



# 11 SHARP BRAINS DEBUNK 10 MYTHS ON THE SCIENCE BEHIND THE NASCENT BRAIN FITNESS INDUSTRY

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# TABLE OF CONTENTS

## I. Introduction

## II. 10 Myths Debunked

## III. 11 In-Depth Interviews

- a. Build Your Cognitive Reserve-Dr. Yaakov Stern.....4
- b. Exercise Your Brain with-Dr. Elkhonon Goldberg.....8
- c. Cognitive Training for ADD/ADHD-Prof. David Rabiner.....12
- d. Train Your Brain to Think Like a Thin Person - Judith Beck .....15
- e. Learning, Teaching and Changing Brains-Dr. James Zull.....19
- f. Working Memory Training and Schools of the Future- Dr. Arthur Lavin.....22
- g. Cognitive Simulations to Develop Mental Muscles- Prof. Daniel Gopher.....26
- h. Enhancing Performance of Traders -Prof. Brett N. Steenbarger.....32
- i. Training Attentional Control, and Development Trajectories-Dr. Bradley Gibson.....36
- j. Cogmed video game for Working Memory Training-Dr. Torkel Klingberg.....39
- k. “Brain Training and “Brain-ism” in Japan”-Go Hirano.....41

## IV. Glossary

# I. INTRODUCTION

Given the growing attention paid by the public, policy-makers and media publications to the role of “brain exercise” as one of the main pillars of Brain Fitness, we are pleased to announce the SharpBrains series of in-depth interviews with 11 (and counting) leading neuroscientists and practitioners worldwide.

So far, we have only scratched the surface of what science-based structured mental exercise can do for brain health and productivity. We are now witnessing the birth of a new industry that crosses traditional sector boundaries and that may help millions of people of all ages understand, assess and train their brains, harnessing the growing research about neurogenesis (the creation of new neurons), neuroplasticity (the ability of the brain to rewire itself through experience), cognitive training and emotional regulation.

Please reflect on the implications for the fields of Health, Education, Corporate Training and Gaming that result from the debunking of the following 10 Brain Fitness Myths. I encourage reading the full interviews that follow: they guarantee a supply of good mental stimulation, at the very least.

Please feel free to contact us with any suggestions. We want to hear from you.

Best regards,

**Alvaro Fernandez**

*CEO & Co-Founder, SharpBrains*

SharpBrains is the leading science-based information portal, market research and consulting firm that helps individuals, companies and institutions navigate brain health and exercise information, products and services.

## II. 10 DEBUNKED BRAIN FITNESS MYTHS

### HEALTH AND MEDICINE-RELATED MYTHS

#### **MYTH 1: It's all in our genes**

Reality: A big component of our lifelong brain health and development depends on what we do with our brains. Our own actions, not only our genes, influence our lives to a large extent.

*“Individuals who lead mentally stimulating lives, through education, occupation and leisure activities, have reduced risk of developing Alzheimer’s. Studies suggest that they have 35-40% less risk of manifesting the disease”* - Dr. Yaakov Stern, Division Leader of the Cognitive Neuroscience Division of the

Sergievsky Center at Columbia University

#### **MYTH 2: The field of Brain Fitness is too new to be credible.**

Reality: The field rests on solid foundations dating back more than a decade -- what is new is the number and range of tools that are now starting to be available for healthy individuals.

*“Rigorous and targeted cognitive training has been used in clinical practice for many years.*

*Exercising our brains systematically is as important as exercising our bodies.”*

- Dr. Elkhonon Goldberg, neuropsychologist, clinical professor of neurology at New York University School of Medicine, and disciple of Alexander Luria.

#### **MYTH 3: Medication is and will remain the only evidence-based intervention for problems such as ADD/ ADHD for many years to come.**

Reality: Cognitive training programs are starting to show value as complements to drug-based interventions.

*“Cognitive training rests on solid premises, and some programs already have very promising research results. Some of the most promising areas are: neurofeedback, which as a whole is starting to present good research results, and working memory training.”*

- Professor David Rabiner, Senior Research Scientist and Director of Psychology and Neuroscience Undergraduate Studies at Duke University.

## EDUCATION-RELATED MYTHS

### **MYTH 4: We need to buy expensive computer-based programs to improve our brains.**

Reality: Every time we learn a new skill, concept or fact, we change the physical composition of our brains. Lifelong learning means lifelong neuroplasticity.

*“Today, thanks to fMRI and other neuroimaging techniques, we are starting to understand the impact our actions can have on specific parts of the brain.”*

- Dr. Judith Beck, Director of the Beck Institute for Cognitive Therapy and Research,  
Clinical Associate Professor of Psychology in Psychiatry at the University of Pennsylvania,

*“Learning is physical. Learning means the modification, growth, and pruning of our neurons, connections—called synapses— and neuronal networks, through experience... we are cultivating our own neuronal networks.”*

- Dr. James Zull, Professor of Biology and Biochemistry at Case Western University

### **MYTH 5: Schools should just focus on basic skills like Reading and Math.**

Reality: “Mental muscles,” such as working memory, are fundamental to academic performance and are currently overlooked by the school system.

*“I don’t see that schools are applying the best knowledge of how minds work. Schools should be the best place for applied neuroscience, taking the latest advances in cognitive research and applying it to the job of educating minds.”*

- Dr. Arthur Lavin, Associate Clinical Professor of Pediatrics at Case Western School of Medicine.

## CORPORATE TRAINING MYTHS

### **MYTH 6: On-the-job training is the only way to train one’s mind.**

Reality: Computer-based programs can be more effective at developing specific “mental muscles”.

*“What research has shown is that cognition, or what we call thinking and performance, is really a set of skills that we can train systematically. And that computer-based cognitive trainers or “cognitive simulations” are the most effective and efficient way to do so.”*

- Dr. Daniel Gopher, Professor of Human Factors Engineering at Technion Institute of Science

**MYTH 7: Brain exercise is only for seniors. And, only about memory.**

Reality: People of all ages can benefit from a variety of regular brain exercises. For active professionals, managing stress and emotions is often a good first step.

*“The elite performers are distinguished by the structuring of their learning process. It is important to understand the role of emotions: they are not “bad”. They are very useful signals. It is important to become aware of them to avoid being engulfed by them, and learn how to manage them.”*

- Dr. Steenbarger, Associate Professor of Behavioral Sciences at SUNY Upstate Medical University, and author of the book Enhancing Trader Performance.

**MYTH 8: This all sounds too soft to be of real value to business people.**

Reality: There is nothing soft about the hard science-based training of specific cognitive and emotional skills.

*“I can easily see the relevance in highly competitive fields, such as professional sports and military training.”*

- Professor Bradley Gibson is an Associate Professor in the Department of Psychology and Director of the Perception and Attention Lab at University of Notre Dame.

**GAMING-RELATED MYTHS**

**MYTH 9: Videogames are always a waste of time.**

Reality: Scientifically-designed, computer-based programs can be a good vehicle for training specific skills. For example, it has been shown that short term memory can be expanded by such programs.

*“We have shown that working memory can be improved by training.”*

- Dr. Torkel Klingberg, Director of the Developmental Cognitive Neuroscience Lab at Karolinska Institute.

**MYTH 10: : This means kids will spend more time playing videogames.**

Reality: In Japan – the world’s earliest adopter of brain-related videogames- overall home video-game sales have declined, with children playing less over time. Interestingly, adults in Japan have started to play brain-related video games more.

*“The sales of software on home game machines have declined (in Japan) from its*

# 1. BUILD YOUR COGNITIVE RESERVE-YAAKOV STERN



Dr. Yaakov Stern is the Division Leader of the Cognitive Neuroscience Division of the Sergievsky Center, and Professor of Clinical Neuropsychology, at the College of Physicians and Surgeons of Columbia University, New York.

He is one of the leading proponents of the Cognitive reserve theory, which aims to explain why some individuals with full Alzheimer's pathology (accumulation of plaques and tangles in their brains) can keep normal lives until they die, while others -with the same amount of plaques and tangles- display the severe symptoms we associate with Alzheimer's Disease. He has published dozens of peer-reviewed scientific papers on the subject.

The concept of a Cognitive Reserve has been around since 1989, when a post mortem analysis of 137 people with Alzheimer's Disease showed that some patients exhibited fewer clinical symptoms than their actual pathology suggested. These patients also showed higher brain weights and greater number of neurons when compared to age-matched controls. The investigators hypothesized that the patients had a larger "reserve" of neurons and abilities that enable them to offset the losses caused by Alzheimer's. Since then, the concept of Cognitive Reserve has been defined as the ability of an individual to tolerate progressive brain pathology without demonstrating clinical cognitive symptoms. (You can check at the end of this interview a great clip on this).

## >> KEY TAKE-AWAYS:

- Lifetime experiences, like education, engaging occupation, and leisure activities, have been shown to have a major influence on how we age, specifically on whether we will develop Alzheimer's symptoms or not.
- This is so because stimulating activities, ideally combining physical exercise, learning and social interaction, help us build a Cognitive Reserve to protect us.
- The earlier we start building our Reserve, the better; but it is never too late to start. And, the more activities, the better: the effect is cumulative.

# **The Cognitive Reserve**

**Alvaro Fernandez (AF):** Dear Dr. Stern, it is a pleasure to have you here. Let me first ask you this: the implications of your research are pretty astounding, presenting major implications across sectors and age groups. What has been the most unexpected reaction so far?

**YS:** Well...I was pretty surprised when, years ago, a reporter from Seventeen magazine requested an interview. I was really curious to learn why she felt that her readers would be interested in studies about dementia. What she told me showed a deep understanding and insight: she wanted to motivate children to stay in school. She understood that early social interventions could be very powerful for building reserve and preventing dementia.

**AF:** That's great...so let's now fast forward, say, 60 years from our high-school years, and suppose that persons A and B both technically have Alzheimer's (plaques and tangles appear in the brain), but only A is showing the disease symptoms. What may explain this discrepancy?

**YS:** Individuals who lead mentally stimulating lives, through education, occupation and leisure activities, have reduced risk of developing Alzheimer's. Studies suggest that they have 35-40% less risk of manifesting the disease. The pathology will still occur, but they are able to cope with it better. Some won't ever be diagnosed with Alzheimer's because they don't present any symptoms. In studies that follow healthy elders over time and then get autopsies, up to 20% of people who did not present any significant problem in the daily lives have full blown Alzheimer's pathology in their brains.

**AF:** What exactly may be going on in the brain that provides that level of protection?

**YS:** There are two ideas that are complementary. One idea (called Brain Reserve by researchers) postulates that some individuals have a greater number of neurons and synapses, and that somehow those extra structures provide a level of protection. In a sense, we have more "hardware", providing a passive protection against the attacks of Alzheimer's. The other theory (called Cognitive Reserve) emphasizes the building of new capabilities, how people can perform tasks better through practice, and how these skills become so well learned that they are not too easy to unlearn. Like developing new and refined "software".

