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# Brain Health: Mending the Mind after Age 50

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# age in action

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## Case Study

### Brain Health: Mending the Mind after Age 50

by Susan Hardwicke, Ph.D.

#### Educational Objectives

1. Increase understanding of brain function and its potential to improve with age.
2. Describe an application of neuroscience, cognitive training, and nutrition for solving a problem associated with aging.
3. Evaluate neural plasticity with aging.

#### Background

Until the 1990s, neuroscientists believed that the capability of the brain (the biological organ), and therefore the mind (mental skills and consciousness), peaked in early adulthood and declined at an increasing rate until the end of life. In the early 1990s, longitudinal studies provided evidence of a “use it or lose it” principle: a brain that engages in stimulating activity

will decrease in performance more slowly than a less active brain. The brains of millions of inactive TV-viewers seemed doomed.

Then good news arrived when cutting-edge researchers started a revolution in neuroscience with the concept of neural plasticity, the ability of the brain to adapt past its supposed ability peak, offering hope that the effects of inactivity can be reversed by generating new brain cells and new connections among cells in the brain. Laboratory research (Gage, 2003 and Holloway, 2003) strongly suggests that the adult brain can build new structure and capability:

1. Stem cells (the non-embryonic kind) are generated by activity such as exercise.
2. Since the brain is adaptive, repeated external stimulation to the brain increases the likelihood that the stem cells will evolve into neurons or the supporting glial cells.

3. Synapses (the spaces between neurons through which electrical waves and chemicals flow) change so that both new and old cells will be used in new connections to in the brain.

The brain adapts from biological necessity: repeated demands on it will elicit attempts to meet those demands regularly and with greater efficiency. Thus, memory, processing or thinking speed, and other forms of brain ability stand to improve throughout life. However, this “rising to the occasion” may be inhibited or potentially prevented when the receptors on brain cells are blocked or a problem exists with the chemicals needed for the brain cells to communicate. Both cells and brain chemicals, called neurotransmitters, play important roles in developing and revitalizing the mind.

The “use it or lose it” principle and the neural plasticity concept have altered the consciousness of older adults: sales of brain-

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boosting puzzle books are booming, and an adult brain-building Nintendo game was an instant hit (Associated Press, 2006). But public acceptance of an idea does not make it valid, and evidence supporting a newer model of brain functioning does not necessarily provide insight as to its limitations. The newer model raises many questions:

- Can the brain restore previous capability past a particular age?
- What specific techniques and exercises improve the brain?
- How long does it take to measurably improve capability of an adult brain?
- Should an “average person” attempt to improve his/her brain?

The possibilities presented by this newer model of brain functioning compelled me to create a center that offers cognitive enhancement services for persons of all ages. While approximately 90 percent of our clients achieve significant, measurable improvement, the overwhelming majority are younger than 20. Earlier this year, a new client afforded an opportunity to apply the principle of neural plasticity for an older adult. The following case study provides initial support that the same methods used to increase cognitive performance in the young can be applied to restore and improve cognitive performance in older adult brains.

## Case Study

Bob, aged 59, thought he was losing his mind, or at least a good part of it. A feature story writer and novelist for many years, he had been unable to generate ideas, let alone works, for at least two years. He reported troubling symptoms which created problems in his relationships and work, and for which he had sought medical help. A physician diagnosed Adult ADD (attention deficit disorder) and prescribed stimulant medications. A compounding pharmacist recommended several herbal, chemical, and food-based supplements. These protocols did little to help his condition.

At the kSero (“I know” in Greek) Center for the Mind, staff followed a five-step process, presented below, that resulted in a customized plan for Bob’s improvement. The plan was based on our proprietary model: customized diet modifications, supplementation, exercise, and cognitive training.

**Application of the Five-Step Process.** With this process, goals for improvement are established only after assessment and analysis.

### **1) Understand the client’s**

**mind.** Staff obtained the following information:

- o Symptoms and complaints: inability to perform his work,

high distractibility, difficulty sustaining concentration and attention, mental and physical fatigue, daily outbursts of anger, poor skin tone, “lifeless” quality in eyes.

- o Medical history: no health problems or prescription medications until age 57; moderate to vigorous physical activity through his mid-forties, after which his physical exercise gradually declined.

- o Medications and supplements: Adderall and amphetamines for Adult ADD, valerian and passionflower for sleep, DHEA for improved hormone function, omega-3 fatty acids for improved neurological performance, multi-vitamin.

