Data-Driven Classification of Spectral Profiles Reveals Brain Region-Specific Plasticity

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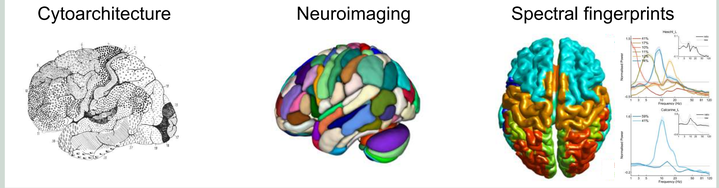
Max Planck Institute for Empirical Aesthetics

Introduction | Background

Cytoarchitecture | Neuroimaging | Spectral fingerprints



Typical approach to brain organization: cells, imaging
Novel approach to brain organization: 'spectral fingerprints' (SF)

Do SF reflect functional properties of brain areas or are they epiphenomenal?

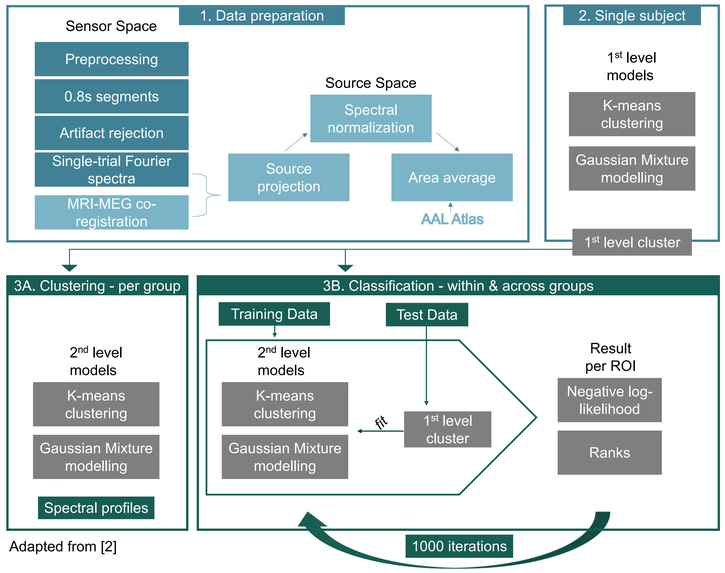
MEG experiment: are SF plastically reorganized in congenitally blind (CB) individuals?

CB show *behavioral adaptation* and *cortical reorganization* [1]

Hypothesis: SF in sensory cortices differ between CB and sighted in a way that can underwrite perceptual adaptation.

Methods | Materials

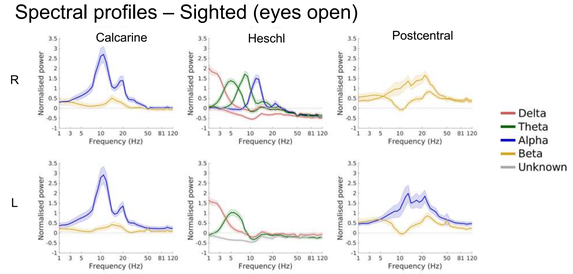
- Resting state MEG
- **Subjects**:
  S (eyes open): N=23;
  S (blindfolded): N=24;
  CB: N=26



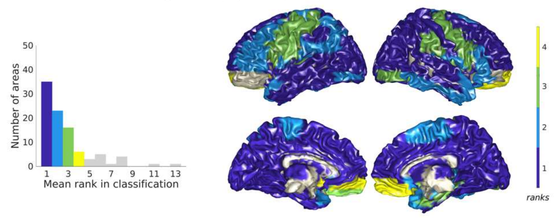
Adapted from [2]

Spectral fingerprinting (à la Keitel & Gross [1])

Spectral profiles – Sighted (eyes open)



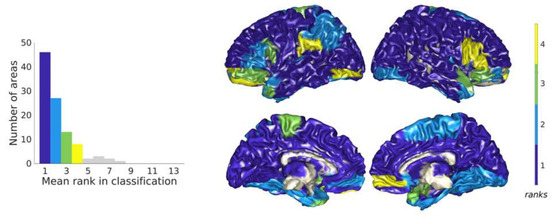
Classification – Sighted (eyes open)