**AF:** But, both seem to go hand in hand, correct? Neuroplasticity means that what you call "hardware" and "software" are two sides of the same coin and they influence each other, right?

**YS:** Correct. So these days we don't make a sharp distinction, and are conducting more neuroimaging studies to better understand the relationship between both.

## **Building Your Cognitive Reserve**

**AF:** OK, so our goal is to build that Reserve of neurons, synapses, and skills. How can we do that? What defines “mentally stimulating activities” or good “brain exercise”?

**YS:** In summary, we could say that “stimulation” consists of engaging in activities. In our research almost all activities are seen to contribute to reserve. Some have challenging levels of cognitive complexity, and some have interpersonal or physical demands. In animal studies, exposure to an enriched environment or increased physical activity result in increased neurogenesis (the creation of new neurons). You can get that stimulation through education and/ or your occupation. There is clear research showing how those two elements reduce the risk. Now, what is very exciting is that, no matter one’s age, education and occupation, our level of participation in leisure activities has a significant and cumulative effect. A key message here is that different activities have independent, synergistic, contributions, which means the more things you do and the earlier you start, the better. But you are never stuck: better late than never.

**AF:** Can you give us some examples of those leisure activities that seem to have the most positive effects?

**YS:** For our 2001 study we evaluated the effect of 13 activities, combining intellectual, physical, and social elements. Some of the activities with the most effect were reading, visiting friends or relatives, going to movies or restaurants, and walking for pleasure or going on an excursion. As you can see, a variety. We saw that the group with high level of leisure activities presented 38% less risk (controlling for other factors) of developing Alzheimer’s symptoms. And that, for each additional type of activity, the risk got reduced by 8%. There is an additional element that we are starting to see more clearly. Physical exercise, by itself, also has a very beneficial impact on cognition. Only a few months ago researchers were able to show for the first time how physical activity promotes neurogenesis in the human brain. So, we need both mental and physical exercise. The not-so-good news is that, as of today, there no clear recipe for success. More research is needed before we prepare a systematic set of interventions that can help maximize our protection.

**AF:** We typically emphasize the importance of a good nutrition, physical exercise, stress management and mental exercise that presents novelty, variety and challenge. What do you think of the relatively recent appearance of so many computer-based cognitive training programs, some more science-based than others?

**YS:** Those elements you mention make sense. The problem is that, at least from the point of view of Alzheimer’s, we cannot be much more specific. We don’t know if learning a new language is more beneficial than learning a new musical instrument or using a computer-based program. A few of the cognitive training computer programs we have seen, like the one you discussed with Prof. Daniel Go

pher to train the mental abilities of pilots, seem to have clear effects on cognition, generalizing beyond the training itself. But, for the most part, it is too early to tell the long-term effects. We need better designed clinical trials with clear controls. Right now, the most we can say is that those who lead mentally stimulating lives, through education, occupation and leisure activities seem to have the least risk of developing Alzheimer's Disease.

## **Research Interests**

**AF: Tell us know a bit more about your current research.**

YS: We are studying a number of related areas, applying neuroimaging techniques to understand how exactly all these Cognitive Reserve concepts are implemented in the brain.

One, we want to understand individual differences in how people approach tasks. We want to measure their efficiency and capacity the brain networks that mediate tasks performance with the idea that those with greater efficiency and capacity might cope better with age-related problems. For example, we can all understand that a competitive swimmer is going to swim better than I would even if he has some weights in his legs, but we haven't yet identified what exactly is the equivalent in the brain.

Second, we want to understand how old people compensate for the areas of decline. For example, do they begin to use new brain areas when the ones that are typically used start to fail.

Third, whether the Cognitive Reserve presents benefits beyond the prevention of Alzheimer's symptoms. Does having a higher reserve result in better attention, better executive functions, more successful aging overall?

**AF: All very important topics. And I am sure everyone reading this interview will devour any new details on how to build our Cognitive Reserves. Thank you for your time, and please keep us informed.**

YS: My pleasure. Thank you for your great educational initiative.

**Great related video on the Nun Study:**

**Further scientific reading**

1. Stern Y. *Cognitive reserve and Alzheimer disease*. *Alzheimer Dis Assoc Disord*. 2006, 20:112-117.
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3. Scarmeas N, Stern Y. *Cognitive reserve and lifestyle*. *J Clin Exp Neuropsychol* 2003;5:625-633.
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## 2. EXERCISE YOUR BRAIN WITH LIFELONG LEARNING, ART AND BRAIN FITNESS PROGRAMS-DR. ELKHONON GOLDBERG



Dr. Elkhonon Goldberg is a clinical professor of neurology at New York University School of Medicine, and author of over 50 peer-reviewed papers. His areas of expertise include executive functions, memory, attention deficit disorder, dementia, traumatic brain injury, and others. Dr. Goldberg was a student and close associate of the great neuropsychologist Alexander Luria. His book *The Executive Brain: Frontal Lobes and the Civilized Mind* (Oxford University Press, 2001) has received critical acclaim and has been published in 12 languages. His recent book *The Wisdom Paradox: How Your Mind Can Grow Stronger As Your Brain Grows Older* (Gotham Books,

Penguin, 2005) offers an innovative understanding of cognitive aging and what can be done to forestall cognitive decline. It has been, or is in the process of being, published in 13 languages.

We are fortunate that Dr. Goldberg is SharpBrains' Co-Founder and Chief Scientific Advisor. His book *The Wisdom Paradox* inspired me to embark in this path, and has been a key sounding board in the development of what we are doing.

### >> KEY TAKE-AWAYS:

- “Use It and Get More of It” reflects reality better than “Use It or Lose It”.
- Let’s demystify cognition and the brain. Everyone needs to have a basic understanding of the brain-and how to cultivate it.
- Well-directed mental exercise is a must for cognitive enhancement and healthy aging.

## **Roots: Vygotsky and Luria**

Alvaro Fernandez (AF): Elkhonon, maybe we could start with Vygotsky. At one of my Stanford classes, I became fascinated by his theory of learning. Which links into modern neuropsychology.

Dr. Elkhonon Goldberg (EG): Vygotsky proposed that learning requires internalization. And that internalization equals, literally, a change in the brain of the learner. Of course there weren't advanced neuroimaging techniques those days, so scientists could only speculate about what happened in healthy brains. But they could carefully analyze what happened with patients who had suffered any kind of serious brain problem, from strokes to traumatic brain injury. And this is how neuropsychology was born: Alexander Luria, Vygotsky's disciple, and my own mentor, was commissioned to help rehabilitate Russian soldiers with brain injuries during WWII. This provided invaluable clinical material for understanding the mechanisms of the healthy brain. Much of modern cognitive neuroscience rests its foundation in Luria's work.

## **Neuroimaging**

AF: And now we have new neuroimaging techniques.

EG: Precisely. It is often said that new neuroimaging methods have changed neuroscience in the same way that the telescope changed astronomy. We use MRI, PET, SPECT, fMRI and MEG both in neuroscience research and in clinical practice. None of these techniques is perfect, but used properly they provide us with a much better understanding than we had only 30 years ago.

## **Research and work**

AF: Please tell us about your main research and practical interests.

EG: As you can see in my papers and books, I will categorize them in 3 areas-a) computer-based cognitive training/ Brain Fitness overall, b) healthy cognitive aging, and c) frontal lobes and executive functions. I am also interested in memory, hemispheric interaction, and in a general theory of cortical functional organization, but we will leave this for another occasion and focus today on those three areas.

First, Cognitive Training/ Brain Fitness. Rigorous and targeted cognitive training has been used in clinical practice for many years. It can help improve memory, attention, confidence and competence, reasoning skills, even how to reduce anxiety and deal with uncomfortable situations.

Second, healthy cognitive aging. The brain evolves as we age. Some areas, such as pattern recognition, get better with age. Some require extra-workouts in order to reduce "chinks in the armor" and

increase neuroprotection through the Cognitive (or Brain) Reserve). Hence, the need for targeted cognitive training.

Third, the Frontal lobes and executive functions, which permeate seemingly very different problems such as ADHD and Alzheimer's, are critical for our identity and successful daily functioning so they require extra attention.

## **Frontal Lobes and executive functions**

**AF:** Please tell us more about what the Frontal Lobes are.

**EG:** We researchers typically call them the Executive Brain. The prefrontal cortex is young by evolutionary terms, and is the brain area critical to adapt to new situations, plan for the future, and self-regulate our actions in order to achieve long-term objectives. We could say that that part of the brain, right behind our forehead, acts as the conductor of an orchestra, directing and integrating the work of other parts of the brain.

I provide a good example in *The Executive Brain* book, where I explain how I was able to organize my escape from Russia into the US.

Significantly, the pathways that connect the frontal lobes with the rest of the brain are slow to mature, reaching full operational state between ages 18 and 30, or maybe even later. And, given that they are not as hard-wired as other parts of the brain, they are typically the first areas to decline.

## **Cognitive Training and Brain Fitness**

**AF:** And is that one of the areas where cognitive training/ Brain Fitness Programs can help

**EG:** Yes. Most programs I have seen so far are better at training other brain areas, which are also very important, but we are getting there, with examples such as working memory training, emotional self-regulation and domain-specific decision-making. Some of the spectacular research and clinical findings of the last 20 years that remain to be discovered by the population at large are that we enjoy lifelong brain plasticity and neurogenesis, that the rate of development of new neurons can be influenced by cognitive activities, and that intense mental challenges provide extra resistance to ageing. Exercising our brains systematically ways is as important as exercising our bodies. In my experience, "Use it or lose it" should really be "Use it and get more of it". And computer-based programs are proving to be a great vehicle for that "Use It".

## **Emotions and Art**

**AF:** We have been talking mostly about cognition or “thinking”. What about the role of emotions, as shown by the great research by Damasio?

**EG:** Great question. Until recently, emotions were simply not relevant for many cognitive neuroscientists. That is changing, and there is more and more research looking into what makes us “uniquely human”: attributes like motivation, judgment, empathy, insight into others, emotional self-regulation.

**AF:** How does that link into the role of art? Can we consider art creation and appreciation as brain exercise?

**EG:** Indeed, and a great one. This is still open territory, but my personal opinion is that art’s main purpose is in fact exercising brains. As I mention in *The Wisdom Paradox*, I wouldn’t be surprised if piano lessons were shown to improve overall sharpness and lucidity. Any activity changes the brain, and systematic programs can be designed to lead that change in a better way than random daily activities. Learning a complex skill such as learning the piano helps train and develop some parts of the brain. Well-designed computer-programs help train and develop other parts.

## **Key Messages**

**AF:** If we had to summarize your key messages to the public, based on your research and clinical career, what would you say?

**EG:** first, I would say, “Forget about Use It or Lose It”. It is “Use It and Get More of It!”. Second, I would like to contribute to demystify cognition and the brain, enabling people to increase their self-awareness, their knowledge of the brain and how to cultivate it throughout life. Finally, I would highlight the importance of well-directed mental exercise, on one hand, and of supportive social networks, on the other. I am enthused about the opportunity to work with you and SharpBrains and get the word out.

