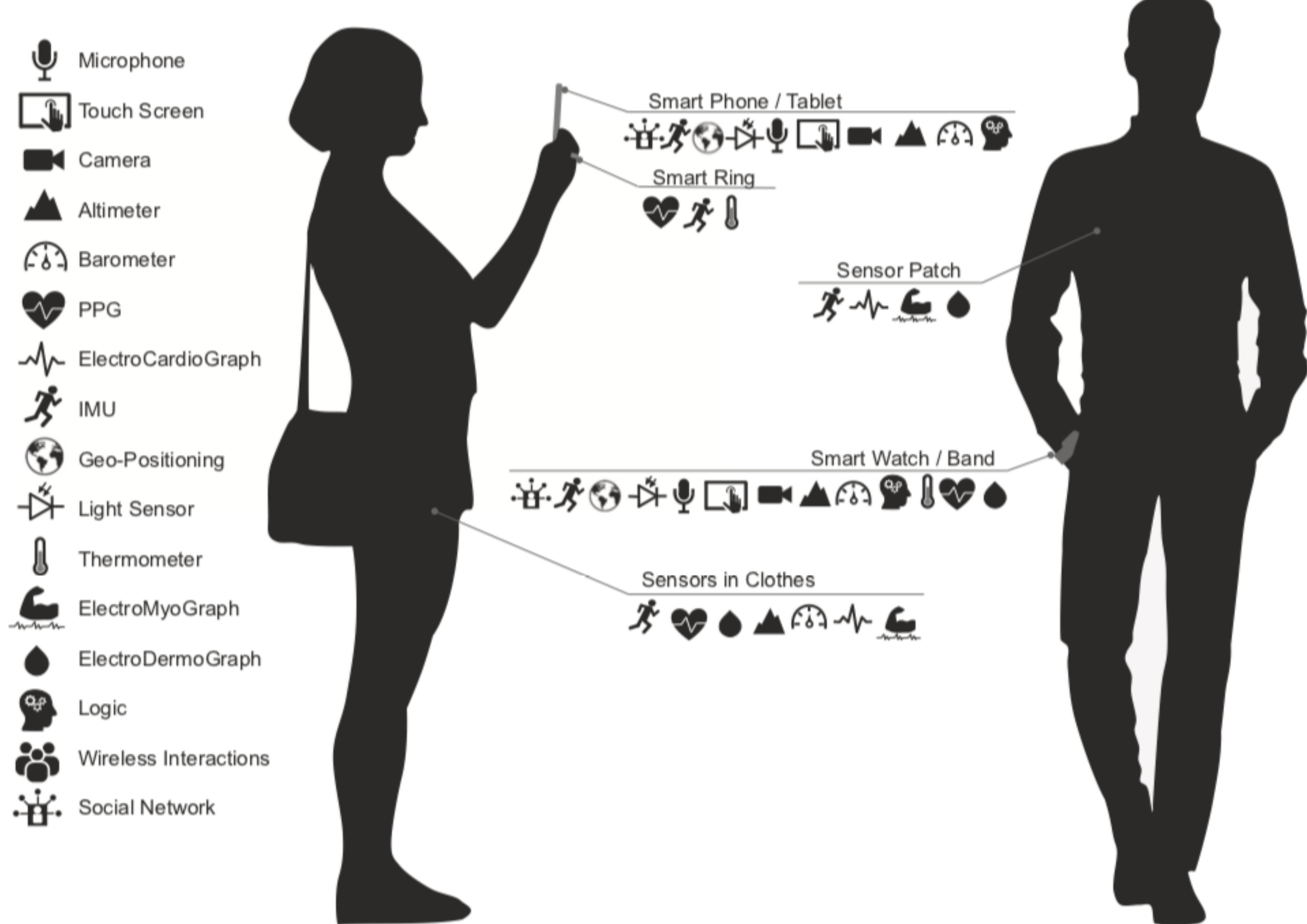


DIGITAL TECHNOLOGIES AND BRAIN ENHANCEMENT

Agnieszka Krzeminska – XPOMET – Berlin, 11.Oct.2019
@Monade - Leuphana University of Luneburg

