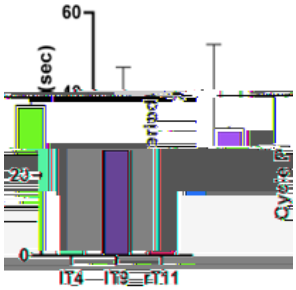
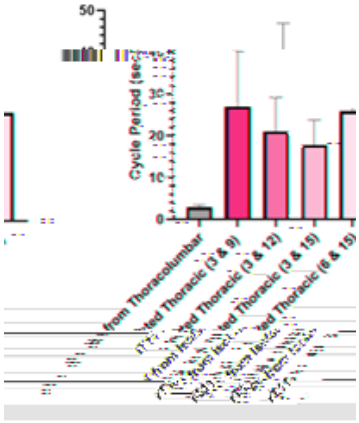
In vertebrates, the motor system is responsible for everyday movements, such as walking, running, swimming, etc. This motor behavior is a result of the coordinated contraction of different muscles throughout the body. Many of these muscle contractions produce rhythmic movement and can be traced back to the various neural networks (interconnected groups of neurons) present throughout the spinal cord. When these neural networks can independently perform rhythmic motion and cause locomotion, they are referred to as “central pattern generators” (CPGs).



The lumbar region of the spinal cord has already been identified as a CPG network when isolated. These neurons have been heavily studied in regards to spinal cord injury due to the lumbar segment’s implication in hindlimb (lower limb) locomotor (walking) control. Thus far, it’s believed that the thoracic region of the spinal cord is controlled by the lumbar portion below it when walking (Beliez et al., 2014). Our goal this summer was to test if the mouse thoracic spinal cord contains an autonomous CPG network capable of producing rhythmic patterns of activity independent of the lumbar network.



Neonatal (P1 to P7) mouse spinal cords were dissected as either an isolated thoracic region (experimental) or thoracic plus lumbar cords, termed thoracolumbar (control). These spinal cords were then placed into an aerated bath and continuously perfused with a mouse ringer solution. Various concentrations of the glutamate analog NMDA and serotonin (5HT), known to induce rhythmic motor bursting (motor neuron activity) in this preparation, were added to the bath to achieve activation. Recordings of bursting activity were taken through the software Spike2. The smooth and rectified versions of these traces were used to identify the average amplitude (strength and motoneuron recruitment of each burst), burst duration (how long each burst lasts), and cycle period (time between the start of one burst to the start of the following).

When recording motor activity from the same lumbar spinal level of the spinal cord, ventral roots contralaterally (oppositely) positioned from one another typically burst in alternation, representing left-to-right movement in mammals. Interestingly, when isolated thoracic bursts were measured, they fired in synchrony with one another, regardless of if they were positioned on the same side (ipsilateral) or opposed. This suggests the thoracic region could be implicated in another form of motor control unrelated to left-to-right activity seen in the lumbar region.

Because the upper thoracic region (T2-T6) receives less input from the lumbar region compared to the lower thoracic (T7-T12), it was believed that the amplitude, burst frequency, and cycle period wouldn’t be comparable between the two. Our research found that, in all three of these areas, the upper thoracic region was similar to that of the lower thoracic. This could imply that, when isolated from the lumbar region, the thoracic portion of the spinal cord produces rhythms uniformly across the entire region.

Future experiments should repeat this study and increase the sample size in hopes of achieving statistical significance across all categories. Similarly, the study of different neuromodulators (e.g.dopamine, norepinephrine, etc.) could help further indicate the rhythmic capabilities of this region. Finally, the previously defined upper and lower thoracic regions should be isolated from one another in order to identify their individual capabilities, specifically the upper thoracic region due to its distance from the lumbar region.