



MyBrain

Chapter 5: Neurocognitive Therapy

The Benefits of Neurostimulation

Research has shown that the brain can fundamentally reorganize itself when confronted with new mental or physical challenges, and that this can occur regardless of age. This ability is known as neuroplasticity.

Neurogenesis

Engaging in persistently challenging and stimulating activities is associated with the release of neurotrophins or proteins that nurture the growth of brain cells. The development of these new neural pathways and connections in the brain is referred to as neurogenesis. The hippocampus and amygdala, areas of the brain critical for learning and memory, appear particularly receptive to the development of new brain cells.

Brain Reserve

Just like depositing money in the bank, a regular brain enrichment program can build a dense network of brain cell connections in a process known as brain reserve.

Cognitive reserve builds a flexible organization of brain networks which can be recruited into service to compensate for cognitive changes associated with normal aging, brain injuries, cancer treatment, life stressors or neurological disease.

Brain Resiliency

The hippocampus and amygdala (the fear center of the brain) appear equally receptive to an enriched environment, as they are vulnerable to stress. When the central nervous system is exposed to stress, adrenal glucocorticoids, a type of steroid hormone, are released into the brain. Stress hormones appear to accelerate neuronal loss in the hippocampus and related cognitive loss with aging.

Brain reserve can not only protect against abnormal brain protein deposits such as beta-amyloid plaques and late onset Alzheimer's disease it can serve to insulate the central nervous system from adrenal glucocorticoids released during periods of prolonged emotional stress.

The Truth about Crossword Puzzles

In order to reap the rewards the cognitive activity must be *persistently* challenging, in other words it has to be new to you. Many people use games like crosswords and Sudoku to sharpen their minds. Chances are if you do The New York Times crossword puzzle in pen then this activity is not sufficiently novel or challenging to stimulate neural growth.

Activities that build brain reserve include travel, learning a new language or musical instrument, picking up a new skill or taking an education class.

The Best Return on Your Investment

Research indicates that if your goal is to engage in activities that are associated with the greatest reduced risk of cognitive decline then cognitive training provides the best return on your investment of time and energy. Results indicated that the gains achieved from training in verbal-based cognitive training, such as strategic problem-solving, compensatory strategies and tools as well as computerized cognitive training is associated with decreased functional loss.

I. Cognitive Training

Training in compensatory strategies and memory tools are examples of declarative learning techniques. Learning is heavily dependent upon conscious effort and active listening skills, such as mental rehearsal and elaboration. Transfer of information occurs through complex neural networks involving the frontal and medial temporal lobe. Think of this type of learning as the Ford approach, with engine in the front.

Is It Really Effective?

The ACTIVE study, a large randomized controlled study performed in 2006, examined the long-term effects of various cognitive interventions on the daily functioning of older adults. Results indicated that the gains achieved from training in verbal-based cognitive training, or declarative learning, such as strategic problem-solving skills were associated with decreased functional loss, which continued up 5 years later (Willis, 2006).

Cognitive Training Beats Physical Exercise, Diet and Social Engagement

A more recently published report in 2010 funded by the National Institutes of Health (NIH) reviewed the extensive literature on cognitive decline and Alzheimer's disease in search of factors that might delay or prevent these age-related conditions. Of all the factors reviewed, including diet and dietary supplements, physical exercise, social engagement, and other leisure activities, only cognitive training was found to have a high level of evidence for being associated with a decreased risk of cognitive decline.

The report was presented at the NIH State-of-the-Science Conference "Preventing Alzheimer's Disease and Cognitive Decline." The conference brought together health experts with specific expertise in aging

and age-related changes in cognition to discuss the current state of knowledge related to treatments for age-related cognitive decline and Alzheimer's disease.

Hundreds of studies were reviewed, and while many studies offered evidence that was suggestive of reducing risks, most were correlational, rather than experimental, in nature. For instance, some studies showed a relationship between eating a "Mediterranean diet" and reduced risk of cognitive decline.

In fact, only cognitive training was found to have a high degree of evidence for reducing the risk of age-related cognitive decline.

