



BRAIN FITNESS 101:
Answers to Your
Top 25 Questions

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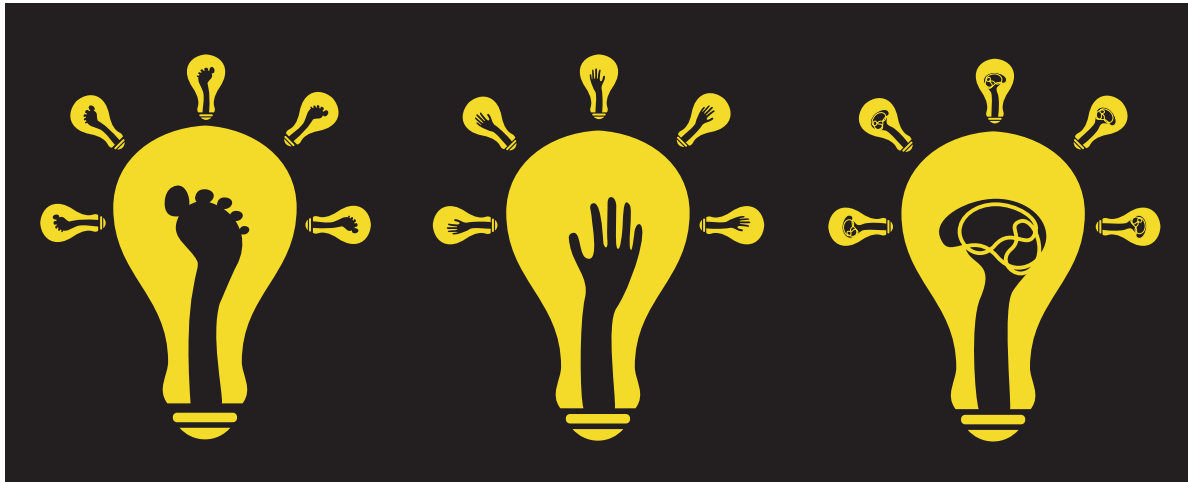
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Why this guide? You may think a crossword puzzle is the ultimate mental workout. Or believe that stress is not that bad for you – and besides, who can avoid it these days? Or be surprised to learn that the brain is indeed another part of our body that we can exercise. Literally.

Within the last decade, neuroscientists have shown that we can exercise our brains and “mental muscles”. We can sharpen our memory, concentration, decision-making, planning skills, reaction time, capacity to learn, ability to manage stress, and other mental abilities with practice, like any muscle in the body.

SharpBrains is the first online brain fitness center dedicated to providing the most updated information and personalized brain fitness programs developed by neuroscience teams worldwide. No other website, to our knowledge, offers these science-based programs in a way that makes it easy for you find the right program and then support you for success.

This guide aims to provide an introduction to the concept, science, and practice of brain fitness. Our team of scientists and writers answer in plain English 25 of the most common questions we have heard. If you have additional questions, please send us a note at information@sharpbrains.com. We would love to hear from you!

We first define what brain fitness is and provide the necessary context to understand what brain fitness programs are and how they work. Given that healthy aging, or healthy development at all ages, is something we all aspire to, we devote a separate section to it.

Brain exercise may be the most recent pillar for brain fitness, but stress management, nutrition and physical fitness are also important. We also want to build a bridge between science and daily life by writing about specific questions relating to kids, executives, and women’s health.

Finally, we offer extracts from a number of interviews with leading scientists that we have published in our blog. To read the full interviews, please go to www.sharpbrains.com/blog.

The consumer health information provided by SharpBrains is for informational purposes only and is not a substitute for medical advice, diagnosis, or treatment of any medical conditions. Please consult your physician with any questions or concerns you may have regarding your health and before starting any fitness regimen.

SUMMARY

When planning a brain healthy lifestyle, be creative in finding what works for you. A guideline to remember is that there are four essential pillars to maintaining a healthy brain that functions better today and tomorrow. These pillars are:

1) Physical Exercise, 2) Mental Exercise, 3) Good Nutrition, 4) Stress Management

How do you develop a lifestyle that includes all four pillars? Let's look at each one separately.

1. Physical Exercise

- Start by talking to your doctor, especially if you are not currently physically active, have special health concerns, or are making significant changes to your current program.
- Set a goal that you can achieve. Do something you enjoy for even just 15 minutes a day; you can always add more time and variety later.
- Schedule exercise into your daily routine. It will become a habit faster if you do.
- If you can only do one thing, do something cardiovascular, meaning something that gets your heart beating faster. This includes walking, running, skiing, swimming, biking, hiking, tennis, basketball, playing tag, ultimate Frisbee, and other similar sports/activities.

2. Mental Exercise

- Be curious! Get to know your local library and community college, look for local organizations or churches that offer classes or workshops, or join a book club.
- Do a variety of things, including things you aren't good at (if you like to sing, try painting or dancing).
- Work puzzles like crosswords and sudoku or play games like chess and bridge.
- Try a computerized brain fitness program for a customized workout.
- If you can only do one thing, learn something new every day.

3. Good Nutrition

- Eat a variety of foods of different colors without a lot of added ingredients or processes.
- Plan your meals around your vegetables, and then add fruit, protein, dairy, and/or grains.
- Add some cold-water fish to your diet (tuna, salmon, mackerel, halibut, sardines, and herring), which contain omega-3 fatty acids.
- Go to the United States Department of Agriculture website at www.mypyramid.gov to learn what a portion-size is, so you don't overeat.
- Try to eat more foods low on the Glycemic Index (learn more at www.glycemicindex.com).
- If you can only do one thing, eat more vegetables, particularly leafy green ones.

4. Stress Management

- Get regular cardiovascular exercise.
- Try to get enough sleep each night.
- Keep connected with your friends and family.
- Practice meditation, yoga, or some other calming activity as way to take a relaxing time-out.
- Try training with a heart rate variability sensor, like the one in the emWave® Stress Management programs.
- If you can only do one thing, set aside 5-10 minutes a day to just breathe deeply and recharge.

Question #1: What Are Cognitive Abilities?

