

Classifying simultaneous auditory steady-state responses: associations between attention, performance, & musicality

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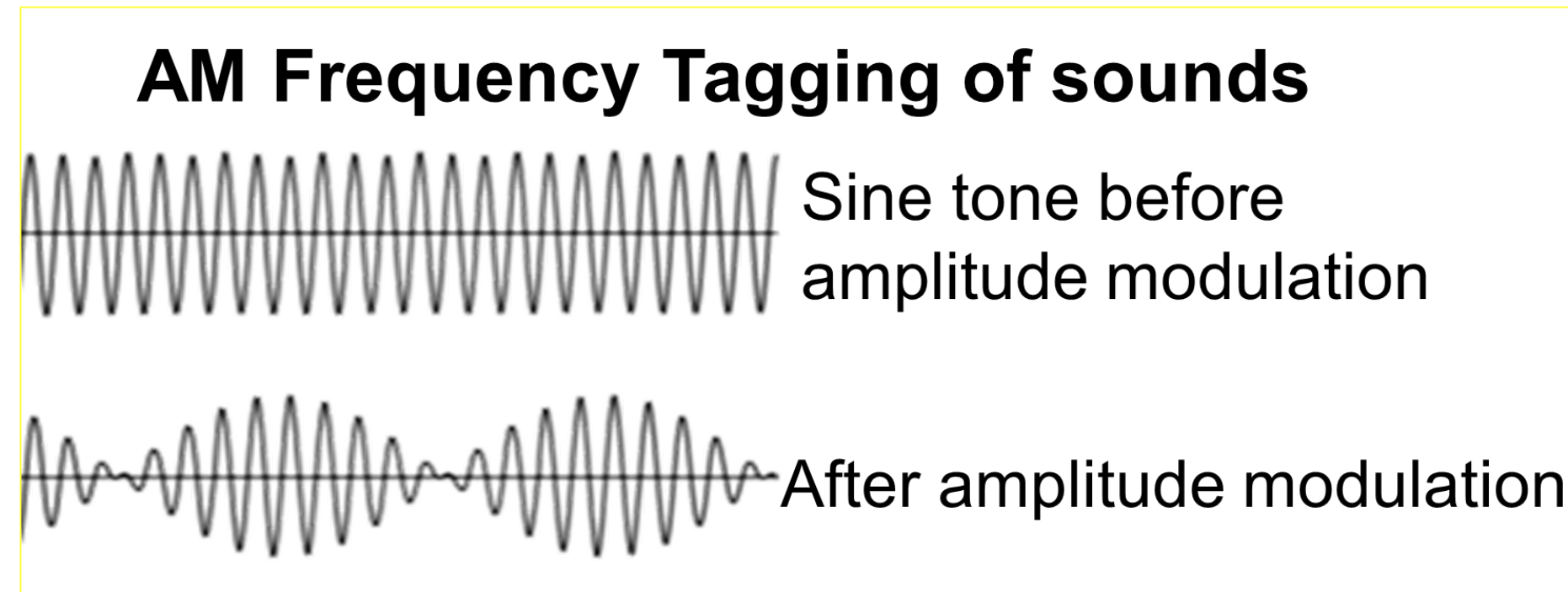
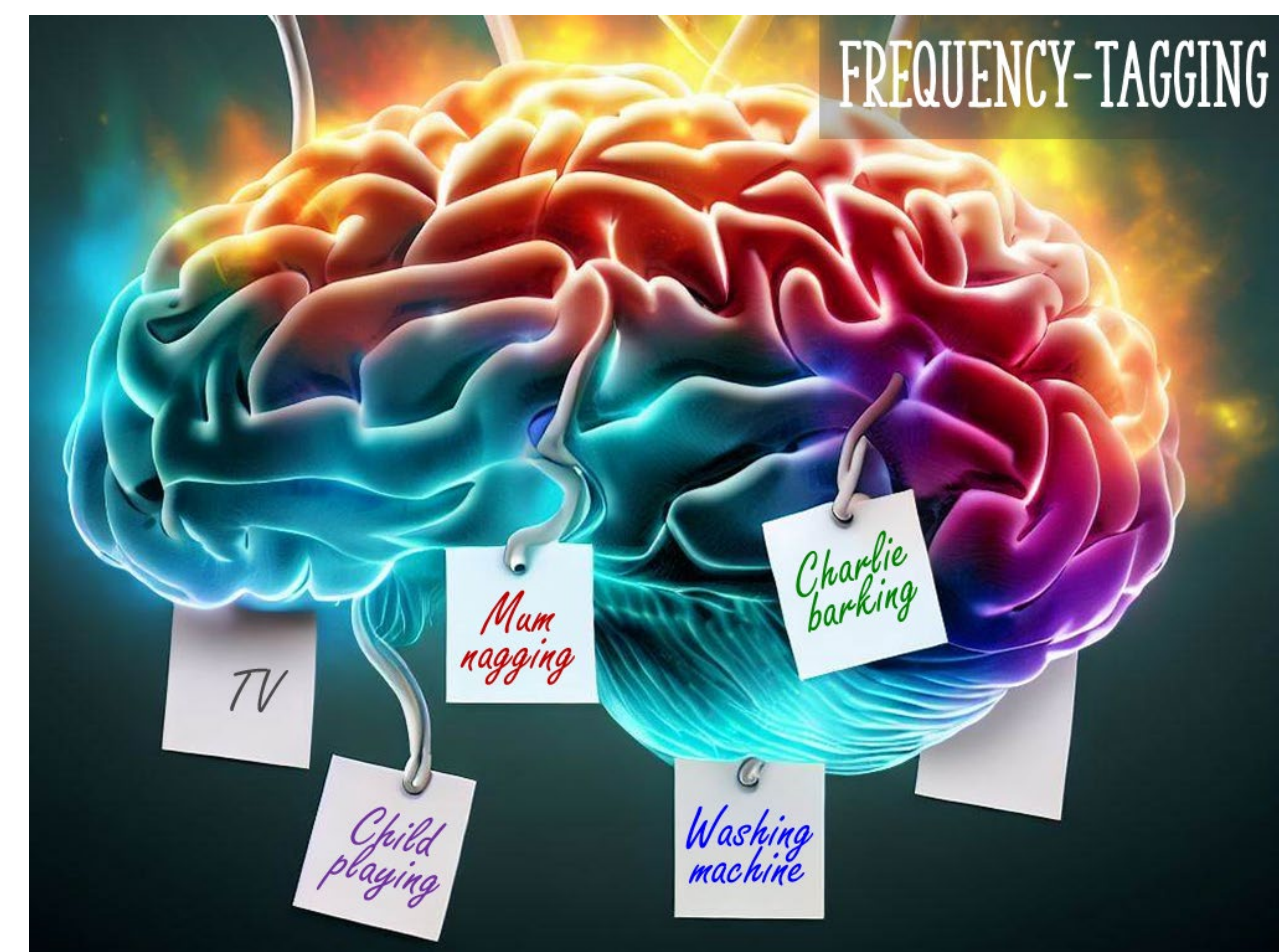
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