

Neurodevelopmental timing of social learning in mice

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Observational learning constitutes a key feature in the evolution of mammals, including mice. Unlike trial-and-error learning strategies, observational learning provides a safer and efficient way for knowledge acquisition. It involves an Observer (OBS) witnessing a Demonstrator's (DEM) behavior, allowing the OBS to detect the action-outcome relationship without directly experiencing the risk of wrong choices. Despite previous studies reported this ability in mice, it remains unclear how it emerges and evolves during development both on behavioral and neurobiological levels.

In this study we investigated the ontogeny of observational learning across different Post Natal Days (PND), by comparing task acquisition through direct experience or observation of an adult DEM.

OBS, at different PND, were paired either to an adult or to an age-matched DEM, to assess any differences in observational learning. We analyzed the efficacy of the learning and behavioral patterns including time spent directing the DEM, approach, avoidance and freezing behaviors to relate with attention abilities in the two conditions.

At a neurobiological level, we quantified markers of synaptic plasticity and spine morphology in hippocampus and prefrontal cortex confronting different PNDs and different learning strategies. Furthermore, to investigate whether the same neurons activated during observation are then reactivated and used in future decision-making in similar context, we used permanent genetic double-labelling of hippocampal cells.

Finally, we used fiber photometry to record neuronal activity in these cells and then we modulated their activity to assess the circuit underlying prosocial behavior.

We provide insight on social learning throughout neurodevelopment and on the different neuronal pathways that undergo this ability. This could constitute a relevant model to study intrinsic and extrinsic causes of social learning impairments that could manifest immediately or later on in the subject's life.