ANSWER

Cognitive abilities are the brain-based skills you need to carry out any task – from the simplest to the most complex. Every task can be broken down into the different cognitive skills needed to complete that task successfully. Exercising these abilities can help improve their performance. Here are a few definitions:

1. **Alternating Attention:** the ability to shift your focus of attention quickly.
2. **Auditory Processing Speed:** the time it takes to perceive relevant auditory stimuli, encode and interpret it, and then make an appropriate response.
3. **Central Processing Speed:** the time it takes to encode, categorize, and understand the meaning of any sensory stimuli.
4. **Conceptual Reasoning:** the ability to form abstract concepts and use deductive and/or inductive logic.
5. **Divided Attention:** the capability to recognize and respond to multiple stimuli at the same time.
6. **Fine Motor Control:** the ability to accurately control fine motor movements.
7. **Fine Motor Speed:** the time it takes to perform a simple motor response.
8. **Focused (or Selective) Attention:** the ability to screen out distracting stimuli.
9. **Response Inhibition:** the ability to avoid automatically reacting to incorrect stimuli.
10. **Sustained Attention:** the ability to maintain vigilance.
11. **Visuospatial Classification:** the ability to discriminate between visual objects based on a concept or rule.
12. **Visuospatial Sequencing:** the ability to discern the sequential order of visual objects based on a concept or rule.
13. **Visual Perception:** the ability to perceive fixed visual objects.
14. **Visual Processing Speed:** the time it takes to perceive visual stimuli.
15. **Visual Scanning:** the ability to find a random visual cue.
16. **Visual Tracking:** the ability to follow a continuous visual cue.
17. **Working Memory:** the ability to hold task-relevant information while processing it.

KEY POINTS

- Cognitive abilities are mental skills necessary to complete any task.
- Cognitive abilities, like any muscle, if not used regularly, decrease over time. If exercised properly, they can improve over time.

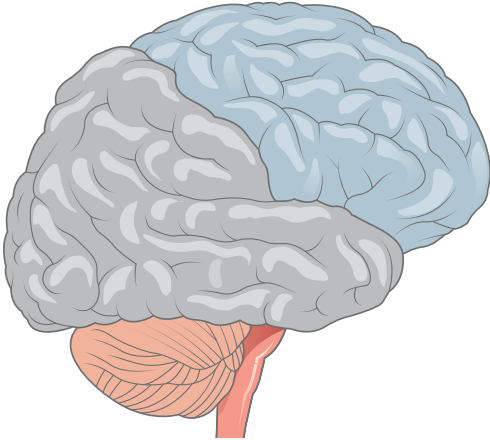
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Question #2: Are Cognitive Abilities The Same Thing As Intelligence?

ANSWER

They are related and intertwined, but not the same thing.



Cognitive abilities are the brain-based skills and mental processes needed to carry out any task and have more to do with the mechanisms of how you learn, remember, and pay attention rather than any actual knowledge you have learned.

The term IQ, or Intelligence Quotient, generally describes a score on a test that rates your cognitive ability as compared to the general population. IQ tests are designed to measure your general ability to solve problems and understand concepts. There is a high positive correlation between IQ and success in school and the work place, but there are many, many cases where IQ and success do not coincide.

For the most part, adult IQ scores don't significantly change over time, but there is evidence that maintaining an intellectually stimulating atmosphere (by learning new skills or solving puzzles, for example) boosts your cognitive abilities, similar to the way maintaining an exercise regimen boosts physical ability.

KEY POINTS

- Cognitive abilities can be trained and improved throughout life.
- Intelligence is a test score that stays relatively static in adulthood.
- Cognitive processes dealing with novelty (fluid intelligence) are just as important as acquired knowledge (crystallized intelligence). It takes both to keep your mental edge.

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Question #3: What Is Brain Fitness?

ANSWER

Brain fitness is your brain's ability to readily create new brain cells, called neurons, with more connections between them. Research from neuropsychology and neuroscience shows that good brain health can lead to good brain fitness, which in turn, can lead to a sharper memory, faster processing of information, better attention, and other improved cognitive skills.

New technologies and brain imaging devices have shown that brain cells grow in active areas of the brain. Therefore you want to challenge your brain with a variety of different types of tasks regularly in order to keep as much of your brain as active as possible. Brain fitness can be cultivated by formal education, an active lifestyle, lifelong learning, as well as specific exercises designed to challenge your cognitive skills. Furthermore, healthy lifestyle choices such as regular physical exercise, good nutrition, stress management, and adequate sleep foster brain fitness. On the other hand, chronic stress, anxiety, depression, and aging can decrease brain fitness, as well as general health.

Practicing cognitive skills encourages their preservation and development at all ages. Research has shown that the more education people have and the more their minds have been occupied, the less they suffered from age-related decline. People who remain intellectually active and engage in hobbies reduce the risk of Alzheimer's disease by one third. All of these studies suggest that cognitive training — exercising your brain — protects your brain against decline in memory, concentration, and information processing.

KEY POINTS

- Brain fitness is the state of having quick, efficient, and flexible cognitive processing.
 - Brain fitness is likely due to increased number of neurons, functional connections between neurons, and processing speed.
 - Brain fitness can be improved with physical exercise, mental stimulation, good nutrition, and stress management.
 - Regular mental stimulation should challenge you, use different skills, and teach you new things.
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Question #4: Is Brain Fitness Scientifically Proven To Improve Cognitive Skills?

ANSWER

Thanks to new neuroimaging techniques, said to be “as important for neuroscience as telescopes were for astronomy,” and other state-of-the-art research methods, neuroscientists are finding that exercising our brain influences the generation of new neurons and their connections.

Previous beliefs about our brain and how it works have been proven false. Some beliefs that have been debunked include claims that adult brains cannot create new neurons (proven false by Princeton scientist Dr. Elizabeth Gould, UC-Berkeley scientists Dr. Marian Diamond and Dr. Mark Rosenzweig, and Salk Institute’s Dr. Fred Gage), notions that working memory has a maximum limit of 6 or 7 items (proven false by Karolinska Institute’s Dr. Torkel Klingberg), and assumptions that the brain’s basic processes can not be reorganized by repeated practice (proven false by UCSF’s Drs. Paula Tallal and Michael Merzenich).

The “mental muscles” we can train include attention, stress and emotional management, memory, visual/spatial skills, auditory processes and language, motor coordination, and executive functions like planning and problem solving.

While there is much basic research around neuroplasticity, cognitive reserve, cognitive training, and neurofeedback, that research alone is not enough to show the effect of specific brain fitness programs. To be useful, the specific skills exercised in brain fitness programs need to transfer into our overall cognitive abilities and enable you to have a better memory, concentration, decision-making, planning skills, reaction time, capacity to learn, ability to manage stress, or other mental abilities.

The scientists who have created the programs we feature at SharpBrains have published extensive studies showing the effectiveness of their products.

KEY POINTS

- Neuropsychology and the understanding of brain mechanisms of cognition took off in 1861 when Pierre-Paul Broca published a paper on brain localization of language.
- Cognitive training and behavioral therapy has been in use in hospitals and the military for 40 years or more.

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Question #5: Do I Really Need A Brain Fitness Program?

ANSWER

A structured brain fitness program can help your mind stay in top shape, work more efficiently, and slow the effects of age-related cognitive decline. When neurons, the cells in your brain, are used, the activity keeps them healthy and creating functional connections with neighboring neurons, which increases their activity and health in a positive cycle. Exerting your brain may even lead to the creation of new neurons and rescue the neurons you already have from decay, the “use it or lose it” phenomenon. Without stimulation, these same neurons are determined to be nonessential and may be destroyed by your body.