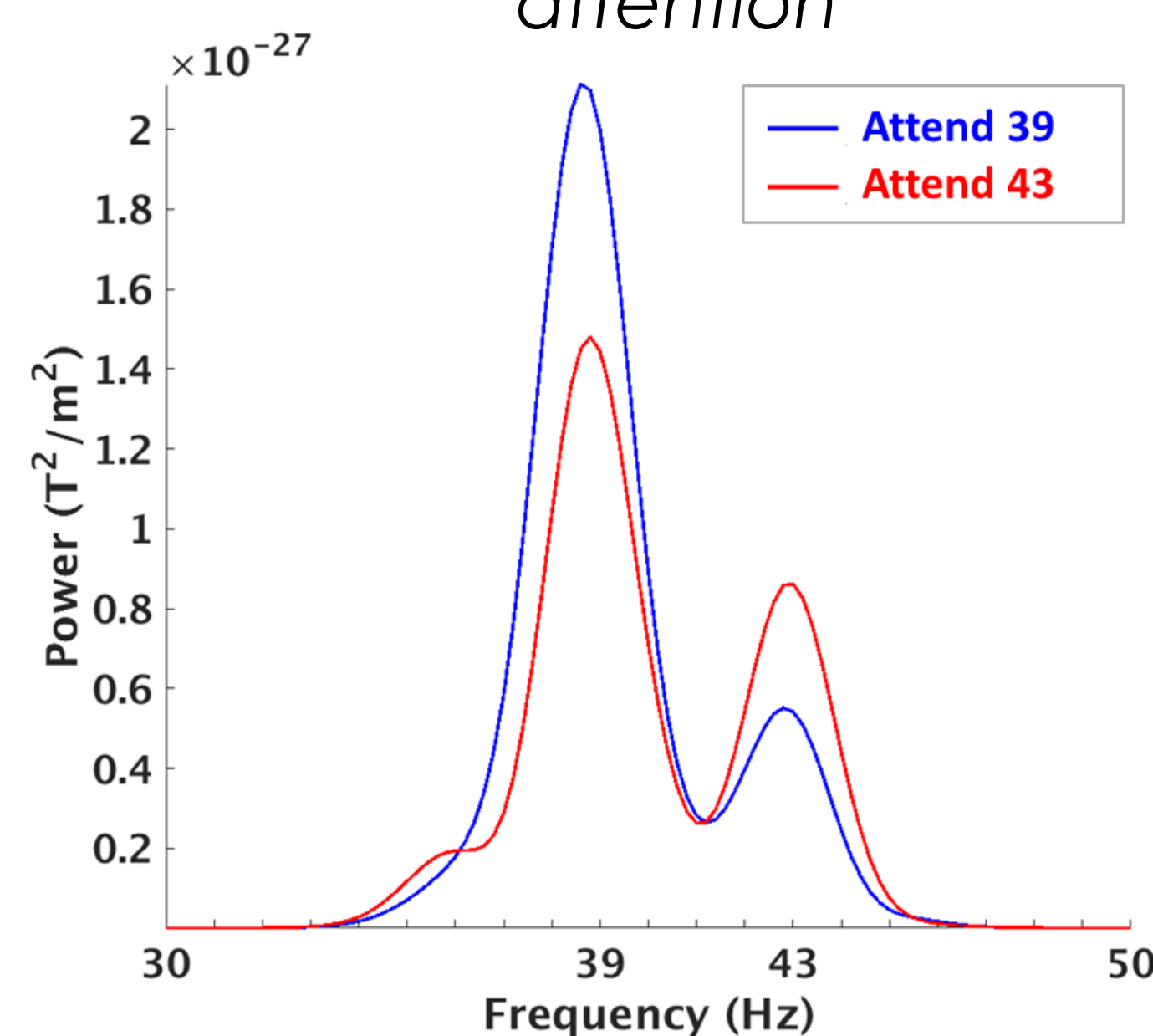
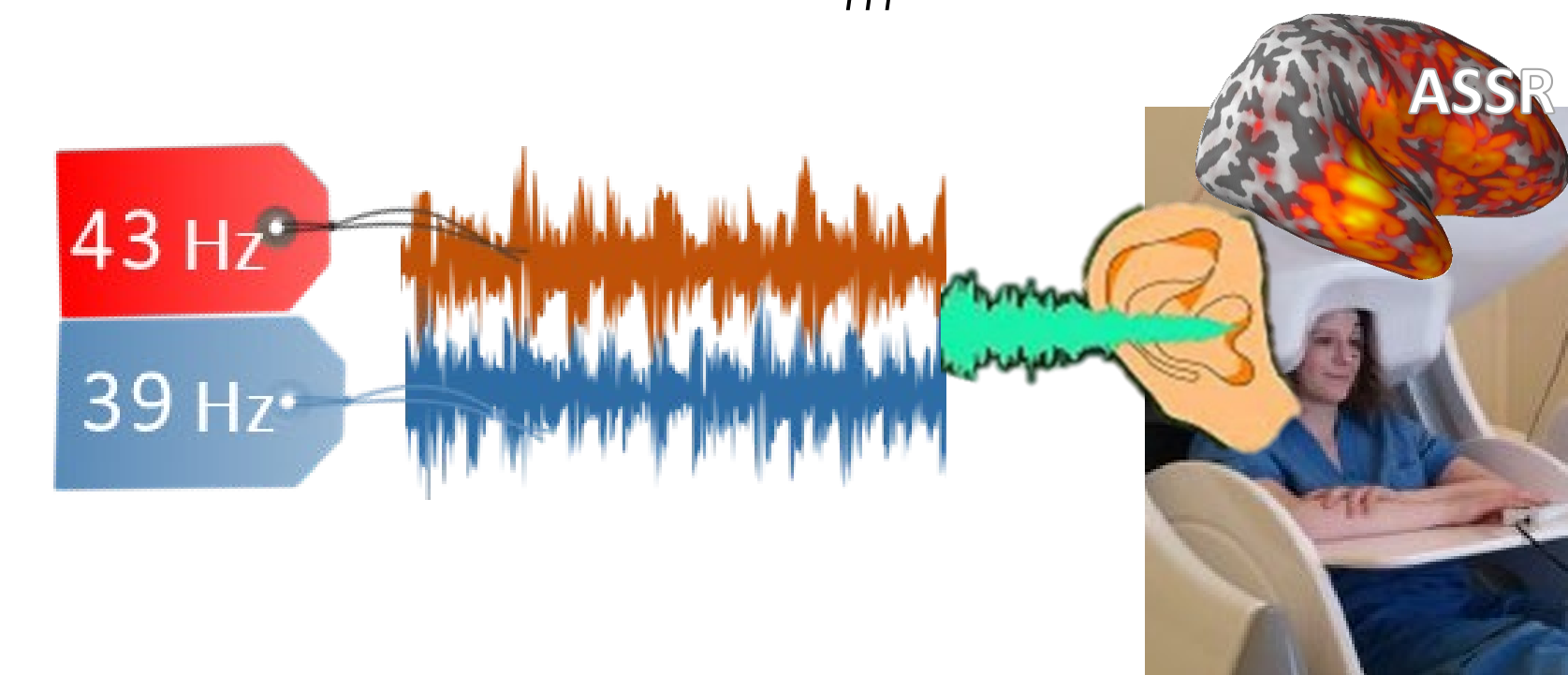
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Introduction to Frequency-tagging