**AF:** So are we. It is a pleasure to collaborate on such an endeavor. Which I am sure will provide us with plenty of brain exercise...

**EG:** as long as you don’t stress out, that’s good! Good night, Alvaro.

**AF:** Good night, Elkhonon.

### 3. COGNITIVE TRAINING FOR ADD/ADHD-PROF. DAVID RABINER



On Friday we had the opportunity to interview Professor David Rabiner. He is a Senior Research Scientist and the Director of Psychology and Neuroscience Undergraduate Studies at Duke University, and also advocate for children and adults with ADD/ADHD.

**Alvaro Fernandez (AF):** welcome, Professor Rabiner. Could you first provide us with some background on your research interests?

**Prof. David Rabiner (DR):** in summary, I will say that my long standing interests have been how to improve the quality of care received by children with ADD/ADHD and how to ensure a positive relationship between children's social experience and their social cognitive functioning.

One of my first ADD/ADHD-related projects was a NIMH-funded grant to assist primary care pediatricians in providing more evidence-based methods for evaluation and treating children with AD/HD. Right now I am an an investigator on two research studies. In one that is funded by the National Institute of Mental Health, we are conducting a longitudinal study of a large, community-based sample of youth with ADD/ADHD, and tracking their academic, clinical and behavioral performance over 6-7 years.

The other one is a 3-year grant by the Department of Education, to evaluate how computer-based programs can help kids with ADD/ADHD. We are analyzing the impact of two types of programs: a) Captain's Log, which is a cognitive training program, and b) curriculum-based programs such as Riverdeep's Destination Reading and Math.

**AF:** when will we start to see results from those studies?

**DR:** for the Mental Health longitudinal one, you may have to wait 4-5 years to see the first papers. For the Department of Education one, some preliminary results will be published in 2008.

**AF:** can you provide us with some background on the field of Cognitive Training and its applications to help people with ADD/ADHD?

**DR:** cognitive training rests on solid premises, and some programs already have very promising re

search results. Cognitive areas, such as attention, or working memory, can be conceptualized as skills and there is growing evidence that like other kinds of skills, they can be developed and improved with concerted practice. (As Professor Rabiner mentions this, I remember Dr. Goldberg's insistence on the need for "intense mental challenges").

Some of the most promising areas are: neurofeedback, which as a whole (not for any specific branded program) is starting to present good research results, and working memory training, led by Dr. Torkel Klingberg, Cogmed and RoboMemo.

**AF:** when Mark Katz and I met some school superintendents, he stressed that "attention deficit" is being reframed by the research community as "executive function deficit". The bottleneck, the problem, is not attention itself, but on reliable and self-directed capacity to execute. Can you please elaborate?

**DR:** Dr. Russel Barkley, Research Professor of Psychiatry at the SUNY Medical University and Clinical Professor of Psychiatry at the Medical University of South Carolina, has been a key advocate for that view. Several years ago he published a comprehensive theory of ADHD in which he argues that the core problem is a deficit in "behavior inhibition", and that this deficit interferes with the normal development of important executive functions.

In this theory, the behavioral symptoms that are currently used to diagnose ADHD - including inattention - reflect these underlying executive functioning deficits. There certainly is substantial evidence that individuals with ADHD perform poorer than others - as a group - on a number of executive functioning tasks that require planning, organizational skills, inhibiting responses (as assessed through tasks such as the Stroop test), decision making, working memory and other Frontal lobes executive functions. His theory is generating significant amounts of research and it is likely that our conceptualization of ADHD will continue to evolve in response to new findings.

**AF:** I understand Dr. Barbara Ingersoll and you are co-leading a panel at the CHADD Conference, in late October in Chicago. What will the panel be about?

**DR:** the title will be "New and Complementary Approaches to the Assessment and Treatment of AD/HD", and we will provide an overview and update of research on complementary approaches to the evaluation and treatment of AD/HD, including the use of Quantitative EEG (QEEG) as part of a comprehensive evaluation for AD/HD, current research pertaining to neurofeedback and computerized training of working memory as treatments for AD/HD. We will also highlight the rationale and need for new evidence-based approaches to evaluation and treatment.

**AF:** I have also seen in CHADD's agenda that Cogmed's Dr. Torkel Klingberg will be presenting research on working memory training results. The panel is called Computerized Training of Working Memory in Children with ADHD. (For anyone interested, the description is "Working memory training, an evidence-based method for children with AD/HD, can significantly improve working memory, response inhibition and reasoning and reduce inattentive symptoms. The focus in this presentation is on research studies on working memory and its clinical use today). The intervention was developed in conjunction with Karolinska Institute, and is commercialized by Cogmed with the name RoboMemo. The question: what do you recommend parents do when they are looking for new interventions for their children? How can they navigate through multiple companies and centers making a variety of claims?

**DR:** very relevant question. Parents are always looking for ways to help their children. Not only that, adults with ADD/ ADHD are also a very self-motivated group. However, there have been a number of disappointments. I would recommend parents discuss new interventions with their doctors, and also make informed decisions that include reading peer-reviewed publications, or at the very least being aware of what specific interventions have published results in respectable journals.

**AF:** how can parents, and anyone who is not a scientist, access those publications you mention?

**DR:** There are different ways. One, they can search for papers in PubMed. Sometimes the papers themselves are not available in PubMed, but the summaries, abstracts, are. If they want to read the whole article, they can go to any university libraries with free access to Medline.

For people who may not want to read the research papers, but be informed of the highlights of new research developments, I launched Attention Research Update, a free monthly newsletter helps parents, professionals, and educators stay informed about important new research on ADHD.

**AF:** Prof. Rabiner, this has been very helpful. Thank you for your time.

**DR:** Thank you. See you in CHADD conference.

## 4. TRAIN YOUR BRAIN TO THINK LIKE A THIN PERSON - JUDITH BECK:



Brain Fitness doesn't require the use of expensive equipment. Your brain is enough. Today we are honored to interview Dr. Judith Beck on how cognitive techniques can be applied to develop a number of important mental skills. The latest application of these?. Losing weight.

Dr. Judith Beck is the Director of the Beck Institute for Cognitive Therapy and Research, Clinical Associate Professor of Psychology in Psychiatry at the University of Pennsylvania, and author of Cognitive Therapy: Basics and Beyond. Her most recent book is The Beck Diet Solution: Train Your Brain to Think Like a Thin Person.

**Dr. Beck, thanks for your time. What does the Beck Institute do?**

We have 3 main activities. One, we train practitioners and researchers through a variety of training programs. Two, we provide clinical care. Three, we are involved in research on cognitive therapy.

**Please explain cognitive therapy in a few sentences**

Cognitive therapy, as developed by my father Aaron Beck, is a comprehensive system of psychotherapy, based on the idea that the way people perceive their experience influences their emotional, behavioral, and physiological responses. Part of what we do is to help people solve the problems they are facing today. We also teach them cognitive and behavioral skills to modify their dysfunctional thinking and actions.

**I understand that cognitive therapy has been tested for many years in a variety of clinical applications. What motivated you to bring those techniques to the weight-loss field by writing The Beck Diet Solution?**

Since the beginning, I have primarily treated psychiatric outpatients with a variety of diagnoses, especially depression and anxiety. Some patients expressed weight loss as a secondary goal in treatment. I found that many of the same cognitive and behavioral techniques that helped them overcome their other problems could also help them to lose weight—and to keep it off.

I became particularly interested in the problem of overweight and was able to identify specific mind-sets or cognitions about food, eating, hunger, craving, perfectionism, helplessness, self-image, unfair-

ness, deprivation, and others, that needed to be targeted to help them reach their goal.

### **What research results back your finding that those techniques help?**

Probably the best published study so far is the randomized controlled study by Karolinska Institute's Stahre and Halstrom (2005, reference below). The results were striking: nearly all 65 patients completed the program and this short-term intervention (10-week, 30-hours) showed significant long-term weight reduction, even larger (when compared to the 40 individuals in the control group) after 18 months than right after the 10-weeks program.

### **That sounds impressive. Can you explain what makes this approach so effective?**

A unique feature is that the book doesn't offer a diet but does provide tools to develop the mindset that is required for sustainable success, for modifying sabotaging thoughts and behaviors that typically follow people's initial good intentions. I help dieters acquire new skills. We have sold over 70,000 books so far, and are planning to release a companion workbook this month to further help readers implement the 6-week program and track progress.

### **So, in a sense, we could say that your book is complementary to all other diet books.**

Exactly—it will help readers at setting and reaching their long-term goals, assuming that the diet is healthy, nutritious, and well-balanced.

The main message of cognitive therapy overall, and its application in the diet world, is straight-forward: problems losing weight are not one's fault. Problems simply reflect lack of skills--skills that can be acquired and mastered through practice. Dieters who read the book or workbook learn a new cognitive or behavioral skill every day for six weeks. They practice some skills just once; they automatically incorporate others for their lifetime.

### **What are the cognitive and emotional skills and habits that dieters need to train, and where your book helps?**

Great question. That is exactly my goal: to show how everyone can learn some critical skills. The key ones are:

1) How to motivate oneself. The first task that dieters do is to write a list of the 15 of 20 reasons why they want to lose weight and read that list every single day.

2) Plan in advance and self-monitor behavior. A typical reason for diet failure is a strong preference for

spontaneity. I ask people to prepare a plan and then I teach them the skills to stick to it.

3) Overcome sabotaging thoughts. Dieters have hundreds and hundreds of thoughts that lead them to engage in unhelpful eating behavior. I have dieters read cards that remind them of key points, e.g., that it isn't worth the few moments of pleasure they'll get from eating something they hadn't planned and that they'll feel badly afterwards; that they can't eat whatever they want, whenever they want, in whatever quantity they want, and still be thinner; that the scale is not supposed to go down every single day; that they deserve credit for each helpful eating behavior they engage in, to name just a few.

4) Tolerate hunger and craving. Overweight people often confuse the two. You experience hunger when your stomach feels empty. Craving is an urge to eat, usually experienced in the mouth or throat, even if your stomach is full.

### **When do people experience cravings?**

Triggers can be environmental (seeing or smelling food), biological (hormonal changes), social (being with others who are eating), mental (thinking about or imagining tempting food), or emotional (wanting to soothe yourself when you're upset). The trigger itself is less important than what you do about it. Dieters need to learn exactly what to say to themselves and what to do when they have cravings so they can wait until their next planned meal or snack.

### **How can people learn that they don't have to eat in response to hunger or craving?**

I ask dieters, once they get medical clearance, to skip lunch one day, not eating between breakfast and dinner. Just doing this exercise once proves to dieters that hunger is never an emergency, that it's tolerable, that it doesn't keep getting worse, but instead, comes and goes, and that they don't need to "fix" their usually mild discomfort by eating. It helps them lose their fear of hunger. They also learn alternative actions to help them change their focus of attention. Feel hungry? Well, try calling a friend, taking a walk, playing a computer game, doing some email, reading a diet book, surfing the net, brushing your teeth, doing a puzzle. My ultimate goal is to train the dieter to resist temptations by firmly saying "No choice," to themselves, then naturally turning their attention back to what they had been doing or engaging in whatever activity comes next.

