’s disease, the most common cause of dementia, has several risk factors, including age, family history and genetics. While many genes are known to increase the risk of Alzheimer’s, many people with these genes do not develop the disease. Hence, it stands to reason that other important risk factors—either disease or lifestyle related—play a role.

Disease risks. Cardiovascular and metabolic conditions such as heart disease, type 2 diabetes, hypertension, high blood-cholesterol levels and obesity significantly affect a person’s chances of

developing dementia. In fact, cardiovascular disease or diabetes double the risk (Alzheimer's Society 2016). Other conditions, such as kidney disease, anxiety and sleep apnea, have been linked to dementia in some studies, but the evidence is still weak.

Lifestyle risks. There is overwhelming evidence that certain lifestyle factors play a significant role in dementia risk. Most of these factors are also closely linked to the risk of cardiovascular disease, so it could be said that “what is good for your heart is also good for your head.” The three primary lifestyle risk factors are physical inactivity, smoking and an unhealthy diet.

These risks point to one conclusion for trainers: **There's a strong case that physical activity and a healthy diet can reduce the risk of dementia.**

Understanding Cognitive Functions

To optimize brain function, you need to understand the variety of cognitive tasks we perform daily, such as reasoning, memory, attention, language and physical movement. These play key roles in our lives, but arguably the most important cognitive task is **executive function**—encompassing the higher-level skills that control and coordinate other cognitive abilities. Executive function is loosely divided into organizational and regulatory abilities:

- **Organization** includes attention, planning, problem-solving, working memory, cognitive flexibility and abstract thinking.
- **Regulation** includes self-control, initiation of action, emotional regulation, inhibitory control, moral reasoning and decision-making.

Cognitive decline usually affects specific aspects of executive function. For example, people with MCI may have significant memory loss (forgetting important information they would previously have recalled with ease, such as appointments, conversations or recent events), while others may lose thinking skills (ability to make sound decisions or to judge the time or sequence of steps needed to complete a complex task). Typically, memory impairments happen first. A decline in thinking skills may indicate a progression toward dementia. While those with MCI are at greater risk of developing Alzheimer's disease, they don't always get it. In some cases, MCI reverts to normal cognition, according to the Alzheimer's Association.

Exercise and Brain Function

Aerobic exercise and resistance training are good for the brain, studies show.

If frequency and intensity are sufficient, these forms of exercise can have a significant, and likely synergistic, effect on executive function, according to recent systematic reviews (Bamidis et al. 2014; Hotting & Roder 2013; Szuhany, Bugatti & Otto 2015). Most cognition studies compare an aerobic exercise program with a nonaerobic activity, such as stretching. More cardiovascular fitness is generally associated with more cognitive function plus better brain size and structure in cross-sectional studies of older adults. Note that while regular aerobic exercise can improve cognitive function in older adults, it is unclear whether the cognitive benefits are directly due to improvements in cardiovascular fitness (Hotting & Roder 2013).

Research suggests that stimulation of a protein called **brain-derived neurotrophic factor (BDNF)** is a key mechanism for improvements after aerobic exercise training. The central nervous system has high concentrations of BDNF, which has been linked to neural development and functioning, including **neurogenesis** (nerve-tissue growth). Higher levels of BDNF are also associated with better spatial, episodic and verbal memory, while lower levels of BDNF—particularly in older adults—have been linked to hippocampal atrophy and may contribute to memory impairment (Szuhany, Bugatti & Otto 2015). BDNF levels can increase after just a single session of aerobic exercise and rise even more with regular exercise.

Regular resistance exercise has also been shown to improve cognitive function, although this type of training has been studied far less than aerobic exercise. The research we have suggests that resistance exercise may stimulate cognition by increasing levels of **immunoglobulin factor 1 (IGF-1)**. Since BDNF and IGF-1 are thought to stimulate neurogenesis, **synaptogenesis** (formation of new synapses) and **angiogenesis** (formation of new blood cells) through interacting pathways, the combination of aerobic and resistance training may be more effective than either one alone (Bamidis et al. 2014).

The data on aerobic and resistance exercise is complicated by numerous variables, including which type of exercise is performed and in what setting. Working out in group settings potentially provides more social stimulation than exercising independently. Outdoor exercise may provide greater sensory stimulation than exercising indoors. Hiking, for example, requires better navigation and coordination skills than walking on a treadmill. Social and cognitive stimulation have proved to be important modulating factors, but it is difficult to tease out their contributions to overall results (Hotting & Roder 2013). Other nonaerobic variables, such as coordination, could also affect the results of these studies.

