

Dysregulated Local Oscillatory Connectivity of the Visual System in Autism Spectrum Disorder



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Background

- Autism Spectrum Disorder (ASD) is associated with a distinct pattern of sensory traits, and hypo/hypersensitivity reactions to sensory stimuli.
- Recent magnetoencephalography (MEG) autism research has suggested that one candidate mechanism may be disorganized local oscillations, combined with reduced top-down modulation (Kessler, Seymour & Rippón, 2016).

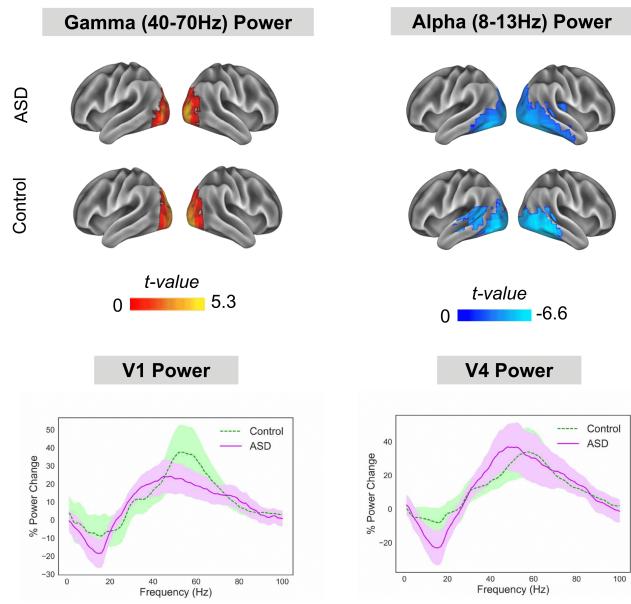
Participants and Paradigm

- Participants performed an interactive visual paradigm designed to elicit non phase-locked high-frequency (40-70Hz) gamma oscillations.
- MEG data acquired using 306-channel Neuromag Elekta scanner

	N	Mean Age	Sex	AQ adult	Mean Trial Number	Movement
ASD	17	17.63 (2.00)	5 female	32.65 (6.76)	62.46	>5mm
Control	17	17.43 (1.90)	5 female	11.38 (6.25)	62.33	>5mm

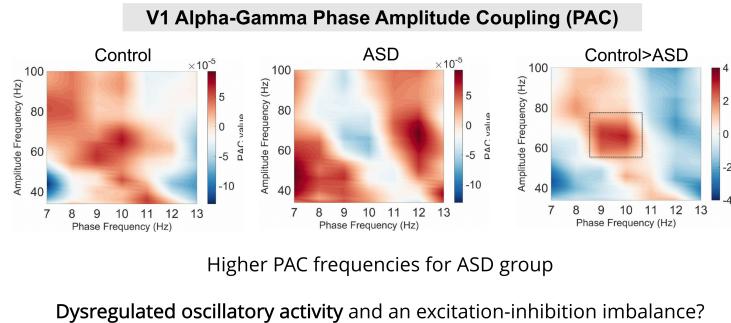
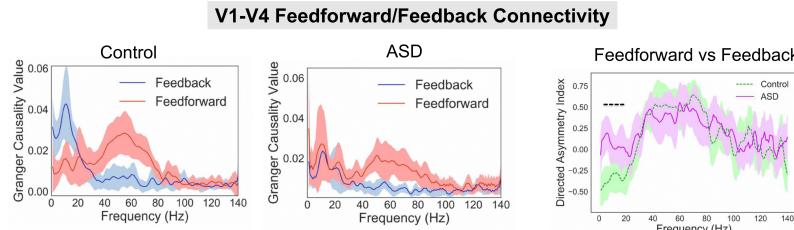


Results (1) - Power



No statistical differences between alpha or gamma power in source-space between groups

Results (2) - Connectivity



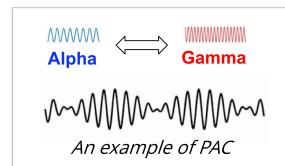
MEG Analysis

Performed in Fieldtrip & customised MATLAB scripts. Statistical analyses conducted using cluster-based permutation tests



Source Localisation

- LCMV Beamformer [0.3s to 1.5s vs. -1.5s to -0.3s ; 40-70Hz]
- Time-courses were extracted from area V1 and V4.

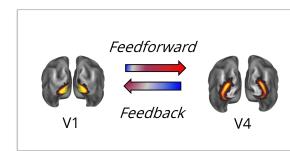


Phase Amplitude Coupling (PAC) Analysis

- PAC = coupling between amplitude of higher frequency and the phase of lower frequency oscillations (Ozkurt & Schnitzler, 2011)

Granger Causality Analysis

- Non-parametric spectrally-resolved granger causality (1-140Hz) computed between V1 and V4.
- Directed Asymmetry Index (DAI) = ratio between feedforward and feedback (Bastos et al., 2015)



Conclusions

- This work suggests that the complex interplay of **alpha** and **gamma** oscillations within the **human visual system** are dysregulated in autism.
- The ASD group showed typical patterns of oscillatory power and feedforward connectivity, but dysregulated oscillatory coupling between frequency bands (PAC) and reduced feedback **alpha-band** connectivity.
- Local V1 PAC and V1→V4 feedback connectivity are not linked in the ASD group, suggesting that the visual system is locally segregated in autism.
- These findings have implications for emerging neurocognitive theories of atypical sensory processing in autism.



Acknowledgments

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