

# Digital dementia: superstition or inevitable reality?

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- I am a Ph.D. student and researcher at FIT BUT
- Researcher for Gen (formerly Avast)
- My research: Application of formal models in security
- I also have ADHD and have long been interested in research in the fields of psychology, neurology, and other sciences
- Areas of interest:
  - Sustainable productivity
  - Theory of happiness and satisfaction
  - Physical and mental health

- A term used in books by a German neuroscientist and psychiatrist, Manfred Spitzer. The origin is attributed to doctors in South Korea who used the term to describe memory and attention problems in young adults who frequently use their smartphones and other smart devices.
- In his books (Spitzer, 2014) (Spitzer, 2016), he has a very critical view on the usage of digital technology (mainly social media and videogames) and their influence on our health
- Risks and side effects according to Spitzer – bad body posture, overweight, diabetes, hypertension, short-sightedness, sleep disorders, stress, high-risk behavior, addiction, aggression, anxiety, attention deficit, dementia, depression, decreased empathy, decreased life satisfaction, . . .

- In his book, *The Glass Cage* (Carr, 2014), author Nicholas Carr explores how our ever-growing dependency on computers, apps, and robotics is reshaping our jobs, talents, and lives.
- Carr presents a problem with airplane crashes due to decreased skills of pilots relying too much on autopilot and can not react quickly and precisely when there is a technical issue. A similar problem can (and has) been raised with self-driving cars, where the faulty behavior of the human driver causes most crashes.
- In general, Carr warns that when we decide to automate certain tasks, it may be convenient for us at the moment, but we are also choosing to lose the skills in the long run. The motto "*use it or lose it*" is applied to many areas of our lives. Automation frees and restrains us simultaneously, and we must keep it in mind.

- Neuroplasticity – the ability of the brain to recover and restructure itself. The brain can recover after disorders or injuries and reduces the effects of altered structures due to pathologies such as Parkinson's disease, Alzheimer's, etc (CogniFit, 2023).
- In the book The Brain That Changes Itself, author Dr. Doidge gives examples of people who, after a stroke that damaged part of their brain, were able to learn to walk and talk again because their brain was able to transfer these functions to other parts of the brain (Doidge, 2007).

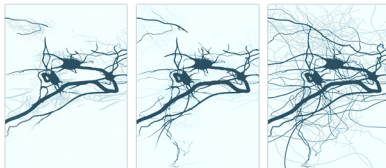
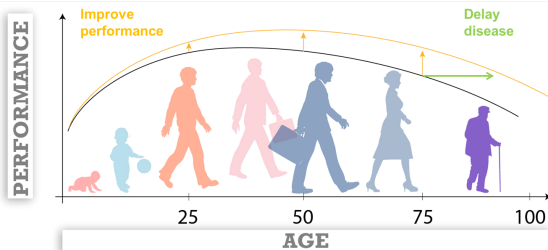


Figure: Neural networks before and after training (CogniFit, 2023)

- On the other hand, our brains do get old and susceptible to degenerative disease, and we do not have a magical remedy for that.
- The time before diseases manifest themselves directly depends on our brain's condition and fitness. The more we exercise our brains and learn new things, the longer it will take the brain to show signs of its decline, even by several years (Fernandez, 2023).

## Brain Fitness Matters



Source: SharpBrains.com

- Sleep
- Learning
- Video games
- Learning to play a musical instrument

- Sleep is critical for our brain. The lack of sleep hurts attention, executive function, working memory, mood, quantitative skills, logical reasoning, and even motor dexterity (Medina, 2014).
- Blue LED light from our screens is blocking the otherwise rising levels of melatonin, and thus the ability to time the onset of sleep. Using LED devices at night impacts our natural sleep rhythms, the quality of our sleep, and how alert we feel during the day. You can install software on your computers, phones, and tablet devices that gradually desaturate the harmful blue LED light as the evening progresses (Walker, 2017).
- Even with apps reducing blue LED light, the goal is not to use screens at least one hour before bed.



- There are additional factors that can harm your sleep:
  - The content we are consuming before bed – catastrophic news, anxiety, and FOMO introducing content on social media, ...
  - Consumption of caffeine, alcohol, or tobacco
  - Jet lag when traveling between time zones
  - ...
- The two most common triggers of chronic insomnia are psychological: emotional concerns, worry, emotional distress, or anxiety (Walker, 2017).

