

MELODIC EXPECTATIONS ARE ENCODED IN THE BRAIN DURING MUSICAL IMAGERY

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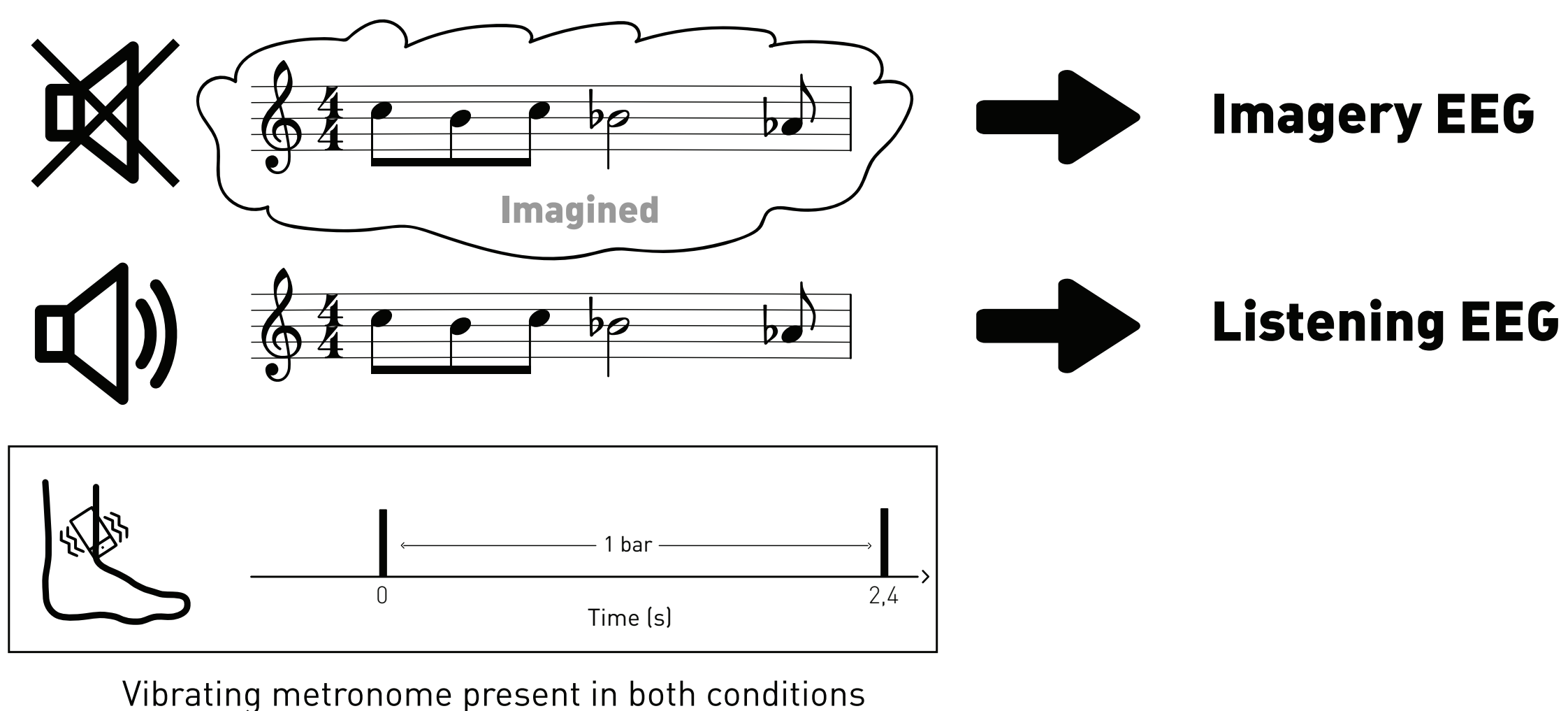
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Introduction