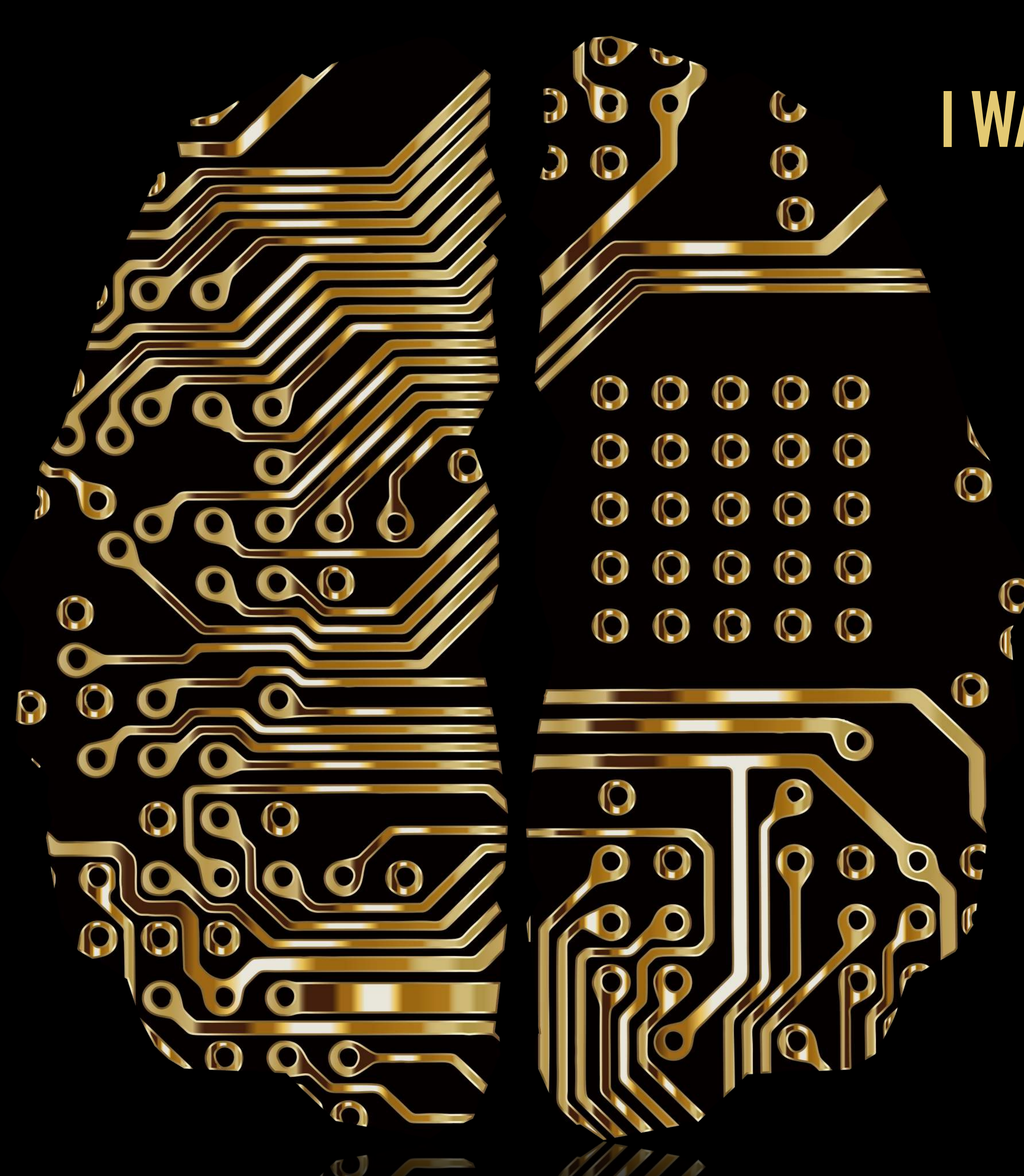


Source: Kourtis, Reagle, Wright and Jones (2019): Digital biomarkers for Alzheimer's disease: the mobile/wearable devices opportunity. *npj Digital Medicine* (2019)2:9 ; <https://doi.org/10.1038/s41746-019-0084-2>



DIGITAL HEALTH REVOLUTION

- mHealth / eHealth
- Wearables, sensors (passive)
- If required continuous
- Individual / Patient centered
- Vantage: costs and time of studies
- Online communities, shared data and Big Data



I WANT TO FOCUS ON MENTAL HEALTH TODAY

- Why is Mental Health Care important?
- Brain Health Techniques Today
- Brain Enhancement Technologies - digital, non-invasive, (not yet) invasive

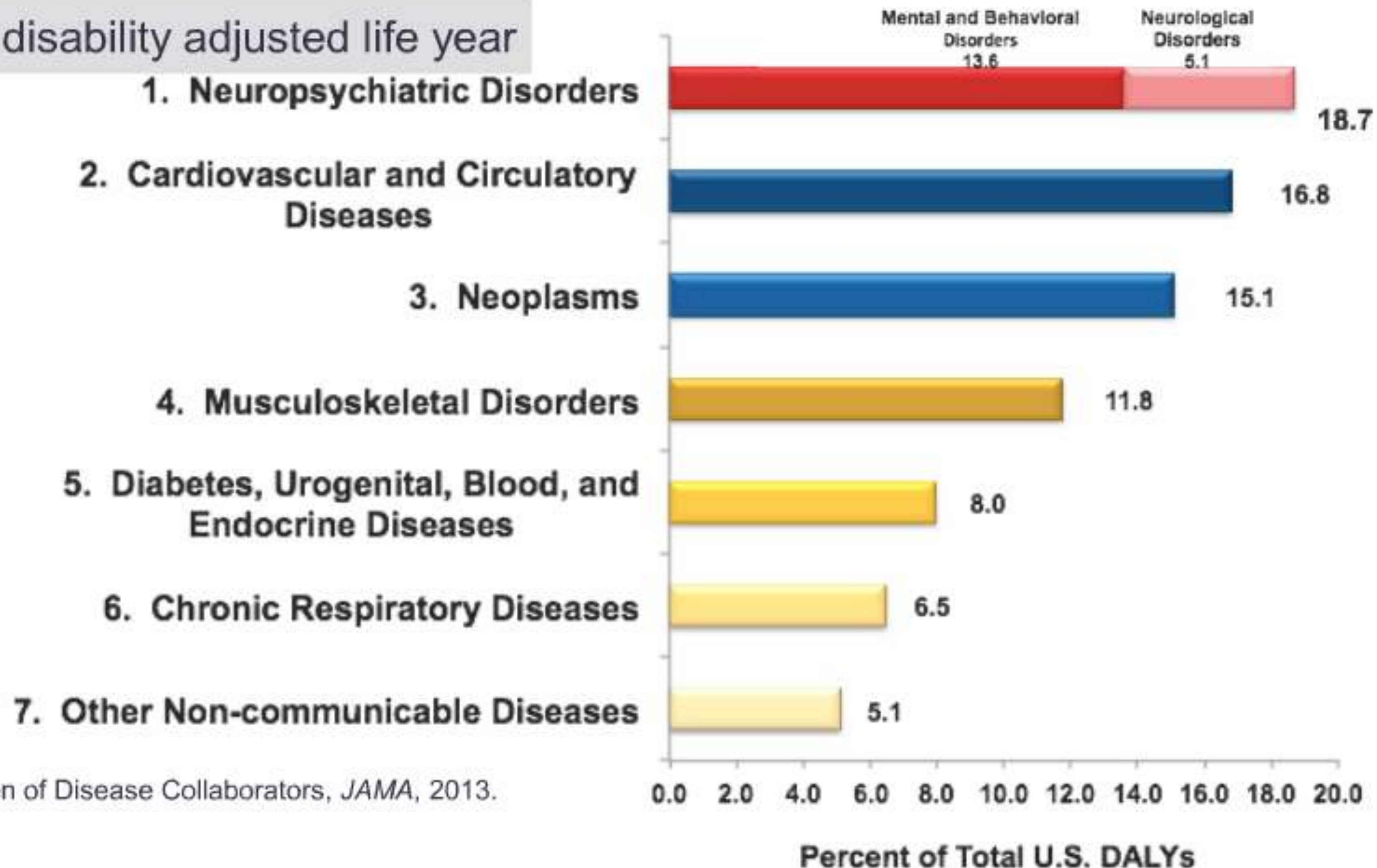
WHY IS MENTAL / BRAIN HEALTH IMPORTANT?

