

# **Mechanisms of Navigation in Fiddler Crabs: An Analysis of Allocentric and Egocentric Contributions**

Navigation in biological systems is a complex task-set that involves learning processes and may include constructing representations of features of their environment. Across the animal kingdom, different learning mechanisms have evolved to similar spatial problems. The extent to which mechanisms are conserved across taxa are an important research area that can guide our understanding of the cognitive dimensions of navigation. Recent studies of mammals, birds, and arthropods has found that these animals often attend to multiple forms of sensory cues, and to either integrate the solutions generated by these cues, or at times prefer one form of cue over another. This dissertation examines the fiddler crab (*Uca pugilator*), a burrow-homing arthropod whose ecology and behavior engender evolutionary pressures that favor spatial memory to determine which these kinds of multi-modal integrative processes are at they employ. Previous field studies give indications of complexity beyond simple route reversal methods. *U. pugilator* are a species that share and likely resemble a basal ancestor to the insect taxa that have proved fruitful to the study of navigation. The results of this dissertation suggest that the ability to employ and integrate solutions from multiple navigational mechanisms is evolutionarily old and conserved across a wide range of taxa. Four experiments are presented that employ a place learning paradigm to examine the roles of externally (allocentric) and internally (egocentric) generated sensory cues in the construction of fiddler crab navigational strategies. Three of these experiments provide evidence for a preexisting taxis in these animals that dictates they approach certain visual stimuli, and two of these experiments provide evidence of an allocentrically informed associative process in navigating fiddler crabs, a finding not before seen in a laboratory study of these animals. Taken together the results of this dissertation suggest that fiddler crabs possess some form of cognitive representation of the external world, which is informed by multiple sensory modalities, and extends beyond response learning and path integration.