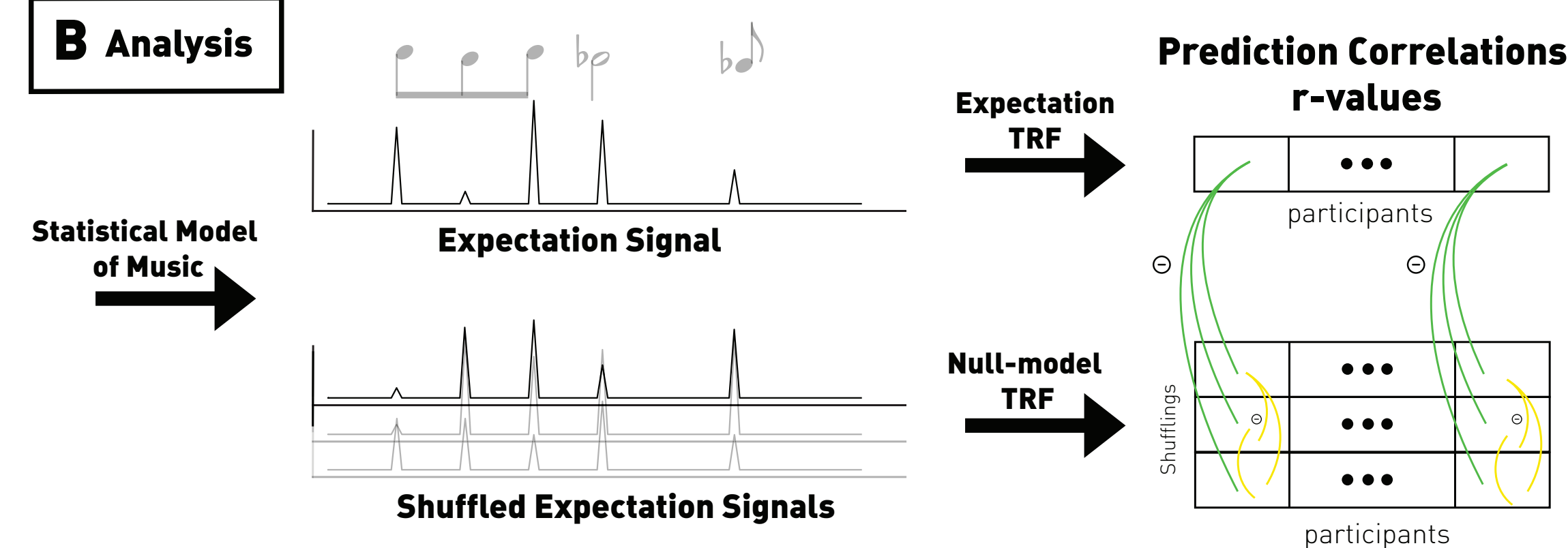
Musical imagery is the voluntary internal hearing of music in the mind without the need for physical action or external stimulation. Numerous studies have already revealed brain areas activated during imagery (Zatorre and Halpern, 2005). However, it remains unclear to what extent imagined music responses preserve the detailed temporal dynamics of the acoustic stimulus envelope and, crucially, whether melodic expectations play any role in modulating responses to imagined music, as they prominently do during listening (Di Liberto, 2020. Omigie, 2013).