- World population 7,6 Bln → 9,7 Bln in 2050 (U.N.) / 2 Bln > 60 years
- Neuropsychiatric diseases largest proportion as measured by work disability ->
- Investment in health start-ups: in the USA, \$15 Bln has been invested in health tech since 2012 by all the tech giants like Alphabet, Alibaba, IBM, Microsoft, Facebook, Intel etc. (Quelle: Dr. Tom Insel)
- High increase in Digital Health Innovations and Patents
- Large number of positive study results confirming different techniques and methods to improve cognitive performance and well-being

U.S. Burden of Diseases: 291 diseases and injuries

Leading Categories of DALYs 2010

DALY = disability adjusted life year

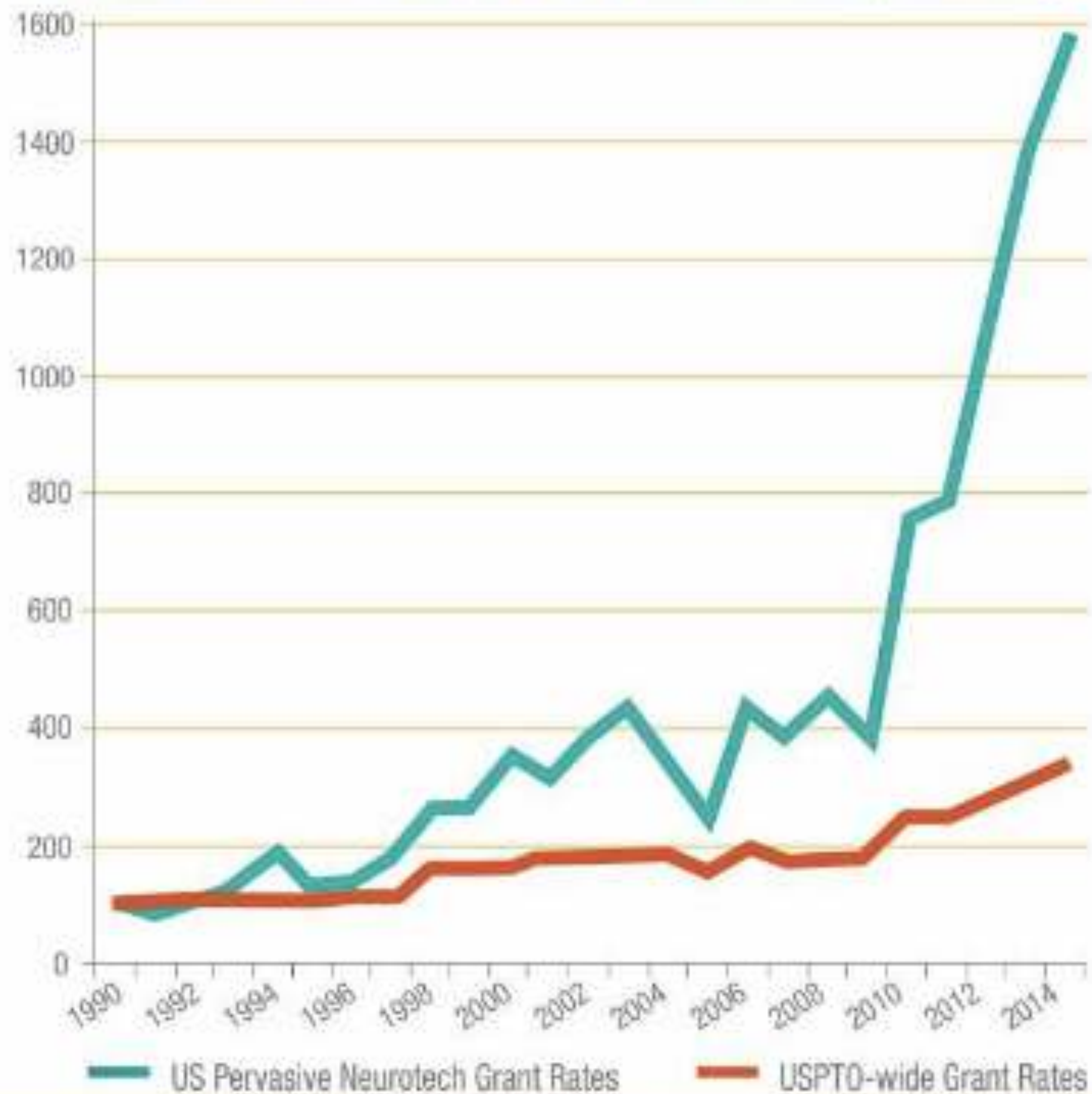


US Burden of Disease Collaborators, *JAMA*, 2013.

THE FACTS

There is an explosion in relevant patent filings and grants.

Pervasive Neurotech vs. USPTO-wide Patents Granted (normalized)



PATENTS IN PERVASIVE NEUROTECH

- Immense growth of pervasive neurotechnologies since 2012
- USPTO = United States Patent and Trademark Office
- Quelle: Sharpbrains Report 2015

