Christian-Albrechts-Universität zu Kiel

Seminar psyM1-1
Data Science in Theory

Letzte Woche: Gedankenlesen?

C A U
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NEUROIMAGING

Decoding mental states from brain activity in humans

John-Dylan Haynes[*‡§] *and Geraint Rees*[‡§]

Recent advances in human neuroimaging have shown that it is possible to accurately **decode a person's conscious experience** based only on non-invasive measurements of their brain activity. […] Such applications raise important **ethical issues** concerning the privacy of personal thought.

- Review: What is the idea of "decoding"?
- What current **technical challenges** exist?
- What **ethical issues** arise from this?

Multimodales Messen

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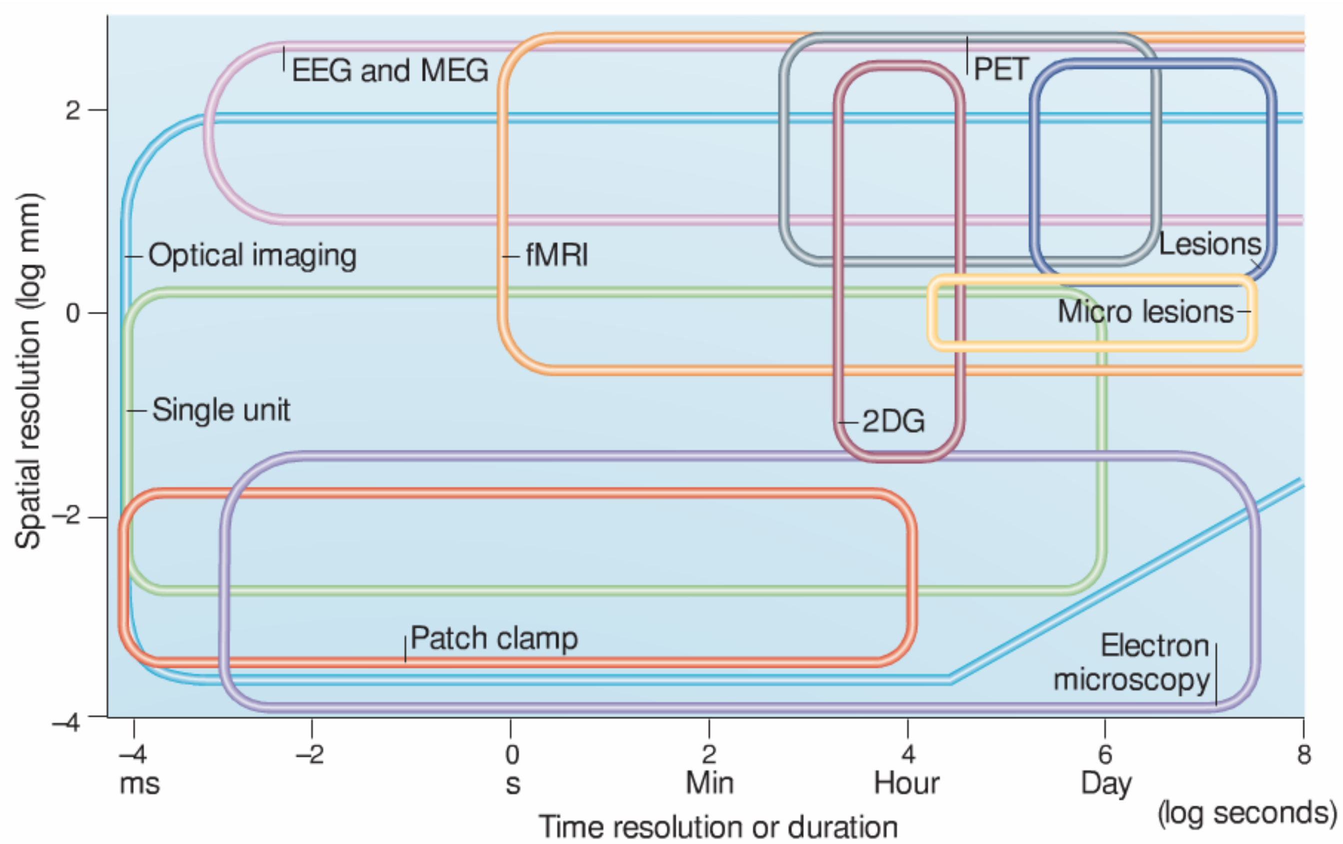
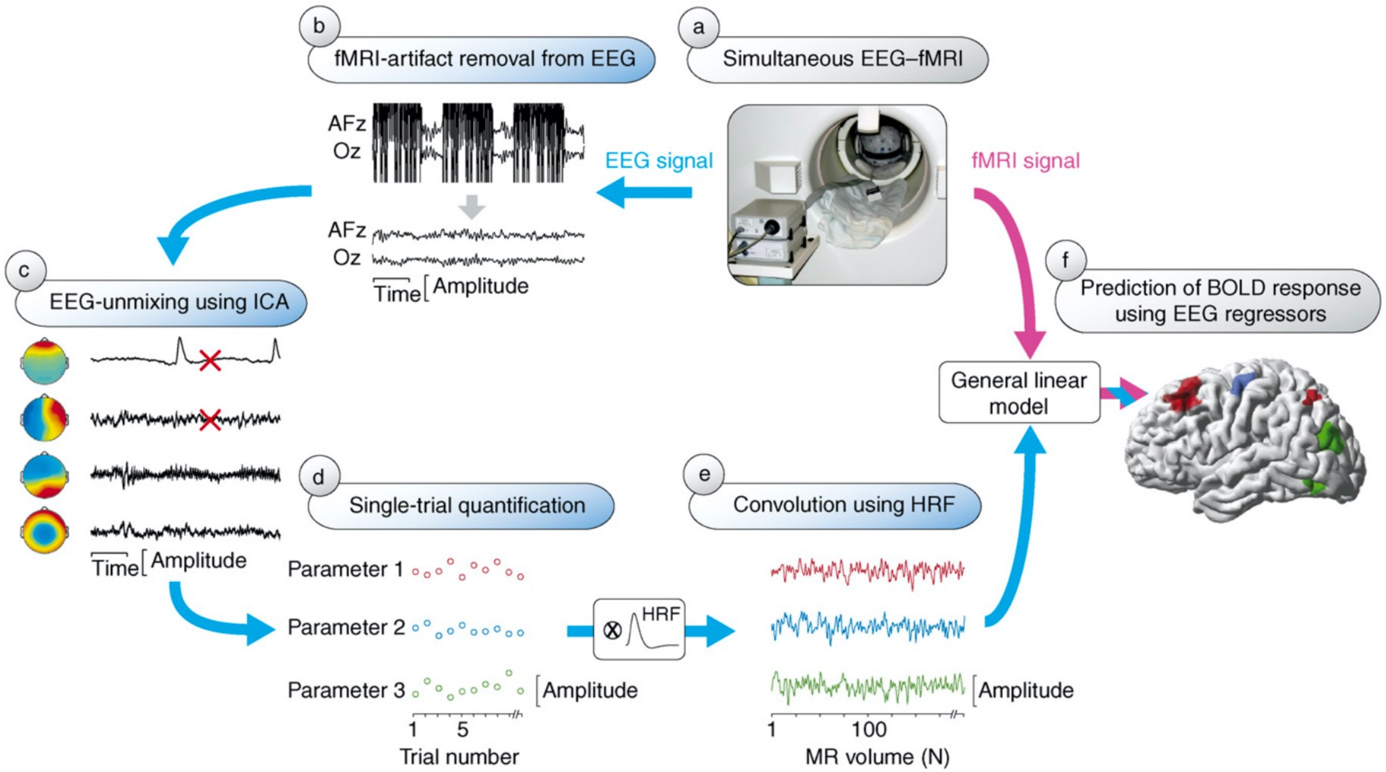
EEG: zeitlich hoch auflösend,
räumlich begrenzt



fMRI: zeitlich begrenzt,
räumlich hoch auflösend



TRENDS in Cognitive Sciences

Gleichzeitige Messung von fMRI und EEG

- + Kombination aus hoher räumlicher und zeitlicher Auflösung
- - Signale stören sich gegenseitig