### **You said earlier that some cravings follow an emotional reaction to stressful situations. Can you elaborate on that, and explain how cognitive techniques help?**

In the short term, the most effective way is to identify the problem and try to solve it. If there's nothing you can do at the moment, call a friend, do deep breathing or relaxation exercises, take a walk to clear

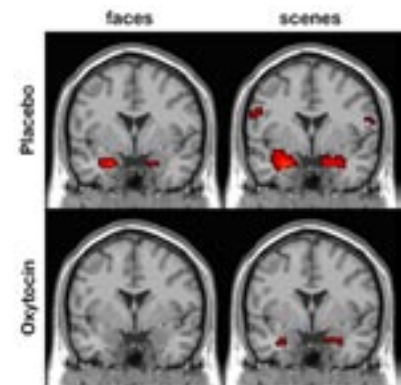
your mind, or distract yourself in another way. Read a card that reminds you that you'll certainly not be able to lose weight or keep it off if you constantly turn to food to comfort yourself when you're upset. People without weight problems generally don't turn to food when they're upset. Dieters can learn to do other things, too.

And in the long term, I encourage people to examine and change their underlying beliefs and internal rules. Many people, for example, want to do everything (and expect others to do everything) in a perfect way 100% of the time, and that is simply impossible. This kind of thinking leads to stress.

**The title of the book includes a “train your brain” promise. Can you tell us a bit about the growing literature that analyzes the neurobiological impact of cognitive therapy?**

Yes, that is a very exciting area. For years, we could only measure the impact of cognitive therapy based on psychological assessments. Today, thanks to fMRI and other neuroimaging techniques, we are starting to understand the impact our actions can have on specific parts of the brain.

For example, take spider phobia. In a 2003 paper (Note: reference below) scientists observed how, prior to the therapy, the fear induced by viewing film clips depicting spiders was correlated with significant activation of specific brain areas, like the amygdala (Editor note: pics added for illustration. On the left, the yellow circle shows the location of the amygdala. On the right, the red color indicates the level of activation of the amygdala, the “fear center of the brain”). After the intervention was complete (one three-hour group session per week, for four weeks), viewing the same spider films did not provoke activation of those areas. Those individuals were able to “train their brains” and managed to reduce the brain response that typically triggers automatic stress responses. And we are talking about adults.



**Dr. Beck, that is exactly what we find most exciting about this emerging field of neuroplasticity: the awareness that we can improve our lives by refining, “training” our brains, and the growing research behind a number of tools such as cognitive therapy. Thanks a lot for sharing your thoughts with us.**

My pleasure.

# LEARNING, TEACHING AND CHANGING BRAINS

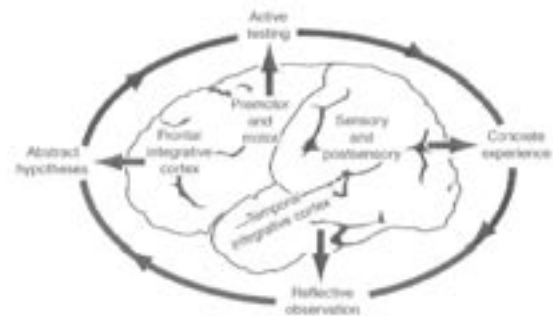
## DR. JAMES ZULL



Learning through a virtuous Learning Cycle. That's the message from Dr. James Zull, Professor of Biology and Biochemistry at Case Western University, Director of UCITE (The University Center for Innovation in Teaching and Education), and Professor of a Human Learning and The Brain class.

Dr. Zull loves to learn. And to teach. And to build connections. He has spent years building bridges between neurobiology and pedagogy, as a result of which he wrote *The Art of Changing the Brain: Enriching the Practice of Teaching by Exploring the Biology of Learning*, which shows how neurobiological research can inform and refine some of the best ideas in educational theory.

In that book, Prof. Zull added biological substrate to David Kolb's Learning Cycle framework. David Kolb's *Experiential Learning: Experience as the Source of Learning and Development* book refers to human learning, but Professor Zull tells that today, in his desk, he has cognitive neuroscience papers and research that show that apes go through the same 4 stages when they are learning a new activity, activating exactly the same brain areas than we do.



**AF: What is Learning? Can apes really learn in the same way we do?**

JZ: Learning is physical. Learning means the modification, growth, and pruning of our neurons, connections—called synapses— and neuronal networks, through experience. And, yes, we have seen that apes go through the same Learning Cycle as we do, activating the same brain areas.

**AF: How does Learning happen?**

JZ: These are the 4 stages of the Learning Cycle.

- 1) We have a Concrete experience,
- 2) We develop Reflective Observation and Connections,
- 3) We generate Abstract hypothesis,
- 4) We then do Active testing of those hypotheses, and therefore have a new Concrete experience, and a new Learning Cycle ensues.

In other words, we 1) get information (sensory cortex), 2) make meaning of that information (back integrative cortex), 3) create new ideas from these meanings (front integrative cortex) and 4) act on those

ideas (motor cortex). From this I propose that there are four pillars of learning: gathering, analyzing, creating, and acting.

This is how we learn. Now, learning this way requires effort and getting out of our comfort zones. A key condition for learning is self-driven motivation, a sense of ownership. To feel in control, to feel that one is making progress, is necessary for this Learning Cycle to self-perpetuate. Antonio Damasio made a strong point on the role of emotions in his great Descartes' Error book.

**AF: can we, as learners, motivate ourselves? How can we become better learners?**

JZ: Great question, because in fact that is a uniquely human ability, at least to the degree we can do so. We know that the Frontal Lobes, which are proportionally much larger in humans than in any other mammal, are key for emotional self-regulation. We can be proactive and identify the areas that motivate us, and build on those. In other words, the Art of the Learner may be the Art of Finding Connections between the new information and challenges and what we already know and care about.

If I had to select one Mental Muscle that students should really exercise, and grow, during the schooling years, I'd say they need to build this Learning Muscle. Learning how to Learn. That might be even more valuable than learning what we stress in the curriculum, i.e., the subjects we teach.

**AF: Do you think this is happening today in our schools?**

JZ: I don't think so. First, of all, too many people still believe that Education means the process by which students passively absorb information. Even if many educators would like to ensure a more participatory and active approach, we still use the structures and priorities of another era. For example, we still pay too much attention to categorizing some kids as intelligent, some as not so, instead of focusing on how they could all learn more.

Second, learning and changing are not that easy. They require effort, and also, by definition, getting out of our comfort zones. We need to try new things, and to fail. The Active Testing phase is a critical one, and sometimes our hypothesis will be right, and sometimes wrong. The fear of failing, the fear of looking un-smart, is a key obstacle to learning that I see too often, especially for people who want to protect perceived reputations to such an extent that they can't try new genuine Learning Cycles.

**AF: Fascinating. Given what you just said, how do you help your students become better learners?**

JZ: Despite the fact that every brain is different, let me simplify and say that I usually observe 2 types of students, with different obstacles to learning and therefore benefiting from different strategies.

A) Students who have an introversion tendency can be very good at the Reflection and Abstract hypothesis phases, but not so at the Active Testing one. In order to change that, I help create small groups where they feel safer and can take risks such as sharing their thoughts aloud and asking more questions.

B) More extroverted students can be very good at having constant Concrete experiences and Active Testing, but may benefit from increased Reflection and Abstract hypothesis. Having them write papers, maybe predicting the outcome of certain experiments or even current political affairs, helps.

**AF: Very useful. What other tips would you offer to teachers and parents?**

JZ: Always provoke an active reaction, ensuring the student is engaged and sees the connection between the new information and what he or she already knows. You can do so by asking questions such as “What does this make you think of? Is there some part of this new material that rings a wild bell for you?” To ensure a safe learning environment, you have to make sure to accept their answers, and build on them. We should view students as plants and flowers that need careful cultivation: growing some areas, helping reduce others.

**AF: Please give us an example.**

JZ: Well, an example I use in my books is that middle school students often have a hard time learning about Martin Luther and the Reformation because they confuse him with Martin Luther King Jr. We can choose to become frustrated about that. Or we can exploit this saying something like, “Yes! Martin Luther King was a lot like Martin Luther. In fact, why do you think Martin Luther King’s parents named him that? Why didn’t they name him Sam King?”

**AF: Thanks. And what would you suggest for us who want to become better learners?**

JZ: Learning is critical at all ages, not only in the school environment. We have brains precisely in order to be able to learn, to adapt to new environments. This is essential throughout life, not just in school. We now know that every brain can change, at any age. There is really no upper limit on learning since the brain neurons seem to be capable of growing new connections whenever they are used repeatedly. I think all of us need to develop the capacity to self-motivate ourselves. One way to do that is to search for those meaningful contact points and bridges, between what we want to learn and what we already know. When we do so, we are cultivating our own neuronal networks. We become our own gardeners.

**AF: Prof. Zull, many thanks for sharing your thoughts through your book, and for your time today. You have changed my brain-and probably will change the brains of a number of readers.**

JZ: My pleasure!

For more information on his Professor Zull’s thoughts and his book, visit the great New Horizons for Learning site at [www.newhorizons.org/neuro/zull.htm](http://www.newhorizons.org/neuro/zull.htm).

A final reflection: this Learning Cycle is very similar to what people at McKinsey & Company (my first job ever), and other strategic consulting firms, need to develop very quickly, and constitutes the core for a very successful Performance Review system. Interesting to understand the neurobiological basis for it. Brain Fitness starts with Learning. Brain and Mind Fitness means being able, and ready, to learn. Not just an Education issue, but a Health and Wellness and Fitness one.

## 5. WORKING MEMORY TRAINING AND SCHOOLS OF THE FUTURE- DR. ARTHUR LAVIN

Today we interview Dr. Arthur Lavin, Associate Clinical Professor of Pediatrics at Case Western School of Medicine, pediatrician in private practice, and one of the first providers of Cogmed Working Memory Training in the US (the program whose research we discussed with Dr. Torkel Klingberg and Dr. Bradley Gibson). Dr. Lavin has a long standing interest in technology-as evidenced by Microsoft's recognition of his paperless office- and in brain research and applications-he trained with esteemed Mel Levine from All Kinds of Minds.

### >> KEY TAKE-AWAYS:

- Schools today are not yet in a position to effectively help kids with cognitive issues deal with increasing cognitive demands.
- Working Memory is a cognitive skill fundamental to planning, sequencing, and executing school-related work.
- Working Memory can be trained, as evidenced by Dr. Lavin's work, based on Cogmed Working Memory Training, with kids who have attention deficits.

### **Context on cognitive fitness and schools**

**AF (Alvaro Fernandez):** Dr. Lavin, thanks for being with us. It is not very common for a pediatrician to have such an active interest in brain research and cognitive fitness. Can you explain the source of your interest?