Cognitive Training as Part of a Balanced Brain Wellness Plan

By no means is this study meant to underplay the noted benefits of a diet high in vegetables and omega-3 fatty acids, aerobic physical activity, mental restoration and supportive social network with a decreased risk of cognitive decline.

Certainly, research is irrefutable that physical exercise is associated with reduced risk of obesity, a precursor to cascade of life style disease such as hypertension, diabetes and cardiovascular disease. In addition it improves bone density, regulates the mood and reduces anxiety and releases BDNF (brain-derived neurotropic factor), which is like "Miracle-Gro" for the brain.

Rather, the study means to reinforce the message that cognitively stimulating activity is critical for brain health and fitness. The more you exercise your brain now; the better off you'll be later.

The Benefits of Brain Training Hold Up Over Time

John Hopkins researchers in 2014 followed more than 2,800 adults age 65 and older who attended 10 1 hour brain training classes over the course of 6 weeks. Participants solved puzzles, memorized lists and did other mental exercises to sharpen their memory, reasoning and information processing skills. Five to 10 years later, most subjects maintained gains they had made and outperformed untrained control subjects.

II. Computerized Cognitive Training

Just to be clear, computer games is not the same thing as computerized cognitive training. Spending hours on PlayStation or Nintendo may be a great way to wind down, but don't fool yourself that you are going to improve your cognitive functioning. Computerized cognitive training exercises, or brain training, target the critical cognitive brain activities needed to succeed in life.

A computerized cognitive training program should include the five major cognitive brain functions: concentration, working memory, language, visual-spatial motor skills as well as logic and reasoning. Brain training also tunes up active listening, effort, self-control and mental flexibility skills needed to build and maintain self control in a hectic world. Now you can't get all that playing Angry Birds, can you?

How Does It work?

Computerized cognitive training relies on procedural learning, or motor based memory. Success is dependent upon the neural plasticity of cortical and subcortical pathways outside the medial temporal lobe. Think of this type of learning as the Volkswagen approach, with engine in the rear. Procedural learning relies on exposure to multiple practice sessions, with gradually increasing speed and performance.

Practice, Practice, Practice

Both declarative and procedural learning depend on the information or actions being sufficiently repeated or rehearsed, through a process called consolidation, to the point it is reliably stored in long term memory and can be retrieved at a later time.

While declarative learning generally is very robust, with few of us likely to forget the first president of the U.S., procedural recall depends on continued practice. Think of these skills as something you have on loan, not something you own. Just like physical fitness, golfing or musical skills, if you don't use it, you lose it.

Progress is directly proportional to effort. The more time spent in the memory gym, the more improvement you will see.

Is It Really Effective?

Prior research demonstrates that both declarative as well as procedural type training is associated with improved memory functioning. A follow-up to the ACTIVE study was conducted by the National Institutes of Health and Aging (NIH) in 2007. Results showed that adults (65 to 94 years old) derived long lasting benefit from ten 90-minute computerized training sessions on memory, reasoning and speed of processing (Unverzagt, 2007). Even five years later, participants from this study outperformed non-participants on cognitive functioning and everyday living skills, such as handling medication tasks, looking up phone book numbers and making calls, and finding food in their pantries, to name a few.

The gains delayed typical cognitive decline of healthy adults by seven to 14 years. Seventy-year-olds exhibited the mental quickness of 60-year-olds!

What Is The Point?

The objective of computerized cognitive training is to improve the building block skills associated with learning and memory. Good learning begins with forming a strong association with the new information. In order to capture the most information at the time of encoding requires various metacognitive skills, such as attention, processing speed and working memory. These frontal lobe skills are considered the building blocks to new learning.

The Link between Processing Speed, Comprehension and Attention

Problems with attention can often be traced back to delays in mental processing speed. Delays in

central processing speed can be very subtle, like air coming out of a balloon. Life can be like a firehose, delivering an onslaught of information that needs to be filtered and organized before it can be retained. Glitches in processing speed can leave us feeling behind, exhausted and overwhelmed. The inability to keep up the pace can result in poor auditory or visual comprehension skills, poor listening skills and distractibility.