A glowing human brain is centered in the upper half of the image. The brain is rendered in a bright, almost white-yellow color, with its gyri and sulci clearly visible. It is set against a dark blue background that features several bright, jagged lightning bolts. The overall effect is one of intense energy and power.

BRAIN HEALTH / ENHANCEMENT

Today

HOW CAN WE ENHANCE OUR BRAINS TODAY?

- Why Enhancement? Because it is always about at least preserving the actual brain state what means working against a decline -> that in turn means to strengthen and enhance our brain by divers proven techniques:
 - Physical exercises: Cardio + Muscle Training
 - Healthy nutrition
 - Active mental activities (e.g. learning a language)
 - Little stress
 - Friends, social commitment
 - What else? Can (digital) technology help?

BRAIN ENHANCEMENT „TECHNOLOGIES“

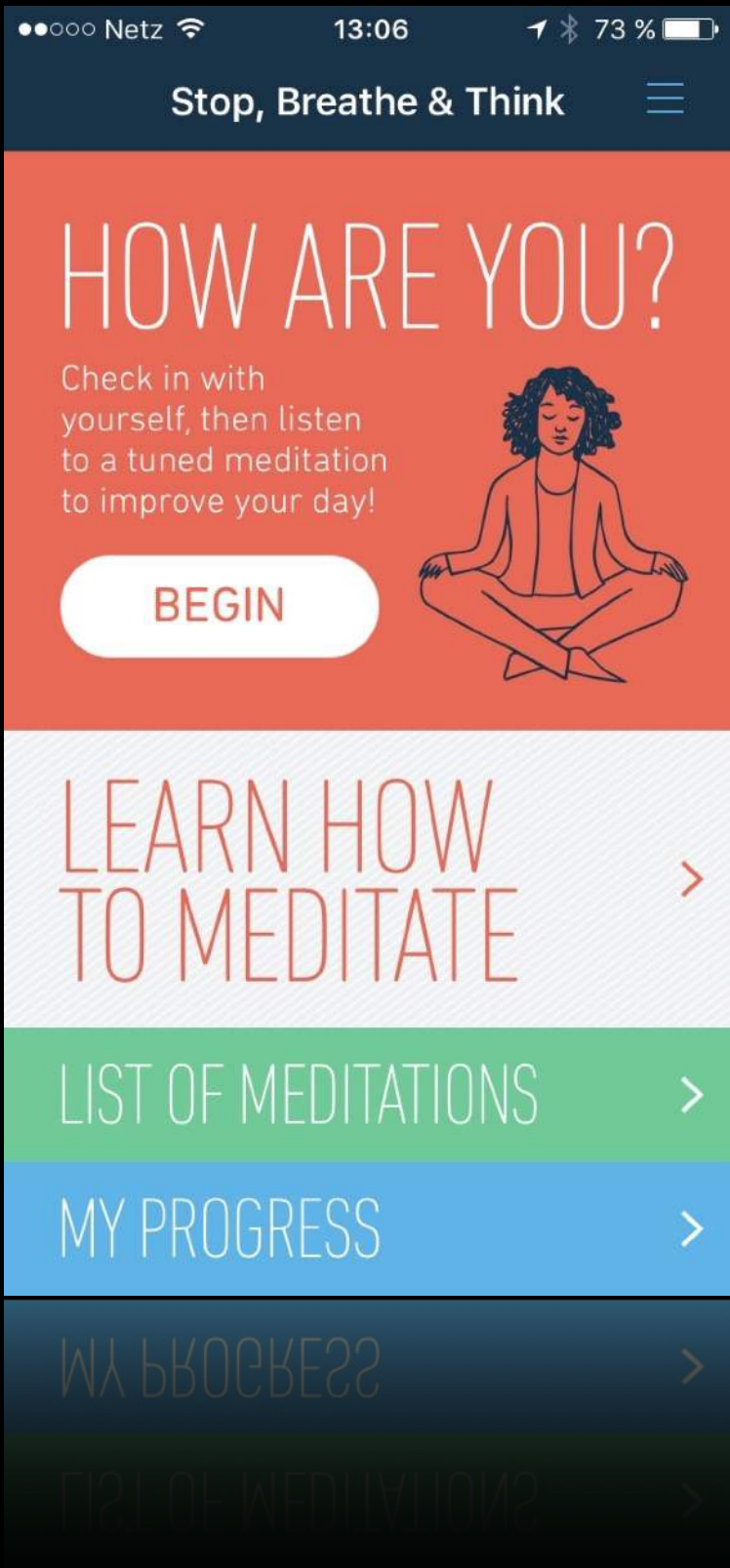
- Brain performance drugs - Nootropics (e.g. Fasoracetam, Provigil)
- Brain Trainings: cognition, reactions times, concentration, problem solving
- Neuromarketing ;)
- Video games treatments for cognitive disfunctions (drug abuse, ADHD, depression, multiple sclerosis)
- Brain activity indices (for assessment, monitoring) ->
- Neuromarkers - EEG & structural imaging techniques
- Brain-Computer-Interfaces (in development, e.g. E. Musk's Neuralink)

