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Presentation Abstract

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Title:	A neurocomputational model relating brain density to neural dynamics in social cognition
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Abstract: Differences in brain density have been recorded across a range of social phenotypes. Correlated changes in behaviors can be observed both at the physiological (e.g., EEG) and behavioral levels. The mechanisms relating these anatomical properties to neural activity and social cognition remain largely unknown. Using spatial neurocomputational models we illustrate how changes in neural arrangement, including cellular density, can result in profound changes to the characteristics of neural dynamics. Our models include spiking networks of up to 100,000 neurons and 5,000,000 synapses. Networks included both inhibitory and excitatory populations with diverse geometrical arrangements. Density was varied from fully connected networks (100% locally-connected cells present) to highly sparse networks (5% density). Results of the simulations showed that both the spectral nature of the activity and the transitions varied as a function of density. Networks at intermediate connectivity densities (approximately 25-70%) showed a diversity of important dynamical features including autonomous transitions in population activity and activity across multiple frequencies bands. Changes in density alone resulted in networks that were able to exhibit ongoing low-frequency activity (e.g., alpha) with simultaneous transitions in high-frequency activity (e.g., gamma) that are associated with transitions in cognition and behavior. We also illustrate how these findings may help infer activity in situation where anatomy is known but recordings are not possible such as in the study of post-mortem tissue in Williams Syndrome (WS). Given that density differs between brain regions, across phenotypes, and social species, we suggest that alternations in density may be an important developmental and evolutionary strategy for dynamical tuning of neural dynamics in social cognition.

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