A Strategy for Cognitive Strength

The most effective strategy for exercising to boost brain health is likely to be a combination of physical exercise with cognitive challenges in a rich sensorimotor environment (see Figure 1). This combination seems to be more beneficial than pure cognitive and physical interventions alone. This does not mean trying to do a Sudoku puzzle while walking on the treadmill. Although the research is still emerging in this area, there is evidence that cognitive challenges need to be linked directly to the physical tasks: Studies combining the activities have demonstrated significant improvements, whereas studies separating the activities have not (Bamidis et al. 2014).

Three interventions are specifically recommended for brain health: tai chi, dance and “exergames” (Bamidis et al. 2014). Each of these activities requires constantly planning, scaling, anticipating, adjusting, responding to and coordinating movements to accomplish a task, which keeps the brain fully engaged with the body.

It has also been hypothesized that novel movement patterns requiring motor learning can have beneficial effects on cognitive function (Bamidis et al. 2014) even in the absence of improvements in cardiorespiratory fitness. In several studies where exercises focused on improving coordination (or motor fitness), participants showed significant gains. It’s clear that complex movement patterns require a high level of cognitive function, so it makes sense that training with such patterns could provide significant stimulus to the brain.

Exercise Resources

Tai chi has been shown to have numerous cognitive and physical benefits for older adults (Wayne et al. 2013). The slow, fluid three-dimensional movements require many aspects of postural control and balance, while performing the movements precisely in a specific sequence fully engages the brain. Dianne Bailey, a longtime martial arts practitioner and personal trainer, created the Open the Door to Tai Chi system (www.taichisystem.com) to teach trainers how to share the physical and cognitive benefits of this revered exercise. [Editor's note: See the June Functional Aging column for more on the benefits of tai chi for older adults.]

An exercise program called Ageless Grace® (www.ageless_grace.com) combines exercise with cognitive stimulation in an engaging and playful manner. The principles can be incorporated into any trainer's programming or taught in a class format. Creator Denise Medved developed 21 exercises performed to music to stimulate what she calls five key functions of the brain: strategic planning, memory and recall, analytical thinking, creativity and imagination, and kinesthetic learning. Here are a few examples of Medved's exercises:

- **Gentle geometry.** Make shapes with different body parts simultaneously. For example, make a circle with your right hand, a vertical line with your left hand and a triangle with your left foot. Make only two shapes simultaneously if that's challenging enough for your clients. Push them to their point of inability, but don't make it so difficult that they'll never succeed.
- **Body math.** Count out loud to 8 while bouncing your right leg and right hand up and down quickly on the count. Switch to the left leg and hand for 8 counts. Alternate back and forth. Mix things up by clapping on 3 or snapping on 7. Count backward on one side and forward on the other. Count backward on both sides. Switch from an 8-count to a 4-count on each side.
- **Front-row orchestra.** Pretend to vigorously play any musical instrument, such as a piano, clarinet, guitar or violin or even castanets, drums or a didgeridoo. It doesn't matter if people have never played the instrument before, since they have likely at least seen it and can imagine what playing it would be like.

Each exercise lasts for the length of a 3- to 4-minute song, but you do them differently every time so participants constantly confront novel movement patterns. These tools stimulate both body and mind and can be used as a complete program or integrated into existing training.

Programming Recommendations

- Ensure that your clients regularly perform aerobic and resistance exercise at moderate to high intensity.
- Integrate tai chi movements and principles into your programming, or teach tai chi classes.
- Teach specific classes, such as Ageless Grace, that focus on combining physical and cognitive elements.
- Incorporate novel movement patterns into all of your training sessions through agility drills, task sequences, obstacle courses, complex movement patterns, or new (or old) dance steps.
- Encourage clients to learn a new sport or encourage them to get back into a sport they gave up because of age or a busy schedule.

Nutritional Strategies

Proper nutrition also keeps an aging brain healthy. The Mediterranean and DASH (Dietary Approaches to Stop Hypertension) diets are both well-known for their cardiovascular health benefits. Recently,

researchers combined elements of these two diets while emphasizing foods purported to have the greatest impact on brain health. The result was the Mediterranean-DASH Diet for Neurodegenerative Delay (MIND).

Two studies (Morris et al. 2015a; Morris et al. 2015b) involving a group of more than 900 older adults in Chicago found that adherence to the MIND diet slowed cognitive decline and lowered the risk of Alzheimer's by as much as 53%. While strict adherence to the diet's principles achieved the best results, even moderate adherence showed evidence of a potential dose-response relationship. The results were so compelling that the National Institute on Aging awarded the researchers \$14.5 million to conduct a randomized, 5-year clinical trial with 600 older adults.

