Brain Prize Lecture

[3BPL02]Replay

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*Videos are available throughout the meeting period.

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Animals and humans replay neural patterns encoding trajectories through their environment, both whilst they solve decision-making tasks and during rest. There is also evidence that activity in sensory cortices is regenerated during periods of time without behaviour in a way that resembles its form when animals are actively engaged in perception. Under a common assumption that we build models of the world and recognize and plan actions using those models, such intrinsically generated patterns are ideal for various forms of model inversion, giving us access to fast and effective methods for sensory processing and decision-making.

I will discuss our recent investigations using magnetoencephalography to detect replay in human subjects as they perform decision-making tasks. In a simple choice task, we found evidence for various forms of replay, which differed between subjects who flexibly adjusted their choices to changes in temporal, spatial and reward structure and those who were slower to adapt to change. The former group predominantly replayed comparatively less good trajectories during task performance, and subsequently avoided these inefficient choices. The latter replayed comparatively preferred, but suboptimal, trajectories during rest periods between task epochs. We suggest that online and offline replay both contribute to planning, but each are associated with distinct model-based and model-free decision strategies.

Parts of this are joint work with Eran Eldar, Zeb Kurth-Nelson and Ray Dolan.