**AL (Arthur Lavin):** Throughout my life I have been fascinated by how the mind works. Both from the research point of view and the practical one: how can scientists' increasing knowledge improve kids' lives? We now live in a truly exciting era in which solid scientific progress in neuroscience is at last creating opportunities to improve people's actual cognitive function. The progress Cogmed has achieved in creating a program that can make great differences in the lives of children with attention deficits is one of the most exciting recent developments. My colleague Ms. Susan Glaser and I recently published two books: *Who's Boss: Moving Families from Conflict to Collaboration* (Collaboration Press, 2006) and *Baby & Toddler Sleep Solutions for Dummies* (Wiley, 2007), so I not only see myself as a pediatrician but also an educator. I see parents in real need of guidance and support. They usually are both very skeptical, since they have been promised too many things too many times by "experts", yet open-minded to ideas with good foundations. Many professionals have only the skeptical frame, since they were educated when scientists still believed the brain was pretty rigid and "untrainable". We need much more brain science-based professional development, and appreciate the great work SharpBrains is doing.

**AF:** Let's talk about that "trainability" and schools. Most people still think of "intelligence" as fixed. Now, I recently read a report on how KIPP schools emphasize the training on some basic skills, such as shared attention, as a needed foundation for good academic performance. So, even if limited in scope, it seems some schools are starting to understand their role in cognitive development. In your experience, are schools fulfilling their roles as "brain gyms", places where young minds get shaped and ready for life?

**AL:** Good question. I have been a pediatrician working with schools in the Cleveland area since 1985, seen all kinds of diseases. For example, I have witnessed the growing incidence of autism spectrum disorders, such as autism and Asperger's. I have also observed how school work has increasingly become more cognitively demanding, starting from kindergarden. There is too much pressure today, and a growing number of problems, yet I don't see that schools are applying the best knowledge of how minds work. Just as doctors offices are centers of applied medical science, taking the latest advances in medical research and applying them to the medical care of people, schools should be the best place for applied neuroscience, taking the latest advances in cognitive research and applying it to the job of educating minds. Yet, they aren't, and I can't blame them, given the wide variety of pressures they work under, and the large change in perspective becoming institutes of applied neuroscience would take.

## **A cognitive gap?**

**AF:** Some readers may be skeptical of the claim that school work is more demanding today than, say, 20 years ago. They may say kids are simply becoming "lazy". What do you say to that?

**AL:** I have never met a lazy kid. All people want to succeed, in life if not in school. Most children who struggle at school struggle mightily to get adequate grades. It is true that some are more resilient than others-if they fail, they will try 10 times harder. The ones that are labeled as "lazy" are typically ashamed of their lack of capacity to deal with demands, and resort to an evasive strategy, they try to avoid the whole situation, run away.

**AF:** You mention a "lack of capacity to deal with demands". Is that gap growing? The equation has 2 components: capacity and demands. In terms of capacity, let me mention that recently, the French Education Ministry just introduced mental arithmetic as part of the curriculum. I remember, as a kid, spending many hours in the math class where the teacher would require us to perform a progressively complex sequence of mental calculations-which is good training for skills such as working memory. Memory training was important.

**AL:** Great point. For example, years ago we had to memorize long texts, which, no matter what the content was, was a great way to train and build our attention span, working memory, and to devise strategies to learn. Today, there are less opportunities for such training.

In terms of demands, I can see how complex homework assignments are these days even in 3-4th grade. Kids need to plan and prepare a whole matrix of tasks that require good organizational work to complete. They need to sequence what they do today, tomorrow, the day after. The major difficulty, for which such young brains may not be fully ready, is to deal with an overwhelming amount of information and demands, and execute.

## **Working Memory and Attention Deficits**

**AF:** That seems to imply a higher need for good executive functions than years ago. A kid needs to have good working memory to retain, prioritize and sequence much information into actionable plans, and then execute them, as I had the fortune to discuss with Mark Katz some months ago. From my previous interviews with Dr. Klingberg and Dr. Gibson, we know that a common problem with many kids with diagnosed attention deficits is, indeed, working memory (the ability to hold in mind and manipulate several units of information). Can you explain what you see in your work with schools?

**AL:** I am afraid that many schools are too quick to diagnose ADD/ ADHD and consider drugs as the only potential intervention. The label itself can be misleading and counterproductive. School psychologists have wonderful expertise in evaluating subject-related problems and describing attentional deficit symptomatology, but are not trained or asked to complete neuropsychological profiles of a child's cognitive functions. Up to a point, many kids with attention problems would benefit from educational, not medical, interventions to improve cognitive functions such as working memory. I am seeing it first hand, having used Cogmed Working Memory Training (also called RoboMemo) with 15 pre-screened kids: 80% of them presented a substantive improvement. With 50%, the results we have seen have been dramatic.

**AF:** Please give us some examples, so our readers can better understand what working memory is and its role in academic performance and daily life.

**AL:** Let me give you 3 vignettes, all 3 with diagnosed attention deficits, who showed clear benefit not only on cognitive functioning but also on AD/HD rating scales.

**Patient 1:** 11-year-old boy, very impulsive, even on medication. Doesn't do homework, constantly forgets chores. After the 5-week program, he is able to sit down and listen instructions, engaging in fewer arguments with his parents. He can do better mental math- for the first time in his life able to do so without using his fingers. He finds that following school and doing homework is easier, grades have improved dramatically.

Patient 2: 16-year-old girl with ADD. She has trouble executing homework, often telling parents she had done it when she really hadn't. Her parents thought she liked to lie. Yet, when I talk to her, she is clearly more ashamed than dishonest. The working memory training program helps her develop a much improved perception of time. For example, she starts to manage her shower time better, being aware of when 5 minutes have passed-instead of spending 30 minutes in the shower, as before. Much improved school work, lying at home has dropped dramatically.

Patient 3: 19-year-old boy in college, who often became paralyzed when he was faced with complex challenges. He had a tough time with the cognitive training program, but after a while he started learning new strategies and developing self-confidence, and showing marked improvement. Now, he can break complex tasks into manageable pieces . His attentional deficits appeared to threaten his opportunities in his family business. Unable to keep track of change at the cash register, lines at the business would grow and customers get angry, leaving him out of consideration for key start-up employment in the business. Now he can manage day-to-day challenges such as these, and the door to being part of the family business is now open. He can sequence tasks and execute them with a clear plan in mind, without being distracted and losing sight of that plan.

**AF: Dr. Lavin, this is all very exciting news, that open the way for new interventions, new policies, a new understanding of what "education" and "learning" is and how to "educate" millions of young minds and equip them for life success. Thank you very much for your time.**

AL: Thank you. I really appreciate all the work you are doing to bring the latest neuroscience research and applications to professionals like me and to parents at large.

## 6. COGNITIVE SIMULATIONS TO DEVELOP OCCUPATION-SPECIFIC MENTAL MUSCLES- PROF. DANIEL GOPHER



Professor Daniel Gopher is a fellow of the U.S. Human Factors and Ergonomics Society and the International Ergonomics Association, Professor of Cognitive Psychology and Human Factors Engineering at Technion, Israel's Institute of Science, and one of world's leading figures in the field of Cognitive Training.

During his 40 year career, he has held a variety of scientific and academic positions, such as acting Head of the Research Unit of the Military Personnel Division, Associate Editor of the European Journal of Cognitive Psychology, member of the Editorial Boards of Acta Psychologica, the International Journal of Human-Computer Interaction, and the journal Psychology.

He published an award-winning article in 1994, Gopher, D., Weil, M. and Baraket, T. (1994), Transfer of skill from a computer game trainer to flight, Human Factors 36, 1-19., that constitutes a key milestone in the cognitive engineering field.

Prof. Gopher has also developed innovative a) medical systems, assessing the nature and causes of human error in medical work, and redesigning medical work environments to improve safety and efficiency, and b) work safety systems, developing methods and models for the analysis of human factors, ergonomic, safety and health problems at the individual, team and plant level.

### >> KEY TAKE-AWAYS

- Cognitive performance can be substantially improved with proper training.
- Research shows that stand-alone, inexpensive, PC-based training is effective to transfer and generalize performance.
- The key for success is to ensure Cognitive fidelity, this is, that the cognitive demands in training resemble those of the real life task.

**Alvaro Fernandez (AF):** Professor Gopher, it is an honor that you speak to us. Could you provide an overview of the projects are you working on now?

Prof. Daniel Gopher (DG): Since 1980 I have been the director of the Research Center for Work Safety and Human Engineering, an interdisciplinary research centre which involves 30 researchers from 5 Technion faculties and 80 graduate students, who work in 7 laboratories. I also act as Scientific Advisor for ACE's Intelligym and am involved in a new integrative research project labeled "Skills – Multimodal Interfaces for the Capturing and Transfer of Skills", directed to facilitate and improve the acquisition and transfer of skills through the development of innovative virtual-reality multimodal interfaces. This is an initiative supported by the European Commission with 15 industry and university research partners, from 9 countries.

## **On Cognitive Training and Cognitive Simulations**

**AF:** Tell us a bit about your overall research interests

DG: My main interest has been how to expand the limits of human attention, information processing and response capabilities which are critical in complex, real-time decision-making, high-demand tasks such as flying a military jet or playing professional basketball. Using a tennis analogy, my goal has been, and is, how to help develop many "Wimbledon"-like champions. Each with their own styles, but performing to their maximum capacity to succeed in their environments.

What research over the last 15-20 years has shown is that cognition, or what we call thinking and performance, is really a set of skills that we can train systematically. And that computer-based cognitive trainers or "cognitive simulations" are the most effective and efficient way to do so.

This is an important point, so let me emphasize it. What we have discovered is that a key factor for an effective transfer from training environment to reality is that the training program ensures "Cognitive Fidelity", this is, it should faithfully represent the mental demands that happen in the real world. Traditional approaches focus instead on physical fidelity, which may seem more intuitive, but less effective and harder to achieve. They are also less efficient, given costs involved in creating expensive physical simulators that faithfully replicate, let's say, a whole military helicopter or just a significant part of it.

**AF:** Very interesting. In the Serious Games Summit this week we are seeing a number of simulations for military training that try to be as realistic as possible. Are you saying that they may not be the best approach for training?

DG: The need for physical fidelity is not based on research, at least for the type of high-performance

training we are talking about. In fact, a simple environment may be better in that it does not create the illusion of reality. Simulations can be very expensive and complex, sometimes even costing as much as the real thing, which limits the access to training. Not only that, but the whole effort may be futile, given that some important features can not be replicated (such as gravitation free tilted or inverted flight), and even result in negative transfer, because learners pick up on specific training features or sensations that do not exist in the real situation.

