

Classifying perception and imagination of music from EEG

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The neural processes involved in the perception of music are also involved in imagination. This overlap can be exploited by techniques that attempt to classify the contents of imagination from neural signals, such as signals recorded by EEG. Successful EEG-based classification of *what* an individual is imagining could pave the way for novel communication technologies, such as brain-computer interfaces. Our study explored whether we could accurately classify perceived and imagined musical stimuli from EEG data. To determine what characteristics of music resulted in the most distinct, and therefore most classifiable, EEG activity, we systematically varied properties of the music. These properties included time signature (3/4 versus 4/4), lyrics (music with lyrics versus music without), tempo (slow versus fast), and instrumentation. Our primary goal was to reliably distinguish between groups of stimuli based on these properties. We recorded EEG with a 64-channel BioSemi system while participants heard or imagined the different musical stimuli. We hypothesized that we would be able to classify which piece was being heard, or being imagined, from the EEG data.

Using principal components analysis, we identified components common to both the perception and imagination conditions. Preliminary analyses show that the time courses of these components are unique to each stimulus and may be used for classification. To investigate other features of the EEG recordings that correlate with stimuli and thus enable accurate classification, we applied a machine learning approach, using deep learning techniques including sparse auto-encoders and convolutional neural networks. This approach has shown promising initial results: we were able to classify stimuli at above chance levels based on their time signature and to estimate the tempo of perceived and imagined music from EEG data. Our findings may ultimately lead to the development of a music-based brain-computer interface.