Remapping the World Around Us: How Do We Track and Avoid Obstacles as We Walk?

Keir Pearson

Department of Physiology, University of Alberta, Edmonton, Canada T6G 2H7

Walking animals rely on vision to step over or around obstacles in their path. However, visual input is not necessarily used directly to guide leg movements. Instead, walking animals look two or three steps ahead of their current position and store visual information in working memory for use at the appropriate time. In quadrupeds, a unique form of visual memory is used to guide the hind legs over obstacles that have already been stepped over by the forelegs. This visual memory is very long-lasting (tens of minutes) and incorporates precise information about the size and position of the obstacle relative to the hind legs. I will present data from electrophysiological and lesion studies that demonstrate that neuronal systems in the parietal cortex are necessary for establishing this memory and for representing the current position of the obstacle relative to the moving body. The lesion studies also indicate that these representations in the parietal cortex are used specifically to retain long-lasting memories (up to minutes) of obstacle location, and that short-lasting memories (up to a few seconds) are represented in other brain regions. I will present the hypothesize that remapping of obstacle location relative to the moving body depends in part on sequential activation of different populations of neurons in parietal cortex, with each population representing the specific location of the obstacle relative to the position of the legs. Challenges for future research are to establish how body movement (signaled by visual, vestibular, proprioceptive, and/or efference copy information) causes transitions of activity from one population of neurons to the next, and how these representations are transformed into motor commands for modifying the functioning of spinal locomotor networks.