

Happy Brain, Happy Life?!

Potenziale der Neurotechnologie, KI und Psychologie

Dr. Nektaria Tagalidou

13.03.2023

In Kooperation mit

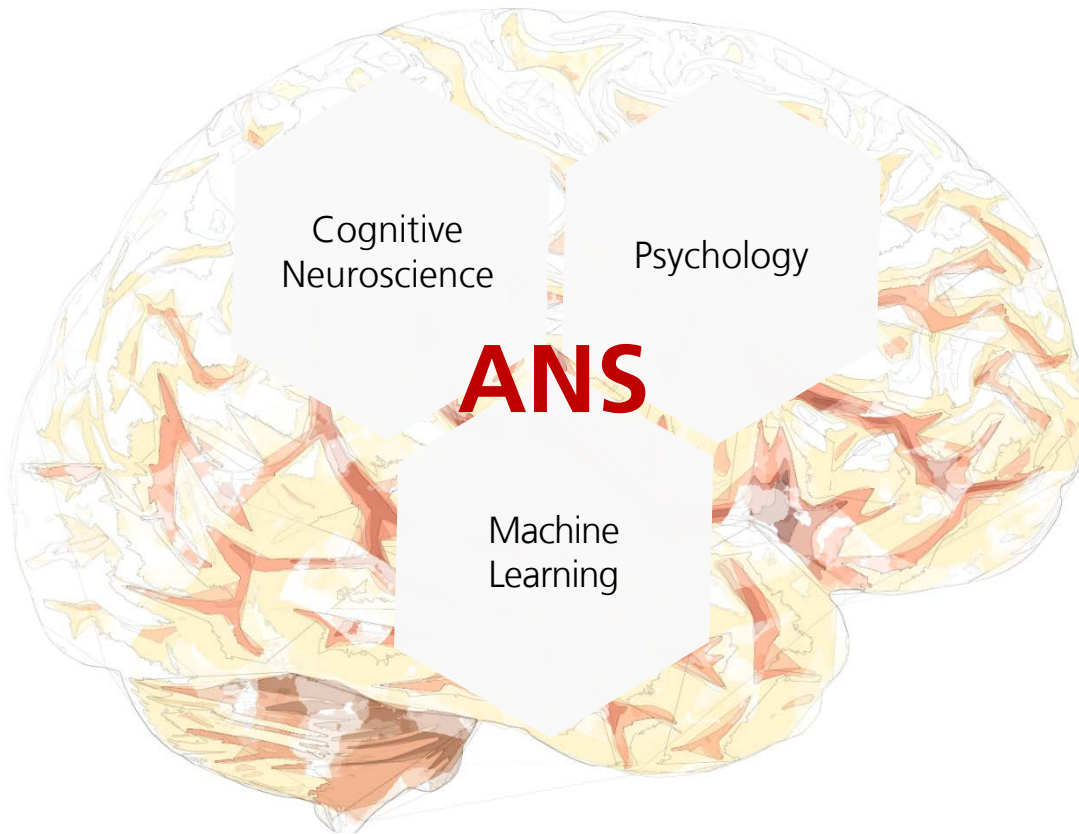


Universität Stuttgart
Institut für Arbeitswissenschaft und
Technologiemanagement IAT

© Fraunhofer IAO | Universität Stuttgart IAT

Applied Neurocognitive Systems (ANS)

We unlock the human potential!



Our vision is to create a better future of work and everyday life; where people are at the forefront while technology is assistive in the background!

We combine methods and knowledge from psychology and neuroscience with machine learning to find new solutions and create interactive technologies that leverage the full range of human potential to foster subjective well-being!

