# The Role of the Medial Prefrontal Cortex and Parietal Cortex in Memory and Spatial Navigation in the Traveling Salesperson Problem

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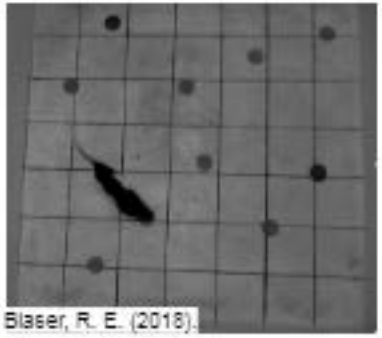
## Traveling Salesperson Problem (TSP)

- The TSP is a spatial optimization task that requires subjects to identify the shortest route to travel from a starting to ending point, while visiting a certain number of targets.
- It is used to study navigation, decision-making, planning, and memory-related processes.
- The TSP forces subjects to hone in on natural foraging behaviors, a complex trait that allows researchers to conduct further studies since the task is completed in a natural setting.
- TSP can target certain cognitive processes such as spatial cognition and memory.
- To solve TSP task, rats must engage in cognitive processes that extend beyond these domains, including attention, working memory, and decision making, which involve brain areas outside of the medial temporal lobes, including the medial prefrontal cortex (mPFC) and the posterior parietal cortex (PPC). We studied both the parietal cortex (PC) and medial prefrontal cortex (mPFC) as potential brain regions to lesion in order to further investigate their role in the TSP task.

## Medial Prefrontal Cortex (mPFC)

- A neocortical region that has previously been found to be involved in certain spatial and nonspatial cognitive processes including monitoring current location and assessing outcome
- The mPFC supports high-level processing of visual representations through interactions with the hippocampus and MEC
- mPFC lesions impair both spatial and non-spatial working memory (Sapiurka et. al., 2016)

## Example TSP Configuration



Blaser, R. E. (2018).

## mPFC Decision Making & Spatial Navigation

- Evidence shows that the mPFC stores schema that influences and contextualizes actions (Euston et al., 2012)
- Recordings from delayed alternation tasks have shown overlapping selective neuron firing encoded by the mPFC (Horst and Laubach, 2012)
- This suggests that these signals encoded by the mPFC track the subject's success and monitor performance based on prior knowledge

## Parietal Cortex (PC) and Visuospatial Memory

The parietal cortex is crucial to the facilitation of several processes carried out in the brain. The PC is responsible for encoding spatial information via an egocentric reference frame; therefore updating the body's spatial representation within the world through the spatial coding of sensory information. Furthermore, studies have suggested that the parietal cortex is associated with the limited capacity working memory. As a task is consolidated and becomes a long term memory, the hippocampus takes over.

## The Parietal Cortex (PC) and TSP

The parietal cortex has proved itself to be integral in visuospatial planning and spatial navigation as it is responsible for the planning, execution, and consolidation across various spatial tasks. It mediates path integration, using top-down attention to memory retrieval in the dorsal parietal cortex (DPC) and bottom-up attentional capture in the ventral parietal cortex (VPC). The PC also takes into account the risk vs the reward in a spatial task, depending on the reward system (Zhou Y, Freedman DJ). Studies suggest that the PPC plays a casual role specifically in visual decision making and may support sensory aspects of the decision making process, for example, interpreting visual signals (Licata AM, et al. 2017).

## References

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