Comparing stomatogastric nervous system modulation in related crab species, *Pugettia producta* and *Libinia emarginata*

Alexandra Ida Miller, Class of 2018

Central pattern generators (CPGs) are multi-functional networks within the nervous system that underlie rhythmic motor behaviors. CPGs produce patterned outputs, which can be generated in the absence of sensory or central input. Outputs generated result in rhythmic behaviors such as locomotion, heartbeat, or breathing. In the absence of inputs, these behaviors are incredibly invariant. However, the environment in which animals live is not invariant, and so it is important that patterned outputs are able to adapt. Neuromodulation can enable these adaptations. Intrinsic or extrinsic neuromodulators vary CPG outputs without changing anatomical connections between neurons.

The mechanistic relationship between CPG modulatory diversity and evolutionary adaption is not well understood. For instance, the extent to which flexibility is exhibited by pattern-generating systems may have adaptive advantages. Changes in modulation of pattern generating systems may mechanistically allow for the selection of behaviors. If it is evolutionarily advantageous to have more or less diversity in movements, the modulation underlying those movements may be a focus of evolutionary selection.

The extent to which CPGs are modulated may underlie the amount of behavioral diversity, and exploring this relationship will be the focus of this study. One system in which this question can be addressed is the crustacean stomatogastric nervous system (STNS). The STNS produces rhythmic bursts of action potentials that control the movements of the muscles in the foregut.

Herbivorous *P. producta* shows limited modulation in response to a range of endogenous neuromodulators that modulate the pyloric pattern in opportunistic-feeding *Cancer* crabs. It is unknown whether this loss in modulatory ability is related to their limited diet, or if it is a result of the phylogenetic distance between these species (Dickinson et al. 2008). It is hypothesized that the decreased modulation in *P. producta* is related to the species' diet. The diversity in foregut movements required to digest kelp is predicted to be less than that required to digest a wider variety of foods. Therefore, *P. producta* may have faced less selective pressure to maintain robust modulation of the STNS, or increased modulatory ability may have been selected for in related crab species that now have more diverse diets.

To test this hypothesis, the degree of STNS modulation in *P. producta* was compared to an opportunistic-feeding member of its same superfamily, *L. emarginata.* It was predicted that the patterned output of the STNS in *L. emarginata* would respond to a greater number of neuromodulators than did *P. producta* because of the differences in their diet. After dissecting the intact nerves out of the stomach, extracellular recordings from motor nerves were taken before, during, and after neuromodulator application. Modulation of the pattern in response to each neuromodulator was then quantified and compared to that seen in *P. producta*.

It was found that all four neuromodulators tested altered the STNS pattern in *L. emarginata,* while only one did so in *P. producta.* Therefore, the hypothesis that the limited modulation seen in *P. prodocta* is related to its more limited diet is supported. Changes in the degree in modulation may be a mechanism by which behaviors are selected for or against.

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Reference: Dickinson, P. S., Stemmler, E. A., & Christie, A. E. (2008). The pyloric neural circuit of the herbivorous crab *Pugettia producta* shows limited sensitivity to several neuromodulators that elicit robust effects in more opportunistically feeding decapods. *Journal of Experimental Biology*, *211*(9), 1434-1447.