A proposal has been made that mapping of the external environment to short-term memory is accomplished through the utilization of many spatial features. These features are distance, direction, and spatial location. Experiments have shown that the hippocampus plays an important role in processing distance and spatial location information. However, its role in processing direction information has not yet been investigated. In addition to the hippocampus, vestibular connections in the medial caudate nucleus (MCN) have made it second region of interest in processing direction information.

A task was designed to assess memory for direction. Long-Evans rats completed trials consisting of test and study phases. During the test phases, the rats traversed a maze arm oriented in one of three directions. In the study phases, a choice between the test phase direction (correct) and a foil direction (incorrect) were presented. Once rats reached a learning criterion, they were given hippocampus, MCN, or cortical control lesions. Unlike control animals, rats with hippocampal and MCN lesions exhibited marked impairments when re-tested. To assess the type of information used to solve the main task, the animals were subject to two different pre-surgery transfer tests: direction vs. response and rotation. During the direction vs. response test, the maze was moved 45° to the right or left between the study and test phases. We found that animals responded notably to direction of the correct arm rather than to the selection of a motor response. In the rotation test, trials were identical to the main task except that the animal was rotated between study and test phases. The rotation test acted to determine the role of vestibular input in solving the main task. We found that animals performed much better during normal, non-rotation compared to rotation trials, indicating that vestibular input is critical for direction responses. In addition to post-surgery testing on the main task, the animals were also subject to a direction discrimination task, where, presumably, the demands on short-term memory were greatly reduced. Each animal was assigned a single maze direction, irrespective of maze orientation. We found that all animals (regardless of lesion) were able to acquire direction discrimination. These results suggested that the deficit in memory for direction was not due to an inability to detect direction but rather to a problem with short-term memory. We concluded that both the hippocampus and MCN have significant roles in processing direction information for short-term memory.