Molecular principles of synaptic specificity: spotlight on synaptic adhesion molecules

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The human brain is a sophisticated organ whose functions are encoded by trillions of nerve cells. These nerve cells are connected to each other to form neural circuits responsible for the computational power that directs all human behaviors. To understand the wiring diagram of neural circuits and their fundamental properties, we need to grasp the cellular and molecular mechanisms that underlie the recognition of correct partners and specification of functional synapses, most of which remain elusive.

My talk is based on two hypotheses: first, that multiple *trans*-synaptic adhesion molecules and their associated proteins (i.e., synapse organizers) are central to synapse formation and function, and second that defective *trans*-synaptic adhesion signaling manifests in the forms of various brain disorders. I will present a series of mechanistic studies that focus on one family of cell-surface molecules as an exemplary that relates to key synaptic adhesion signaling pathways, providing novel molecular principles for understanding the excitation-to-inhibition balance at the synapses. Our studies also illustrate the significance of interdisciplinary experimental approaches in addressing key neurobiological questions.