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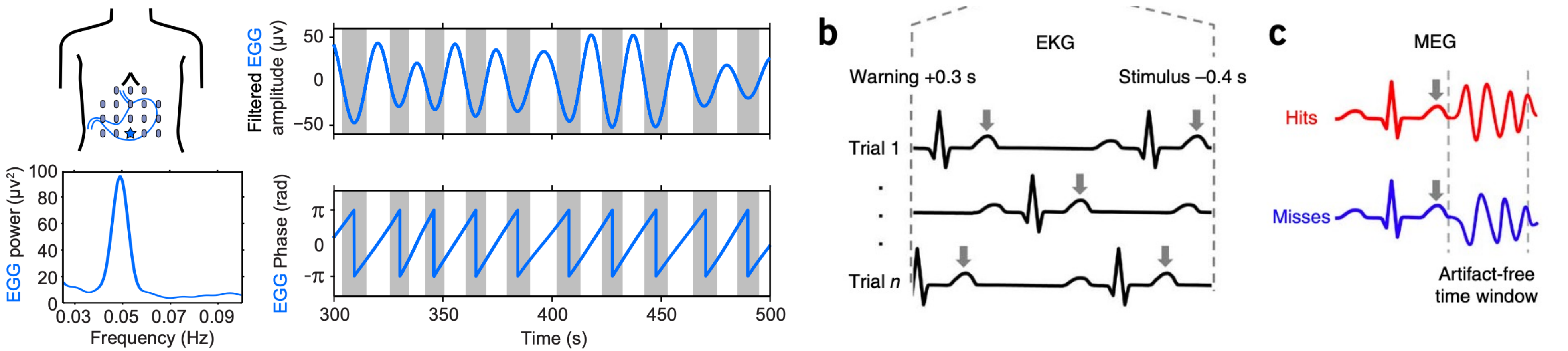
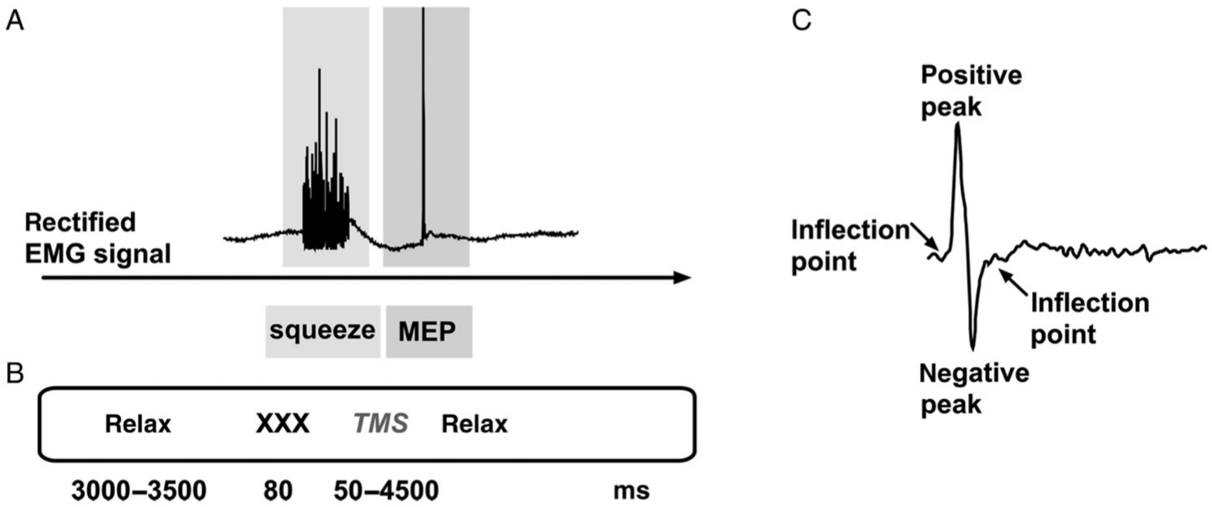


Gleichzeitige Messung von ZNS (M/EEG) und PNS (EKG, EGG)

- \+ Kombination aus Information unterschiedlicher Anteile des Nervensystems
- \- Signale stören sich gegenseitig
    - Aber: Eventuell von Interesse