- Critics have long argued that phones and computers don't belong in schools because they disrupt attention and thus impair student performance.
- The problem is not the technology itself but a distraction connected to it. For example, notifications constantly interrupt the focus, leading to worse performance.
- Frequent testing is one the most effective ways to learn because it provides feedback on what we have already learned and what we need to study further (Oakley, 2021). Technology can help us with testing SW, AnkiCards, etc.
- We can use online learning modules and videos to learn, but taking notes on paper (even short ones, with keywords, for example) seems to be the most effective. We are freeing our working memory, and at the same time, we are telling our brain that these facts and concepts are worth remembering.

- Learning during the pandemic was hard for most of us, no matter if in the role of student, teacher, or parent.
- Most studies showed that we were unprepared for this kind of education – we faced technical issues, students, and most small children have problems with learning, and also faced with social issues coming with isolation from their friends and peers.
- Technology helped us connect with teachers but was also a distraction that affected how much we could learn during online classes.

- With brain training games (cognitive training), we can improve focus, and working memory (EEG Biofeedback, Sunball, CogniFit, ...) (Ribas et al., 2022).
- Games can improve resilience and persistence (mostly when played from a young age).
- Games help process aggression. Contrary to common belief, we do not have enough good evidence that games increase violence in users. It maybe even decrease aggression, as some studies suggest.
- Especially shooting games can improve cognitive functioning.

- Try to improve and keep up a good sleep (ideally 8 hours)
- Get some sunlight every day as soon as possible
- Exercise moderately (aerobic exercise twice a week)
- Eat a balanced diet and do not drink coffee after 3 pm
- Keep learning – languages, playing a musical instrument, reading a lot of books, ...
- Turn off or at least limit your notifications

- Playing a musical instrument activates several parts of your brain – motor, auditory, visual, and somatosensory pathways.
- **Benefits:** improved global cognition, working memory, executive functions, language, and visuospatial abilities, ...
- The best results were shown on children age 12 and younger (e. g. (Lippolis et al., 2022)). But it is never too late to start learning, and even adults can benefit from learning to play an instrument (Olszewska et al., 2021).
- There are studies suggesting that playing a musical instrument during life relates to better late-life cognitive abilities and greater brain capacities in older adults (Böttcher, 2022).

## HOW MUSICAL TRAINING SHAPES THE BRAIN

INCREMENTS IN STRUCTURE AND FUNCTION  
MUSICIANS COMPARED TO NON-MUSICIANS

### FRONTAL LOBE

INCREASED GREY MATTER VOLUME  
superior, medial, inferior frontal gyrus  
– executive functions

INCREASED fMRI ACTIVATION  
primary & supplementary motor areas  
– motor preparation and execution  
Broca's area – speech production

### TEMPORAL LOBE

INCREASED GREY MATTER VOLUME &  
INCREASED fMRI ACTIVATION

Heschl's gyrus – primary auditory cortex,  
pitch perception  
superior temporal gyrus – auditory  
processing

INCREASED MISMATCH NEGATIVITY (EEG)

### BASAL GANGLIA & LIMBIC SYSTEM

INCREASED GREY MATTER VOLUME  
hippocampus – memory formation & retrieval

INCREASED EEG RESPONSE  
temporal-limbic areas – emotions and memory

### PARIETAL LOBE

INCREASED GREY MATTER VOLUME  
primary somatosensory cortex – touch perception

INCREASED fMRI ACTIVATION  
supramarginal gyrus – syntax processing  
and attention

### WHITE MATTER TRACTS

INCREASED WHITE-MATTER INTEGRITY

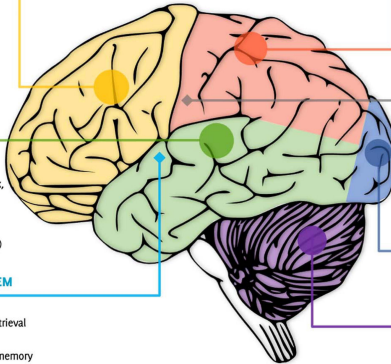
corpus callosum – connects brain hemispheres  
corticospinal tracts – connect motor areas with  
spinal cord  
short fibres – connect sensory and motor areas  
striatum – motor planning and reward perception

### OCCIPITAL LOBE

INCREASED GREY MATTER VOLUME  
lingual gyrus – score reading

### CEREBELLUM

INCREASED GREY & WHITE MATTER VOLUME  
movement coordination and motor learning



**Figure:** Overview of cross-sectional studies on the incremental differences observed when comparing musicians to non-musicians (Olszewska et al., 2021).



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