The Potential Role and Characterization of MAGUK Family Proteins in the Mediterranean Field Cricket *G. bimaculatus*

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Due to the global COVID-19 pandemic and the inability to safely practice social distancing in a laboratory setting, my original project for this summer titled "Investigating the Role of Semaphorin Signaling in Nervous System Development" was altered to better fit a remote model. For my new project, I spent the summer researching and characterizing the membrane-associated guanylate kinase (MAGUK) protein family within the cricket to better understand the molecular neurobiological basis of plasticity in adult crickets, which is the current goal of the Horch lab.

Plasticity is the ability of the brain and its associated neurons to continuously alter connectivity and shape of circuits in response to environmental stimuli, behavior, injury, or changes in neurological activity or use, all of which significantly impacts the development of organisms and recovery from injuries. However, it is currently a mystery how plastic the nervous system of the cricket and other organisms remains through adulthood. Previous research has shown that the auditory system of the cricket has a high level of plasticity following an injury to the auditory organ, which is located on the foreleg. When a single foreleg is amputated during postembryonic development, many auditory neurons become disconnected from the ear, or "deafferented." The recovery process of these disconnected neurons involves new, abnormal dendritic growth across the midline to the other side of the cricket body. This is peculiar because the midline is a boundary that neurons usually respect after the early stages of development. However, certain cricket auditory neurons can disregard the midline following an injury and form compensatory connections, or synapses, with neurons on the opposite side. Quite remarkably, the auditory function of the deafferented neurons is restored as a result of the creation of these novel synapses.

Members of the MAGUK family, a group of well-conserved scaffolding proteins involved in cell-cell adhesion and the formation of cell junctions (such as synapses), have been shown to play a key role in the recruitment and localization of key proteins involved in synapse formation. This led us to believe that certain members of the MAGUK family may be involved in or responsible for the peculiar plasticity of adult cricket auditory neurons and their compensatory synapse formation. To verify this, my research partner Hannah Scotch (Class of 2022) and I 'mined' a cricket transcriptome—a database of all the messenger RNA transcripts expressed from the genes of an organism—previously assembled by Professor Horch and others for MAGUK proteins. By performing a series of BLAST (Basic Local Alignment Search Tool) searches against the cricket transcriptome, we were able to pinpoint twenty-six sequences in the *G. bimaculatus* transcriptome that we believe to be genetically related to the fruit fly *D. melanogaster* MAGUK proteins, including polychaetoid, stardust, varicose, metro, caki, calcium channel β, and discs large. These sequences could play an important role in the process of synapse formation starting three days after the deafferentation of the cricket auditory neurons. Whenever in-person laboratory work becomes safe and feasible once again, we hope to perform qPCR, immunohistochemistry, and in situ hybridization experiments to the role of these proteins in the plastic cricket auditory system.

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