

Title: Decreased Granger Causality Intensity from the Right to the Left Hemisphere Functional Network in Autism Spectrum Disorder

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Graphs have been extensively used to model high-dimensional systems with complex dependence structures such as the brain. For several random graph models, the spectral radius (the largest eigenvalue of the adjacency matrix) has been proven to be a function of the model parameters and, therefore, associated with the network's topological and dynamical properties. Based on this idea, we propose in [1] a novel method that identifies Granger causality between time series of graphs by fitting a vector autoregressive (VAR) model on the corresponding time series of spectral radii. Here, we discuss an application to the Autism Brain Imaging Data Exchange I (ABIDE I) dataset that aims to investigate the Granger causality between the functional brain networks of the two hemispheres in subjects diagnosed with Autism Spectrum Disorder (ASD). The analysis is based on demographic factors (age, sex, and site) and resting-state fMRI signals of 90 anatomical regions of interest (45 per hemisphere) from 737 subjects (429 controls and 308 diagnosed with ASD). Our findings suggest that the Granger causality from the right to the left hemisphere has a different intensity in subjects with ASD, compared to typical development subjects. In particular, we observe that the difference depends on sex and age. Further, the pars opercularis and superior parietal gyrus are the brain regions with the greatest influence on the interaction effect between age and ASD diagnosis. We believe these results provide critical and relevant insights on brain connectivity disruptions in ASD patients and their relation to neurodevelopment and sex.

[1] Ribeiro, A.H.; Vidal, M.C.; Sato, J.R.; Fujita, A. Granger Causality among Graphs and Application to Functional Brain Connectivity in Autism Spectrum Disorder. *Entropy* **2021**, *23*, 1204. https://doi.org/10.3390/e23091204

Biography

Adèle H. Ribeiro is a Postdoctoral Researcher in the Causal Artificial Intelligence Lab at Columbia University. Her research focuses on developing causal inference theory, algorithms, and tools that address fundamental challenges that emerge in real-world domains, especially in Health Research. She holds a BSc degree in Computational and Applied Mathematics and an MSc and a PhD in Computer Science, all from the Institute of Mathematics and Statistics of the University of São Paulo (USP). Before joining Columbia, she completed a research internship in the Neuroscience Institute at Princeton University and worked as a Postdoctoral Fellow at the Heart Institute, USP.

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