Recent research shows that the brain remains plastic and trainable throughout life. In a study published in the *Journal of the American Medical Association*, significant percentages of the participants age 65 and older who trained for five weeks improved their memory, reasoning and information-processing speed.

When we learn, we create physical changes inside our heads. By practicing a skill, we repeatedly stimulate the same area of the brain, which strengthens existing neural connections and creates new ones. Over time, we can become more cognitively efficient, using fewer neurons to do the same job. And the more often we fire up certain mental circuits, the easier it is to get them going again.

Conclusion: Putting in the time now to exercise your brain will help you build the cognitive reserve you need as defense against aging later.

“It's wise to start mental workouts even in one's 40s, 30s, or 20s,” says Dr. George Rebok, professor at the Johns Hopkins Bloomberg School of Public Health. “We haven't yet developed a culture of mental exercise like our culture of physical exercise, but we should,” he says.

KEY POINTS

- Brain fitness requires mental stimulation, physical fitness, good nutrition, and stress management.
- A good program of mental stimulation must provide novelty, challenge, and cognitive variety.
- Use it or lose it! (Or even better, “use it and improve it!”)

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Question #6: How Do I Start A Brain Fitness Program?

ANSWER

Do something. Anything. Essentially doing anything is better than nothing. So, if you enjoy playing strategy games like bridge and chess, then great – keep doing it. You’re working your spatial, memory, and planning skills, among others. Much like physical fitness, if you do something you enjoy, you’re more likely to stick with it over time. Find activities that use your brain and fit into your life.

The drawback to relying on social and recreational activities for your brain exercise is that they tend to be incomplete. For a more structured and comprehensive mental workout, try a computer-based program. These programs have the ability to assess your abilities at the start and create a regimen that will improve both your strengths and weaknesses. The programs also adapt to your performance to keep on challenging you over time.

Physical exercise and good nutrition will support your commitment to brain health. Passive activities like television watching will do very little to improve and stimulate your brain. And chronic stress will actually damage your brain.

Use “down” time to take a much-needed break. If you find yourself with ten minutes in the shower, in your car, on a walk, or even at your desk, try pausing to focus on your breathing and systematically relaxing all your muscles. Continued elevated stress levels can actually kill your brain cells, as well as cause other physical ailments. Therefore, just a few minutes of relaxation on a regular basis will go a long way to improving both your brain and overall fitness.



KEY POINTS

- Any activity that requires you to use your brain in new, challenging ways helps your brain.
- Recreational activities like bridge, chess, puzzles, sudoku, various classes, reading, and sports are all better than passively watching television.
- Add a computerized brain fitness program to get a complete mental workout on a regular basis.

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Question #7: I Already Do Crosswords And Sudoku. Do I Need Anything Else?

ANSWER



What you're doing is fun and can't hurt. But nor is it complete. Recent recommendations made by a panel of experts reviewing a poll by the American Society on Aging stated: "A single activity, no matter how challenging, is not sufficient to sustain the kind of mental acuity that virtually everyone can achieve."

Using your brain to solve creative challenges is excellent practice and will help slow down the effects of aging. The limitation with your current brain workout program is that it does not have enough variety or novelty to work out all your mental muscles. Have you ever seen the guys in the gym with the buff upper bodies supported by little chicken legs? The same thing can happen in your brain. Just as you cross-train in your physical fitness routine (mixing cardio with strength training and flexibility) to get a balanced workout, you need to cross-train your mental fitness to exercise your brain through motor coordination, emotional understanding, memory, focus and attention, sensory processes, communication, language skills, and mental visualization.

Furthermore, how can you gauge your improvement if you don't have a way to measure it? Using computer software to give you a baseline score, workout routines for your brain, and follow up tests gives you a measure of your improvement. So basically, right now you

may be doing a highly focused workout using language and memory but with inconsistent challenge and limited feedback. A structured program should give you assessment, novelty, and performance-based challenge while still being fun. That mental stimulation can dramatically increase the rate of neurogenesis, or the creation of new neurons and the connections between neurons.

A randomized controlled double-blind study published in August 2006 "demonstrates that intensive, plasticity-engaging training can result in an enhancement of cognitive function in normal mature adults." Challenging cognitive function leads to learning and neurogenesis. So keep doing crosswords and sudoku, especially if you enjoy them, but don't neglect the rest of your brain!

KEY POINTS

- Recreational activities like crossword puzzles, sudoku, bridge, chess, poker, etc. are all good for you and better than doing nothing.
- BUT, recreational activities are limited in their range of mental cross-training as well as difficult to control for both challenge and novelty.

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Question #8: What Advantages Do Computer Programs Offer Over Paper-based Programs Or Live Classes?

ANSWER

Taking classes and reading can be great fun and an easy way to learn something new. Learning something new is always good for your brain. It doesn't even matter so much what you learn as the fact that you are engaging your brain and challenging it.

The limitation with classes is much the same as the trouble with using only recreational games for brain fitness. While they offer many benefits, the actual "workout" can vary dramatically. What if you get a terrible teacher, or the class turns out to be way below your ability – or way above it. Suddenly, what seems like a good idea either doesn't challenge or doesn't support you (not understanding something is stressful). Also, no single class can exercise all of your mental muscles. A great teacher can provide challenging, novel material and, in a small class, even adjust for the level of the students. But in many cases, a single class will only exercise the specific cognitive skills relevant to that class and may be difficult to adjust the level of challenge.

When you use one of the computer-based programs, there is generally an assessment to determine your current ability and where to start exercising. From there, the computer instantly checks your performance and adjusts the challenge so that you are always pushed just a little bit harder. Hard enough to keep you working, but not so hard that you become frustrated and give up.

Furthermore, the computer-based programs have an almost unlimited capability to exercise the same skills with an endless variety of stimuli. This means you get to practice the

skill over time, but in a way that allows it to generalize versus merely becoming good at playing a specific game and nothing else.

By all means, take classes, read, and do engaging things you enjoy. It's all good for your brain. Just don't get lulled into thinking you've got a complete brain fitness program when you don't.

KEY POINTS

- Paper-based and in-person classes are good and better than not doing anything mentally stimulating.
- Like other recreational activities, classes are hard to control for using various mental muscles and providing increasing challenge and novelty over time.

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Question #9: How Do I Know If The Computer-based Programs Work?

ANSWER

Always ask the questions:

What does the specific program look like? How many hours for how many weeks will it take to accomplish what goals? Some programs leave it so open-ended that it is unclear how users are supposed to get what benefits. The program should be clear and easy to follow with a clear sense of where you are headed and how you are getting there.