- Stimulus sounds elicit mixed neural responses that are difficult to disentangle & distinguish from one another
- Frequency-tagging can be used to label, identify & separate these neural signals (**Auditory Steady-State Responses; ASSRs**) according to the respective stimuli modulation frequencies (f_m)
- ASSRs are modulated by selective attention



(i) Frequency-tagged auditory streams trigger (ii) ASSR power \uparrow with selective ASSRs at $f_m = 39$ & 43 Hz



Melody Tracking task

- 2 simultaneous frequency-tagged melody streams
- Subjects attended selectively to either one via top-down attention (TDA) while pitch changes draw bottom-up attention (BUA).
- Strong correlations between subjects' task accuracy & musicality (MSI)

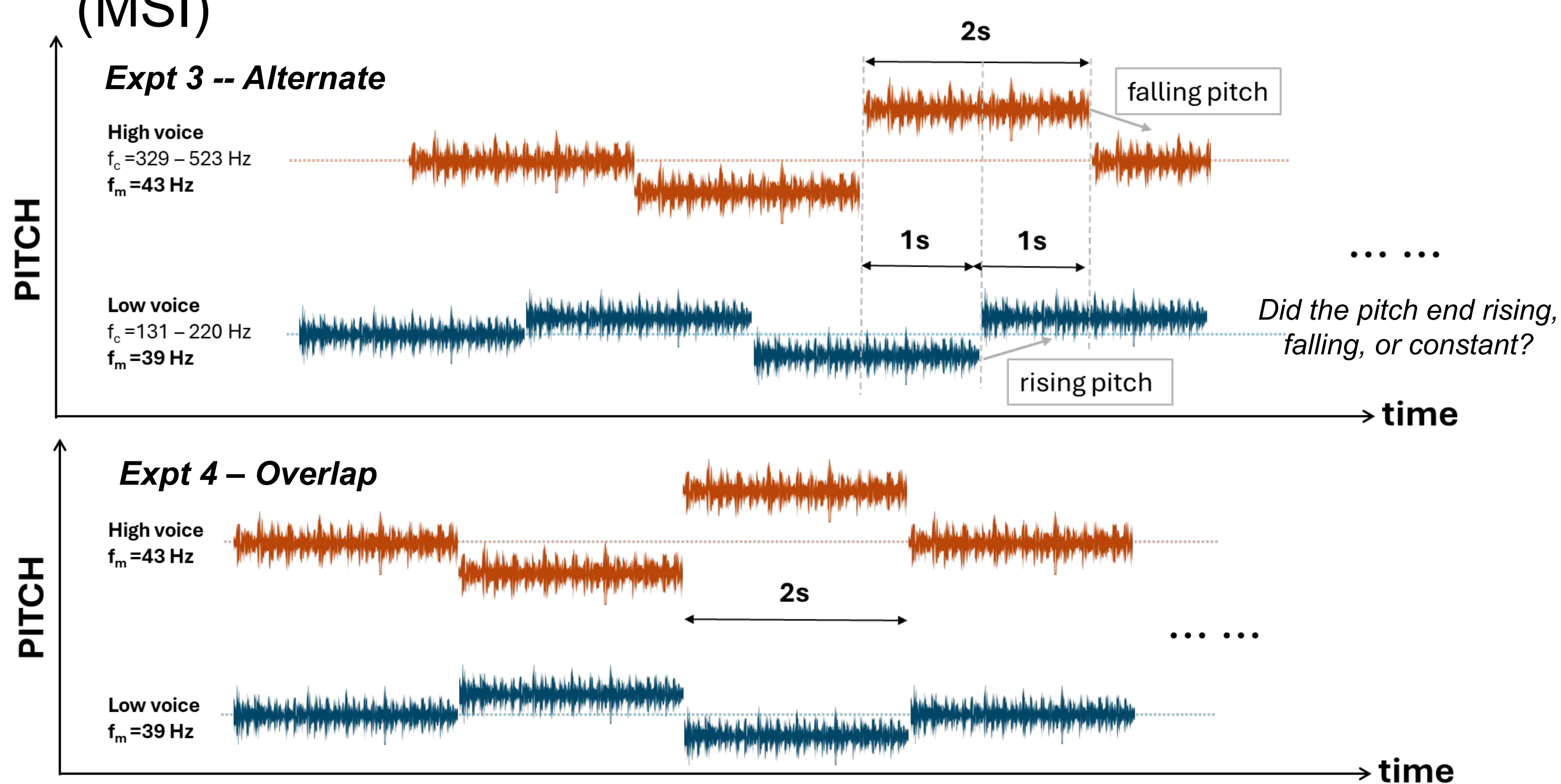
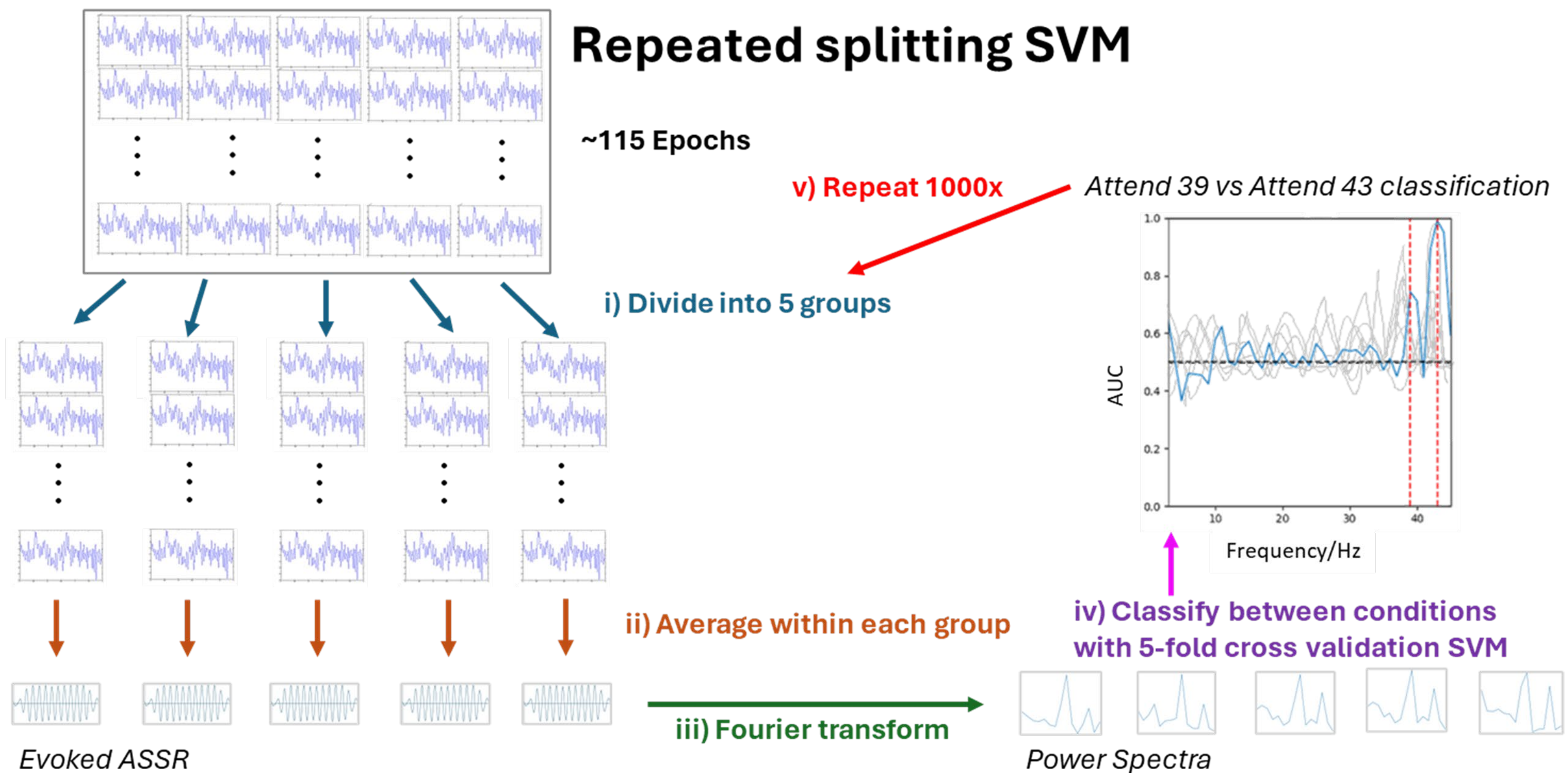


