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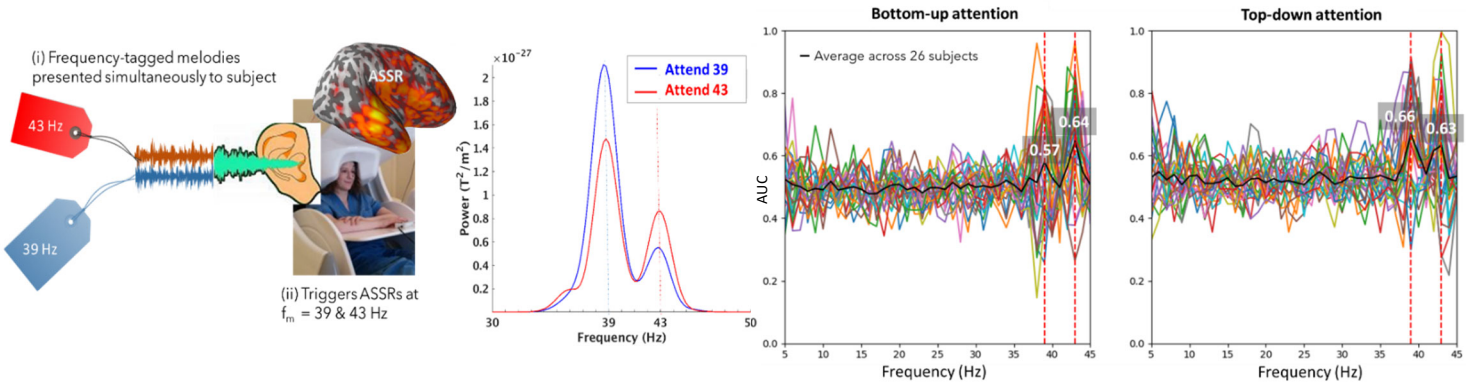
Title: Precision tagging of neural responses for tracking selective attention & learning mechanisms in the brain

Neural auditory steady-state responses (ASSRs) have emerged as a unique tool to separate and identify simultaneous sounds back to their respective driving stimuli, making them an ideal method for studying human cognition in complex auditory environments containing mixtures of sounds, such as in a choir or a cocktail party. ASSRs refer to the neural responses elicited by presenting an auditory stimulus at a specific frequency over time, producing a sustained oscillatory neural activity precisely at the stimulus driving frequency that can be recorded with magnetoencephalography (MEG). We showed that bottom-up and top-down attention to a specific melody within a mixture of melodies modulate the ASSR at different cortical regions. To improve sensitivity, we used a support vector machine to classify ASSRs to different attention conditions at auditory attention-related areas. Interestingly, the modulation effect by top-down attention was found to be positively correlated to individual musicality scores at the left inferior parietal lobe (IPL), while the modulation by bottom-up attention was negatively correlated to musicality at the right IPL. These results suggest that musical training can be beneficial to directing top-down attention towards a target while reducing the influence of bottom-up distractions, and that these effects are mediated by areas in the parietal cortex. Planned future studies aim to adopt a multimodal neuroimaging approach by incorporating neuroanatomical and biochemical measures, using voxel-based morphometry and magnetic resonance spectroscopy respectively, alongside MEG measurements of ASSRs. These studies will focus on investigating the neural underpinnings of auditory learning under distracting conditions, examining target- and distractor-specific responses individually as well as how their interactions affect learning.

SVM classification of attention



Top-down & bottom-up attentional modulation across lobes

	Frontal		Temporal		Parietal	
	LH	RH	LH	RH	LH	RH
Mean ASSR power modulation by a) top-down attention	18%	-5%	11%	12%	6%	8%
$p_{one\text{-}tailed}$ (uncorrected)	0.0050**^	0.21	0.067	0.028*	0.16	0.035*

	Frontal		Temporal		Parietal	
	LH	RH	LH	RH	LH	RH
Mean ASSR power modulation by b) bottom-up attention	3%	7%	8%	10%	9%	6%
$p_{one\text{-}tailed}$ (uncorrected)	0.24	0.13	0.083	0.00072***^^	0.035*	0.026*

*$p < 0.001$***, $p < 0.01$**, $p < 0.05$* (uncorrected)*

$p < 0.05$^, $p < 0.01$^^ (Bonferroni-corrected)

AUC vs Musicality correlation