DOCTORAL DISSERTATION DEFENSE

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DISSERTATION TITLE

Functional Brain Networks in Human Clinical Neuroscience: A Population-to-Precision Approach

DATE June 11, 2026

TIME 12:00–2:00 PM PST

LOCATION PEB 721

JOIN ON ZOOM ucsd.zoom.us/j/97843310144

ABSTRACT

Understanding how emotional states shape action — and how action, in turn, influences emotional experience — is a central challenge in human clinical neuroscience. These interactions emerge through coordinated activity across brain networks involved in emotion, motor control, and autonomic regulation, and are disrupted across many neurodevelopmental and psychiatric conditions. Tourette syndrome (TS), a neurodevelopmental disorder characterized by unwanted motor and vocal tics that are influenced by emotional arousal, autonomic state, and premonitory urges, provides a particularly informative model system for investigating these interactions. Using TS as a model system, this dissertation combines functional neuroimaging and autonomic physiology to examine how functional brain network organization and bodily state interact across multiple levels of analysis.

First, I establish a normative foundation by characterizing the reproducibility and developmental organization of whole-brain functional networks in more than 7,000 children using resting-state functional MRI. Findings demonstrate highly reproducible large-scale network organization across independent samples while revealing developmental differences in cross-network integration between children and adults, providing a benchmark for understanding normative brain network organization and contextualizing clinical variation.

Second, I apply precision functional mapping and concurrent autonomic physiology in sibling pairs discordant for TS to examine individual-level brain–heart coupling dynamics. These analyses reveal substantial heterogeneity in functional network organization and identify individualized patterns of brain–heart coupling, particularly among networks implicated in interoception, attention, and action organization, that are not captured by traditional group-averaged approaches.

Finally, I situate these empirical contributions within a broader theoretical framework, examining how population-scale and individualized precision approaches can be integrated to advance understanding of brain organization across typical development and neurodevelopmental conditions. This methodological pluralism — moving deliberately from population to individual — provides a complete understanding of how brain networks give rise to behavior.

Together, this dissertation demonstrates that functional brain networks carry clinically meaningful signal that is richer when studied alongside the body and across multiple levels of resolution. More broadly, this work advances our understanding of how functional brain organization and autonomic regulation interact across development and neurodevelopmental conditions — and highlights the value of integrating population-scale and individualized approaches in human clinical neuroscience.

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All are welcome to attend