Superior colliculus turn cell activity is coordinated with locomotor dynamics and hippocampal representations of future paths

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Introduction

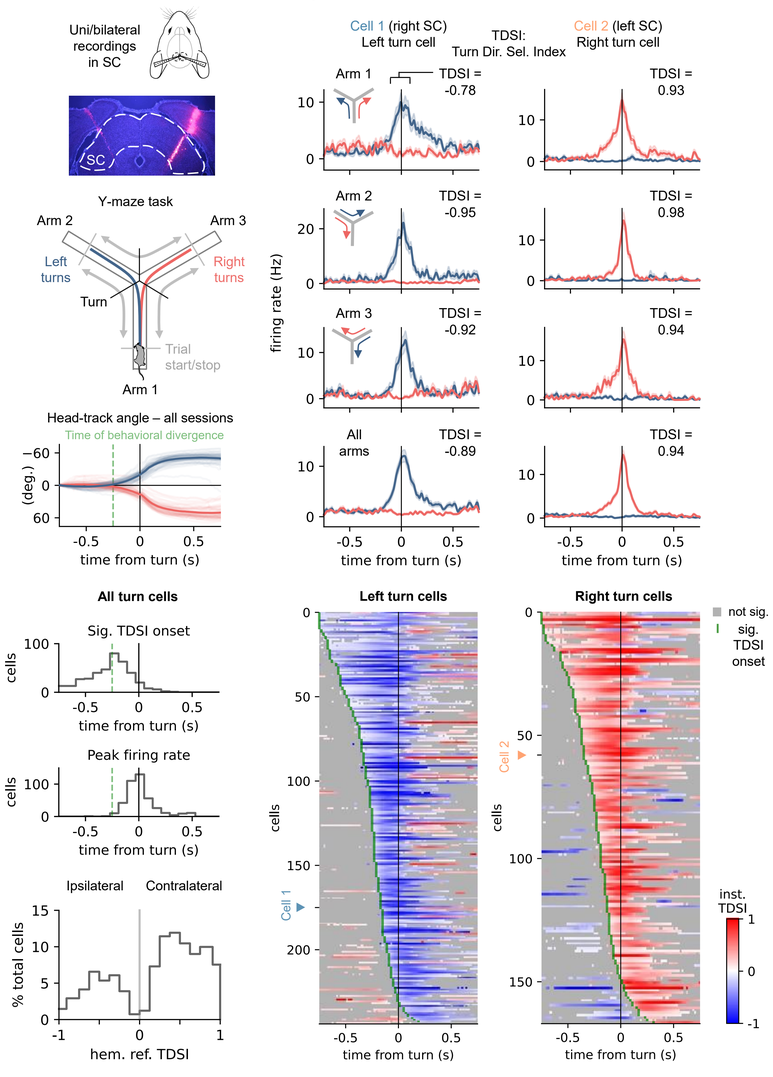
During navigation, turns occur in precise coordination with the ongoing stepping rhythm and require internal planning for the animal's potential future path. The intermediate/deep "motor" layers of the superior colliculus (SC) contain neurons whose activity reports turn direction and whose stimulation triggers turning movements. Is the activity of neurons in the motor layers of the SC coupled to locomotor dynamics and modulated in coordination with internal representations of future paths?

Summary

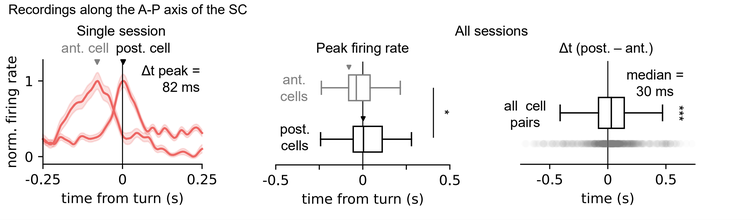
- "Turn cells" in the intermediate/deep motor layers of the SC fire more as the animal turns in one or the other direction at the maze bifurcation.
- Turn cell activity is directionally coordinated with both rhythmic locomotor dynamics and hippocampal representations of future paths. This coordination may allow animals to seamlessly execute turns during locomotion while navigating toward planned destinations.