Applied Neurocognitive Systems (ANS)

Mental state recognition



Neurophysiological Recordings

Electroencephalography (EEG)

Functional Near-infrared Spectroscopy (fNIRS)

Physiological Recordings

Electrodermal Activity

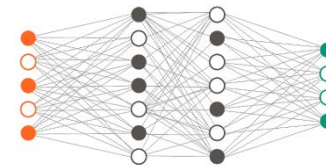
Heart-rate Variability

Respiration

Eye-tracking

Facial Decoding

Signal Processing



Machine Learning

Mental User States

Identifying Psychological Constructs

- Attention and Concentration
- Mental Load (Cognitive Workload)
- Error Perception
- Affect and Emotion

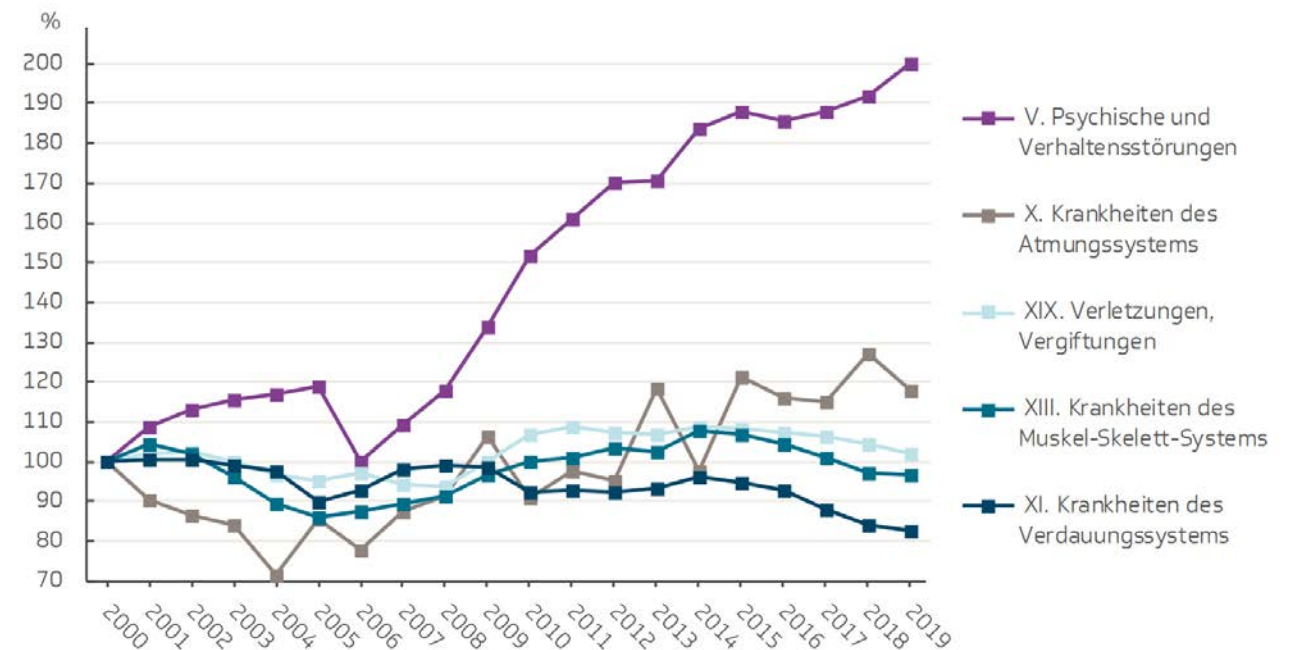
(Envisioned) Applications

- Evaluation, Improvement and User Acceptance of Human-Machine Systems
- Emotion- and Cognitive-Adaptive Human-Machine Interfaces

Auswirkungen von zu viel Stress

Was passiert, wenn der Stress zu groß wird?

