Mice in the Manhattan Maze: Rapid Learning, Flexible Routing and Generalization, With and Without Cortex

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SCAN ME

OBJECTIVES

We observed mice navigating in the "**Manhattan maze**" – a novel and reconfigurable 3D maze and asked:

Rapid learning: **How fast…**

… do mice solve multiple mazes?

… are short routes developed?

Long-term memory: do mice remember maps over night?

Generalization: do mice learn…

… different types of graphs?

… new maps faster than old ones?

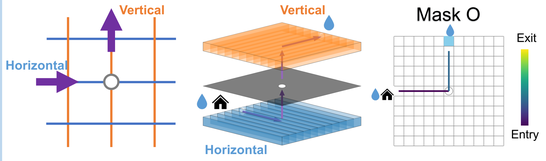
Neural substrate: Is neocortex and hippocampus…

… strictly required for learning, generalization, or long-term memory?

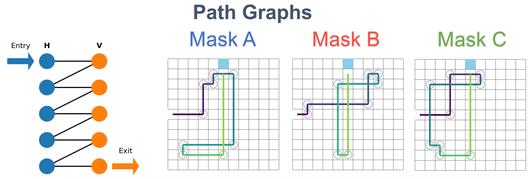
THE MANHATTAN MAZE

Tablet for video

Design principles: street grids in 3D

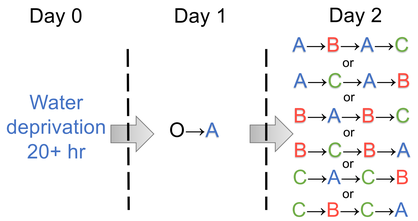


Path Graphs



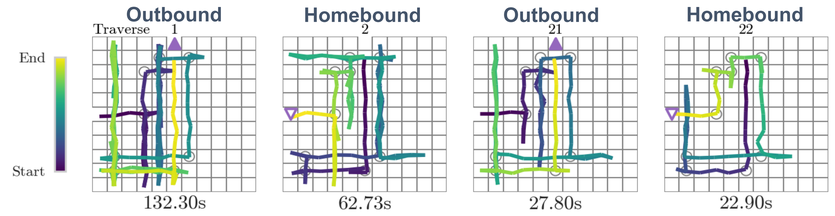
	A	B	C
Turn seq.	LRLRRRLLL	Same as A	LRRRLLRLL

Experiment Timeline

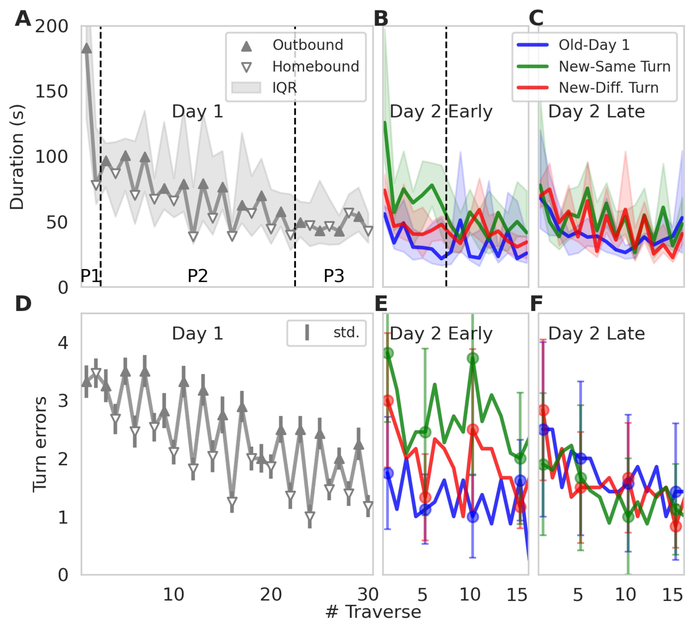


WITH CORTEX

1. RAPID LEARNING



2. TWO-DAY RESULTS



Overnight memory

- **Blue (Day 2) vs. Green (Day 1)**
- **B and E: Blue (Old) vs. Red and green (New)**