## **Main studies and applications**

**AF: What are the main studies have you conducted?**

DG: in this field of work, I would mention two. In one, which constituted the basis for the 1994 paper, we showed that 10 hours of training for flight cadets, in an attention trainer instantiated as a computer game-Space Fortress- resulted in 30% improvement in their flight performance. The results led the trainer to be integrated into the regular training program of the flight school. It was used in the training of hundreds of flight cadets for several years. In the other one, sponsored by NASA, we compared the results of the cognitive trainer vs. a sophisticated, pictorial and high-level-graphic and physical-fidelity-based computer simulation of a Blackhawk helicopter. The result: the Space Fortress cognitive trainer was very successful in improving performance, while the alternative was not. The study was published in the proceedings of the Human Factors and Ergonomic Society: Hart S. G and Battiste V. (1992), Flight test of a video game trainer. Proceedings of the Human Factors Society 26th Meeting (pp. 1291-1295).

**AF: What have been to date the main applications of your computer-based cognitive simulations?**

DG: in summary, I'd say

- Flying high-performance airplanes: in 10 hours, we showed an increase in 30% flight performance
- Flying with HMD (helmet mounted displays)
- Touch-typing skills
- Teaching old adults to cope with high workload attention demands.
- Developing Basketball “game-intelligence” for professional players, to improve the performance of individuals and teams

## **Trainer for basketball “game-intelligence”**

AF: talk to us about the basketball example. I am sure many readers will find that fascinating.

DG: I served as a scientific advisor to ACE, who developed the program called Intelligym. Although the context is different, the approach and basic principles are the same of those of developing a trainer for the task of flying a high performance jet airplane. First, one needs to analyze what cognitive skills are involved in playing at top level, and then develop a computer-based cognitive simulation that trains those skills. What most people don't realize is that top players are not born top players. We are not just talking about instincts. We are talking about skills that can be trained.

AF: what are the results of the program so far?

DG: Well, first let me say that the company has had to overcome huge cultural barriers to get adoption by a good number of university teams and some NBA players. Coaches see the value of this tool very quickly, but administrators are harder to convince in the beginning. We have seen that the teams and individuals using Intelligym have improved their performance significantly. From the cognitive training, or skill development point of view, we have seen that players improve their positional awareness-of themselves, their mates and opponents, and ability to predict what is going on in the game and to make fast and good decisions. Players quickly develop attention allocation strategies that enable them better participate in the game, and also improve their spatial orientation.

## **Summary of key findings**

AF: Fascinating real-world experience. Can you summarize your research findings across all these examples and fields, and how you see the field evolving?

DG: In short, I'd summarize by saying that

- Cognitive performance can be substantially improved with proper training.
- It is not rigidly constrained by innate, fixed abilities.
- Cognitive task analysis enables us to extract major cognitive skills involved in any task.
- Attention control and attention allocation strategies are a critical determinants in performing at top level in complex, real-time decision-making environments
- Those skills, and other associated, can be improved through training
- Research shows that stand-alone, inexpensive, PC-based training is effective to transfer and generalize performance.
- The key for success is to ensure Cognitive fidelity, this is, that the cognitive demands in training resemble those of the real life task.

I can think of many other applications. Probably currency and options traders would benefit from a system like this. Now, we will need to increase awareness, and will need to find champions willing to take risks. The cognitive simulation approach is less intuitive than traditional ones.

Professor Wayne Shebilske, at Wright State University Psychology department, is conducting additional research on applications, such as outlined on the paper Shebilske, Wayne L., et al, “Revised Space Fortress: A Validation Study” (accepted for Behavior Research Methods, Instruments and computers). (Professor Shebilske was kind enough to write a great comment below, giving us 2 detailed references:

1. Shebilske, W. L., Volz, R. A., Gildea, K. M., Workman, J. W., Nanjanath, M., Cao, S., & Whetzel, J. (2005). Revised Space Fortress: A validation study. Behavior Research Methods, 37, 591-601.

2. Volz, R.A., Johnson, J.C., Cao, S., Nanjanath, M., Whetzel, J., Ioerger, T.R., Raman, B., Shebilske, W.L., and Xu, Dianxiang (2005). Fine-Grained data acquisition and agent oriented tools for distributed training protocol research: Revised Space Fortress. Down Load Technical Supplement, Psychonomic Society Web-based Archive (see 37,591-601).

**AF: are you doing something to spread the word?**

DG: apart from conferences and journals, I have written the chapter Emphasis change as a training protocol for high demands tasks, in the book Applied Attention: From Theory to Practice, A. Kramer, D. Wiegman, A. Kirlik (Eds): Oxford Psychology Press, about to be released.

## **A more in-depth view of his cognitive simulation approach**

**AF: Great. For readers who may be interested in more specific details about your specific approach to cognitive training, could you give us some lessons learned?**

DG: Good question. There are different types of cognitive training. The one we have specialized in focuses on the development of attention-control, attention-allocation strategies, which are bottleneck in some high-performing, high-mental-workload- environments. Our approach is called Emphasis Change Protocol, and is based on the introduction of systematic variability in training, while maintaining the overall task intact. We just change the emphasis on sub-components of a complex task during performance. In our research, this has proven to be the most effective way to train attention management skills, task switching and control processes, such as the ability to initiate, coordinate, synchronize and regulate goal-directed behavior.

This “whole task” approach increases transfer and adaptation capabilities, vs. traditional part task training, which decomposes the complex task and trains elements in isolation. However, whole task training is harder at the beginning-there is slower progress at early stages of training.

Other principles we use, based on our and others' literature, is the need for intermittent schedules of feedback (vs. full one), to help retention and transfer (at the cost of making learning slower), and the encouragement to explore alternatives to reach a general optimum. This exploration is important: we want to help the user find a flexible, and personal best, match between his abilities and task demands, out of localized peaks. Coming back to the tennis example, we know that McEnroe and Boris Becker have different styles, but both are Wimbledon winners. We want to make sure the user increases sensitivity to real-time changes in the environment and expands his or her ability to cope with them.

**AF: Professor Gopher, it has been a pleasure to talk to you. Thank you for your time.**

DG: Thank you. I enjoyed very much reading your interview with Dr. Torkel Klingberg on working memory training, and appreciate your help in increasing awareness of the whole field. Btw, I will be traveling next week to Spain, for a meeting of the Skills project. The meeting will be in Bilbao.

**AF: Well, that is my hometown...so please say Hi for me! Hola in Spanish, Kaixo in Basque.**

DG: I will.

## 7. ENHANCING PERFORMANCE OF TRADERS AND TOP PERFORMERS-PROF. BRETT N. STEENBARGER



Today we are going to talk about the applications of cognitive neuroscience to trading and neurofinance. Brett N. Steenbarger, Ph.D. is Associate Professor of Psychiatry and Behavioral Sciences at SUNY Upstate Medical University, active trader for over 30 years, former Director of Trader Development for Kingstree Trading, LLC, and author of *The Psychology of Trading: Tools and Techniques for Minding the Markets* (Wiley, 2003) and the new *Enhancing Trader Performance: Proven Strategies From the Cutting Edge of Trading Psychology* (Wiley, 2007).

He writes feature columns for the Trading Markets website and several trading publications, including *Stocks Futures and Options Magazine*.

### >> KEY TAKE-AWAYS

- Elite performers in any highly-competitive field follow structured learning and training processes to develop their skills, ensuring continuous feedback and refinement.
- Traders would benefit to following this example. Tools at their disposal include books, simulation programs, biofeedback programs for emotional management, and coaches.
- Specific skills to train are brain speed and working memory (for short-term traders), analytical skills (long-term ones). For both, managing emotional-driven impulsive behavior.

## Books on Trading and Peak Performance

**Alvaro Fernandez (Alvaro):** Welcome, Prof. Steenbarger. Why don't you start by providing us some context on your interest in trading performance and how it led you to your new book?

**Brett N. Steenbarger (Brett):** Thanks, Alvaro, for having me here. I really enjoyed your last interview with Prof. Gopher. My main interest is how to enhance cognitive and emotional development among traders to help them become more successful. My first book, *The Psychology of Trading*, focused on emotional and stress management, and tried to help traders (both professional and amateur) overcome emotional disruptions of trading. My new book, *Enhancing Trader Performance*, helps traders develop their own training programs or, we may even call them, "brain gyms", to build their skills, strengthen their mental capacities, and improve their performance.

**Alvaro: please tell us about your new book. What is the premise, and what are you trying to get at?**

Brett: The premise is that elite, performers in highly competitive fields share common traits. This includes people in such fields as athletics, performing arts, chess, the military, and medicine. I review the research regarding what makes people successful in a those fields, find the common factors behind their success, and then apply the findings to traders.

**Alvaro: what are those common factors for top performers? And what differentiates elite performers from the rest?**

Brett: The elite performers are distinguished by the structuring of their learning process. From a relatively early age, they are engaged in an intensive learning process that builds upon their natural talents. They find a niche—a field that makes use of these talents—and become absorbed with a deliberative and systematic learning process that provides them with continuous feedback about their performance. The recipe for success seems to be talent, skill, hard work, and opportunity. In contrast, many people who don't end up performing at a high level were driven mostly by practical reasons to enter that field and are not motivated to follow the same level of intensive and systematic training. (What Brett is saying reminds me of the Learning Cycle that Professor Zull outlined a few weeks back).

## **Specific Learning and Training Advice for Traders**

**Alvaro: What specific advice do you provide to traders in your book?**

Brett: Traders typically devote little time to practice and a structured learning process. I want to encourage them to see that “learning on the job” is not a substitute for breaking down skills into components, drilling these, receiving feedback about performance, and making continuous modifications and improvements. In every field of performance, elite performers devote more time on practice than performing. You need to protect and optimize that practice, learning time. The average trader doesn't do that, and the result is that many traders lose their trading capital within 7 months of trading. To develop themselves, I suggest traders structure their learning processes.

There are several elements to this development:

- **Tools:** There are already very good simulations out there that can help traders become more sensitive to patterns in the market and internalize these. The ability to play and replay market days provides traders with enhanced screen time to accelerate and deepen learning. Another set of tools includes biofeedback programs that help traders manage their emotions. Biofeedback is especially helpful in reducing emotional arousal that can disrupt our executive functions: judgment, planning, analyzing, and reasoning.

- Reflection and feedback: Traders who utilize programs to provide them with metrics on their trading—analyses of their winning and losing trades—have considerable data at their disposal. The patterns revealed by these metrics help traders figure out both strengths and weaknesses. Many times, building on successes is more important than trying to change weaknesses. Constant feedback on trading results will show traders what they do best—and help them do more of it.

- Role of mentors and coaches: In many performance fields, such as music and tennis, coaches help students break down their performance into component skills and then systematically work on these and combine them. The mentor is someone who can structure the learning process for the developing performer and help them move along the path from being a novice to being competent to being expert.

**Alvaro: interesting analogy. Who would be a good “trader coach” and where does one find one?**

Brett: Ideally, you need an experienced and successful trader who is familiar with the kind of trading that you will be doing. The book contains an appendix with different resources that can help you find educational and mentoring resources. For emotional development, you can coach yourself with practical cognitive and behavioral techniques and build new, positive ways of thinking and behaving. The last two chapters of the book provides readers with self-help manuals for utilizing these techniques.