- Gesundheitliche Beschwerden
 - HKS, Wirbelsäule, Schlafstörungen, Tinnitus, Magen-Darm
- Emotionale Erschöpfung
 - Reizbarkeit, Resignation, Zynismus, Verlust von Empathie, Verbitterung
- Reduzierte Leistungsfähigkeit
 - Konzentrationsprobleme, Reizüberempfindlichkeit, Ermüdung
- Arbeitsplatzprobleme
 - Unzufriedenheit, Geringere Verbundenheit mit dem Arbeitgeber, Geringere Bindung an den Arbeitsplatz



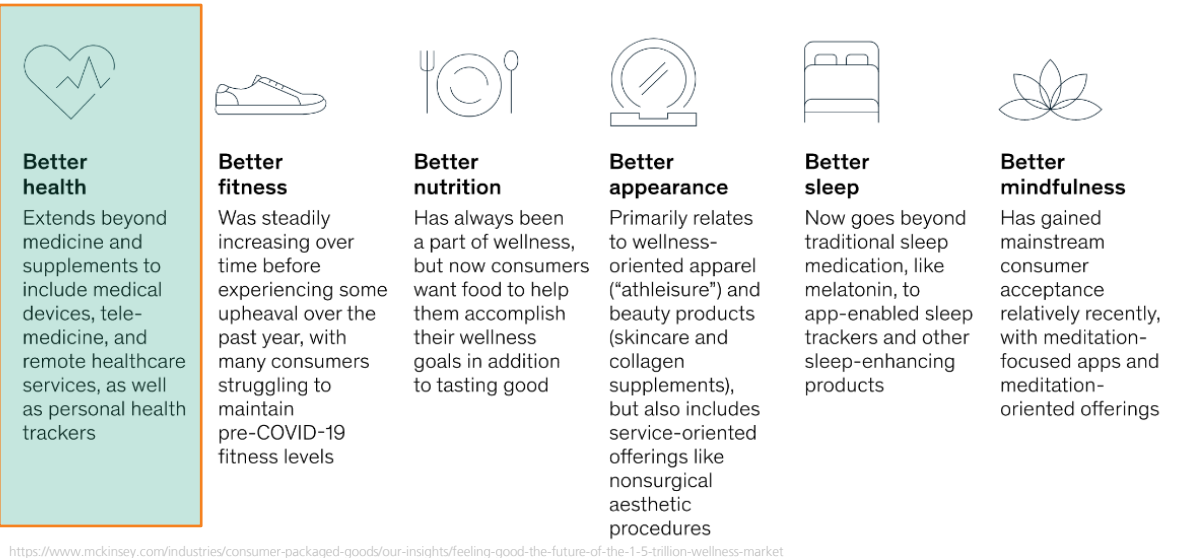
TK Gesundheitsreport 2020, <https://www.tk.de/resource/blob/2081662/6382c77f2ecb10cc0ae040de07c6807f/gesundheitsreport-au-2020-data.pdf>

Methoden eines gesunden Lifestyles

Smarte Produkte als Unterstützung

- *Health and Wellness Industry* wichtiger Bestandteil der Wirtschaft (~1.5 Milliarden, jährliches Wachstum 5-10%)
- Das meiste Geld wird in eine bessere Gesundheit investiert
- Immer mehr Menschen entdecken durch Technik Unterstützung ihren Alltag zu verbessern
- Trend der Zukunft: **Personalisierte, digitale Anwendungen für definierte Fragestellungen**