Figure 2. Variations of melody tracking task. Subjects attended to one out of two simultaneous melody streams that differed in pitch (f_c), and answered if the melody ended with a falling, rising or constant pitch.

Future Work

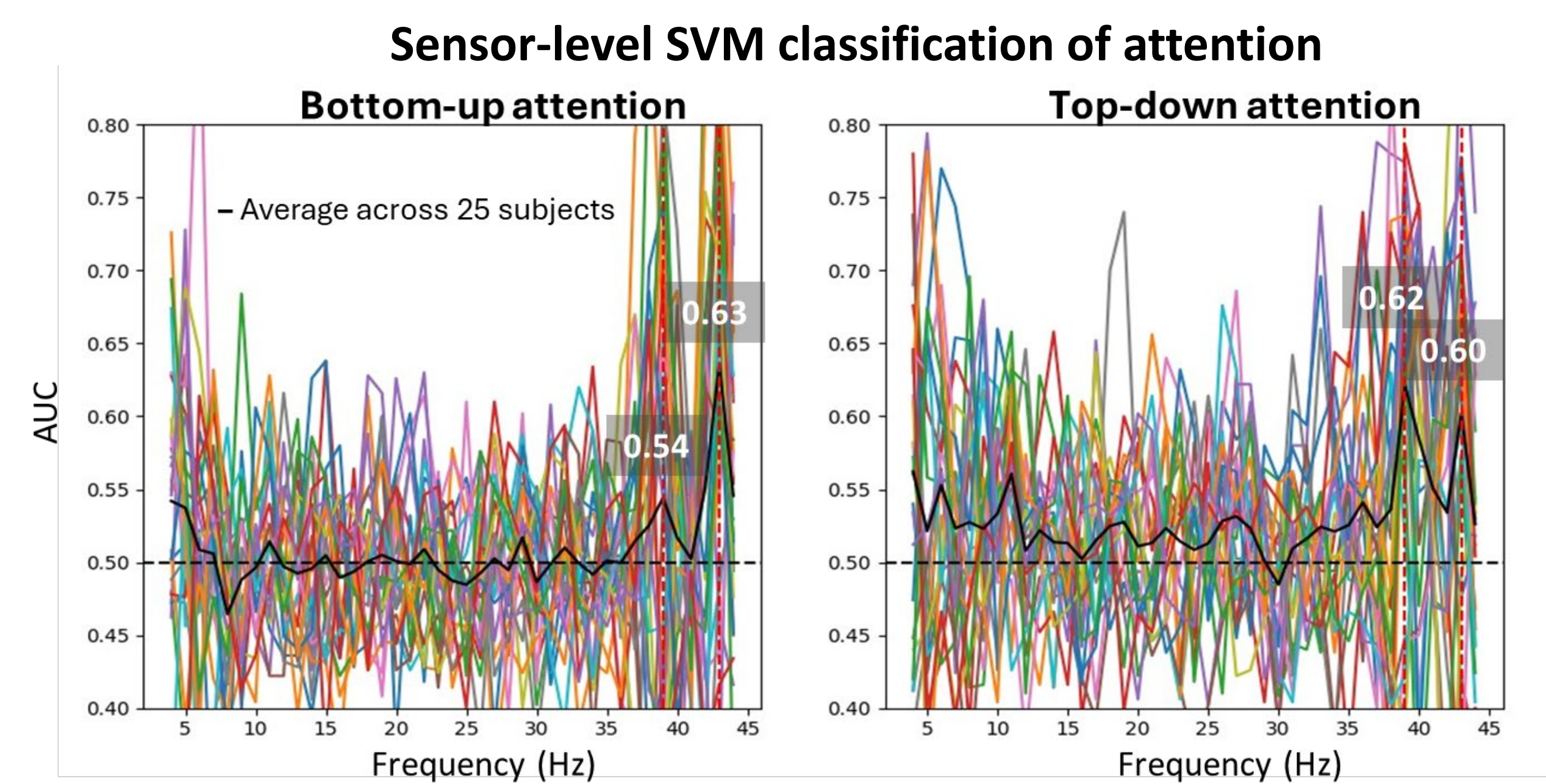
- More complex & natural sounds for frequency-tagging
- Multimodal MEG-MRS neuroimaging

