The purpose of this study was to examine the effect of movement on mice's neural membrane potential (Vm), neural synchrony, and local field potential (LFP). The Vm is the electrical activity of a single neuron, and though the LFP is believed to represent the summed activity of all neurons, the relationship between individual neurons' Vm and the LFP is still largely unexplored. Thus, we examined this relationship, focusing on how the correlation between neuronal membrane potentials reflects the LFP activity—specifically, high-frequency gamma oscillations in the LFP, hypothesizing that they would be more correlated with the neurons we recorded: parvalbumin neurons. Our results show that neural activity during movement is more disorganized than during rest, with the correlation between spikes and between membrane potentials decreasing. Furthermore, our results could be used to identify the standard LFP activity during movement and rest. Identifying this healthy neural activity could help inform and improve neuromodulation therapies for neurodegenerative movement disorders, in which the frequency bands associated with movement are amplified and attenuated to treat symptoms. In addition, the observed synchrony between neuronal membrane potentials was typically found to be reflective of the calculated synchrony between neuronal membrane potentials and the LFP. However, we were unable to predict the LFP using the Vm-Vm correlation, likely due to our small sample size. In our future work, we hope to increase the sample size, as well as repeat this study in different regions of the brain to analyze how location changes the Vm-LFP dynamics.