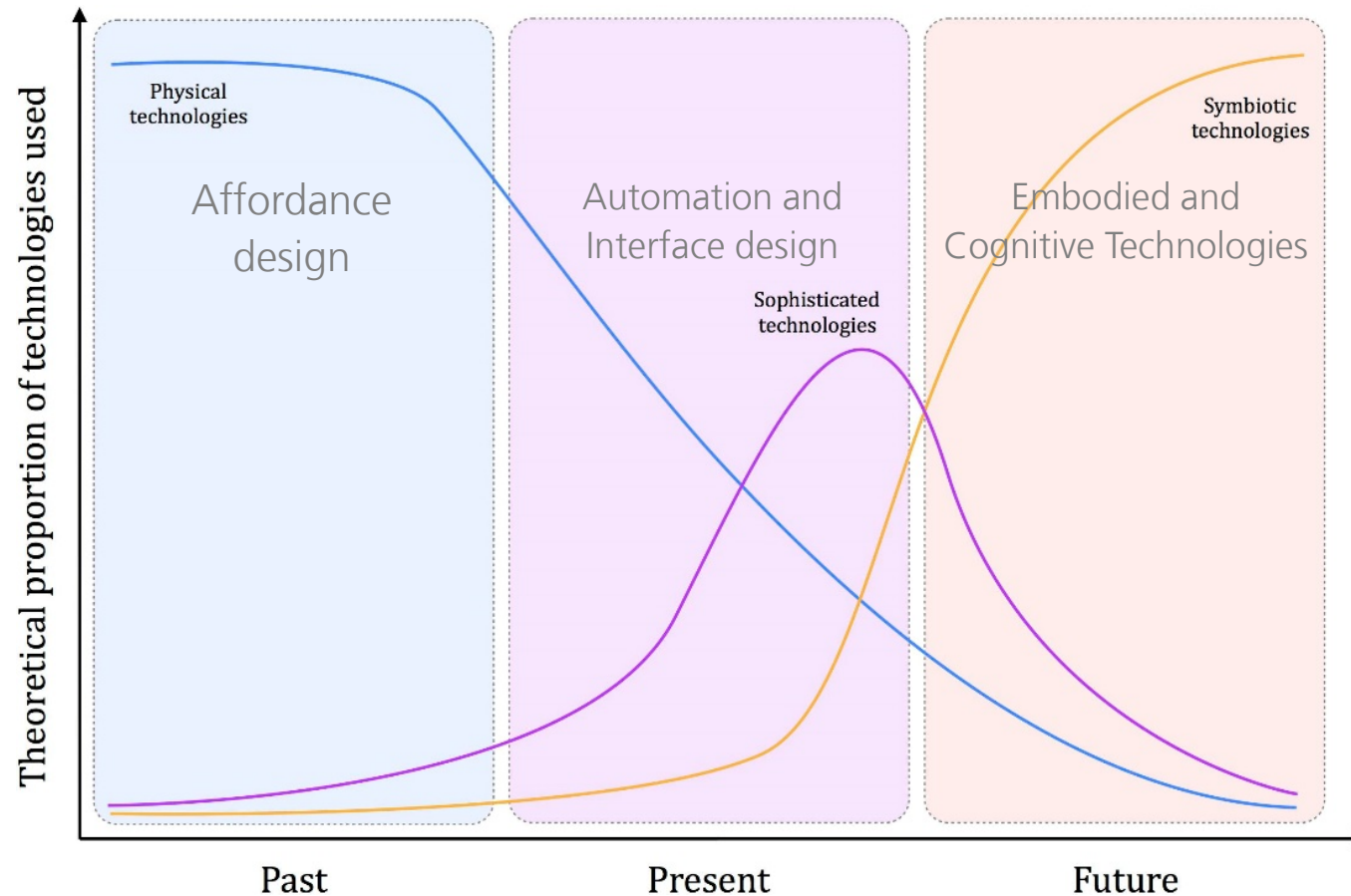
Today's consumer views wellness across six dimensions.



<https://www.mckinsey.com/industries/consumer-packaged-goods/our-insights/feeling-good-the-future-of-the-1-5-trillion-wellness-market>