Support Vector Machine (SVM) classification of ASSRs



Results

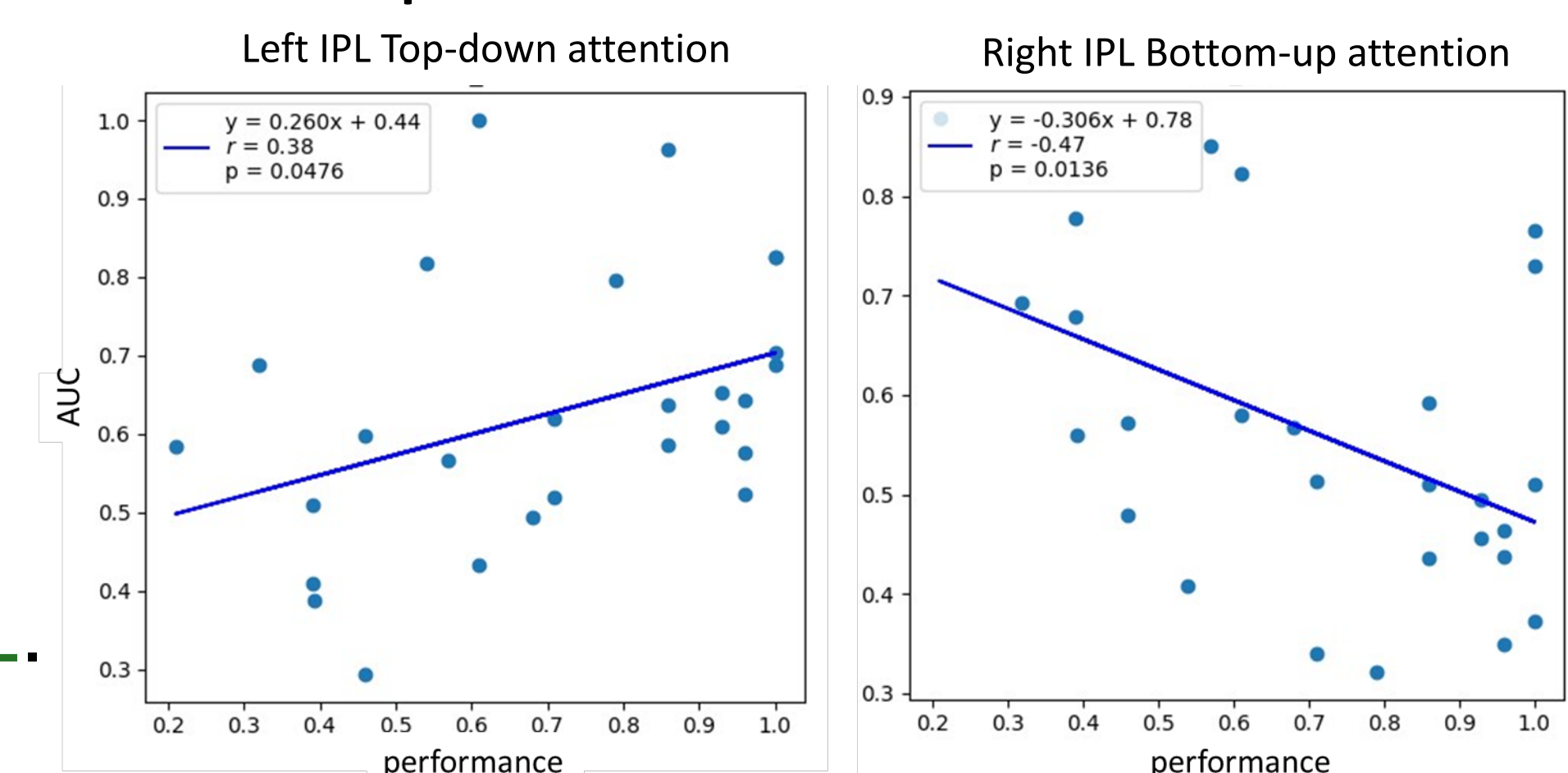
- Support vector machine classifiers demonstrated above-chance (50%) area-under-curve (AUC) values for both top-down & bottom-up attention at sensor level