The MIND diet emphasizes 10 brain-healthy food groups: green leafy vegetables, all other vegetables, nuts, berries, beans, whole grains, fish, poultry, olive oil and wine. It avoids foods from five unhealthy groups: red meats, butter and stick margarine, cheeses, pastries and sweets, and fried or fast food. Several books and cookbooks now help people follow the MIND diet guidelines.

Exercises to Stimulate Cognition

Here are three of my favorite exercises for stimulating body and mind:

What time is it? Have your clients stand in an open area and imagine they are in the middle of a clock face with 12:00 directly in front of them, 3:00 to the right, 6:00 behind, 9:00 to the left, and all of the other numbers in their positions. Instruct the clients to step (or lunge) to the number you call out and then return to their starting position as quickly as possible. If, for example, you say 3:00, they will perform a side step (or lunge) to their right and immediately return to their initial standing position. To increase the cognitive challenge of this activity, keeping them guessing:

- Vary the pace and rhythm when calling out numbers.
- Have clients step only with their right or left foot (so they must cross over).
- Have them take a step only when you call an even (or odd) number.
- Ask them to step with the right foot when you call an even number and the left foot when you call an odd number.
- Have them rotate the clock 90 degrees so that 3:00 (or 9:00) is now directly in front of them.
- Place colored agility dots on the ground around them and call out colors instead of times (you can also indicate which foot to step with, like "right red").

Agility ladders. This exercise challenges coordination and cognition. The key here is to use a lot of stepping patterns from session to session so that you are continually challenging clients. Don't let them get comfortable with any single stepping pattern. The key is constant variability.

Complex movement sequences. In line with the concepts of dance and Ageless Grace exercises, teach your clients any sort of movement pattern that is sequenced and complex and (preferably) follows a specific rhythm. Use traditional or popular dance steps (like the macarena, chicken dance or electric slide), or make up your own. The point is to have clients remember and perform individual movements in the proper sequence and with the proper rhythm and timing.

On the Road to Active Brain Improvements

While any exercise is good for the brain, combining aerobic and resistance training is better. Adding cognitive challenges in a physically demanding context like tai chi, dance or sport is likely the “sweet spot” with optimal impact on cognition. Other factors—such as environmental and social stimuli, as well as diet—can potentially magnify the benefit.

With the explosion of the 65-plus population worldwide and growing concerns about the prevalence of dementia, it is more important than ever to train older clients in a manner that stimulates their brains as well as their bodies.

Editor’s note: For suggestions on designing a chair exercise class for adults with dementia, see this issue’s [Inner IDEA](#) column.

3 CRUCIAL POINTS ON PRESERVING COGNITIVE FUNCTION

Research points to three critical observations about cognitive abilities in the elderly:

1. Following a basic healthy lifestyle is an important first step toward maintaining cognitive function with age.
2. Brain-training games may be fun, but research suggests they do little to reduce dementia risk or optimize brain function. Game challenges can improve specific cognitive functions, but they do little good for unchallenged functions.
3. Aerobic and resistance exercise have a significant impact on cognition as we age. Incorporating cognitively demanding tasks in a rich sensorimotor environment is likely to have an even greater impact.

DO BRAIN GAMES IMPROVE COGNITIVE FUNCTION?

Brain-training programs and games have blossomed into a competitive industry with direct consumer spending on digital brain-health software products expected to reach \$1.52 billion by 2020 (Simons et al. 2016). Companies such as Lumosity, Posit Science, Cogmed and CogniFit advertise the brain-boosting benefits of their software platforms.

But do these products really work? The scientific evidence is somewhat scattered, but several recent reports (Simons et al. 2016) conclude that brain-training games do not reduce the risk of cognitive decline or dementia. They can significantly improve specific cognitive processes—but not much else.

Limits of Brain Training

The saying that “doing crossword puzzles only makes you better at doing crossword puzzles” is somewhat true. Indeed, the U.S. Federal Trade Commission charged Lumos Labs with “deceptive advertising” because it could not produce sufficient data supporting its claims on the efficacy of its games (Peterson & Fung 2016).

Research on computerized brain training demonstrates that trained processes do improve but untrained cognitive functions remain much the same (Ballesteros et al. 2015). For example, an intervention challenging verbal working memory improves that skill. However, closely related (near-transfer) skills,

such as spatial working memory, will likely be unaffected, while more distant (far-transfer) skills will be completely unaffected. While the evidence of near-transfer effects is somewhat mixed and ultimately weak, there is almost no evidence of far-transfer effects (Ballesteros et al. 2015).

