presentation of planned pilot-study for my master-thesis in cognitive neuroscience

The networks they are a´-changin

Investigating auditory system connectivities during cortical processing of speech, song and music in left-handers and musicians

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Aim of the study

Neuronal connectivity differences within unimodal primary and secondary auditory cortex during the processing of speech, song and music shall be investigated. According to this findings the leading question will be further expanded to the influence of handedness and musical training on inter- and intrahemispheric connectivities.

To visualize the information flow of neuronal correlates in an optimal manner of spatial and temporal resolution, combined measurements with fMRI and EEG will be implemented.

Hypotheses

1. How does an increasing musical gradient, manipulated through the presentation of speech, song and music, modify connectivities between areas of auditory cortex?

2. Do left-handers and musicians exhibit other models of connectivity than right-handed non-musicians?

Overview - 1

- Areas of primary and secondary auditory cortex: Heschel's gyrus (HG) and superior temporal gyrus (STG) [1] [2]
- Differences between processing of music and speech in non-primary auditory cortex: planum polare (aSTG) & planum temporale (pSTG) [3] [4] [5]
- proposed lateralisation of music (right) and speech (left) → hemispheric dominance according to spectral and temporal resolution [3] [6]
- differences of music and speech are based on their different spectrotemporal properties → high temporal resolution of speech vs. fine-graded spectral resolution of music [7] [8]

→ adding singing combines these properties: definition of a **musical gradient**

Overview - 2

- Musical training seems to influence the neuronal processing of music and speech (intra- as well as interhemispheric) [9]
- It is known, that neuronal processing makes a difference between right- and left-handers, therefore left-handers are often excluded in cognitive sciences [10] [11]

  → inclusion of lefthanders as additional value in understanding neuronal functionality!

- past studies mostly concentrated on differences of neuronal activity and not connectivity!

Participant-groups

- Healthy participants between 18 & 29; no diagnosis of speech development disorder or dyslexia
- 3 groups of participants: right-handed non-musicians, left-handed non-musicians, right-handed musicians
- Comparison: RH-nM (control group and 1st hypothesis) vs. LH-nM and vs. RH-M (both 2nd hypothesis)

Combined EEG-fMRI-Measurement

Image:

https://www.google.de/search?q=EEG+for+mri&client=ubuntu&hs=3PU&channel=fs&dcr=0&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjb-byn35jZAhWSJlAKHT65DfMQ_AUICygC&biw=1920&bih=1102#imgrc=qodUT1bbVAf9FM:

Experimental procedure

- 60 sentences (different languages, equal male/female speakers), 60 extracts of novel songs (“), 60 extracts of novel melodies (different instruments)
- Block-design similar to the study of Angulo-Perkins et al. (2014) [9]

https://www.sciencedirect.com/science/article/pii/S0010945214002445?via%3Dihub#fig1

Statistical analysis

- Hypothesis-driven connectivity-models via dynamic causal modelling (DCM) [12]
- Python

Sources

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