Who designed the program? What are their credentials? Look for the scientists, universities, and/or hospitals behind the program. A good software program will have many people involved, and particularly some scientists or physicians to be sure it works.

Has the program been tested in rigorous scientific studies? Peer-reviewed academic journals have a lengthy system involved to try to ensure studies are done ethically and are valid. Use a search engine like PubMed (<http://www.ncbi.nlm.nih.gov/entrez/query.fcgi>) to find the names of the scientists behind the program.

Do any benefits transfer to real life and to our cognitive abilities? Effective brain fitness programs transfer into an expanded “mental muscle” or cognitive ability that will help you in real-life challenges beyond the specific game you learned.

Do existing users recommend it? Some programs are more user-friendly than others. Given that we are talking about fitness programs, not medical interventions, the programs must place reasonable demands for you to complete, otherwise you simply may not finish it and not reap the benefits.



KEY POINTS

- Research the product and the names involved with the product to see what has been published.
- Look for articles in high caliber, peer-reviewed journals.
- Ask for referrals.
- Assessments done before you begin and then after your training allow you to track your performance.
- Observe yourself. How do you feel after doing the training? Do you feel sharper?

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Question #10: Why Are So Many Programs Appearing Now?

ANSWER

Although some knowledge about the brain has been around since the days of Ancient Greece and Rome, it really got a boost in the 19th century with some major discoveries in brain localization. Since then, the field has been growing with the amount of knowledge increasing steadily. Yet, due to technical and economic constraints, many of the tools to understand cognition stayed within university, medical, and military research labs where they were inaccessible to most people.

With recent scientific developments, it has become much easier and cheaper to learn more. Research on neuroplasticity and neurogenesis is increasing all the time. With these tools came the scientific evidence that cognitive training is neuroprotective.

As our population ages and faces some of the challenges of getting older, more people are interested in protecting their quality of life. Now that we know there is something we can do about it, the programs are starting to pop up on the market. More and more programs will appear, and SharpBrains will always be on the forefront looking for proven science-based programs that are also fun. Come back and look for recommendations. If we don't talk about a program you've seen, send us a note at www.sharpbrains.com.

KEY POINTS

- Research on cognitive exercise and its clinical applications and tools have been around for a long time in hospitals and the military.
- Gaming has become so popular and widespread, that it is an easy and natural medium to utilize for brain fitness.
- The science is being published showing that brain exercise leads to enhanced neuroplasticity (grows of new neurons and connections between them) throughout life.

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“It’s not like you can practice for a while and then your memory is set,” cautions cognitive researcher Dr. George Rebok, professor at the Johns Hopkins Bloomberg School of Public Health. “It’s like physical exercise in that if you don’t continue to exercise, the muscles atrophy.”

Question #11: Is It Necessary To Train Under The Supervision Of A Doctor Or Other Specialist?

ANSWER

In most cases, no. Brain fitness is not a medical intervention. Fitness is about healthy individuals and the prevention of potential problems. If a person has a serious condition, he or she should always consult a physician.

The field of brain fitness evolved from neuropsychology, which is usually practiced in hospitals or doctors' offices with highly trained specialists administering and interpreting complex tests.

But most of the software programs today are designed to be user-friendly and used in the comfort and privacy of your own home without any outside supervision.

Many programs have a built in coach or teacher to help explain what you are doing in each exercise, why you are doing it, and how you are doing. Others may have a coach or advisor that you can call for support.

SharpBrains provides access to forums moderated by our Head Coach and other coaches. These coaches are available to answer your questions in a timely manner.



KEY POINTS

- Recreational activities have always been done for fun either socially or independently.
- Most computer-based software programs are intended for you to use on your own computer when it suits you. Think exercise and fitness, not medicine.
- A few programs used for people with medical conditions may be supervised or reviewed by the treating neuropsychologist, physician, or other healthcare personnel.

Question # 12: What Does “Normal Aging” Mean? Do We All Age The Same Way?

ANSWER

No. Generally, getting older both reduces your attentional capacity and the capacity for learning new information, and increases your brain processing requirements. Basically, it takes more and more inhibition skills to tune out distractions and stay focused. Individuals will vary in how and when they feel these decreases, but they will eventually occur.

Fortunately, a great deal of research has shown that practicing cognitive skills encourages their preservation and development at all ages. Research into cognitive reserves found that the more education people had and the more their minds were occupied, the less they suffered from age-related decline. People who remain intellectually active and engage in hobbies reduce the risk of Alzheimer’s disease and other dementias by one third. All of these facts show that cognitive training — exercising your brain — protects your brain against decline in memory, concentration, and information processing.

So, plan your brain fitness program now. It’s never too late or too early.

KEY POINTS

- Age-related cognitive decline typically starts at about 40 when your brain processing speed slows down.
- At the same time, older adults have generally acquired more knowledge and wisdom, but may still have difficulties memorizing specific information.
- The more education people have and the more their minds are challenged throughout lifetime, the less they suffer from age-related decline.



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Question #13: Are There Specific Programs For Adults?

ANSWER

Yes, there are science-based software programs designed to provide a comprehensive brain workout specifically for adults who want to maintain an agile and sharp mind.

A good program should include an assessment, a variety of challenging tasks that use different cognitive skills, regular practice, and feedback. It should also be easy to use with minimal computer knowledge and based on scientific research.

The advantage of computerized brain fitness programs is the ability to create an individualized training regimen for your exact level of cognitive skill. No two people are alike, and no two training regimens should be alike. The good programs provide an initial assessment to learn your current level of ability and then work to challenge and improve both your strengths and your weaknesses. The software adapts to your performance and provides tougher challenges as you improve. It can also provide customized training schedules and feedback during and after your training session.

Look for programs that focus on life abilities such as: working memory, visual and auditory short term memory, planning, location memory, naming, time estimation, divided attention, and hand-eye coordination. These are all skills that are trainable and will generalize to your daily life.

KEY POINTS

- In the course of normal aging, brain processing speed slows down.
- Without specific activities to keep your brain

engaged, neurons are more likely to die off without being replaced.

- A good program should include an assessment, a variety of challenging tasks that use different cognitive skills, regular practice, and feedback.

“The generally accepted knowledge about the brain is that it starts going downhill fairly early in life, which is true, and that there is little one can do about changing that pattern, which is not true. Increases in cortical growth as a consequence of stimulating environmental input have been demonstrated at every age, including very old age.”

– Dr. Marion Diamond, Professor of Integrative Biology, UC Berkeley.

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Question #14: Does A Brain Fitness Program Prevent Alzheimer's Disease And Other Forms Of Dementia?

ANSWER

No specific program has been shown to prevent Alzheimer's. However, regular brain exercise can slow the appearance of disease related symptoms. Studies have shown that particularly in the early stages of these diseases, the brain is still able to learn and change.