What is frequently referred to as attention deficit, upon careful examination reveal relative delays in auditory or visual central processing speed than can result in attention regulation problems. Difficulty disengaging attention, alternating attention between two tasks or exhibiting inattention under high or low demand conditions are frequently the side effect of attention dysregulation.

Common patterns include drifting off when listening to slower paced or predictable conversations as well as inability to keep up the pace under demanding, noisy, fast paced environmental conditions, especially when tasks may be new or challenging. The result is the same, an increase inattentive error, absent minded mistakes and forgetfulness.

The Link between Working Memory and Conceptual Reasoning

Within the last several years, research has found an association between improvement in various metacognitive skills, such as speed of information processing, attention and working memory with gains in strategic thinking. One metacognitive skill may be more important than others in relation to strategic problem-solving skills. And the winner is.... working memory. Working memory is the ability to simultaneously hold and process information and is the skill used when doing mental computations.

As our working memory becomes faster it frees up our focus to encode more details when learning a task or solving a problem. It only makes sense that those who can hold more information in mind are better equipped to simultaneously consider different angles of a complex problem and make more reasonable decisions.

The Link between Reasoning, Executive Function and Independent Living

Although we may be impressed by factual knowledge or vocabulary skills, fluid reasoning is what counts to live and thrive in life. Fluid reasoning or conceptual thinking is the ability to think logically and problem solve in absence of being taught. Life demands that we remain flexible, able to adapt our thinking to changing demands. There is no rule book in life.

While all neurocognitive functions are important for learning, some skills are more relevant to the ability to succeed in life than others. It should not surprise you that research has found gains in fluid reasoning is linked to strategic thinking or the skills required to live and thrive independently. Strategic thinking or executive function is the ability to formulate goals, carry them out in an timely and efficient manner, change course and improvise in the face of obstacles and to do this successfully in absence of external direction.

Who Can Benefit From It?

Exposure to multiple practice sessions, or procedural-based learning, is a powerful and effective means to establish new behaviors. In addition, it seems to work for everyone, including those with moderate memory loss.

Individuals diagnosed with mild cognitive impairment (MCI) do not readily benefit from declarative learning techniques which rely on verbal-based or mnemonic strategies. Because the neural network involving the medial temporal lobe and association cortex is often compromised, an alternative to memorization and verbal reasoning strategies is required.

That's where multiple practice sessions with computerized cognitive training can be so advantageous. In the same NIH research study described above, results indicated that memory impaired adults can also profit from exposure to multiple practice sessions involving visual attention, speed of information processing and working memory.

Brain Training Software Programs

A. Home Computerized Brain Training Programs

Home based computerized cognitive training programs employ a *procedural learning approach*, to increase fluid intelligence by challenging cognitive faculties using novel and challenging exercises in which the difficulty level constantly adapts to each person's individual development. When practiced routinely, these exercises can produce significant and long-lasting results.

Qualifications of A Good Brain Training Software Program

There are numerous computerized cognitive enhancement games and brain teasers. However, research indicates in order to achieve gains in functional daily living skills, one must choose a home program that targets the "big three" cognitive skills. These include speed of information processing, working memory and fluid problem solving.

A Good Program Should Offer These Basics:

- Customized Training: Individual assessment to determine training needs
- Core Cognitive Functions: Information processing Speed, Working Memory, Fluid Reasoning
- Adaptive Learning: Programs automatically adapt to your level of performance
- Tracking your Progress: Graphs to track development over practice sessions

One needs to make a commitment of approximately 35 to 40 hours. In a home setting that may look like 30"/day, 7 days/week, for 3 months or so. Home programs allow you to sign up online, for a monthly fee, usually with a free trial period to determine if the program is a good match for you.

Lumosity

Lumosity was designed by a team of neuroscientists from Stanford University, UCSF, McGill, Boston University and other top research institutions. Lumosity targets key cognitive functions including

attention, processing speed, memory, mental flexibility and problem solving. Lumosity designs personalized training programs tailored to each person's goals, whether those be improving your memory, reaching peak performance, or fighting cognitive decline. Subscribers have access to over 35+ brain games and exercises.