- o Lifestyle information: two to four hours of television daily, difficulty sleeping, vigorous physical activity less than once a week, low protein intake and few raw vegetables, low to moderate alcohol consumption, poor sleep quality, interests and hobbies centered on work and friends.

- o Cognitive performance: obtained cognitive skill and processing speed data from the Center’s Cognitive Portfolio and BrainTrain®’s Captain’s Log program, obtained basic electroencephalograph information during the BrainTrain® exercises.

### **2) Analyze symptoms and available data.** Staff found the following:

- o Cognitive skill problems:

long-term memory, short-term memory, executive (self-regulation) function, and processing speed problems. We concluded that his cognitive problems were caused, at least in part, by insufficient energy.

- o Diet and lifestyle were causal factors: low protein, enzymes, and choline intake resulted in inadequate amounts of key neurotransmitters related to memory and speed; inadequate physical activity was lessening the probability that he was generating new neurons; energy was being drained by excessive television, and was not replenished by adequate sleep or diet.

- o Inappropriate supplementation: valerian and other herbs for sleep likely contributed to slow processing speed; supplement regimen over-emphasized omega-3 fish oils and did not supply adequate choline, a component of the memory-related neurotransmitter acetylcholine.

- o Side effects of amphetamines: could cause or aggravate Bob's distractibility and outbursts of anger.

**3) Design plan.** The Center designed a program for Bob that addressed goals of increased processing speed, concentration, and memory, and decreased distractibility. Additional goals included improved sleep and sense of well-being. Bob needed to make the following changes:

- o Diet and nutrition: increased protein; lecithin as

source for choline; ribonucleic acid supplement; daily raw, green, leafy vegetables; changes to supplements recommended by the compounding pharmacy; recommendation that he discuss amphetamines with his doctor.

- o Lifestyle: rebounding on trampoline (for stimulating cells throughout the body); daily activity such as brisk walking or tennis; reduced television exposure.

- o Cognitive training: meditation, customized BrainTrain® at least four hours per week.

**4) Implement plan.** Bob began cognitive training, started supplementation, stopped taking amphetamines, and made dietary changes. He continued on Adderall until late in the data collection period. He began the BrainTrain® training program. His adherence to the plan, except for diet and supplementation, was uneven. During some weeks, Bob trained for six to nine hours; then he was absent for a week or two. Overall, diet improved by adding more protein, raw green leafy vegetables, and suggested supplements. Bob generally complied with the revised television schedule.

**5) Monitor and adjust.** Bob quickly made progress in some skill areas and very little on others. Therefore, staff modified individual sessions so that he would obtain concentrated training on a single skill group for an hour or more, until he had

made progress in mastering it. Supplementation was also modified to include more lecithin, which had a positive effect, as reflected in the improvements in memory (see Table 1).

**Results.** The Center collected copious qualitative and quantitative data. Within three and a half months, Bob performed more than 100 hours of cognitive training on the BrainTrain® system, and staff collected and stored detailed information for each training session.

*Quantitative information.* The BrainTrain® cognitive training system has three tracks, corresponding to age groups, that present 35 different exercises in an average of 15 different levels of difficulty for each track. The Diamond track (shown as D Table 1) is the target track for adults aged 16 and higher. Bob's BrainTrain® program was customized for his needs, and subsequently modified according to his changing needs over time. Clients typically train on seven to 15 exercises at a time, in order to maximize repetition.

At baseline, Bob was performing below the criterion level appropriate for his education and occupation, with his highest scores obtained for skills related to excessive television-watching (visual tracking, for example). At the end of the reporting period for this publication, Bob

had consistently improved in the majority of skill areas, despite inconsistent attendance. Since Bob's training program changed over time, data comparing baseline and three months after intervention were available for a limited number of the exercises. Table 1 presents a subset of available data from the BrainTrain® system. Of note, Bob stopped taking Adderall just before the end of data collection for this study. Additional information was retrieved from the BrainTrain® user data (See Table 2).