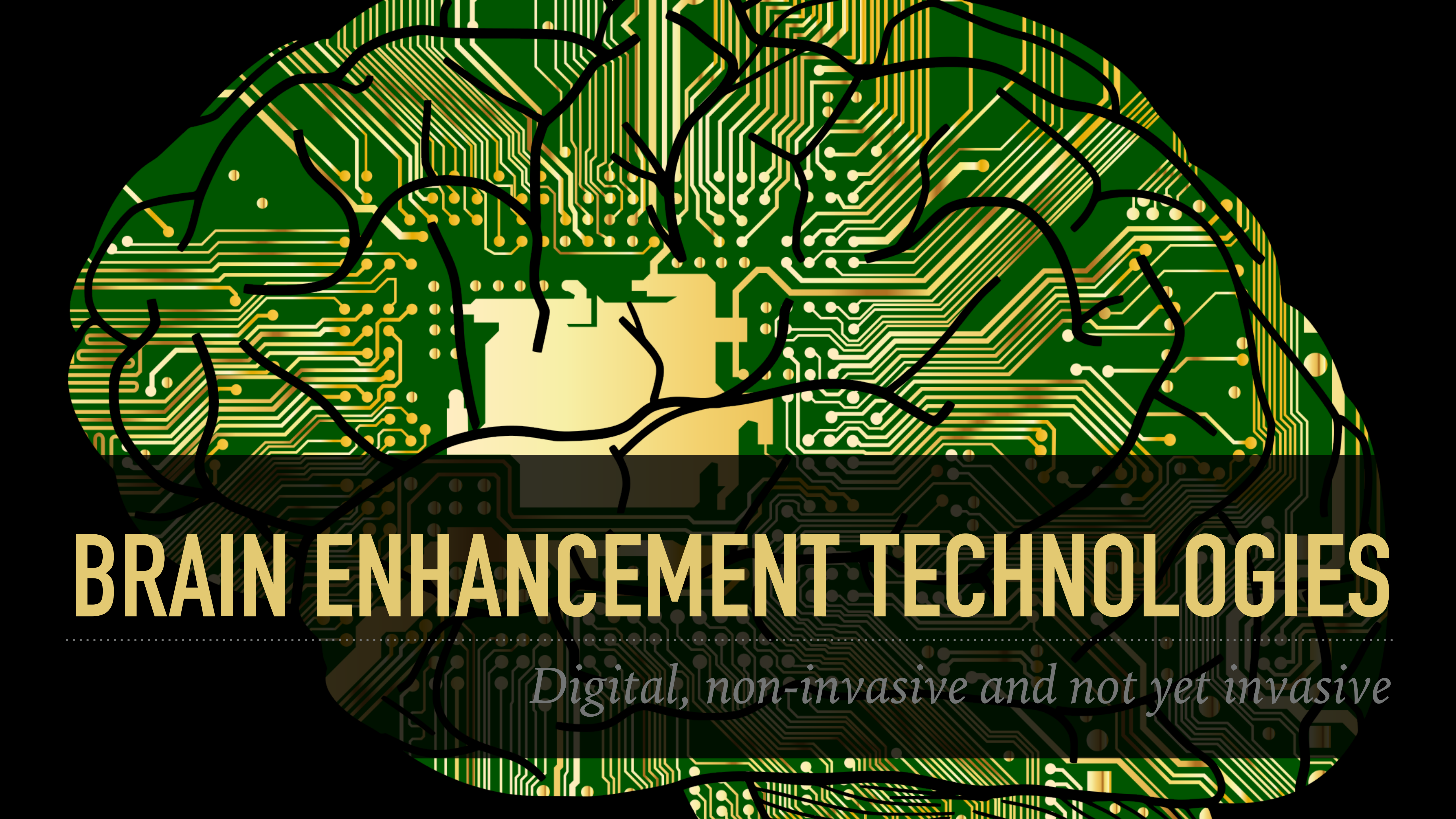
BRAIN TRAINING APPS

- e.g. Neuronation, Lumosity, FitBrains etc
- still controversial:
 - some studies suggest that exercises can improve cognitive performance
 - 2014 Statement „A Consensus on the Brain Training Industry from the Scientific Community
 - No longterm results...