**Alvaro: let’s talk about some of the key components of top performance in trading, and what skills traders can develop.**

Brett: First, we must differentiate whether we are talking about short-term or long-term traders. For short-term traders, the priority would be the ability to process large amounts of information and quickly see patterns that lead to effective decision-making. They need speed, and good working memory. For long-term traders, analytical skills are paramount.

For both, I would add, knowing how to deal with “the emotional factor” is very important. Many traders get very frustrated when bets don’t go the way they expected, and become paralyzed or make non-logical decisions. Others may lose concentration and focus when they get fatigued, and make impulsive decisions. But I would stress that there is more to trading success than controlling emotions. It takes talent, skill, and a constant learning process. I would also emphasize that, yes, we can train and get better at many things, but it is equally important to ensure an optimal fit between our trading talents and interests: the markets we trade and the ways we trade them. There has to be a fit between what we’re good at and the opportunities afforded by a particular market and trading style.

## **Programs: now and in the future**

**Alvaro: let’s now talk about the tools you mentioned earlier. What training programs are available now and which ones can you foresee will be available in the future?**

Brett: First, I find that Dr. Elkhonon Goldberg’s metaphor of a gymnasium for the brain is very appealing. We will be seeing more and more tools for cognitive and brain fitness. Dr. Goldberg cites considerable research that indicates we can improve the functioning of our frontal cortex - home of our executive functions such as our reasoning, planning, judgment, analysis, and problem-solving -, through structured exercises, much as we can build our muscles in the gym.

Today, traders have very realistic simulation programs that can help them identify market patterns and improve decision-making. True, as Professor Gopher said in your interview with him, what matters is the cognitive fidelity of those simulations, and how they will help traders see new, non-historical, patterns. But, at the very least, existing simulation packages help traders learn very quickly how to identify a wealth of recurring patterns in markets.

Finally, I work with many traders on their emotional reactions—especially new traders. Behavioral techniques can be very helpful to develop calmer, open-minded, attitudes. You linked my blog post that stressed the need to keep an open mind and avoid missing unexpected “Gorillas in the market”; we need to be aware of and manage the narrowing of our attention that usually follows hyperfocus. For the many people out there who become angry and frustrated after trading losses, I recommend exercises such as deep breathing and visual imagery, which, after a period of practice, can be applied very quickly to our work when we need it. These techniques can be reinforced by the use of biofeedback programs that provide real-time visual feedback on the trader’s “internal performance”, revealing whether they are in the Zone of optimal learning and performance or becoming stressed, anxious and impulsive.

It is important to understand the role of emotions: they are not “bad”. They are very useful signals. It is important to become aware of them to avoid being engulfed by them, and learn how to manage them.

**Alvaro: Prof. Steenbarger, many thanks for your very illuminating comments, both on trading and on improving performance overall. Any parting thoughts for our readers?**

Brett: Let me go back to the key findings of my new book. One, people who aspire to be top performers in any field must build on what comes naturally to them, in order to be truly motivated and absorbed in constant learning. Two, they will need to structure programs to develop their skills and work these programs diligently. Because elite performers do what comes naturally, they become absorbed in the development of their skills. If you have to motivate yourself to work at something, it’s probably not your calling.

**Alvaro: Brett, many thanks.**

Brett: a pleasure.

## 8. TRAINING ATTENTIONAL CONTROL, AND DEVELOPMENT TRAJECTORIES-DR. BRADLEY GIBSON



Professor Bradley Gibson is an Associate Professor in the Department of Psychology at University of Notre Dame, and Director of the Perception and Attention Lab there. He is a cognitive psychologist with research interests in perception, attention, and visual cognition. Gibson's research has been published in a variety of journals, including Journal of Experimental Psychology, Human Perception and Performance, Psychological Science, and Perception & Psychophysics.

In 2006 he conducted the first independent replication study based on the Cogmed Working Memory Training program we discussed with Dr. Torkel Klingberg.

A local newspaper introduced some preliminary results of the study Attention, please: Memory exercises reduce symptoms of ADHD. Some quotes from the articles:

- “The computer game has been shown to reduce ADHD symptoms in children in experiments conducted in Sweden, where it was developed, and more recently in a Granger school, where it was tested by psychologists from the University of Notre Dame.
- Fifteen students at Discovery Middle School tried RoboMemo during a five-week period in February and March, said lead researcher Brad Gibson
- As a result of that experience, symptoms of inattention and hyperactivity were both reduced, according to reports by teachers and parents, Gibson said.
- Other tests found significant improvement in “working memory”, a short-term memory function that’s considered key to focusing attention and controlling impulses.
- RoboMemo’s effectiveness is not as well established as medications, and it’s a lot more work than popping a pill.
- Gibson said Notre Dame’s study is considered preliminary because it involved a small number of students. Another limitation is that the study did not have a control group of students receiving a placebo treatment.”

We feel fortunate to interview Dr. Gibson today.

**Alvaro Fernandez (AF):** Dr. Gibson, thanks for being with us. Could you first tell us about your overall research interests?

**Dr. Bradley Gibson (BG):** Thanks for giving me this opportunity. My primary research interest is Attention and Attentional control: how we prioritize information in order to process it without being overwhelmed by it. This is an executive function that helps each of us manage the tension between the outside environment and our self-directed preferences and goals. This is more complex than it sounds. For example, we must learn how to be focused on one task but be able to pay attention to the overall picture at the same time—you may be aware of Chandler’s experiment on inattention blindness.

**AF:** Yes, we posted about that experiment recently. Let’s not talk too much about it, so readers can try it themselves here if they want. Now, tell us about the Attention Lab, we understand it is nicely multi-disciplinary.

**BG:** It is. We have 5 graduate students, and work together with Prof. Dawn Gondoli, who studies development psychology and socioemotional development. We want to bridge a number of domains to better explain the transition from childhood to adolescence. We are interested in how kids develop cognitive and executive functions. ADD/ ADHD is an extreme case where the normal development trajectory does not apply.

### Westerberg et al. (2004)

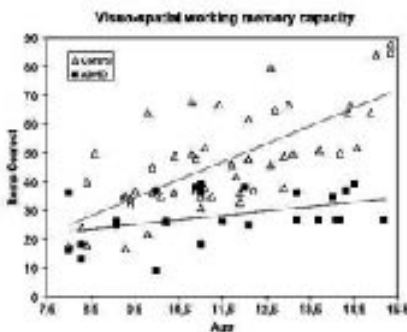


Fig. 1. Working memory scores for all participants in the main study ( $N=80$ ). Linear regression lines for ADHD and control group, respectively.

**AF:** Tell us about ADD/ ADHD and development trajectories.

**BG:** There is a very insightful study by Walter Mischel on preschoolers aged 4 and 5. Some of them had a better ability to control their attention and delay gratification (measured as the capacity not to immediately eat a marshmallow but to wait for a larger posterior reward), and those kids were shown, 14 years later, to be happier, have better overall school grades, score around 200 points higher in the SAT, and, when tested, display better executive functioning overall.

The study showed that there are individual differences at very young ages—and the important implications from this fact. Now, the part that I consider more exciting is that these differences are not fixed. Training is very important: attentional control is one of the last cognitive abilities to develop in normal brain development and, as Prof. Daniel Gopher’s research has shown, can be trained at any age. What we are studying is how to help kids that for one reason or another start from a bad development trajectory get into a more positive one as quickly as possible. This is why we contacted Cogmed to

conduct a small replication study of their Working Memory Training program. We wanted to see if we can enhance, accelerate, the development of working memory and executive functioning.

**AF: We could see this as a “snowball” effect. If kids are well-equipped to engage in a number of demanding activities, they will, and will only get better at them. If they struggle with them, they will not participate, and not “exercise those muscles” so the gap will only grow. What did the replication study show?**

BG: The “snowball” metaphor is a good one. The study we conducted was a small one and we did not have a control group, so it was not as rigorous as the original research conducted by Dr. Kingberg and the Karolinska Institute. However, the results were very positive. Even better than the original results. We saw that Cogmed working memory training led to cognitive improvements-increased verbal working memory and abstract reasoning (measured by Ravens)- and, more importantly, to the reduction in ADHD symptoms as measured both by parent and teacher ratings. The study has been accepted for presentation by the Society for Research in Child Development. I will present the results at their conference in Boston in March.

**AF: Please send us the paper when ready. Now, working memory is a very important cognitive ability for all of us. What other applications can you envision for well-designed and structured working memory programs?**

BG: I can easily see the relevance in 2 fields. One, professional sports. Two, military training. The Army’s Build Better Soldier initiative is very interested in developing resistance and in cognitive enhancements. This would be a natural enhancement, free of secondary and unexpected side-effects of other interventions such as drugs and brain implants. We are right now conducting another study, this one focused on working memory training for healthy college students, to see if the intervention can also be relevant to non-ADD/ ADHD populations and could then be of interest for the Army.

**AF: Professor Gibson, many thanks for being with us. You are doing a lot of interesting work, please keep up in the loop.**

BG: the pleasure has been mine. I hope to talk to you soon.

## 9. COGMED VIDEOGAME FOR WORKING MEMORY TRAINING - DR. TORHEL KLINGBERG



Wikipedia says “Recent studies suggest that Working Memory can be improved by working memory training (Klingberg et al., 2002)...Perhaps of greater importance, another study has found after a period of working memory training an increase in a range of cognitive abilities and an increase in IQ test scores of approximately 8%.”

A search for “Torkel Klingberg” in PubMed returns 26 papers published in peer-reviewed publications such as the Journal of the American Academy of Child & Adolescent Psychiatry, Journal of Cognitive Neuroscience, and Nature Neuroscience.

We are happy to launch our Neuroscientist Interview Series with an interview with Dr. Torkel Klingberg.

**Alvaro Fernandez (AF):** Welcome. Can you let us know where you work, and what your Lab does?

**Dr. Torkel Klingberg (TK):** I have a professorship at Karolinska Institute, and lead the Developmental Cognitive Neuroscience Lab, part of the Stockholm Brain Institute. The lab is addressing the questions of development and plasticity of working memory. We do that through several techniques, such as fMRI, diffusion tensor imaging to look at myelination of white matter in the brain, neural network models of working memory and behavioral studies. In addition, I am a scientific advisor for Cogmed, the company that developed and commercializes RoboMemo.

**AF:** What studies have you published so far? What studies are in the pipeline, and will be published soon?

**TK:** You can find a complete list, and the studies themselves, at the lab homepage. Among our studies are three studies on the effect of working memory training: Klingberg et al. 2002, 2005 and Olesen et al. 2004. We have recently submitted two papers on the effect of training in combination with medication, and the effect of training on school performance.

**AF:** What are the highlights of your research so far?

**TK:** Our paper from 2004 in Nature Neuroscience, on the effect of working memory training on brain activity, and the 2005 randomized, controlled clinical trial that showed the impact of working memory

training specifically in kids with ADD/ ADHD, have caught most public attention, including references in Scientific American.

My other research concerns the neural basis for development and plasticity of cognitive functions during childhood, in particular development of attention and working memory.

In short, I'd say that we have shown that working memory can be improved by training and that such training helps people with attention deficits and it also improves reasoning ability overall.