Methoden eines gesunden Lifestyles

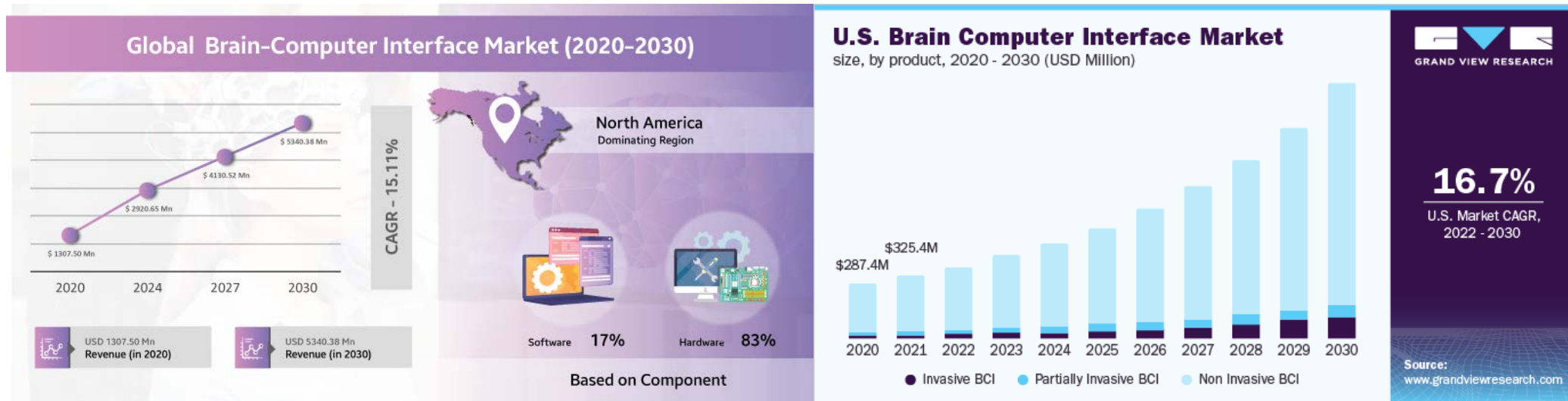
Technologieentwicklung als Enabler



F. Osiurak, 2018, How our cognition shapes and is shaped by technology: A common framework for understanding human tool-use interactions in the past, present and future. *Frontiers in Psychology*. Vol 9 Article 293

Methoden eines gesunden Lifestyles

Zukünftige Unterstützung durch technologische Innovationen?



<https://www.strategicmarketresearch.com/market-report/brain-computer-interface-market>

<https://www.grandviewresearch.com/industry-analysis/brain-computer-interfaces-market>