MEDITATION UND FOKUS





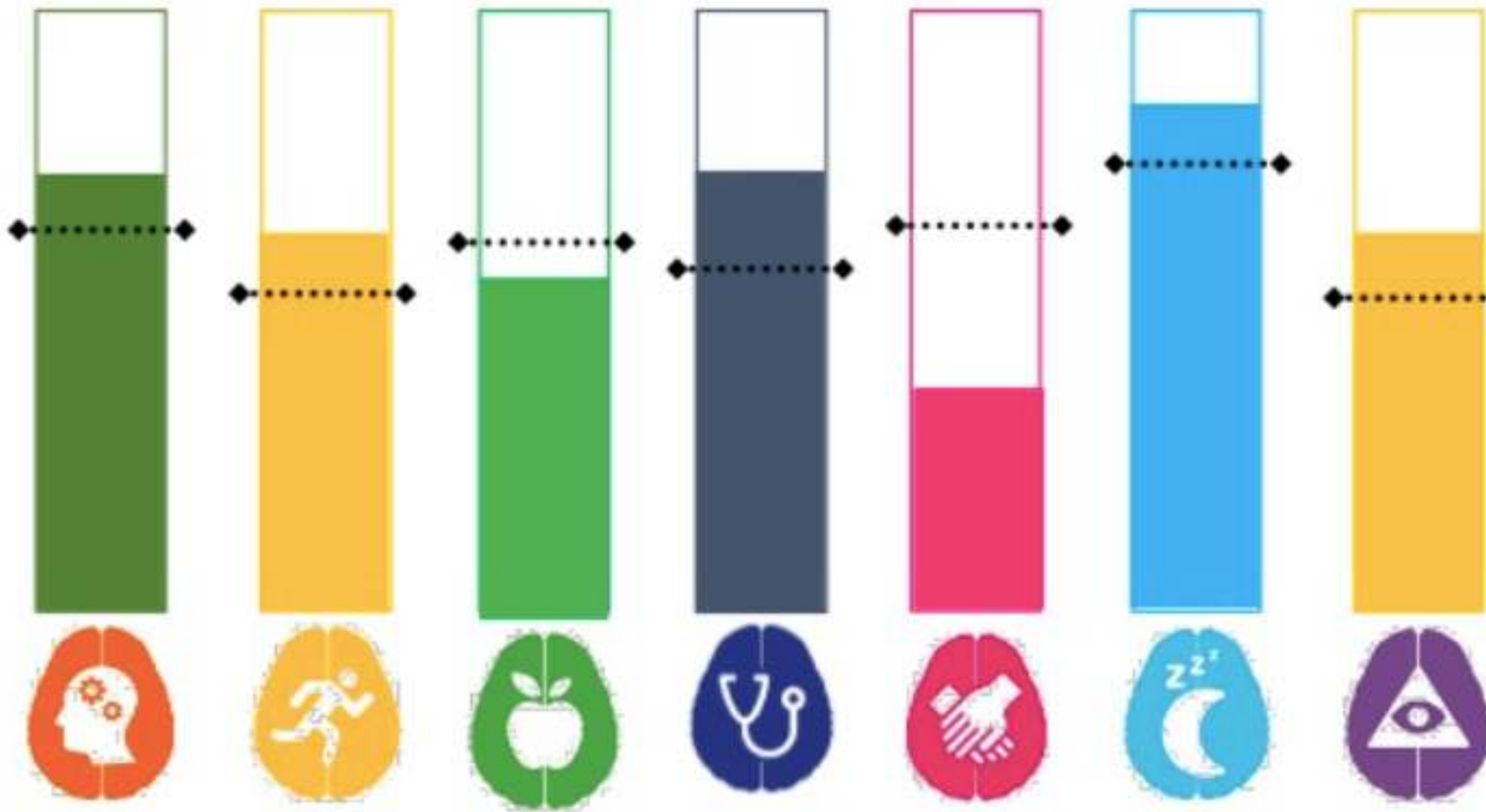
BRAIN ENHANCEMENT TECHNOLOGIES

Digital, non-invasive and not yet invasive

BRAIN ENHANCEMENT „TECHNOLOGIES“ AKA NEUROTECHNOLOGIES

- Brain activity indices (for assessment, monitoring) ->
- Video games treatments for cognitive disfunctions (drug abuse, ADHD, depression, multiple sclerosis) *
- AR & VR Technologies ->
- Neuromarkers - EEG & structural imaging techniques
- Brain-Computer-Interfaces (in development, e.g. E. Musk's Neuralink)

BARCELONA BRAINHEATH INITIATIVE – INDEX



Goals:

- Measures the Brain Health Index
- Personalizes the medication plan
- Monitors progress and adjusts medication if necessary



VR & AR TECHNOLOGIES @STANFORD

- Walter Greenleaf of Stanford Virtual Human Interaction Lab estimates that in 3 years VR and AR will have the widest application range in medicine
- VR can be used in:
 - physical and cognitive training,
 - rehabilitation,
 - surgical exercises,
 - phobias,
 - addiction treatment
 - and much more

NEUROSCAPE @UCSF – DEVELOPING MULTIMODAL BIOSENSORS

- EEG (neural responses)
- GSR/skin conductance (stress)
- Heart Rate Variability (stress)
- Facial expressions (emotion)
- Eye-tracking (attention)
- Pupilometry (arousal & vigilance)





EEG EXAMPLE: MEDITATION HEADBANDS — MUSE , EMOTIVE

Typing cadence - how long do you hold a keyboard key - supposed to give hints on diseases like Alzheimers



+



=



Digital Bio-marker

- Install and forget
- Passive
- No tests
- No sensors
- Cadence NOT content
- Runs in background

- Fully automated
- Cloud-based
- Big data analytics
- Proprietary algorithms
- HIPAA compliant

- Sub-clinical (ms)
- Binary
- Continuous
- Predictive
- Personalized



HOW

IT WORKS

BLAST ¹bi-lateral ²alternating ³stimulation

NOT ¹just ²prompts ³or ⁴information

NOT ¹inaccurate ²biofeedback

ACTUAL ³stress ¹reduction ²without ³focused ⁴attention

1

Reduces sympathetic nervous system response non-invasively through the peripheral nervous system and key brain networks process signals.