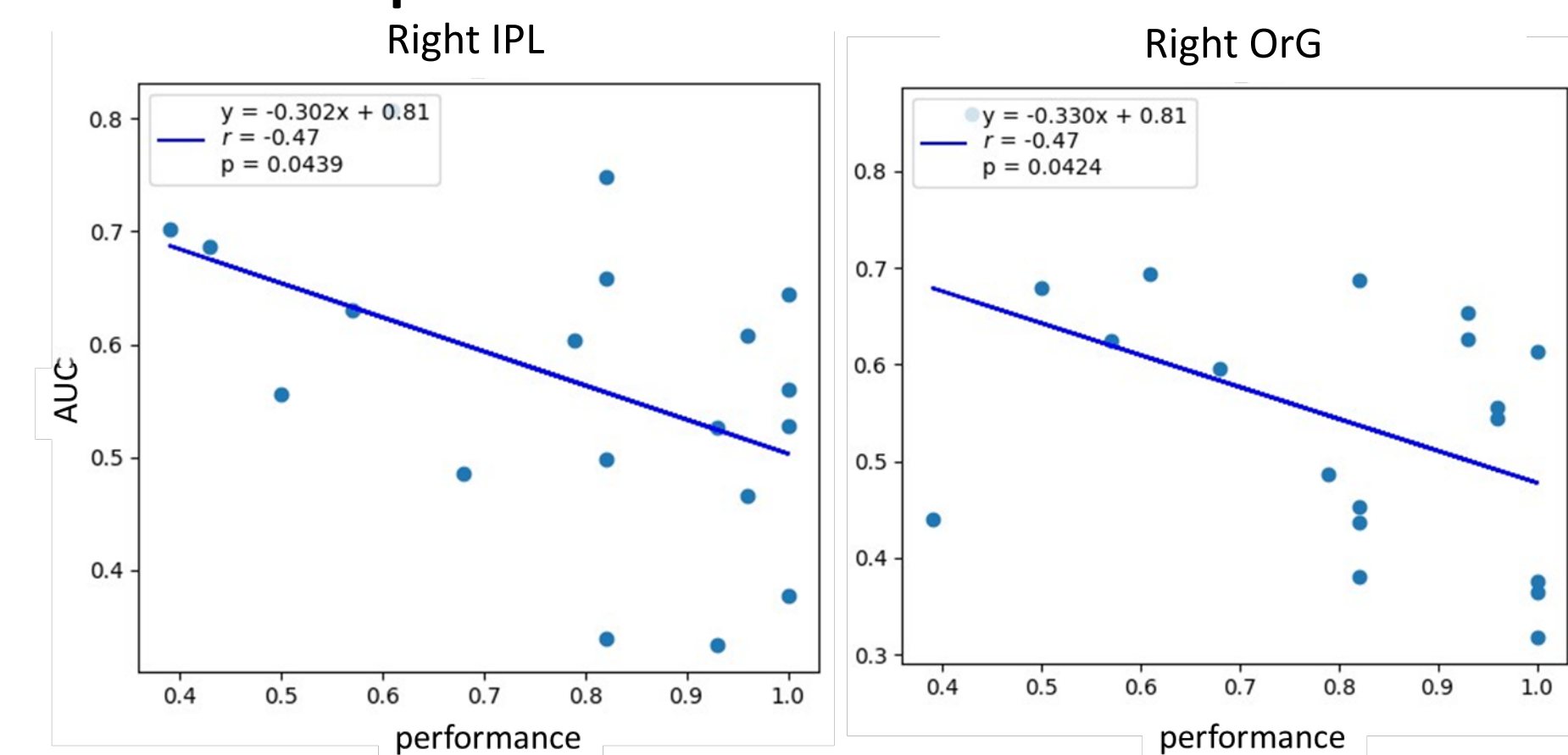
Source-level

- Right top: In Exp 3, TDA correlated positively with task performance at the left inferior parietal lobe (IPL) but BUA correlated negatively at the right IPL.
- Right bottom: In Exp 4, correlations between attention & performance were negative in the right IPL & orbital gyrus (OrG).
- Bottom: TDA correlated positively with individual musicality (MSI) in Exp 3.

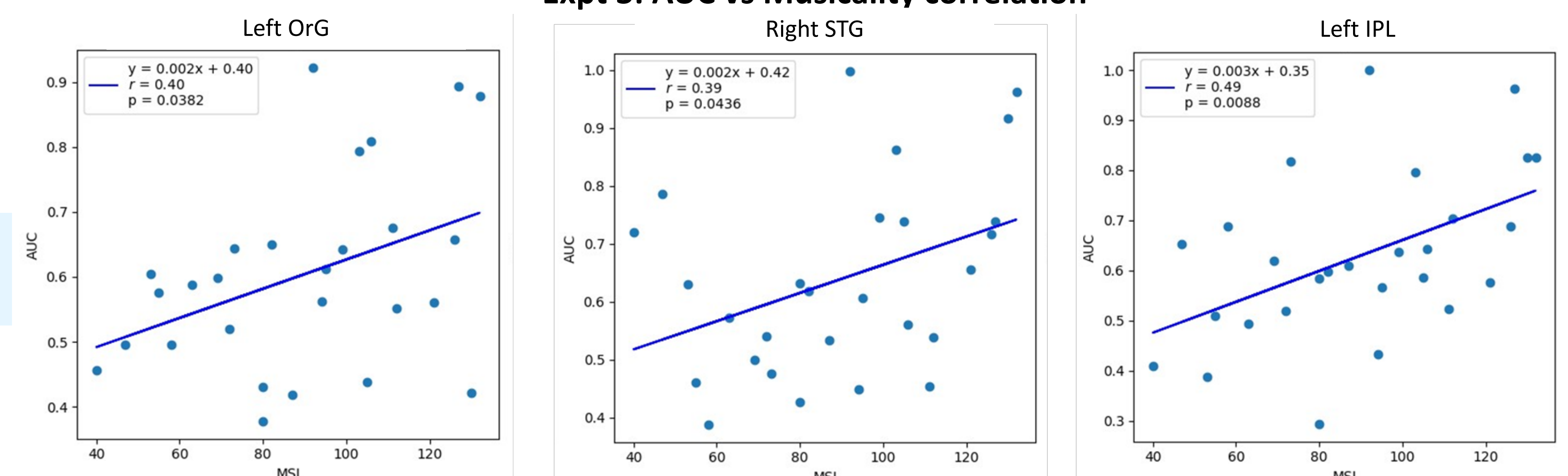
Expt 3: AUC vs Performance correlation



Expt 4: AUC vs Performance correlation



Expt 3: AUC vs Musicality correlation



Relevant Publications:

- Manting, C. L.; Gulyas, B.; Ullén, F.; Lundqvist, D., Steady-state responses to concurrent melodies: source distribution, top-down, and bottom-up attention. *Cerebral cortex* **2023**, 33(6), 3053–3066.
- Manting, C. L.; Gulyas, B.; Ullén, F.; Lundqvist, D., Auditory steady-state responses during and after a stimulus: Cortical sources, and the influence of attention and musicality. *NeuroImage* **2021**, 233, 117962.
- Manting, C. L.; Andersen, L. M.; Gulyas, B.; Ullén, F.; Lundqvist, D., Attentional modulation of the auditory steady-state response across the cortex. *NeuroImage* **2020**, 217, 116930.