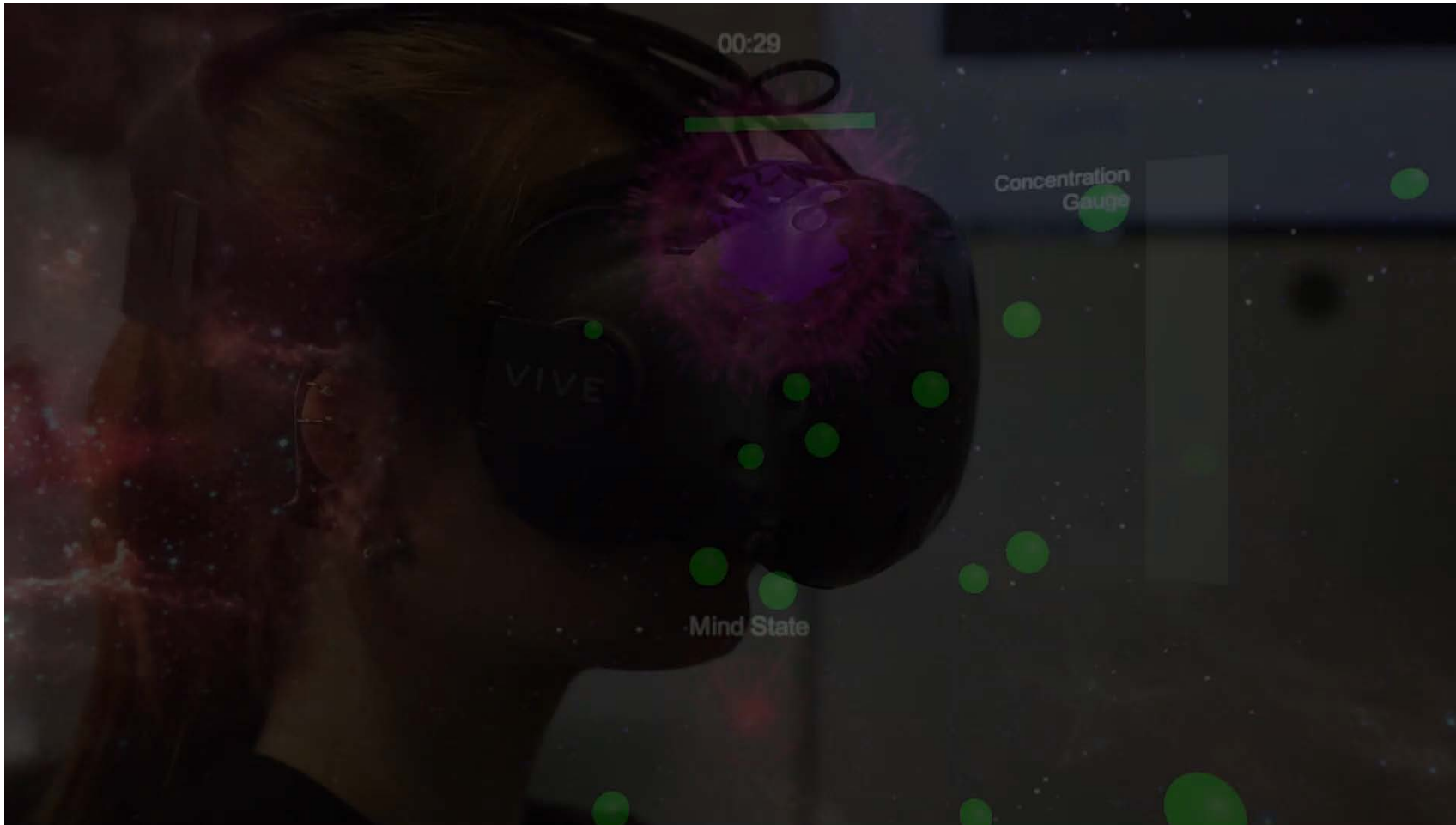
Happy Brain? Happy life?

Was bedeutet das für uns?



Happy Brain? Happy life?

Neurofeedback zur Entspannung



Kosuru RK, Lingelbach K, Bui M and Vukelić M (2019). MindTrain: How to Train Your Mind with Interactive Technologies. Proceedings of Mensch und Computer 2019, 643-647

Happy Brain? Happy life?