2

Brain shifts into the calm, logical, rational parasympathetic nervous system, reduces stressful body sensations and negative thoughts remit.

3

New cognitive appraisal association forms similar to exposure with response prevention and situation/stressor does not seem as stressful.

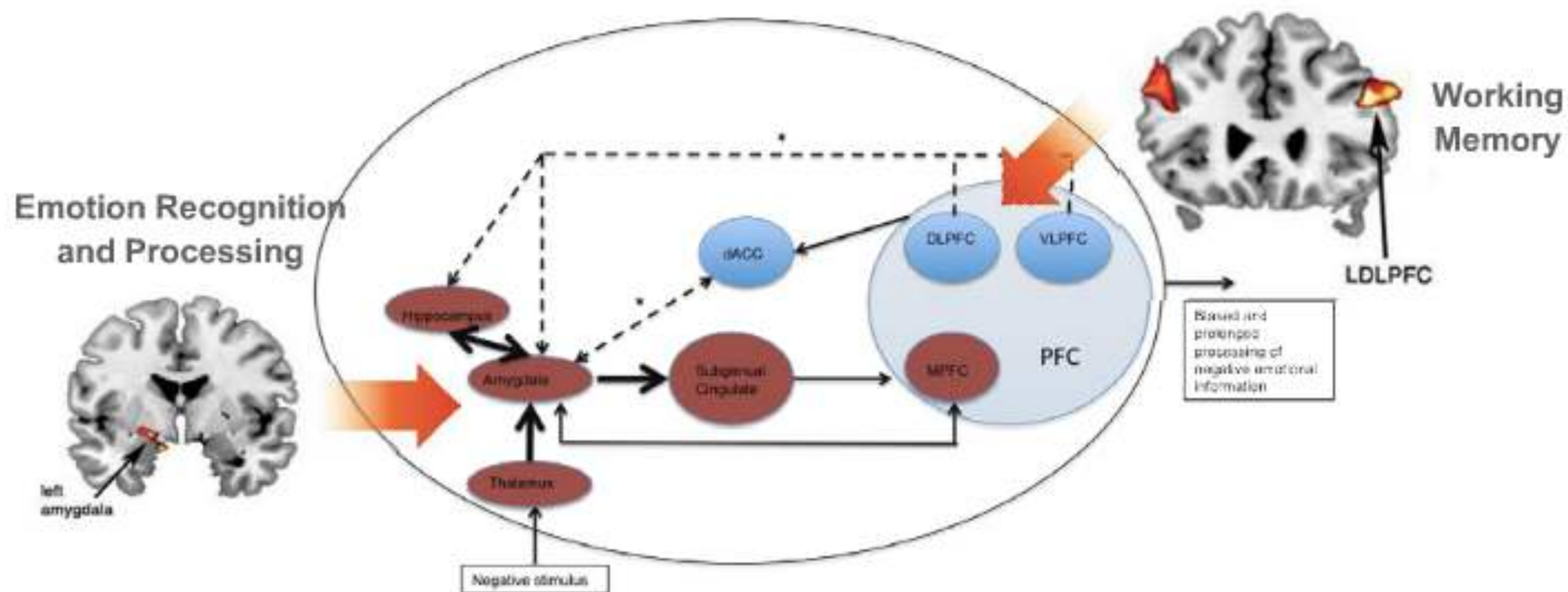
#PRESSandDESTRESS

TOUCHPOINT™

BETTER LIVING THROUGH NEUROSCIENCE



Emotional Faces Memory Task (EFMT) helps patients with **Major Depressive Disorder (MDD)** enhance **cognitive control over emotion** by practicing **emotion recognition** and **working memory** together



EFMT targets the imbalance between hyperactive (RED) emotion processing regions and hypoactive (BLUE) prefrontal regions underlying the cognitive control impairments observed in MDD patients



VIELIGHT BRAIN PHOTOBIMODULATION DEVICES COMBINE ELECTRICAL ENGINEERING AND NEUROSCIENCE

Aim: brain stimulation





BIOHACKER CONF 2019

➤ Here are some of our many partners and sponsors you will get to know:

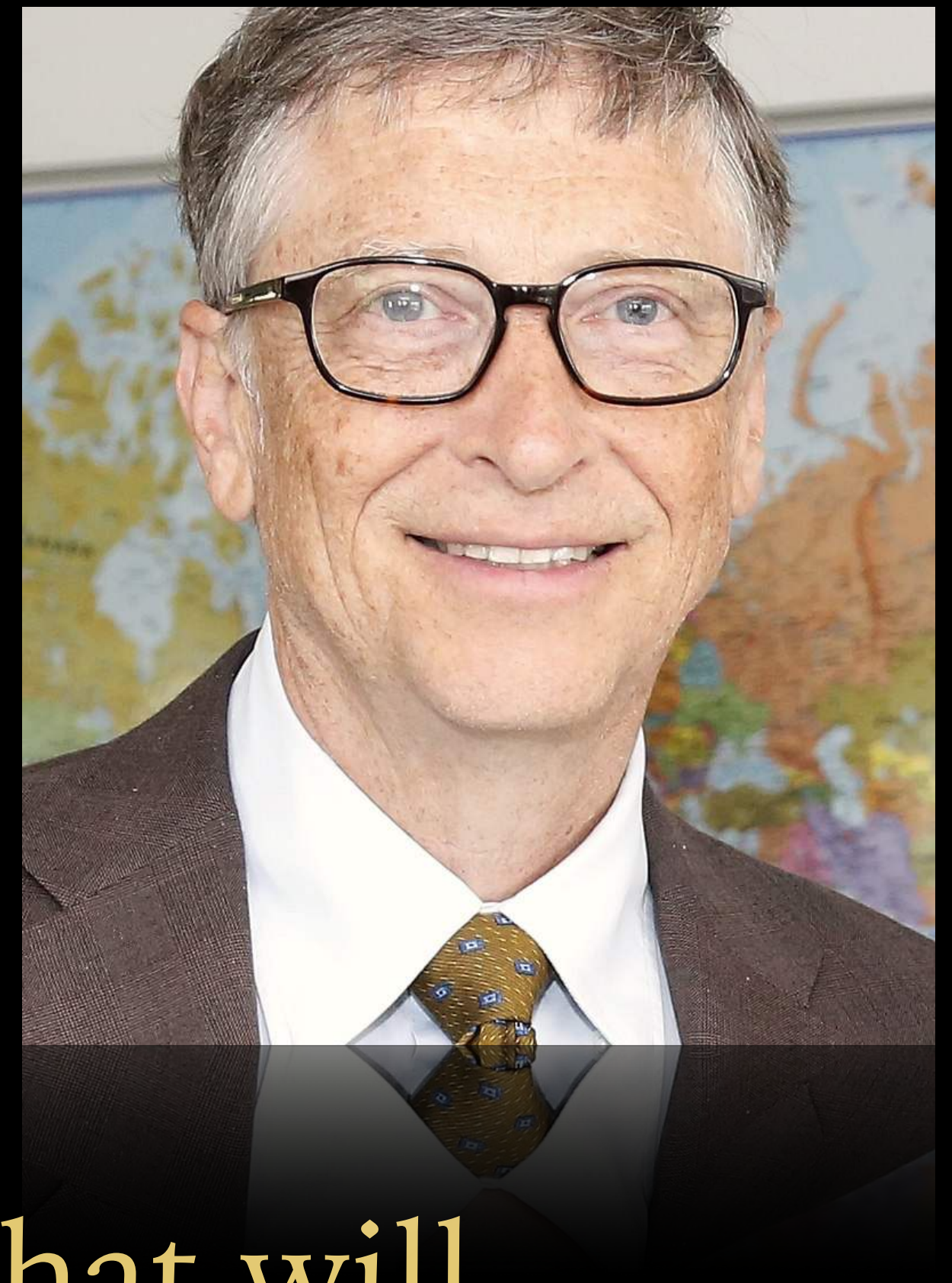
- [OURA](#): pioneering **sleep performance** platform, focused on improving sleep that leads to a better life. The Oura Ring and app gives users daily feedback to improve their health, allowing users to better understand their body and reach their goals.
- [Neurosonic](#): they use **design to expand the range of possibilities** for people who need to get work done, or to take a relaxing break, both in the office and while on the move. Check out their N.A.P. Neuron Activation Pod, and other designs.
- [Biohacker Center](#): Creators of the Biohacker's Handbook, and a curated selection of biohacking products from EMF protecting pants to blue light blocking glasses.
- [Bioptimizers](#): Sharing their stellar supplements including MassZymes: The Most Potent Enzymes 17 enzymes including more protease per capsule (100,000 HUTs of protease per capsule) than anyone else.
- [Cellgym](#): Providing a "Cellgym Energy Lounge" for all attendees to test live. Cellgym is a unique cell training that improves people's health and performance. The result of the Cellgym method is a perceptible and measurable optimization of your mitochondrial performance level and thus of your cellular energy production.
- [Ahead](#): Food and supplement products for human performance, 100% natural. Made in Germany.
- [Vielight](#): Photobiomodulation devices for cognition and mental performance.
- [FlowVR](#): Flow Meditation for modern life's state of the art virtual reality meditation app
- [KRYO, Inc.](#): The OOLER® most advanced and most luxurious sleep system with a hydro-powered thermal range from 55-115°F (13-46°C). It includes a hydronic pad, control unit(s) and OOLER app for sleep schedules.
- [KÄÄPÄ Health](#): Incredible medicinal mushroom products
- [Neurohacker Collective](#): We are focused on making groundbreaking products for health and well-being through complex systems science. We will be featuring our premium nootropic products Qualia and our latest in longevity support, Eternus.

INVASIVE BRAIN ENHANCEMENT TECHNOLOGIES – CONCEPT STAGE

- Human-Computer-Interfaces with implanted electrodes
- Neuralink (Elon Musk, founded 2016, SF)
- Kernel (Bryan Johnson, gegründet 2016, LA) - is building advanced neural interfaces to treat disease and dysfunction, illuminate the mechanisms of intelligence, and extend cognition.



“



We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten.

-Bill Gates

**PLEASE FEEL FREE TO
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THANK YOU !