Einfluss & Zeit

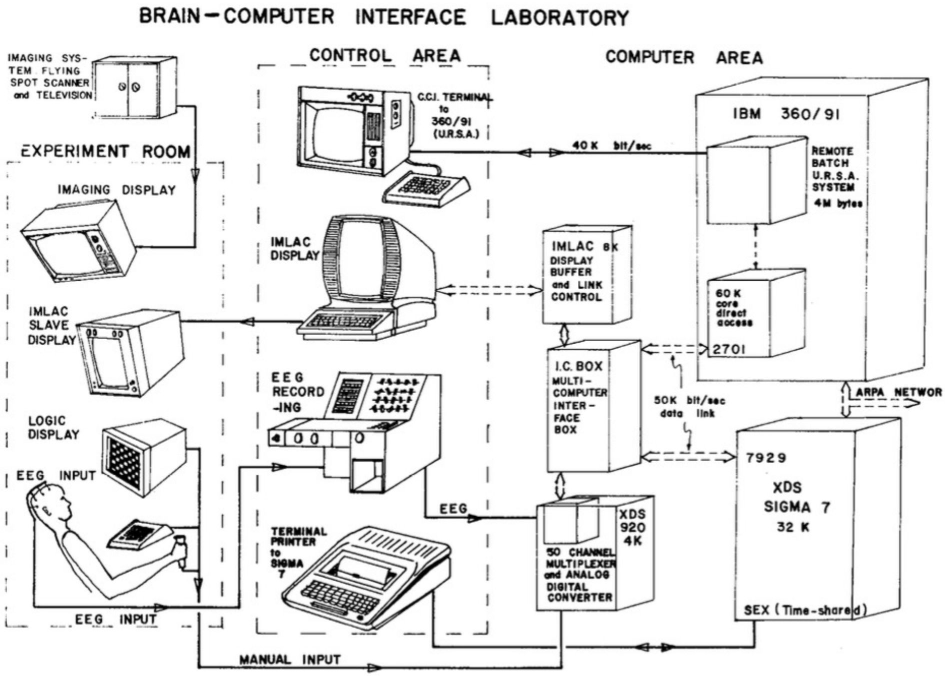


Gleichzeitiges EEG und Neurostimulation

- Online (Closed Loop) oder durch Experiment (Open Loop)
- + Direkter Einfluss auf neuronale Aktivität
- - Stimulation stört Messung

Probleme

- **Synchronisierung unterschiedlicher Messmethoden**
  - Unterschiedliche Zeitskalender Signale (z.B. EGG vs. EEG)
  - Unterschiedliche Verzögerung der Signale (z.B. BOLD vs. ERP)
  - Zeitliche Abhängigkeit der Messung (z.B. EEG zwischen fMRI Messungen)
  - Unterschiedliche optimale Reizdarbietung
- **Gegenseitige Einflüsse der Signale**
  - Optimierung des Designs um relevante Daten zu extrahieren
  - Aufwändige Vorverarbeitung der relevanten Signale



Diese Woche: Gedankenlesen im Schlaf?

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Neural Decoding of Visual Imagery During Sleep

T. Horikawa,[1,2] M. Tamaki,[1]* Y. Miyawaki,[3,1]† Y. Kamitani[1,2]‡

Visual imagery during sleep has long been a topic of persistent speculation, but its **private nature** has hampered objective analysis. [...] Our findings demonstrate that specific visual experience during sleep is represented by brain activity patterns shared by stimulus perception, **providing a means to uncover subjective contents of dreaming** using objective neural measurement.

- How is neural activity related to **subjective experience** here?
- How is subjective experience **decoded**?
- Is **perception and imagery** the same?

Nächste Woche:
Gedanken hören?

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Speech synthesis from neural decoding of spoken sentences

Gopala K. Anumanchipalli[1,2,4], Josh Chartier[1,2,3,4] & Edward F. Chang[1,2,3]*

Decoding speech from neural activity is challenging because speaking requires very precise and rapid multi-dimensional control of vocal tract articulators. Here we designed a neural decoder that explicitly leverages kinematic and sound representations **encoded in human cortical activity to synthesize audible speech.** [...] In closed vocabulary tests, listeners could readily identify and transcribe speech synthesized from cortical activity.

- What cortical areas are relevant for **speech perception and production**?
- How is speech **decoded**?
- How does this compare to BCI?
- What is the role of expectations for speech perception?

https://static-content.springer.com/esm/art%3A10.1038%2Fs41586-019-1119-1/MediaObjects/41586_2019_1119_MOESM3_ESM.mp4

Literatur

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