Method

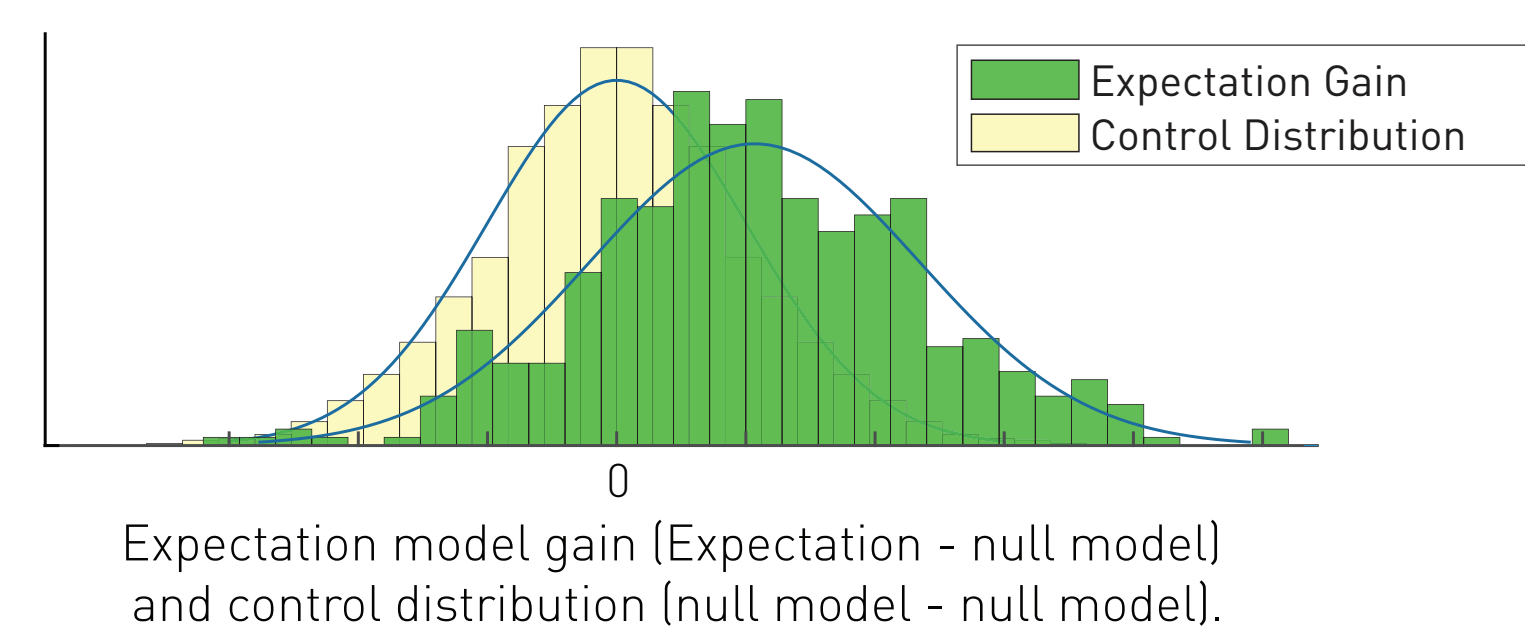
A Data Collection



B Analysis

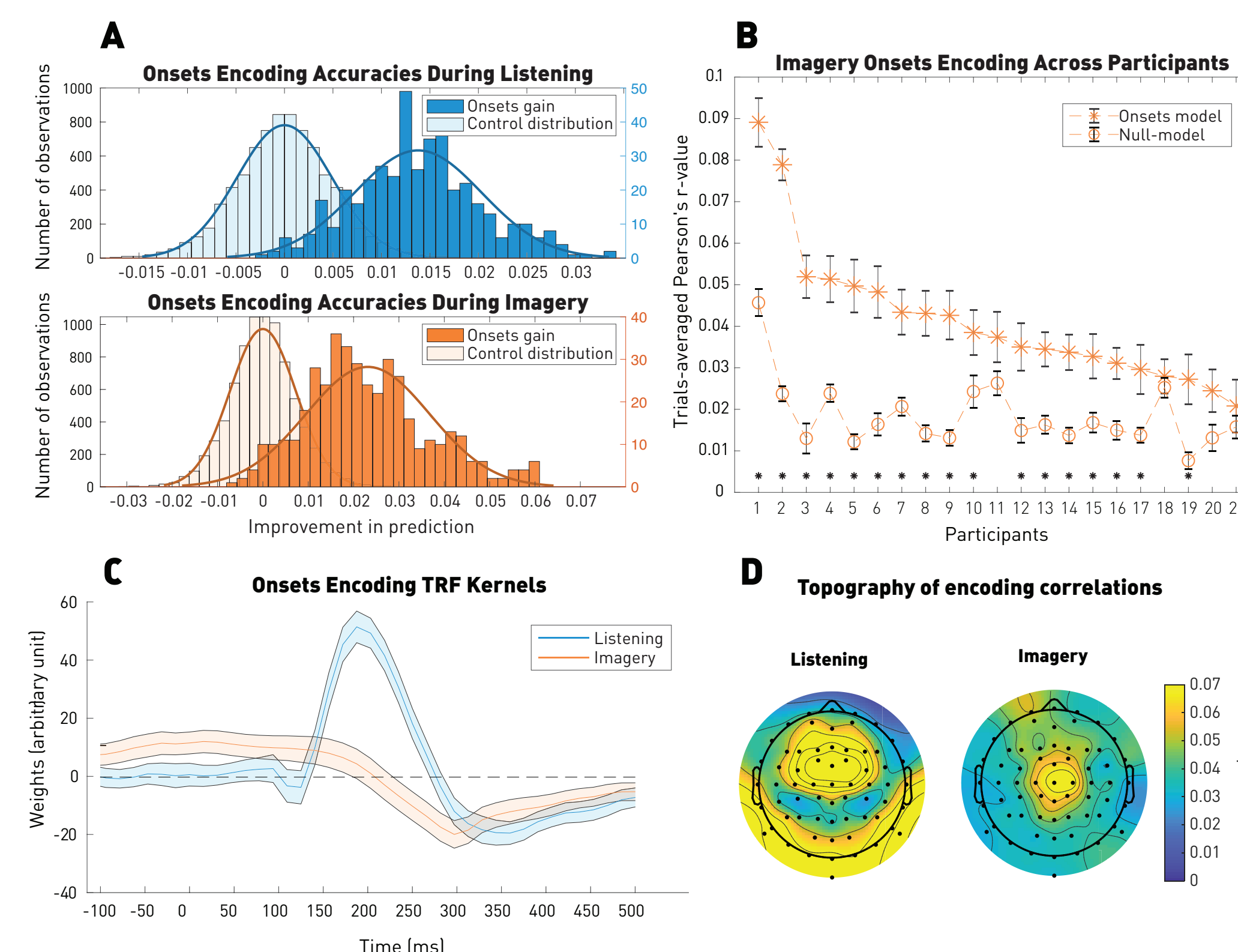


HYPOTHESIS



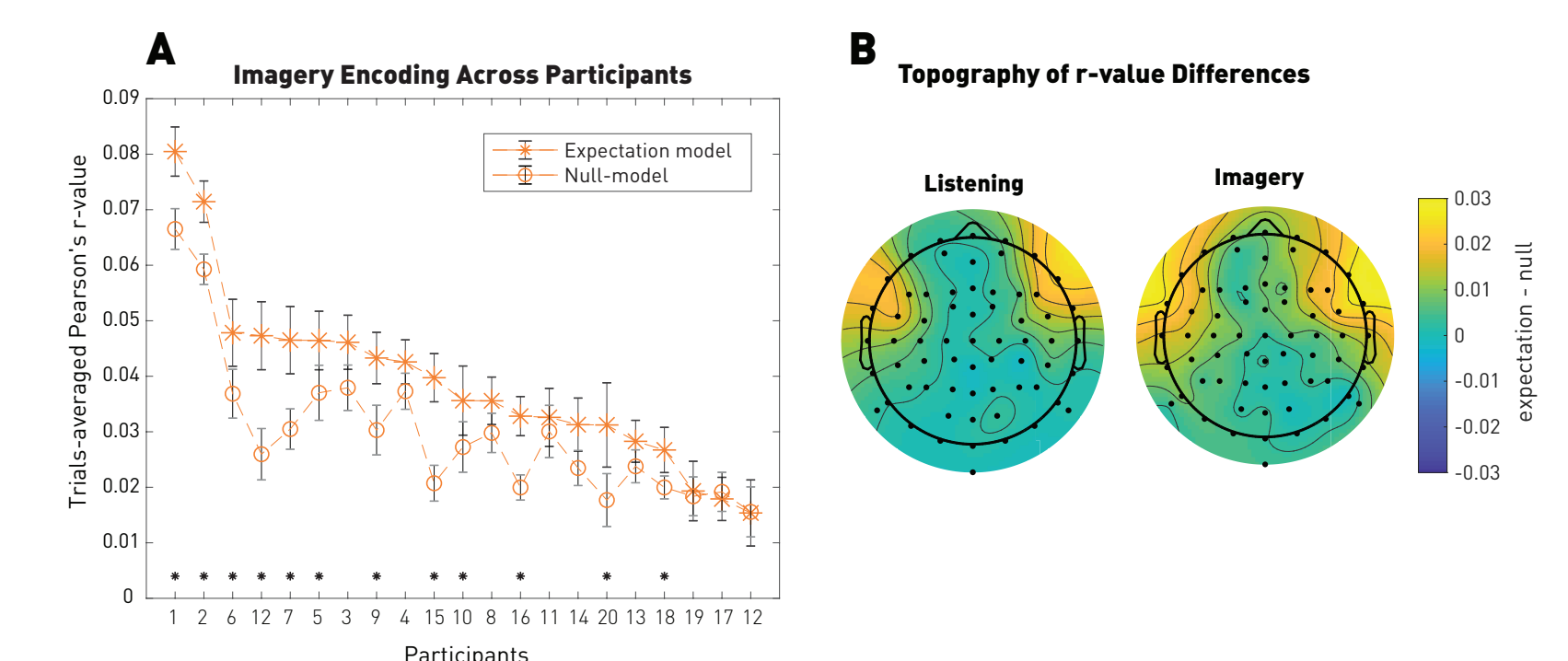
Cortical Encoding of Acoustics

We can see the acoustic information is actually encoded in the EEG recordings (A), even at the individual participant level (B). The EEG responses seem to show an inverted polarity (C) calling a predictive nature of these responses, finally, as suggested by the literature (Herholz, 2012), the signal seems to be encoded in distinct but overlapping cortical areas (D).



