EcologHear

Ecological Hearing: Designing soundscapes through human auditory perception of ecosystem biodiversity

« […] The goal of EcologHear is to understand how people experience ecosystem biodiversity through sounds and to use this knowledge to improve well-being in noisy environments. […] »

Listening to polluted soundscapes has a negative impact on health
correlation with stress, stroke, obesity
(de Paiva, Cardoso, Rodrigues, 2015; Murphy & King, 2022)

Listening to natural soundscapes has a positive impact on health
mental health, well-being
(Buxton et al., 2021, 2024; Ratcliff et al., 2021; Aletta et al., 2018)

Soundscapes acoustic organisation: insights from sound ecology

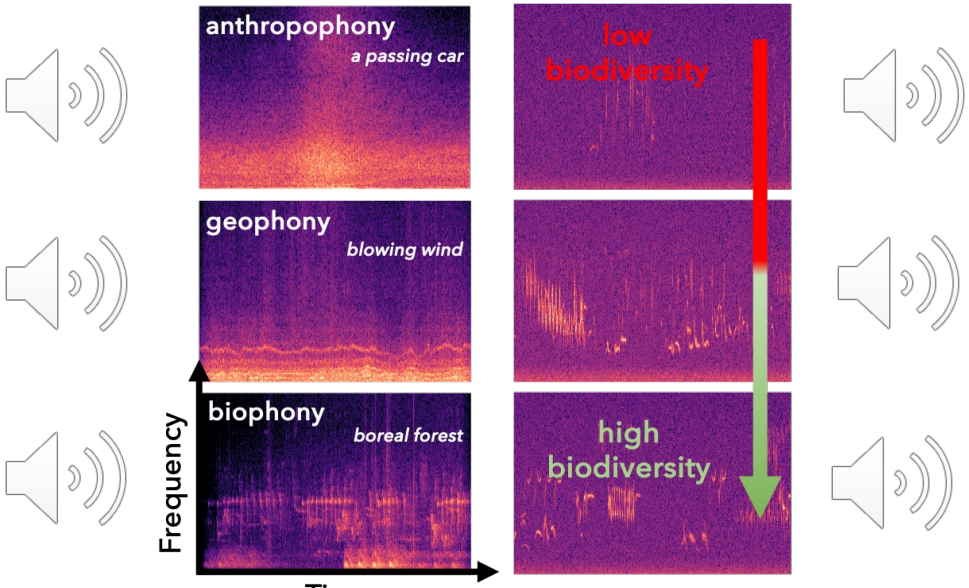


Figure 2. Examples of soundscapes' spectrograms

Figure 3. Example of a biodiversity gradient

How the brain process soundscape is largely unknown!

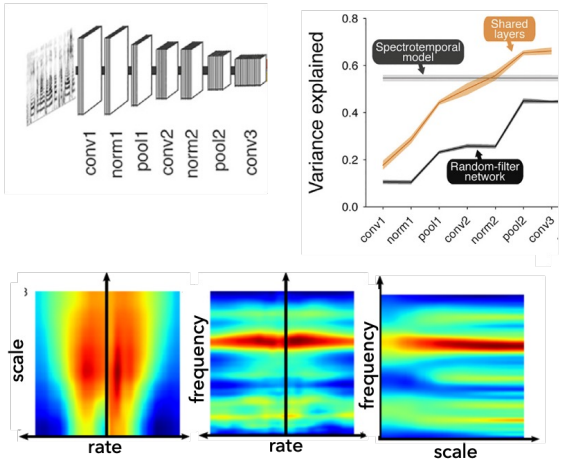
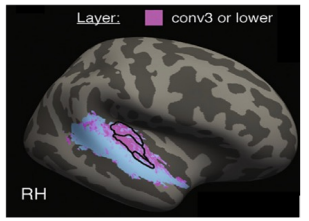


Figure 6a. Spectro-Temporal modulation representations models primary auditory cortex receptive fields

CNN layers model auditory cortex activity



6b. The auditory cortex representations are well modeled by deep convolutional neural networks (Kell et al., 2018)

