Finding the neural signature of musicality

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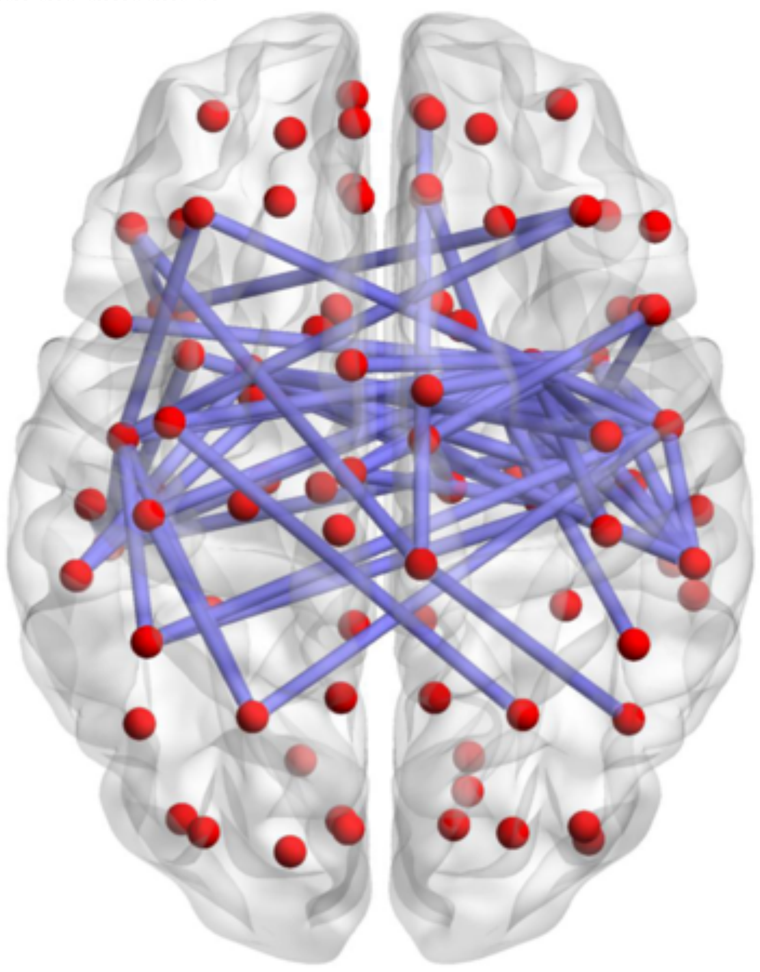
Introduction

Musical training and practice involves multiple regions and processes within the brain, including auditory, visual, motor, somatosensory, and memory systems. It is ideal for studying how expertise brings about changes in neural structure and function. Resting state activity in the brain is no longer seen as merely noise, it is now believed to reflect repetitive training in a domain. The current study hypothesises that intense musical training will alter the resting activity in areas associated with musicality, and the functional connectivity between them.

The goal of this project is to attempt to identify a neural signature within resting state EEG data which indicates a level of musical training. The strength of this signature is hypothesised to correlate with the amount of musical training a participant has received.

A similar study by Klein et al. (2016) investigated resting state neural activity in fifteen string players and fifteen control subjects. The current study aims expand on this work, analysing resting state data from a much larger group of participants (c. 150), with varying levels of musical training and expertise.



Materials

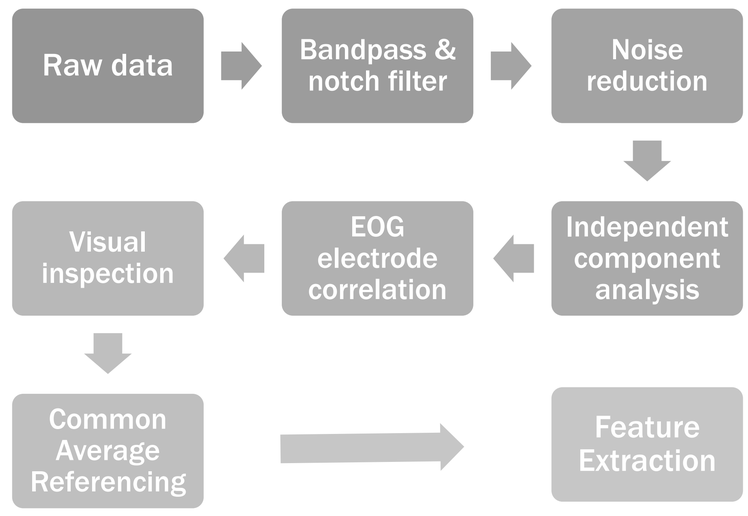
Resting state EEG data was acquired from participants, with 3 minutes of data in the eyes closed condition and 3 minutes of data in the eyes open condition. Participants' level of musicality and training was calculated using their responses to the Goldsmiths Musical Sophistication Index questionnaire.

EEG signals were recorded using 64 active electrodes placed according to the extended 10 - 20 system of electrode placement, as shown above. These electrodes were amplified using a BioSemi ActiveTwo amplifier. Four additional electrodes were used to record horizontal and vertical EOGs. The EEG signals were recorded at a sampling frequency of 512Hz.

Method

Raw EEG data in BioSemi format will be analysed in MATLAB using the Fieldtrip toolbox. Preprocessing, according to the flow chart below, will be performed to reduce noise and remove artifacts from the data.

Machine learning will be used to predict the level of musical training of participants from features extracted from the processed EEG data. The dataset will be split up, 80% will be used as a training set, and the remaining 20% will be used as a test set to ascertain prediction accuracy of the classifier.



Next Steps

The neural signature of musicality will most likely be found within or between regions commonly associated with musicality (such as the auditory, somatosensory, and motor cortices), which have been shown to be modulated by musical training.

By defining seed regions a priori, it will be possible to investigate how resting activity in these areas is affected by musical training. Additionally, using a graph-theoretical approach to analysis will allow functional connectivity to be investigated, and discovery of how networks are formed in response to the demands of musical processing in the brain.

Klein et al. (2016) also implicate functional connectivity between areas such as Broca's region and the planum temporale in the musical resting state network, which this study aims to confirm.

References

Klein, C., Liem, F., Hänggi, J., Elmer, S., & Jäncke, L. (2016). The "silent" imprint of musical training. *Human Brain Mapping*, 37(2), 536–546.

Müllensiefen, D., Gingras, B., Musil, J., & Stewart L. (2014). The Musicality of Non-Musicians: An Index for Assessing Musical Sophistication in the General Population. *PLoS ONE*, 9(2): e89642.

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