You can track your development over time across five main areas according to your personalized Brain Performance Index, or BPI, a chart that calculates progress based on practice sessions.

<http://www.lumosity.com>

B. Professional Computerized Cognitive Training

Professional computerized cognitive training programs integrate skill building as well as strategic problem solving instruction into each session to bring the *why and how* of learning together.

Strategic Problem Solving Training

While the “Just Do It” approach has much to recommend it when starting a new habit or exercise program, it should not be your “go to” strategy for everything in life. Just pushing the mouse because you feel the need to something, does not mean you are doing the right thing. RMMC will teach you the “Errorless Learning” approach to problem solving and benefits of developing a game plan before you spring into action.

Begin by asking yourself, “What is the question?” Before you know where to begin, you have to make sure you know what is being asked of you. Next, “What is the point?” Make sure you know the objective or purpose of the activity. Consider all your options and then narrow down the choices to increase your odds of getting the right answer. Where you wrong? No big deal. Take a time out and figure out the cause. Practice brainstorming alternative strategies. Stay optimistic, recheck your assumptions and make sure you are framing the problem correctly.

The Gold Standard

At RMMC we offer Constant Therapy © computerized cognitive training system

<https://thelearningcorp.com>. The Learning Corp. is a trusted name in cognitive rehabilitation therapy for patients with a range of neurological conditions, including stroke, brain injuries, Multiple Sclerosis, Parkinson’s disease, Alzheimer’s disease and other dementias. Exercises are specifically designed to help people regain various cognitive functions such auditory comprehension, auditory attention, word retrieval, auditory and visual memory, visuospatial processing, analytical reasoning, visuospatial processing, executive function and functional problem solving as well as speech and language skills.

Consistently Challenging Exercise to Build Neurogenesis

Constant Therapy © offers over a 130 different game- like exercises and trains 14 different neurocognitive areas. The training protocol is based on a hierarchy of skill sets and automatically calibrates your training program based on what has been learned from the prior session. Each cognitive domain has increasing levels of complexity which automatically adapts to you. Exercises get harder or easier based on your progress, keeping you challenged and your rehab on track. In addition, your therapist can refine your therapy program according to your needs during each session.

The Future of Brain Rehabilitation Is On-Demand, Data-Driven and Personalized

Constant Therapy © runs on a mobile app so you can access your training program and exercises anytime and anywhere. It can be run on your phone or a tablet, although we recommend use of a tablet for ease of handling. You can do the exercises as much as you like, with 24/7 access.

The use of artificial intelligence (AI) and data driven technology constantly analyzes and monitors user performance and progress to fine tune the sequence of generated exercises to deliver a personalized exercise program. You may want to listen to recent TED talk on use of Constant Therapy as a brain rehabilitation tool.

<https://thelearningcorp.com/brainwire/tedx-talk-the-future-of-brain-rehabilitation-by-dr-swathi-kiran>

Emphasis on Real Life Working Memory

Because working memory is so vital to executive function, Constant Therapy © trains both auditory working memory and visual working memory. In many cases exercises train a number of critical cognitive functions in one task, such as attention, visuospatial processing and executive function. A home run!

Individualized Training Program and Real Time Feedback

An individualized training protocol will be developed to target key areas of weakness as well as areas known to be associated with living and thriving on an independent basis. The program tracks your progress to help you clearly see where you are improving or where you might need extra effort.

Customized Homework Sessions

An individualized set of homework exercises will be available for you to do for home. You can do the exercises as much as you like outside the therapy session. Your therapist can access your progress during home sessions to capture your progress both in the session and at home.

We strongly recommend engaging in 20 minutes of daily cognitive exercise to build brain reserve. One needs to make a commitment of approximately 35 to 40 hours. In a clinic setting, it would realistic to spend two 20" sessions for approximately 40 sessions. Home training sessions would need to make up the additional training time.