Objective 2: UNDERSTANDING

I will decipher the behavioral and neural bases of soundscape's biodiversity perception

preliminary results

Two fMRI pilots:

- Spatialization x (biophony x geophony x anthropophony)
- 3 biodiversity gradients

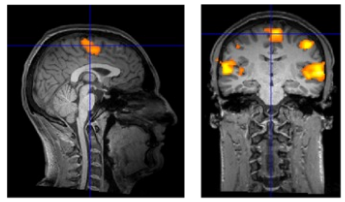


Figure 7. Pilot fMRI experiment suggests specific cerebral networks specific to soundscapes, here the contrast between biophony and anthropophony

Deliverables:

- neural markers of soundscapes biodiversity and well-being

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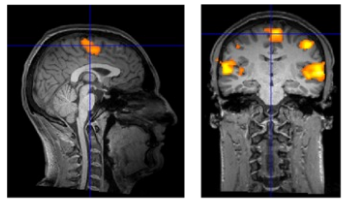

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A HUGE thanks to
Thierry, Régis, Pascal & Centre IRM!

preliminary results

Spatialization
x
biophony x geophony x anthropophony

3 synthetic biodiversity gradients

low biodiversity high biodiversity

7 participants scanned | 2 participants analyzed
sensimetrics + hearing protections

Contrasts:

- Biophony vs. Other
- Anthropophony vs. Other

RSA:

« which voxel has an activation that correlates with the biodiversity gradient »

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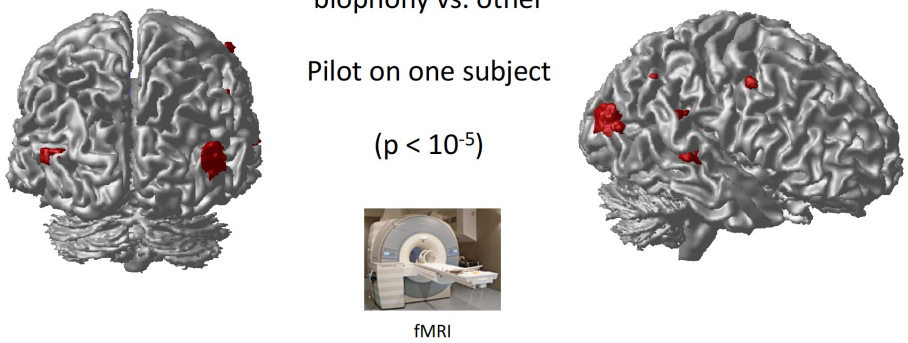
Biophony vs. Other

Sub #01



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Overlap with experience 1

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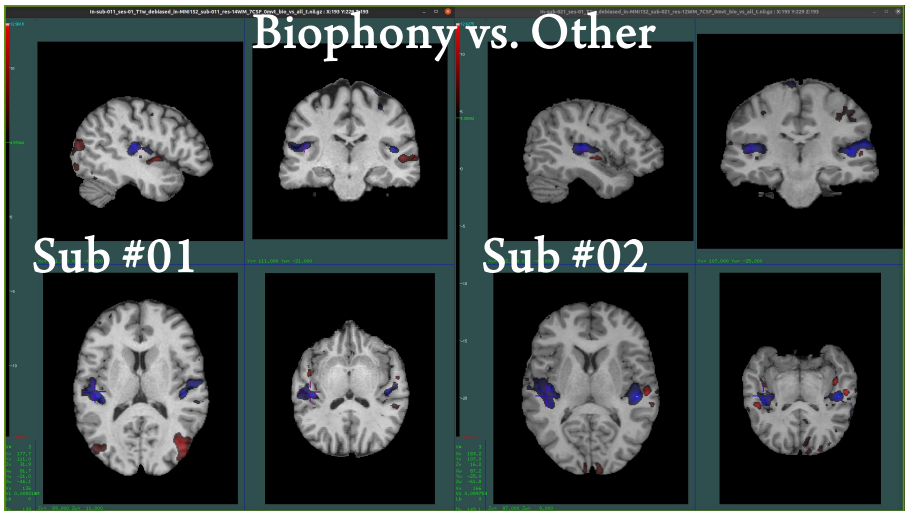