Learning is neuroprotective by increasing neuronal connections between neurons, increasing cellular metabolism, and increasing the production of nerve growth factor, a substance produced by your body to help maintain and repair neurons.

Building up your cognitive reserve while you're young, aging well, or even are in the early stages of disease will most likely improve your quality of life even as the disease progresses. A larger reserve gives you a backup of neurons to help you continue to be self-sufficient for longer.

Unfortunately, nothing available today can fully prevent these diseases from occurring. However, regular training with the cognitive fitness program can postpone the appearance of the cognitive symptoms and build up your cognitive reserve.

KEY POINTS

- Studies have shown mentally active people have lower rates and later onset of symptoms for Alzheimer's disease and other forms of dementia. These diseases involve a number of variables like family history, physical fitness, nutrition, and brain fitness.
- People who remain intellectually active and engage in hobbies reduce the risk of Alzheimer's disease by one third.



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Question #15: Don't Want To Ever Retire. What Can I Do To Remain Sharp?

ANSWER

Work out, eat well, stimulate your brain, and reduce chronic stress.

Any good brain fitness program must provide you a variety of new challenges over time. Recreational activities like bridge, classes, and crossword puzzles can work your brain and be fun, but a comprehensive scientifically-based program will easily provide you the tools you need to take care of your brain for the rest of your life. A computer-based program can work all of your mental muscles systematically and regularly. It provides novelty, challenge, and stretching practice for your mind.

Fred Gage, PhD at the Salk Institute shows us that using your brain is the best way to optimize your brain function:

“In the natural course of aging there is cognitive decline. We know we lose the ability to generate new neurons with age. We are currently trying to figure out how generate as many neurons as possible to potentially enhance learning or increase the amount of neurogenesis in adults.”

Stress reduction is another major concern. Maintaining your exercise routine and social networks will help a lot in this regard. Make social appointments to go for a walk with a friend or family member. Get a dog. Write letters to friends you haven't talked to in ages. Volunteer in your community. Take ballroom dancing lessons. All these activities will help keep you mentally engaged, physically fit, and socially active.

KEY POINTS

- Provide your brain with regular mental stimulation that is novel and challenging.

- Maintain your social network for both stimulation and stress reduction.

“Research has shown that contrary to popular belief, the brain is constantly undergoing neurogenesis, the development of new neurons and dendrites,” said Dr. Elkhonon Goldberg, Clinical Professor of Neurology at New York University School of Medicine. “Learning and targeted mental exercise promotes neurogenesis – the creation of new neurons – just as muscle growth is promoted through physical exercise.”

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Question #16: Are Yoga And Meditation Good For My Brain?

ANSWER

Yes. It's clear that our society has changed faster than our genes. Instead of being faced with physical, immediately life-threatening crises that demand instant action, these days we deal with events and illnesses that gnaw away at us slowly, without any stress release.

Dr. Robert Sapolsky, in an interview about his book *Why Zebras Don't Get Ulcers*, points out that **humans uniquely "can get stressed simply with thought, turning on the same stress response as does the zebra."** But, the zebra releases the stress hormones through life-preserving action, while we usually just keep muddling along, getting more anxious by the moment.

Prolonged exposure to the adrenal steroid hormones like cortisol, released during the stress response, can damage the brain and block the formation of new neurons in the hippocampus, which is the key player in encoding new memories in your brain. Recent studies have shown these neurons can be regenerated with learning and environmental stimulation, but while short-term stress may improve attention and memory, chronic stress leads indirectly to cell death and hampers our ability to make changes and be creative enough to even think of possible changes to reduce the stress.

What are the best defenses against chronic stress?

1. Exercise strengthens the body and can reduce the experience of stress, depression, and anxiety.
2. Relaxation through meditation, tai chi, yoga, or other techniques to lower blood



pressure, slow respiration, slow metabolism, and release muscle tension.

3. Biofeedback programs that provide real-time information, allowing you to learn effective techniques for reducing stress levels.
4. Empowerment, because attitudes of personal confidence and control of your environment resolve the stress response.
5. Social network of friends, family, and even pets help foster trust, support, and relaxation.

KEY POINTS

- Yoga, meditation, and visualization are all excellent ways to learn to manage your stress levels.
- Reducing stress, and the stress hormones, in your system is critical to your brain and overall fitness.

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Question #17: Are There Herbal And Vitamin Supplements That Will Protect My Memory?

ANSWER

Perhaps. The New England Journal of Medicine published an article debunking DHEA, a steroid precursor to testosterone and estrogen used to fight aging. The conclusion of a two-year study at the Mayo Clinic in Minnesota and University of Padua in Italy showed it did not improve strength, physical performance, or other measures of health. The study's lead author, Dr. Nair said, **"No beneficial effects on quality of life were observed. There's no evidence based on this study that DHEA has an antiaging effect."**

Ginkgo biloba is another over-the-counter memory-enhancing supplement frequently mentioned. Yet, Paul Solomon from Williams College found **"when taken following the manufacturer's instructions, ginkgo provides no measurable benefit in memory or related cognitive function to adults with healthy cognitive function."** Nicholas Burns from the University of Adelaide, Australia found longer-term memory improved in healthy 55-79 year olds, but no other cognitive measure improved for either younger or older participants. Sarah Elsabagh from King's College London found ginkgo initially improved attention and memory. However, there were no benefits after 6 weeks, suggesting that a tolerance develops quickly. Not an overwhelming endorsement.

Omega-3 fatty acids found in cold-water fish such as mackerel, herring, salmon, and tuna look more promising. Giuliano Fontani's work at the University of Siena in Italy associated omega-3 supplementation with improved attentional and physiological functions, particularly those involving complex cortical processing.

What can you do right now?

1. Eat a balanced diet with plenty of green leafy vegetables such as spinach, kale and collards.
2. Get plenty of physical exercise.
3. Stay cognitively active.
4. Reduce your stress.
5. And as always, talk with your doctor about any health concerns.

KEY POINTS

- Omega-3 and omega-6 fatty acids found in cold-water fish may be helpful to long term brain health.
- Ginkgo biloba and DHEA do not appear to help your brain.
- There is still more research to be done and never dismiss the placebo eff

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Question #18: Is Physical Fitness Important?

ANSWER

Yes. According to Fred Gage, PhD, of the Salk Institute for Biological Studies, “We now know that exercise helps generate new brain cells, even in the aging brain.”

According to the research of Richard Smeyne, PhD at Saint Jude Children’s Research Hospital in Memphis, with just two months of exercise there are more brain cells and that higher levels of exercise were significantly more beneficial than lower amounts, although any exercise was better than none. He also found that starting an exercise program early in life to be an effective way to lower the risk of developing Parkinson’s disease later in life.