Turn cells in the intermediate and deep layers of the SC

Temporal dynamics of SC turn cells

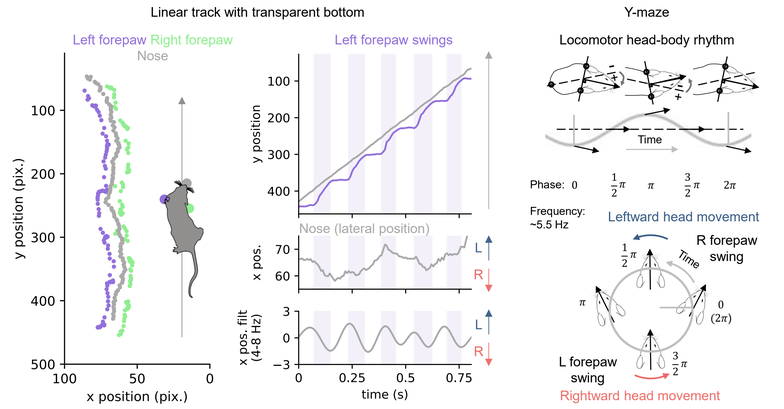


Turn cell activity propagates posteriorly during turns

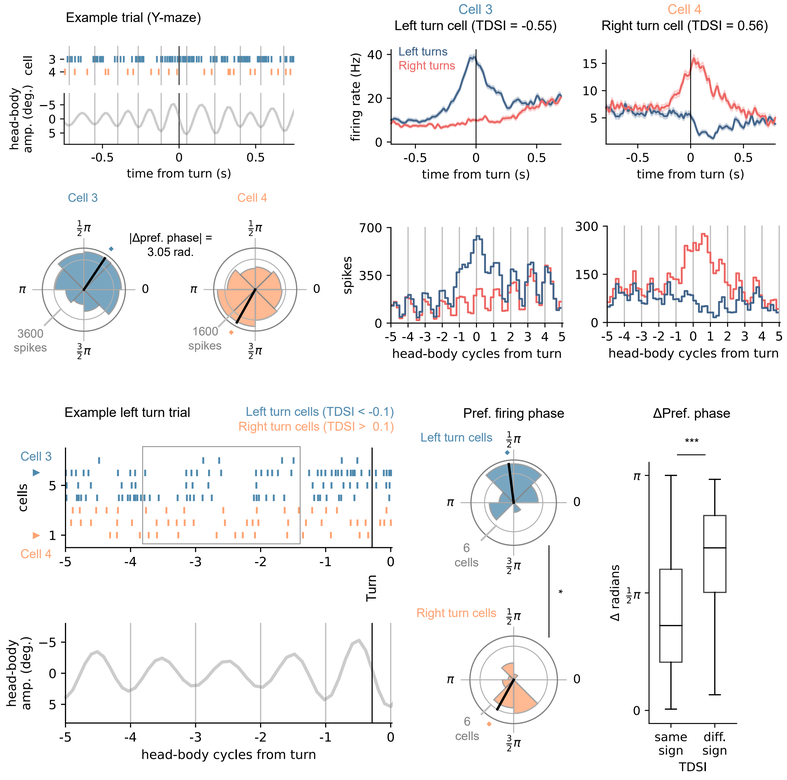


Turn cell activity is coupled to the locomotor rhythm

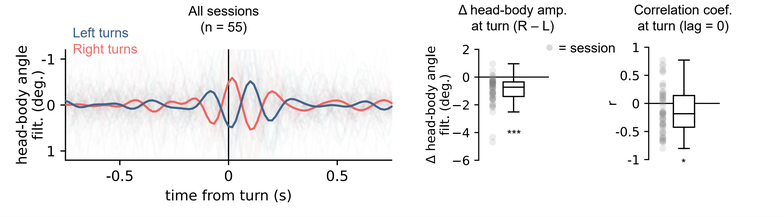
Head-body angle as a proxy for the locomotor rhythm



Left and right turn cell activity alternates in phase with the locomotor rhythm

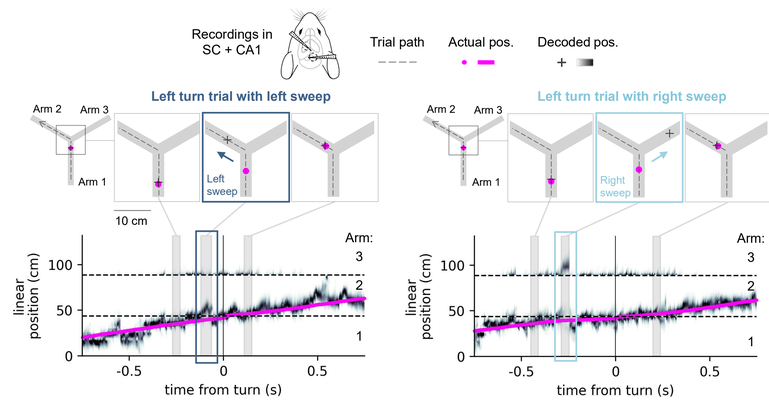


Left and right turns exhibit opposite locomotor dynamics

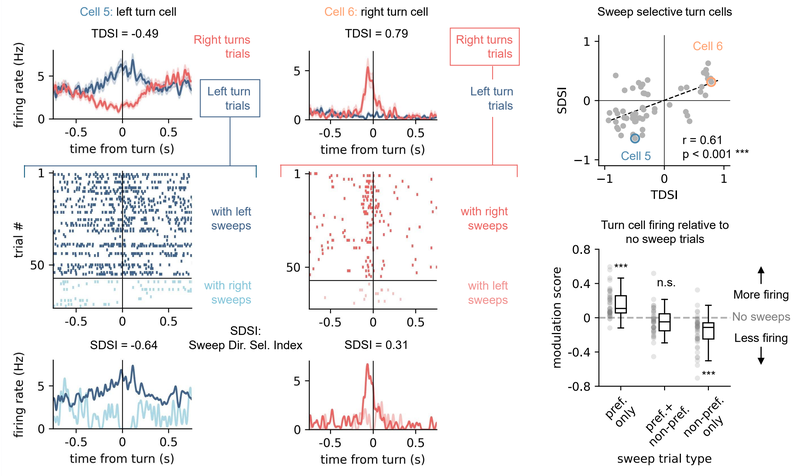


Turn cell activity is modulated in coordination with hippocampal representations of future paths

Decoding hippocampal sweeps from CA1 place cell activity



Turn cell activity is modulated in coordination with hippocampal sweeps



Hippocampal sweep direction is linked to subtle deviations in behavior