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Molecular and Neural Mechanisms of Memory-Dependent Salt Chemotaxis in *C. elegans*

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Summary

Mapping the neuronal components of perception, memory, and motor control is critical in understanding how memory-dependent behavior is encoded by the nervous system. Salt chemotaxis of *Caenorhabditis elegans* is a memory-dependent navigation behavior: animals are attracted to the salt concentration at which they have been fed, whereas they avoid it if they have been starved (salt concentration chemotaxis).

Input from a single sensory neuron, ASER, is required and sufficient for salt concentration chemotaxis under well fed conditions, and ASER is activated by salt concentration decrease irrespective of cultivation salt concentrations. To understand how sensory inputs are translated into behavior, we examined the roles of postsynaptic neurons of ASER by ablating them individually or in combination. ASER densely synapses on three pairs of interneurons, AIA, AIB and AIY. Loss of AIY resulted in impaired chemotaxis to low salt but not to high salt. On the other hand, AIA-ablated animals showed a weak but significant defect in chemotaxis to high salt. Ablating both AIY and AIA disrupted chemotaxis to both directions. Quantitative analyses of locomotion revealed that these chemotaxis defects were concomitant with altered properties of klinokinesis strategy. Ablation of AIB interneurons did not cause discernible effect on salt concentration chemotaxis, although these neurons were involved in the regulation of ASER-evoked reorientation. These results indicate that although both AIY and AIA are involved in the regulation of turning frequency upon salt concentration decreases, they differently mediate transmission of sensory information after cultivation at distinct salt concentrations.

To identify genes involved in salt concentration chemotaxis, we screened mutants that show deficits in salt concentration chemotaxis. A CLC-type chloride channel *clh-1* appeared to function in ASER to migrate toward food-associated salt concentrations.