As little as three hours a week of brisk walking has been shown to halt, and even reverse, the brain shrinkage that starts in a person’s 40s, especially in the regions responsible for memory and higher cognition. The exercise increased the brain’s volume of gray matter (actual neurons) and white matter (connections between neurons).

Increased blood flow to the brain triggers biochemical changes that spur the production of new brain neurons. Brain exercise then protects these fledgling neurons by bathing them in nerve growth factor and forming functional connections with neighboring neurons.

Dr. Kramer said “After only three months, the people who exercised had the brain volumes of people three years younger. This is the first time anyone has shown that exercise increases brain volume in the elderly. It suggests that aerobic exercise can stave off neural decline, and even roll back some normal age-related deterioration of brain structure.”

KEY POINTS

- Exercise improves learning through increased blood supply and growth hormones.
- Exercise is an anti-depressant by reducing stress and promoting neurogenesis.
- Exercise protects the brain from damage and disease, as well speeding the recovery.
- Exercise benefits you the most when you start young.

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Question #19: How Can I Improve My Concentration And My Memory?

ANSWER

Attention is among the most important components of your mental life. By choosing to attend to something and focus on it, you create a personal interaction with it, which gives it personal meaning, making it easier to remember.

One of the main reasons it gets harder for you to learn and remember new things as you age is that your brain's processing speed slows down as you get older. It becomes harder to do more than one thing at the same time, so it's easier to get confused. Your brain may also become less flexible, so it's harder to change learning strategies in mid-stream. All these things mean it becomes harder to focus, but there are techniques to increase your learning performance, even if your processing speed has slowed.

Focus

Alertness, focus, concentration, motivation, and heightened awareness are to a large extent a matter of attitude. Focus takes effort. In fact, many memory complaints have nothing to do with the actual ability of the brain to remember things. They come from a failure to focus properly on the task at hand. If you want to learn or remember something, concentrate on just that one thing. The harder the task, the more important it is to tune out distractions. Make more of an effort not to let yourself get distracted until you've finished what you have to do.

Separate

When you learn something new, take breaks



so that the facts won't interfere with one another as you study them.

Elaborate

Your brain remembers things by their meaning. If you spend a little extra effort up front to create meaning, you'll need less effort later to recall it. Elaboration involves creating a rich context for the experience by adding together visual, auditory, and other information about the fact. By weaving a web of information around that fact, you create multiple access points to that piece of information.

KEY POINTS

- Attention is among the most important components of our mental life
- Reduce your stress to improve concentration and reduce distractions.
- Focus, take breaks, and elaborate in order to remember

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Question #20: Can A Brain Fitness Program Help Me Become More Creative?

ANSWER

Yes. As with all forms of brain exercise, creativity takes consistent effort, organization, and commitment. It is hard to be creative if you work without any structure. This structure can take many forms: daily routines, limited distractions, or a record of the steps you took to get from the beginning to the end of a project or idea.

Idea generation and creative drive originate in interactions between the frontal lobes, other parts of the neocortex, and the limbic system. Positron-emission tomography (PET) scans of people's brains during creative tasks suggests that creativity arises largely from the "association cortex" — parts of the frontal, parietal and temporal lobes that integrate sensory and other information. Frontal lobe damage usually decreases idea generation, in part because of mental rigidity.

The frontal lobes and other parts of the neocortex can be exercised by a variety of activities and shut down with stress. Try making close observations of a specific item or imagine being someone else – try to experience life in those shoes. Do less of the passive things in life, like watching television and do more activities that challenge you to be original. Try new things.

KEY POINTS

- Creativity can be trained, like other mental muscles.
- Set up structured time, places, or routines that provide a framework for creativity to happen.



- Reducing your stress helps to keep your brain more flexible.
- Using many parts of the brain as well as trying new things will stimulate the areas of your brain involved in creativity.

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Question #21: I Am A Busy Executive With A Challenging Job. All This Doesn't Sound Very Relevant To Me.

ANSWER

Executives, or anyone involved in complex and rapidly evolving environments, need to make pressured decisions based on sound logic, instead of emotional impulses. It is not easy to deal with the frustration, for example, when the market doesn't go the way we anticipate. Stress can also limit our mental flexibility and ability to see alternative solutions, thereby preventing us from adapting to, and succeeding in, new circumstances.

Stress is an unavoidable consequence of life. But when work stress becomes too much, it can lead to burnout, a combination of:

- Emotional exhaustion,
- Physical exhaustion, and
- Cognitive weariness (slow thinking).

Excessive stress also leads to various cardiac and immune problems as well.

There is such thing as the "positive" stress you feel pre-game or pre-performance that helps you deliver the performance of your life. You may feel that same good stress at work if you are primed for an activity that you can accomplish right then and there. Short term, acute stress, known as the fight-or-flight response, can help you focus and perform, if it is in the right amount. This kind of stress is short lived. You feel the jitters or adrenaline for a period of time, then you use it up accomplishing your goal, and then you get to rest and recover while basking in the glow of your accomplishment.

The General Adaptation Syndrome (GAS)

describes the long-term, nasty kind of stress that just doesn't go away. The kind of stress that paralyzes you into inaction - where you just stare at the problem and worry about it without being able to do anything about it. This is the kind of stress that kills your neurons, destroys your immune and cardiovascular systems, and makes you anxious, irritable, and unable to sleep. This is the kind that can be helped through a biofeedback-based Peak Performance/Stress Management program which provides real-time visual feedback on your "internal performance" and helps you identify and learn how to manage the emotional arousal that can disrupt executive functions: judgment, planning, analyzing, and reasoning.

As with most things, there are levels of stress. While an optimal amount can help you, too much or too little can hurt. Find ways to help control and lower your long-term stress.

KEY POINTS

- Reduce your stress to improve concentration and learning readiness and reduce distractions.
- Increase your mental stimulation to help maintain a healthy, flexible brain.

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Question #22: My Kids Have Problems With Math. Shouldn't they just do math?

ANSWER

Stress reduction can help not only with test or math anxiety, but also with overall high-levels of anxiety that inhibit learning and higher-order thinking. Programs teaching relaxation through breathing techniques with biofeedback training are already used in a number of schools with promising research results.

High levels of anxiety provoke cortical inhibition, which is when high emotional arousal overwhelms higher-order thinking or executive functions in the frontal lobes. Fortunately, positive emotion-focused tools and techniques that foster physiological coherence have been shown to significantly improve key aspects of health, emotional well-being, and performance.

Educational intervention studies examine the effects of these programs in school settings. Programs and curricula incorporating positive emotion-focused tools and techniques introduced at the elementary, middle school, high school, and college levels have been demonstrated to reduce general psychological distress, test anxiety, and risky behaviors, as well as improve test scores, classroom behaviors, stress resiliency, learning, and academic performance. Studies are also underway to investigate the impact of positive emotion interventions for children with specific learning disabilities as well as with attention-deficit hyperactivity disorder (ADHD).