Evidence Favoring Cognitive Training

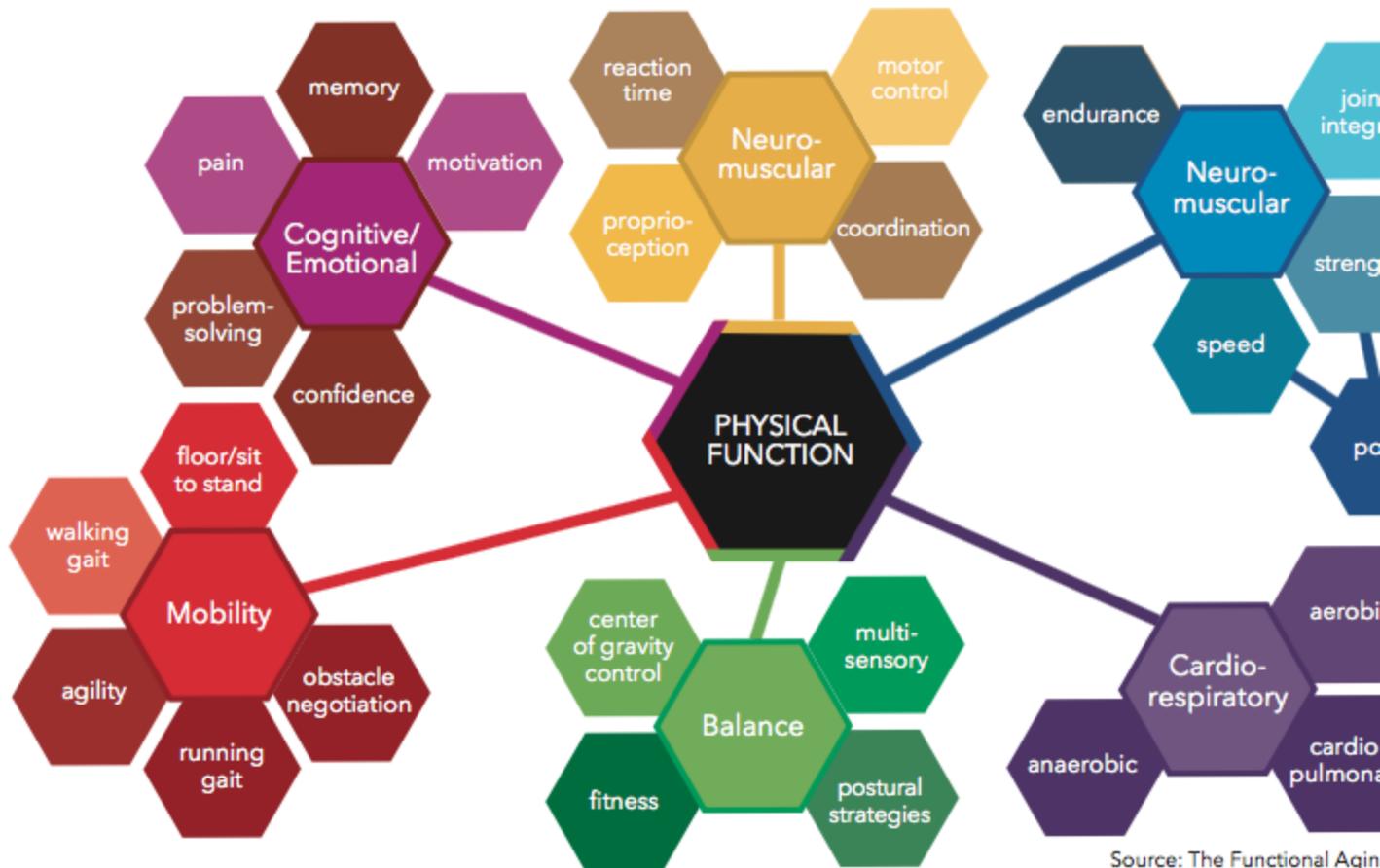
Probably the strongest evidence of cognitive training's effectiveness emerged from the ACTIVE study (Ball et al. 2002), which is the most rigorous, comprehensive trial to date. Over 2,800 older subjects were randomly assigned to one of three cognitive interventions (memory, speed of processing and reasoning) or a no-contact control group. Participants completed 10 sessions over a period of 5–6 weeks, with some receiving four booster training sessions a year later.

The study showed that the trained skills improved, but it found no transfer to other skills. Improvements lasted up to 2 years after training. A 10-year follow-up of the ACTIVE data (Rebok et al. 2014) suggested that the three treatments led to less decline in self-reported instrumental activities of daily living, but results were inconsistent across treatment groups.

FIGURE 1: FUNCTIONAL AGING TRAINING MODEL

FIGURE 1: Functional Aging Training Model

A solid strategy for training elderly clients combines elements of balance, mobility, cognitive and emotional health, as well as neuromuscular, musculoskeletal and cardiorespiratory functions.



Source: The Functional Aging

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[IDEA Fitness Journal, Volume 14, Issue 11](#)