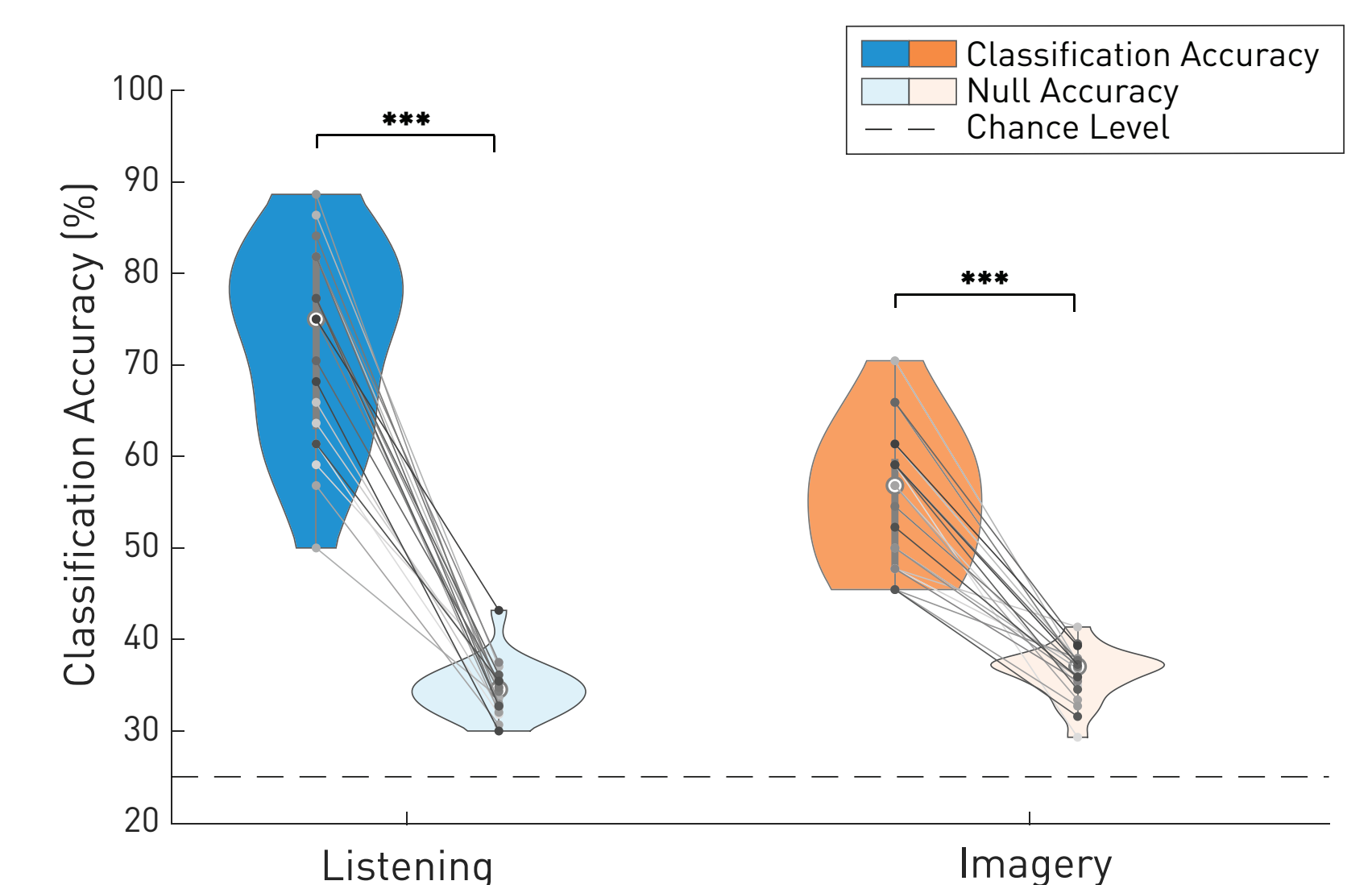
Cortical Encoding of Expectations

The model-computed expectation signal was correlated in time with the EEG responses using the Temporal Response Function (Crosse, 2016). We showed that this signal is also encoded in the EEG recordings and even at the individual level (A). More interestingly, this signal seems to be encoded in different cortical areas than the acoustics and to show the same pattern for both listening and imagery. The pre-frontal looking activation are really consistent with the literature (Tillman, 2003; Opitz, 2002).