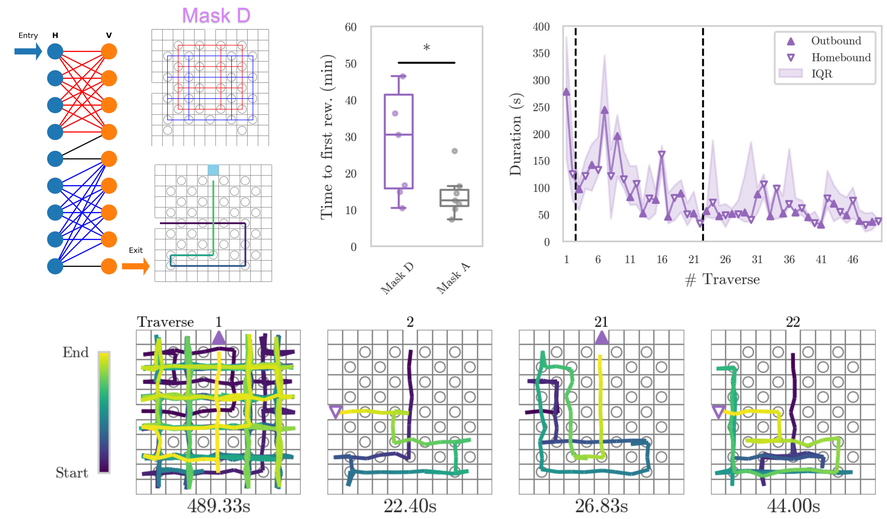
Accelerated learning

- **Red and green (Day 2) vs. Grey (Day 1)**
- **Day 2 Late (C and F) vs. Day 2 Early (B and E)**

Sequence learning:

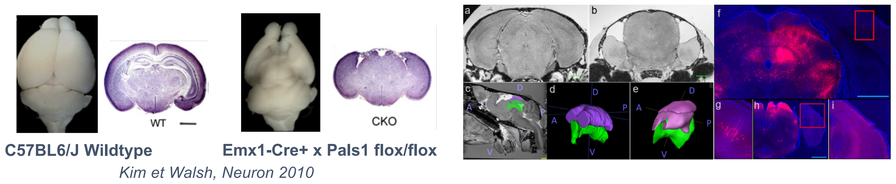
- **Red (same turns) vs. Green (different turns)**

3. LEARNING A COMPLEX MASK



WITHOUT CORTEX

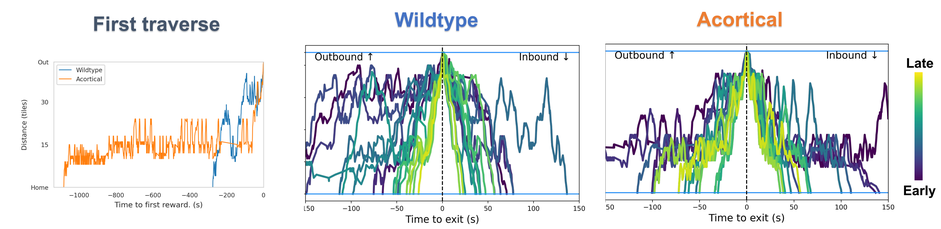
1. THE ACORTICAL MICE



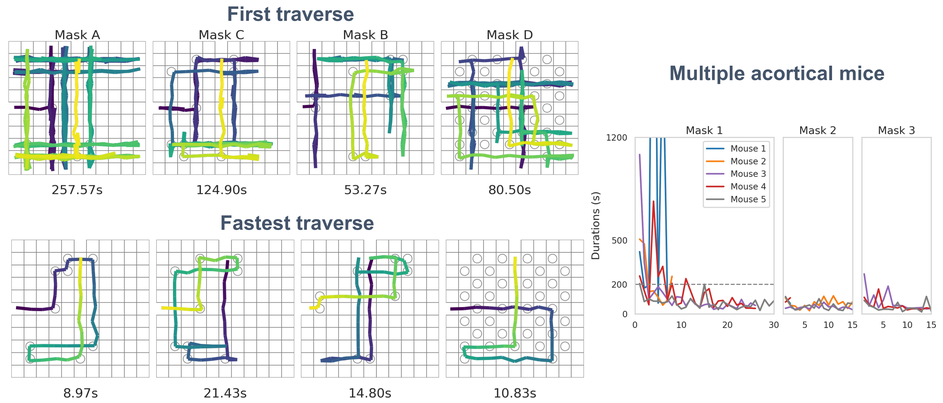
C57BL6/J Wildtype **Emx1-Cre+ x Pals1 flox/flox**

Kim et Walsh, Neuron 2010

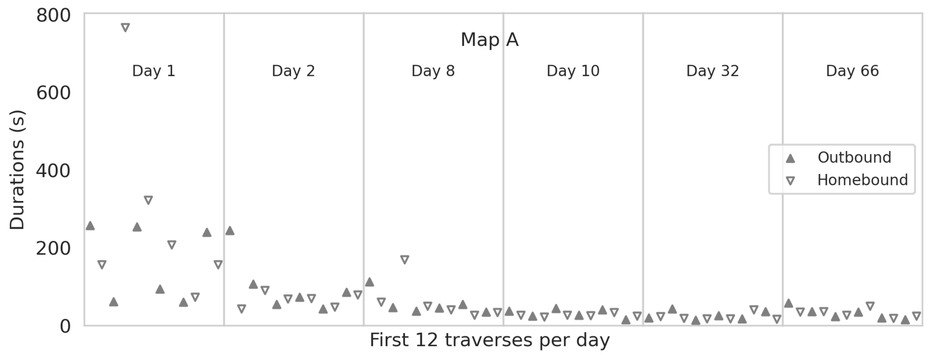
2. RAPID LEARNING



3. GENERALIZATION



4. LONG-TERM MEMORY



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