

Questions to guide your reading – Week 6

Paper 1. Lu J, et al. “Transforming representations of movement from body- to world-centric space.” *Nature*. 2021

Q1: Explain the difference between ‘World-centric travel direction’ and ‘Heading direction’.

Q2: How does ‘World-centric travel direction’ relate to ‘Heading direction’ and ‘Body-centric translation direction’? Why is ‘World-centric travel direction’ required for path integration?

The authors record the activity of a number of neuron types in behaving animals: (i) EPG, (ii) PFNd/PFNv, (iii) SpsP, (iv) LNO2, and (v) hΔB.

Q3: What behavioral/positional information do these different neuron subtypes encode?

Q4: Based on known anatomy, in what manner is information thought to flow between these subtypes (e.g., EPG -> PFNd/v -> ...).

Q5: What happens to path integration in a ring-shaped channel when PFNd neurons are silenced? What would you expect to happen if hΔB neurons were silenced?

Q6: Based on these findings, where do the authors speculate that path integration (i.e., a temporal summation of ongoing world-centric travel direction) occur?

Paper 2. Westeinde et al. “Transforming a head direction signal into a goal-oriented steering command.” *Nature*. 2024

Q1: What problem that animals and robots face in behavioral control do the authors study in this paper?

Q2: How are PFL2 and PFL3 cells well anatomically positioned to link the allocentric map of space and the an egocentric map of motor control? What does this mean in simpler words?

Q3: Under what conditions is PFL2 most active? What might be the purpose of such cells in engineering terms?

Q4: Under what conditions are PFL3L and PFL3R most active? How does this relate to steering and rotational velocity?

Q5: Which DNs are directly downstream of PFL3, providing the opportunity to control locomotor steering? Which do the authors call the 'direct' and which the 'indirect' pathway?

Q6: From Q5, what do the authors propose as the function of the 'indirect' pathway?