KEY POINTS

- Learning stress management skills can reduce test anxiety and improve learning readiness.



- If stress levels are too high, concentration and focus are negatively impacted.

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Question #23: During My Pregnancy, I Felt Really Absent-minded. Is This Normal?

ANSWER

Women everywhere have complained that they feel extremely absent-minded while they're pregnant. According to Pamela Keenan, PhD at Wayne State University School of Medicine, women in their third trimester of pregnancy experience approximately 15% more forgetfulness than the average person. Possible culprits for the memory loss could be high levels of anxiety, depression, or the hormones oxytocin and/or cortisol, both of which can impair learning and memory functions.



Ros Crawley, PhD from the University of Sunderland has found between 50% to 80% of pregnant women believe they have some problems with memory or thinking. But, when she tested them, she could not find pervasive, reliable differences. This lack of a finding could just mean the right tests weren't chosen, the deficits are more specific and/or variable, or a number of other possibilities. She concludes that while there may be specific deficits in cognitive processing, there is not a global deterioration.

Finally, another recent study found motherhood actually facilitates lifelong learning and memory and protects against age-related cognitive decline by combining natural hormonal exposure with a lot of mental stimulation from the new baby.

What can you do?

- Get enough rest so that you can pay better attention to what's going on around you.
- Eat well to fuel your body and further fight fatigue.
- Talk to your doctor about what exercise is right for you at each stage of your pregnancy.
- Surround yourself with loved ones because it's pleasant, reduces stress, and provides healthy mental stimulation.
- Stay mentally active – read, play games, do puzzles, get the latest sudoku book, or try a computerized training program.

KEY POINTS

- Memory recall has been shown to decrease in the third trimester.
- Focus on eating well, exercising, and reducing stress/anxiety through your pregnancy.

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Question #24: Ever Since Menopause, I Can't Really Think Or Concentrate As I Used To. Is This Normal?

ANSWER

Yes. There is some evidence that women with low estrogen levels experience faster cognitive decline, and women who take estrogen supplements sometimes do better on certain memory tests. But the evidence is inconsistent.

According to the Women's Health Initiative, women older than 65 who took Prempro had a higher risk of getting Alzheimer's disease and other forms of dementia than women taking dummy pills. A longitudinal study published in 2003 concluded there is little or no risk for immediate memory loss during perimenopause.

Other studies, however, have suggested that estrogen-use protects against Alzheimer's if it's started near the onset of menopause. Some experts now believe estrogen can protect both the brain and the heart if it's started early, before age-related deterioration sets in, but not after that window of opportunity closes.

An October 2006 publication, found that longer treatment with estrogen hormone replacement therapy (HRT) in postmenopausal women protected neurons in the hippocampus against age-related cognitive decline. Another article in *Menopause* concludes that using HRT early in menopause, or even just before the final menstrual period, resulted in better cognitive performance later in life than in women of similar age and background who had never used HRT. However, starting HRT many years after menopause was not associated with any cognitive benefit.

The good news is whether or not you and your doctor decide to go with hormone replacement therapy, lifestyle choices like exercise, nutritional management, and brain exercise

can help alleviate the symptoms of menopause and aging. If you feel mentally fuzzy, try various strategies for dealing with weak attention or try some of the software programs out there that specifically work on increasing attention and working memory.

KEY POINTS

- Using hormone replacement therapy early in menopause, or even just before the final menstrual period, results in better cognitive performance later in life.
- The reason people feel like their memory or thinking skills are slipping is often due to lack of attention.

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Question #25: I Play Casual Games Online, Such As Bejeweled. Is That Good? Do I Need Something Else?

ANSWER

Yes to both questions. Bejeweled is a popular computer game that emphasizes puzzle-solving strategies. Computer puzzle games can involve logic, strategy, pattern recognition, sequence solving, or word completion, depending on the game.

While these can be good mental stimulation and are often fun, they are unfortunately incomplete as stand-alone brain fitness programs and rarely scientifically based.

If you enjoy them, by all means continue doing them. They won't harm you as long as they don't keep you from other types of mental stimulation, physical exercise, and social interaction.

KEY POINTS

- Brain workouts need to present a variety of challenging stimuli over time.
- Casual games not based in science can exercise some of your mental muscles, but most likely do not cross train a wide number of them.



NEUROSCIENCE INTERVIEW SERIES

Dr. Elkhonon Goldberg

Elkhonon Goldberg, Ph.D. 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 recent book *The Wisdom Paradox: How Your Mind Can Grow Stronger As Your Brain Grows Older* offers an innovative understanding of cognitive aging and what can be done to forestall cognitive decline.

Maybe we could start with Vygotsky – his theory of learning links into modern neuropsychology.

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.

And now we have new neuroimaging techniques.

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.

Please tell us about your main research and practical interests.

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.

Please tell us more about the frontal lobes.

We researchers typically call them the *Executive Brain*. The prefrontal cortex is young on 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.

And is that where cognitive training/brain fitness programs can help?

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 in systematic 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".

What about the role of emotions, as shown by the great research by Damasio?

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.

Key Messages

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.

*Read the complete interview at
www.sharpbrains.com/blog.*

Dr. Daniel Gopher

Professor Daniel Gopher is a fellow of the US 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, published an award-winning article that constitutes a key milestone in the cognitive engineering field, and 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.

Could you provide an overview of the projects are you working on now?

Since 1980, I have been the director of the Research Center for Work Safety and Human Engineering, an interdisciplinary research center, 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.

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.

What are the main studies have you conducted?

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 training computer game 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 versus 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.

Talk to us about developing basketball “game-intelligence”.

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.

What are the results of the program so far?

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.

Can you summarize your research findings?

- 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.

*Read the complete interview at
www.sharpbrains.com/blog.*

Dr. Torkel Klingberg

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.



Can you let us know where you work, and what your lab does?

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.

What are the highlights of your research so far?

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.

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

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.

What do you expect that we will learn over the next 5 years in the field of brain fitness programs and cognitive training?

I think that we are seeing the beginning of a new era of computerized training for a wide range of applications. Our studies have 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.

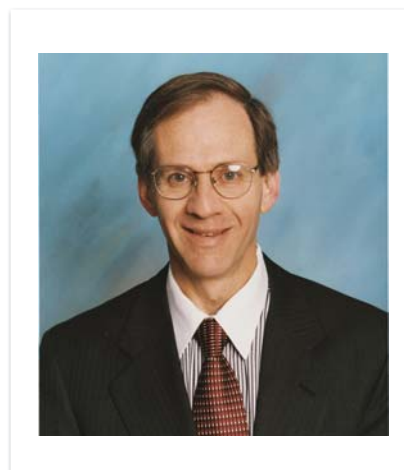
What is your book about?