Digital phenotypes zur Detektion von Stress

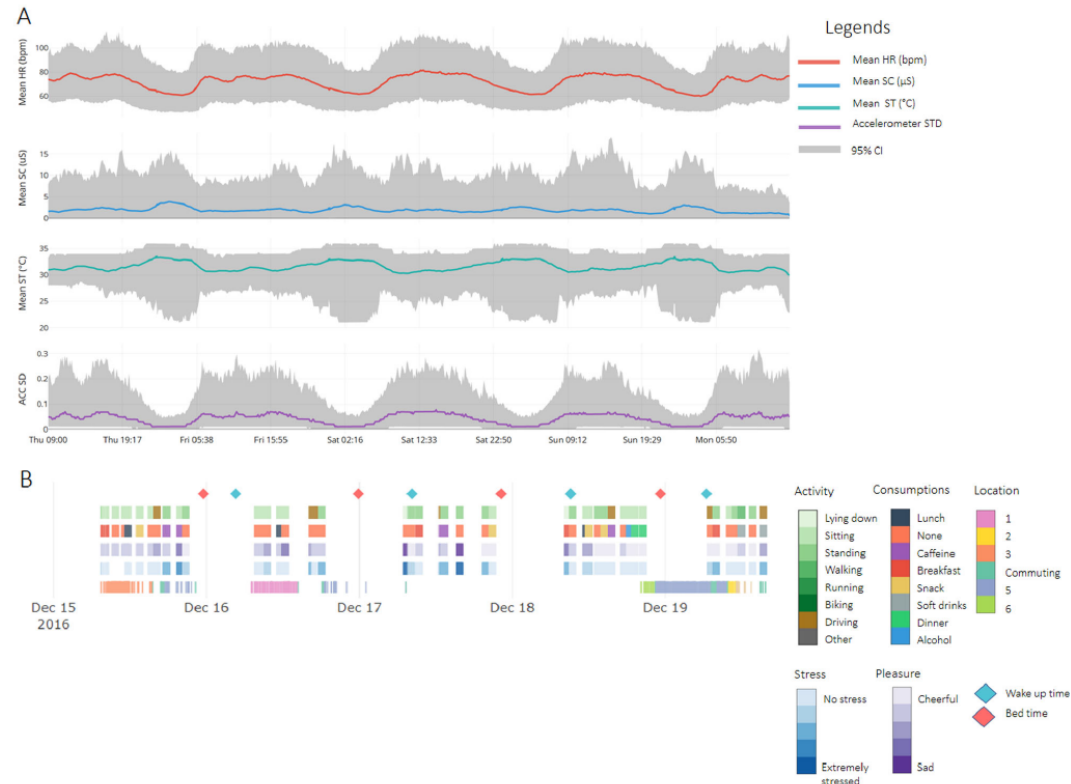


Fig. 1 Physiology and context timeline. **a** Healthy-population physiological data over 5 days of measurements depicting smoothed daily profiles of high quality (Quality > 0.8) physiological signals (mean HR, SC, and ST) and activity (ACC SD), averaged in 1 min windows. **b** Self-reported annotations (stress, pleasure, activity, consumptions, and wake up/bed times) and location, as indicated with vertical lines when available for a representative subject. Location data are indicated as unique stay locations or commuting locations. An online version of **a** and **b** can be downloaded from <https://drive.google.com/open?id=1Z1q0YLG8cvUJISM84X3mgwmCCBjf00M7>

npj | Digital Medicine

www.nature.com/npjdigitalmed

ARTICLE OPEN

Large-scale wearable data reveal digital phenotypes for daily-life stress detection

Elena Smets^{1,2}, Emmanuel Rios Velazquez³, Giuseppina Schiavone³, Imen Chakroun², Ellie D'Hondt², Walter De Raedt², Jan Cornelis², Olivier Janssens⁴, Sofie Van Hoecke⁴, Stephan Claes⁵, Ilse Van Diest⁶ and Chris Van Hoof^{1,2,3}

Physiologische Sensoren



- Skin Conductance (SC)
- Skin Temperature (ST)
- Acceleration (ACC)



- Electrocardiogram (ECG)
- Acceleration (ACC)

Kontextsensoren



Location



Movement



SMS/call/mail logs



Phone usage
e.g. locked/unlocked



Audio



Environmental sensors

Happy Brain? Happy life?

Stress und dessen Einfluss auf mentale Beanspruchung



Happy Brain, Happy Life?!

Zusammenfassung

- **Sustainable Human-centred Technologies**
Shape intelligent technology to foster human abilities, needs and preferences
- **Symbiotic Interaction**
Empathic or augmented technologies are gaining importance for future human-technology-interaction
- **Personalized (neuro-)technology**
for secure and safe, acceptable and pleasant interaction with intelligent machines

Vukelić, M. (2021). Connecting Brain and Machine – The Mind is the Next Frontier. Clinical Neuroethics Meets Artificial Intelligence - Philosophical, Ethical, Legal and Social Implications. Springer Verlag. Eds. O. Friedrich, A. Wolkenstein, C. Bublitz, R. Jox, E. Racine



Kontakt



Dr. rer. nat. Nektaria Tagalidou
Fraunhofer IAO
Team »Applied Neurocognitive Systems«
nektaria.tagalidou@iao.fraunhofer.de
+49 711 970 5439

Nobelstraße 12
70569 Stuttgart
www.iao.fraunhofer.de
www.hci.iao.fraunhofer.de