The data obtained on memory show that the speed of retrieval, as well as level of ability, improved substantially in the three-month period. These data provide the most clear-cut support for changes in the brain, since memory involves the hippocampus, a site in the brain

that produces new neurons. The interpretation of changes in categorization, attention, and decision-making are more problematic since speed decreased while skill level increased. For example, practice in the categorization exercise could have helped Bob make the appropriate trade-off between speed and accuracy without a change occurring in his actual skill. On the other hand, the slight (10%) decrease in decision speed seems more than offset by Bob's large increase in the skill level (5 levels or 30% of the track). A similar conclusion can be drawn concerning attention, because Bob advanced 11 of the entire 15 levels in three months of inconsistent attendance. Improved attention is equivalent to decreased distractibility. Bob's average speed increased substantially, as did the average difficulty level.

*Qualitative information and observations.* Bob's skin tone and general appearance improved remarkably within about three weeks. His sallow and somewhat lifeless coloring became ruddier, apparently from increased circulation. His eyes began to have a brighter appearance. He appeared to have, and reported having, a more positive mood. He walked with more energy while in the Center, and appeared engaged in the process of improving his mind. He began a creative project and reported that he had episodes of inspiration.

Bob's improved symptoms correspond to the results expected from implementing the diet, supplementation, and lifestyle protocols. The reduction in television-watching combined with increased raw food and nucleic acids and increased exercise should have increased physical energy needed for improved neuronal connectivity and enhanced attention and speed. Increased protein intake can also increase energy, as it supplies the needed components of the key neurotransmitters involved in focused attention. Improved mood would also have been expected from an improved neuro-transmitter profile. Improved memory was predicted from both neurogenesis (the body's generation of new

**Table 1. Processing Speed and Difficulty Levels Before Implementing Changes and After at Least Three Months of the Cognitive Improvement Program**

| Skill           | Baseline Processing Speed (seconds) | Baseline Level | After 3 mo. Processing Speed (seconds) | After 3 mo. Level | Change           |
|-----------------|-------------------------------------|----------------|--|-------------------|------------------|
| Memory          | 29.27                               | D1             | 12.65                                  | D4                | +57%, +3 levels  |
| Categorization  | 1.98                                | D2             | 2.83                                   | D7                | -43%, +5 levels  |
| Attention       | .38                                 | D3             | .56                                    | D14               | -47%, +11 levels |
| Decision-making | 1.1                                 | D2             | 1.22                                   | D7                | -10%, +5 levels  |

**Table 2.**

| Skill            | Baseline Processing Speed (seconds) | Baseline Level | After 3 mo. Processing Speed (seconds) | After 3 mo. Level | Change          |
|------------------|-------------------------------------|----------------|--|-------------------|-----------------|
| Exercise average | 7.8                                 | D1             | 4.03                                   | D6                | +48%, +5 levels |

*-Continued on page 12*

## Case Study, continued from page 4

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neurons) as well as the lecithin supplementation: lecithin supplies choline, which the body uses to make acetylcholine, a neurotransmitter involved in memory.

Bob reported highly positive results from the program. Currently, he has at least one project underway. He reported higher energy and greater interest in living, greatly improved mood, ability to focus, resistance to distractions, and sleep. It is clear to Center staff that Bob enjoys life, and has a higher quality of life than before starting the program.

### Conclusions

This case study supports the Center's model for improvement and provides at least limited evidence for neural plasticity in later life. Bob had previously higher skill levels, which decreased over a period of years, and then increased in a period of months during the study. Because the measures of Bob's performance were obtained on an objective system, performance improvements were most likely due to the Center's protocols and not to placebo or experimenter expectations.

Considering that Bob had cognitive skill deficits and a diagnosis of Adult ADD, the

achievement of substantially higher levels of performance in approximately four months is remarkable. Data showed that a combination of diet modifications, supplementation, cognitive training, and lifestyle changes can improve speed and capability, and, further, that these can improve the quality of life. Comparisons of subjects of different ages and with different symptoms would provide valuable insight into the factors that contribute and hinder cognitive skill improvements.

### Study Questions

1. What is the diet-neurotransmitter-brain function relationship?
2. Why is a multi-dimensional approach needed for cognitive improvement?
3. Which evidence best supports the concept of neural plasticity?

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### About the Author



Susan Hardwicke, Ph.D., earned her doctorate in psychology at George Washington University. A cognitive psychologist, she has been the Founder and CEO of Edutest, Inc., the first online educational testing company; kSero Corporation Inc., and kSero Centers for the Mind, which developed an after-school program that builds foundational cognitive skills; and Virginia Bionutrients LLC, a nutraceutical company that develops products designed to improve cognitive functioning.