**AF: What are the effects in every-day life for a child with attention deficits?**

TK: When looking at the 1,200 children who have trained in Cogmed's Stockholm Clinic since start, the most common effects are sustained attention, better impulse control and improved learning ability. Parents often report that their children perform better in school and are able to keep up a coherent conversation more easily after training. Being able to hold back impulses, such as anger outbursts, and keeping better track of one's things are other every-day life benefits.

**AF: How are you making the program available?**

TK: All rights are with Cogmed, who is making this available in Sweden and starting to offer this to selected clinics in the US this year. The program is called RoboMemo Working Memory Training Program.

**AF: What do you expect that we will learn over the next 5 years in the field of Brain Fitness Programs and cognitive training?**

TK: I think that we are seeing the beginning of a new era of computerized training for a wide range of applications. Our studies has mostly been aimed at individuals with marked problems of inattention, but there is a wider zone concerning what you define as attention problems, and we will see how RoboMemo can help a larger part of the population in improving cognitive function.

**AF: What will you talk about at CHADD?**

TK: I will present the data from our published studies on ADHD, as well as some new data from independent researchers in US universities that confirm our findings concerning the effect of working memory training.

**AF: You are writing a book, correct? what is it about?**

TK: The book is a popular science book about working memory, in the lab and in daily life. It will be out in March in Sweden and we are currently looking for a US publisher.

**AF: Dr. Klingberg, thanks for your time.**

TK: My pleasure.

## 10. “BRAIN TRAINING AND “BRAIN-ISM” IN JAPAN” -GO HIRANO



Today we are traveling to Japan. Go Hirano is a serial Japanese entrepreneur who has been exploring neuroscience-based opportunities in Japan, having recently created the company NeuWell (neuroscience for wellness). NeuWell and SharpBrains are exploring opportunities together to bring world-class programs to Japan, and we thought that SharpBrains’ blog readers may be interested in learning about trends in Japan.

### KEY TAKE-AWAYS:

- People in Japan devour any product with brain-related claims
- But there has been a recent backlash against children videogames, so game developers have started to focus on older audiences with (mostly unproven) brain-health-improving games
- The market is ripe for programs with proven research and tangible benefits

**AF:** Hirano-san, tell us a bit about yourself and how you became interested in applied neuroscience.

**GH:** after helping launch one of the first DSL providers in Japan, I started to wonder what the next bigger value for society would be. I have always been fascinated by brain research, so I started to explore opportunities to help bring to market neuroscience-based programs to help students do better in exams, and adults age in brain-friendly ways.

**AF:** what is the state of Brain Fitness and Brain Training in Japan? what are the most popular applications so far?

**GH:** I think people understand the concepts of Brain Fitness and Brain Training. If one method or product/service sounds a bit scientific there are people who would try it for fun and curiosity. However, majority of the people know that many existing ones have low returns on efforts and time. So far, the most popular application was anti-aging, and product was Dr. Kawashima’s book of calculations and oral reading for adults since it made people to get the concept of brain training.

**AF:** Japan population’s average age is getting older probably at the fastest speed on earth, and people there have been exposed to videogames for a long while. How do people in Japan react towards programs and games that make brain-related claims?

GH: In any bookstore, there always is a section for brain books where you can find names like Takeshi Yoro, Takashi Tachibana, Ryuta Kawashima, Tony Buzan, Steven Pinker, V.S. Ramachandran and so on. TV variety shows regularly come up with Brain specials. It is hardly deniable that brains enchant Japanese people. We love brain training.

Long before Dr. Olesen, Dr. Westerberg and Dr. Torkel Klingberg published their very-well-received paper about working memory training (titled Increased prefrontal and parietal activity after training of working memory), brain-training services had been available here. “Speed Listening” advertisements say “Why haven’t we come up with this idea before?”, and the idea is that by listening 2x speed, your brain works 2x faster. I believe it was there from the 70s and, even now inside the paper bag from bookshop you can find its brochure when you buy books. World popular speed-reading has its Japanese version of propaganda that it not only speeds up your reading but also your brain and even “activates” your right brain. This is not based on actual research, but many people believe it.

There were two times of “brain boom” in the past and Brain Imaging created a third one most recently. Dr. Kawashima claimed calculations and oral reading are good to develop kids’ brains in the book for children “Jibun no Nou wo Jibun de Sodateru (Develop your own brain)” in 2001. In the book, gaming was said to reduce prefrontal activation and have bad or no benefit for kid’s brain. He compared the fMRI image of someone doing simple calculations and playing games, and apparently the image of the former showed more activities. To see the activities inside the brain was fresh for people, but the methodology and logic was not reviewed by any scientific publication. It was published by a company that provides a franchised chain of learning classes. The company maintained books at bookstores to create a boom and was very successful. Then they came up with adult version of training book, and sold more than 2 million. Adults and senior people were seriously did addition and subtraction of 1 digit numbers for countless times believing it will maintain and even enhance their brainpower.

This then became the basis for the Brain Age video game (AF’s note: this is a game that is selling very well in Europe and the USA). More recently from him, cooking became good for brain since cooking demands planning and multiple tasks. They demand prefrontal cortex activation, and he showed image of a brain when cooking. A gas company that wants to sell more gas ranges and ovens helped sponsor the research.

**AF: we have heard there has been a backlash recently. Is it more of a scientific, or consumer one?**

GH: Scientific for adults’ games, consumer for kids’ ones. In 2001, another researcher, Dr. Akio Mori wrote an article called “Gemu(=Game) Nou(=Brain) no Kyofu (The Fear of Game Brain)”. He created his own EEG machine and gathered the data of people who frequently play games and people who do not. He found the “beta-wave” from frequent game players that are “same as senior people with

dementia". That, he said, is because of lack of activities in their prefrontal cortex, and that means more probabilities for lower academic performance and crime. Though his equipment was not verified, and he was said to get confused about alpha and beta wave of EEG, parents and education authorities like municipal education committees loved his book and invited him for lectures and conferences. His new book in 2006 became the recommended book of the year from the National PTA Committee.

The sales of software on home game machines have declined from its peak of 533 billion yen in 1997 to its 53%, 315 billion yen in 2005. Dr. Mori's book and phenomena was the finishing blow to the industry, especially for kids' games. Therefore game companies had to find new targets who had never played game machines, like middle-aged group and women. Brain Age was preceded by a Sega's game box that was the natural next step after the book from Dr. Kawashima I mentioned.

For women, games on English training, language support for traveling, cooking, common sense and etiquette are provided. These new sort of serious games not only helped the handheld game machine stay always out of stock and reach multi-million sales, but also successfully gave the image that games are, depending on the software, good for the brain and education. Funny it is that the authority backing the campaign is the same Dr. Kawashima who originally recommended kids to calculate rather than to play games for the benefit for brains.

No wonder, authorities from the academic and medical societies of the neuroscience field started criticizing scientifically unproven or no evidence-based products, books and opinion makers. This year, neuroscience researchers started a group called "Nou wo Ikasu (Make the best out of Neuroscience)" and have frequent meetings of researchers where people can join. I visited one of those and saw participants were busy not only criticizing them but also hinting that authorization criteria by neuroscientists are being prepared.

However, adult consumers keep devouring such games. Dentsu, the biggest advertising agency announced the No.1 Consumer-chosen Choice of the Product 2006 was game software and books for brain training. So far, apparently the demands went far out before the real neuroscience comes to fill. Between the balance of body and brain, Japanese people are one of the extreme that is most brain-ism oriented, to the brain side, says Dr. Yoro. It seems we, brain-ism extremists, cannot wait the real neuroscience to come.

**AF: What would you suggest that non-Japanese companies do if they want to bring their programs to Japan?**

GH: I would suggest to define and attack from a target where you can provide very tangible value based on scientific facts. If you already have actual results in US or your market, they will work. People

are tired of “just for fun” products and wait for results that is worth effort and time based on science. Since the demands are mounting, communication and good research is all what matters. Since neuroscientists are nervous about “Far Out” products, products’ research background will be asked more than past.

**AF: What are some specific neuroscience-based programs that you think may find a market in Japan?**

GH: We are very excited about the potential to introduce Cogmed Working Memory Training here in Japan, where the ADD/ ADHD problem is becoming more acknowledged. Also, given that being student here is very stressful, we think biofeedback-based programs for peak performance and stress management may be very helpful to improve overall learning and test performance. Not only for students, but also for traders-we are following with great attention SharpBrains’ series of interviews and posts based on Brett N. Steenbarger’s research on Trader Performance and The Psychology of Trading.

**AF: Go, thanks for updating us on what is going on in Japan. Please keep us informed.**

GH: I will happily do so. We will soon have ready an English website and blog.

**AF: We will gladly let our readers know when those are ready**

## IV. GLOSSARY

**Brain Fitness:** the general state of good, sharp, brain and mind, especially as the result of mental and physical exercise and proper nutrition.

**Brain Fitness Program:** structured set of brain exercises, usually computer-based, designed to train specific brain areas and functions in targeted ways, and measured by brain fitness assessments.

**Chronic Stress:** ongoing, long-term stress. Continued physiological arousal where stressors block the formation of new neurons and negatively impact the immune system's defenses.

**Cognitive training (or Brain Training):** variety of brain exercises designed to help work out specific "mental muscles". The principle underlying cognitive training is to help improve "core" abilities, such as attention, memory, problem-solving, which many people consider as fixed.

**Cognitive Reserve (or Brain Reserve):** theory that addresses the fact that individuals vary considerably in the severity of cognitive aging and clinical dementia. Mental stimulation, education and occupational level are believed to be major active components of building a cognitive reserve that can help resist the attacks of mental disease.

**fMRI:** functional magnetic resonance imaging (fMRI) is a non-invasive neuroimaging technique that enables researchers see images of changing blood flow in the brain associated with neural activity. This allows images to be generated that reflect which structures are activated (and how) during performance of different tasks.

**Heart Rate Variability (HRV):** describes the frequency of the cardiac cycle, and is one of the best predictors of stress and anxiety. Our hear rate is not "flat" or constant: HRV measures the pattern of change.

**Mindfulness-Based Stress Reduction (MBSR):** yoga and meditation practices designed to enable effective responses to stress, pain, and illness.

**Neurogenesis:** the process by which neurons are created all throughout our lives.

**Neuroimaging:** techniques that either directly or indirectly image the structure, function, or pharmacology of the brain. Recent techniques (such as fMRI) have enabled researchers to understand better the living human brain.

**Neuroplasticity:** the brain's ability to reorganize itself by forming new connections throughout life.

**PubMed:** very useful tool to search for published studies. "PubMed is a service of the U.S. National Library of Medicine that includes over 16 million citations from MEDLINE and other life science journals for biomedical articles back to the 1950s. PubMed includes links to full text articles and other related resources."

**Working memory:** the ability to keep information current for a short period while using this information. Working memory is used for controlling attention, and deficits in working memory capacity lead to attention problems. Recent research has proven that working memory training is possible and helpful for people with ADD/ ADHD.