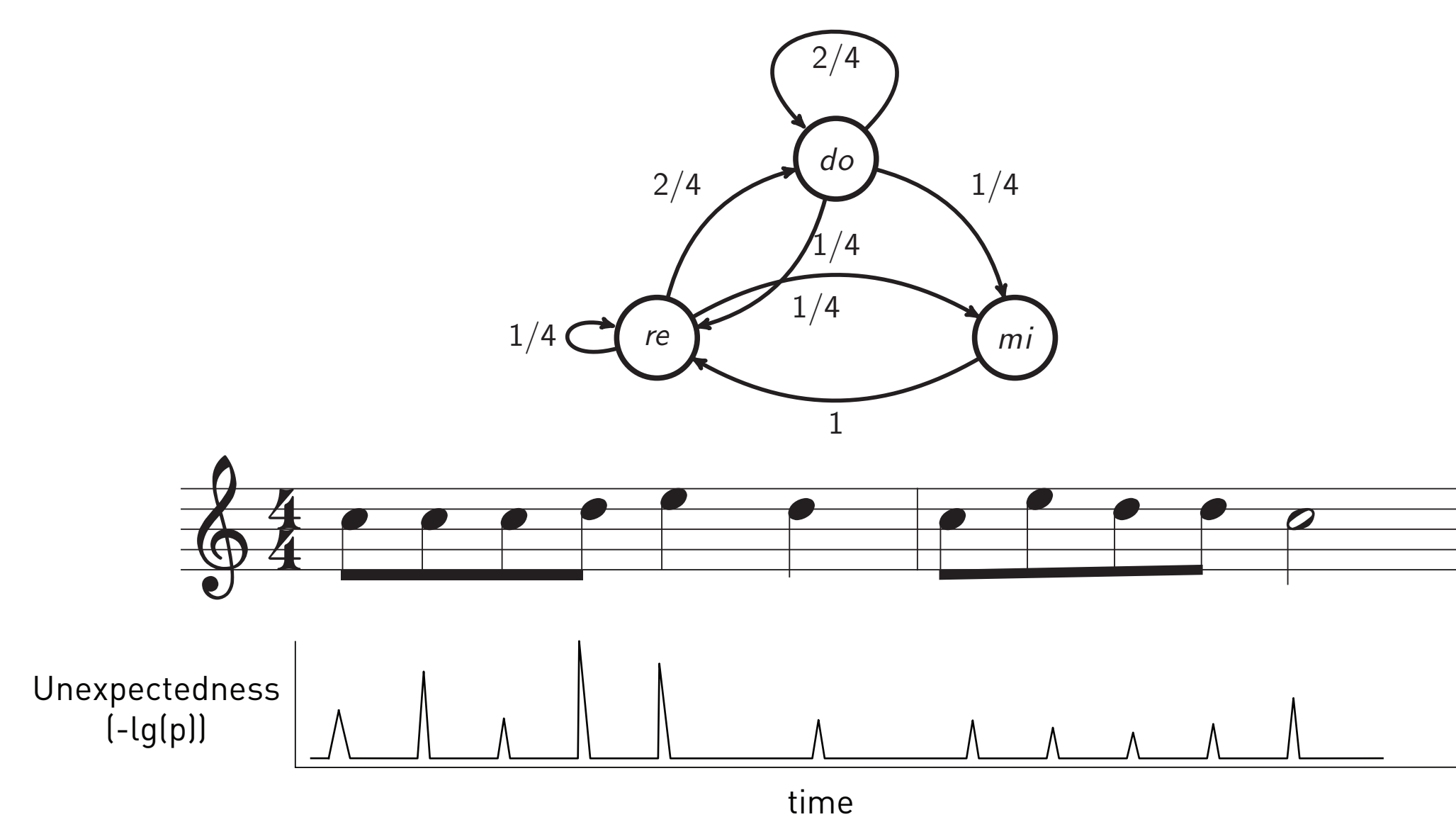
Piece Classification

We finally, used the data that we already showed to classify which song the participant were imagining/listening (we correlated all four songs and chose the one that maximized the correlation with the target EEG).



IDyOM (Melodic Expectation Modeling)

IDyOM is a model of musical grammars based on variable-order Markov chains. It learns, from a training corpus, musical regularities and predict, on an unknown corpus the unexpectedness of each notes (how unlikely they are). The model has been shown to accurately predict behavioral (Omigie, 2013) and neural data (Di Liberto, 2020) as well as to be related to the reward system (Blood and Zatorre, 2001).



Conclusion

We demonstrated that imagery encodes expectations, in addition the inverted polarity of the responses hints at the predictive nature of these responses, suggesting that imagery responses are triggered by the same networks as predictions. Moreover, as expectations are known to be used for high-level perception, this could explain why imagining music makes us feel it as we were hearing it.