Exploring the Role of Frazzled in Drosophila Neural Circuit Assembly and Foraging Behavior

Chen, Ying-Ru (School: The Affiliated Senior High School of National Taiwan Normal University)

The mushroom body (MB) is an intelligence center of the Drosophila brain. It plays essential roles in many aspects of behavior, including learning and memory, motivation, courtship, and sleep. The function of MB requires a precisely wired neural circuit. However, the molecular mechanisms regulating the assembly of the circuit remains unclear. To understand the mechanisms, I focus on the PPL1-a'2a2 neurons in MB's neural circuits. PPL1-a'2a2 is a type of dopaminergic neuron specifically projecting neurites to the a'2 and a2 zones of the MB. Its neurotransmission is known to mediate food-seeking behavior in hungry flies. To explore the molecular machinery underpinning PPL1-a'2a2 neurite targeting, I adopted the GAL4-UAS system to express RNAi against candidate genes that are potentially involved in neurite guidance in PPL1-a'2a2 neurons. Among these genes, knockdown of frazzled caused a significant innervation loss in the a2 and a’2 zone of MB. I then examined the impact of frazzled overexpression on neurite guidance in other MB neurons. Interestingly, this manipulation misdirected the neurites towards the a2 and a’2 zone in some neurons, but had no obvious effect in others. These results suggest that the effect of frazzled on neurite guidance is context-dependent. Finally, I found that abnormal neurite targeting of PPL1-a'2a2 neurons under frazzled knockdown did not affect food-seeking behavior in hungry flies, suggesting the MB neural circuit is flexible and can adapt to developmental errors. An exciting future research direction is to understand how the MB circuit detects and compensates for the miswiring of PPL1-a'2a2 neurons.

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