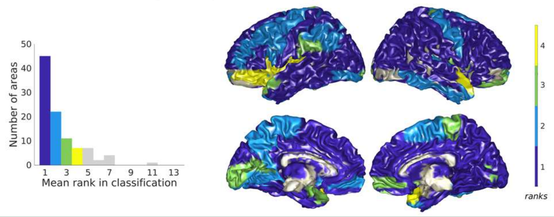
➡ Automatic, region-specific classification based on clustered spectral properties (replication)

Spectral fingerprinting (à la Keitel & Gross [2])

Classification – Blind

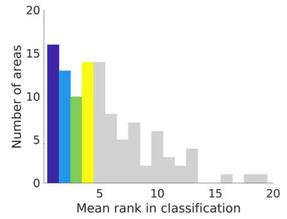


Classification – Sighted (blindfolded)

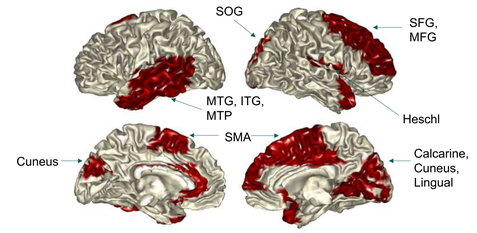


New news: sensory and right frontal areas do not classify across groups

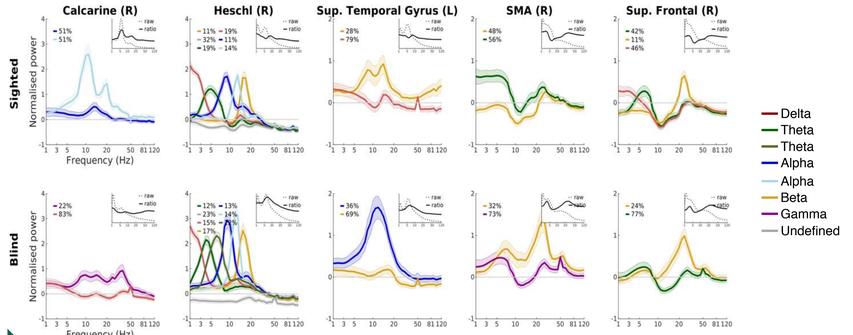
Cross-group classification – Sighted vs. Blind



Cross-group classification – significant brain regions

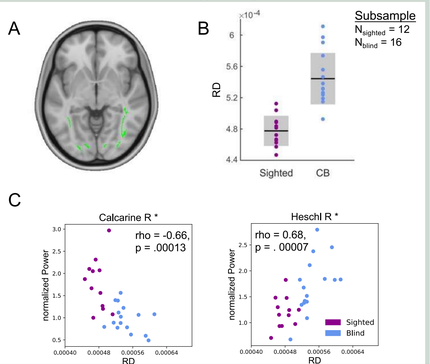


New news: SF reflect altered power and peak frequencies



CB: no visual alpha, but beta & gamma | more temporal alpha & beta | more frontal beta

Microstructural group differences



➡ Microstructure correlates with power

Discussion

1. spectral properties in congenitally blind differ from sighted
   - in auditory and visual areas
     → intra- and cross-modal plasticity
   - in right frontal areas
     → speculation: frontotemporal language network in CB?
2. increased power at higher frequencies in congenitally blind [3,4]
   - auditory & frontal: temporal processing
   - visual: inhibitory-excitatory circuitry

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References [1] Voss, P. et al. (2010). *Wiley Interdiscip. Rev. Cogn. Sci.* [2] Keitel, A., & Gross, J. (2016). *PLoS Biol.* [3] Rimmele, J.M. et al. (2019). *NeuroImage*. [4] Gudi-Mindermann, H. et al. (2018). *Behav. Brain Res.*

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