The book is a popular science book about working memory, in the lab and in daily life. It will be out in March 2007 in Sweden and we are currently looking for a US publisher.

*Read the complete interview at
www.sharpbrains.com/blog.*

Dr. Brett N. Steenbarger

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 and Enhancing Trader Performance: Proven Strategies From the Cutting Edge of Trading Psychology*. He writes feature columns for the Trading Markets website and several trading publications, including *Stocks Futures and Options* magazine.



Tell us about your interest in trading performance and how it led you to your new book.

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. 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 those fields, find the common factors behind their success, and then apply the findings to traders.

What differentiates elite performers from the rest?

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 specific advice do you provide to traders in your book?

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.

What training programs are available now and which ones can you foresee will be available in the future?

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. 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. 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.

*Read the complete interview at
www.sharpbrains.com/blog.*

Dr. James Zull

Dr. James Zull is 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.

What is learning? Can apes really learn in the same way we do?

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.

How does learning happen?

These are the Four Stages of the Learning Cycle:

- 1) Concrete experience,
- 2) Reflective observation and connections,
- 3) Abstract hypothesis,
- 4) 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 book *Descartes' Error*.

Can we, as learners, motivate ourselves? How can we become better learners?

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.

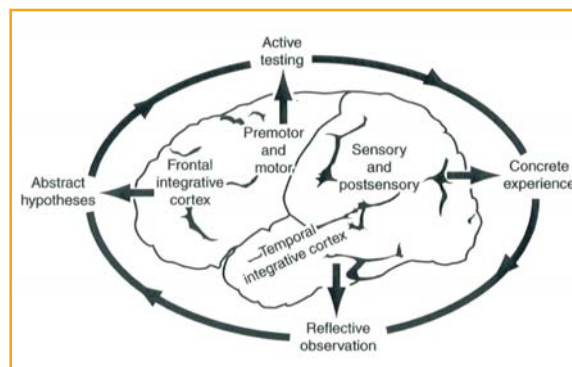
How do you help your students become better learners?

Despite the fact that every brain is different, let me simplify and say that I usually observe two 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.

What other tips would you offer to teachers and parents?

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.

Please give us an example.

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?”

What would you suggest for us who want to become better learners?

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.

Read the complete interview at www.sharpbrains.com/blog.

Brain Fitness or Mind 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 brain 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 heart 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 new neurons are created all throughout our lives.

Neuroimaging: techniques that either directly or indirectly image the structure, function, or biochemistry 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.

Books

With a health/medical angle

- Brain Longevity: The Breakthrough Medical Program that Improves Your Mind and Memory* by Dharmā Singh Khalsa, MD
- The Memory Prescription: Dr. Gary Small's 14-Day Plan to Keep Your Brain and Body Young* by Gary Small, MD

Fascinating, user-friendly scientific books

- A User's Guide to the Brain: Perception, Attention, and the Four Theaters of the Brain* by John J. Ratey, MD
- Mapping the Mind* by Rita Carter
- Phantoms in the Brain: Probing the Mysteries of the Human Mind* by V.S. Ramachandran, MD, PhD & Sandra Blakeslee
- The Executive Brain: Frontal Lobes and the Civilized Mind* by Elkhonon Goldberg, PhD
- The Wisdom Paradox: How Your Mind Can Grow Stronger As Your Brain Grows Older* by Elkhonon Goldberg, PhD
- Why Zebras Don't Get Ulcers: An Updated Guide To Stress, Stress Related Diseases, and Coping* by Robert M. Sapolsky, PhD
- Magic Trees of the Mind* by Marian Diamond, PhD

Great combination of information and activities

- Building Mental Muscle: Conditioning Exercises for the Six Intelligence Zones* by David Gamon, PhD & Allen Bragdon

Fun activities

- The Book of Sudoku: The Hot New Puzzle Craze (Book of Sudoku)* by Michael Mepham

Websites

- SharpBrains Online Brain Fitness Center: www.sharpbrains.com
 - Visit the website to read an educational blog, find the right brain fitness program for you, and access a complete listing of articles and references
- Brain Awareness Week: www.dana.org/brainweek
- Brain Connection, a web resource by Scientific Learning: www.brainconnection.com
- Center for Mindfulness at the University of Massachusetts Medical School: www.umassmed.edu/cfm/index.aspx
- DANA Foundation: www.dana.org
- NeuroInsights, a research company focused on the neurotechnology sector: www.neuroinsights.com
- PBS' Adult Guide to The Secret Life of the Brain: www.pbs.org/wnet/brain

Alvaro Fernandez: Mr. Fernandez holds an MBA and MA in Education from Stanford University. Alvaro started his career in McKinsey & Company in Europe and has participated in the launch of online bookstore Bertelsmann Online, the turnaround of corporate e-learning company Docent, Inc, and the launch of a new business unit of Edusoft, a Houghton Mifflin company. He enjoys advising the management teams at social enterprises Ashoka, abcd espanol and Arcandina, and teaching the class “Exercising Our Brains” at the Bay Area Osher Lifelong Learning Center. Alvaro recently presented at the Neurotech Leaders 2006 conference and the Serious Games Summit in Washington, DC and will moderate a panel on brain fitness at the Neurotechnology Industry Conference in May 2007. He is Chief Executive Officer and Co-Founder of SharpBrains.

Dr. Elkhonon Goldberg: Dr. Goldberg is a clinical professor of neurology at New York University School of Medicine. He also serves on the faculties of Columbia University, Mt. Sinai School of Medicine, The City University of New York, and the Fielding Graduate University. He is a diplomate of The American Board of Professional Psychology/American Board of Clinical Neuropsychology, with over 30 years of experience in neuropsychological diagnosis, cognitive rehabilitation, and forensic neuropsychology. Dr. Goldberg is internationally renowned for his clinical work, research, writings and teaching in the area of clinical neuropsychology and cognitive neuroscience. His areas of expertise include executive deficit, memory disorders, attention deficit disorder, dementia, traumatic brain injury, and others. Dr. Goldberg was a student and close associate of the great neuropsychologist Alexander Luria. He is the author of *Contemporary Neuropsychology and the Legacy of Luria* (Lawrence Erlbaum, 1990) and *The Executive Control Battery* (PsychPress, 2001). 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 new 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 published in eight languages and counting, and has received wide international acclaim. Dr. Goldberg is Chief Scientific Advisor and Co-Founder of SharpBrains.

Caroline Latham: Ms. Latham received her undergraduate degree in experimental psychology from Davidson College and worked in research labs studying human memory, pain perception, oculomotor behavior, and attention. After several years working towards a combined MD/PhD in neurosurgery and neuroscience at the University of Texas Medical Branch, she launched her career working with medical and health-related companies and publications.