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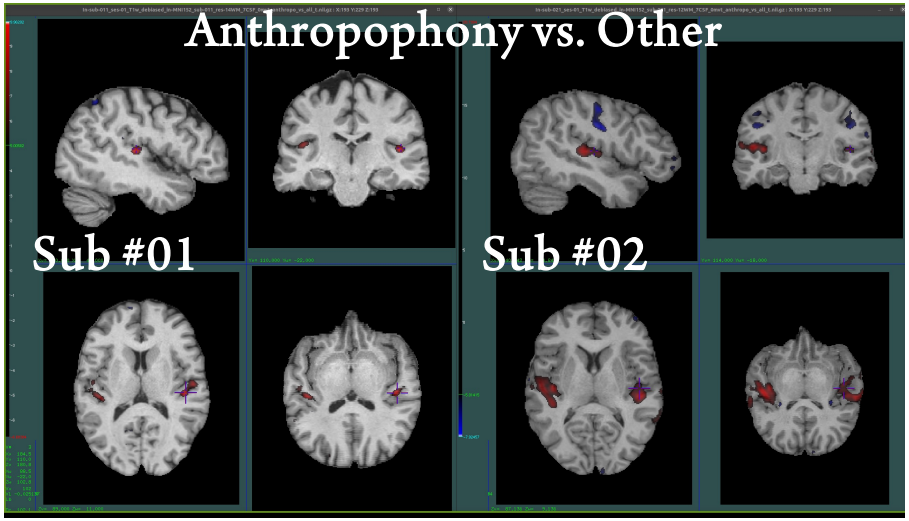

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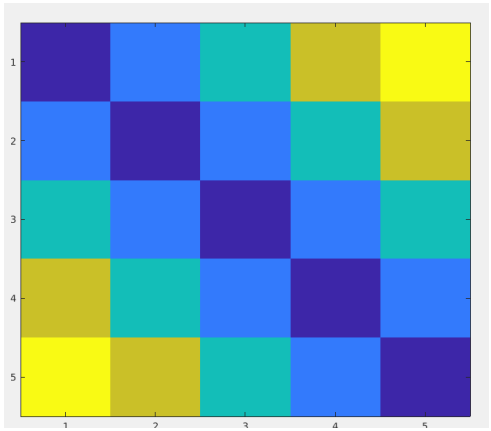
RDM model

low biodiv → high biodiv



high biodiv

preliminary results

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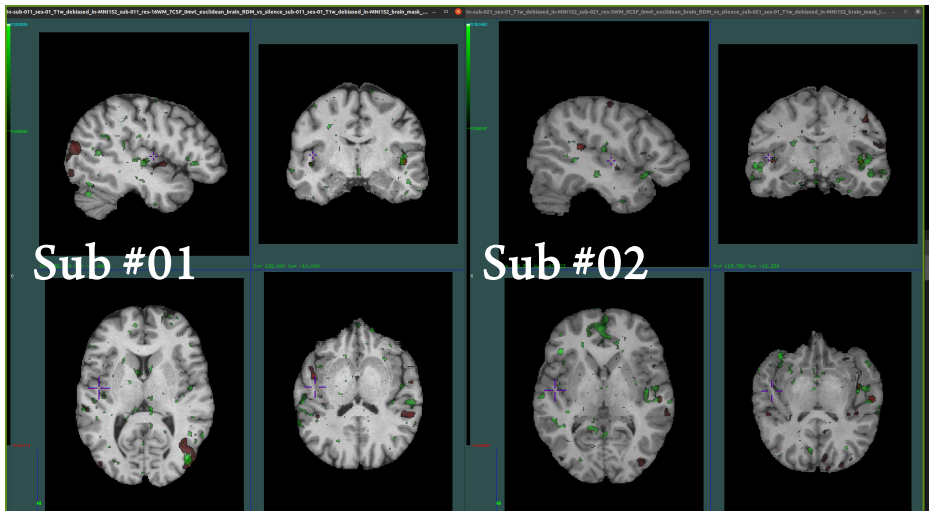
low biodiversity — high biodiversity



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