Building compositional tasks with shared neural subspaces. Tafazoli S, Bouchacourt FM, Ardalan A, Markov NT, Uchimura M, Mattar MG, Daw ND, Buschman TJ. Nature. 2026 February. 650(8100):164-172. Article

Re-interpretation based on the IPL mechanism

This study demonstrates that learning gives rise to shared, task-general neural subspaces that are reused across different behavioral contexts, implying that cognitive flexibility depends on stable, **reusable** circuit substrates rather than task-specific representations. The semblance hypothesis offers a concrete biological mechanism for the emergence of such shared substrates by proposing that learning induces inter-postsynaptic functional LINKs (IPLs) between simultaneously active dendritic spines. When learning repeatedly engages overlapping input configurations, these IPLs cluster into higher-order hubs called islets of inter-LINKed spines (IILSPs) **that can be reactivated by different combinations of afferent activity**. At the population level, the coordinated recruitment of IILSPs across neurons would appear as shared neural subspaces, providing a structural basis for compositionality and rapid task recombination without requiring de novo circuit formation.

IILSPs highly suited to account for these observations because they operate through inter-neuronal, lateral associations and explain how the same representational components are **rapidly reused across tasks without interference**. IILSPs form distributed hubs spanning multiple neurons, enabling degeneracy, robustness, and flexible reuse by design. This distinction leads to falsifiable predictions: tasks sharing population-level subspaces should recruit overlapping inter-neuronal spine clusters; selective disruption of inter-spine coupling should impair generalization while sparing basic performance; and destabilization of IILSPs should abolish subspace reuse without eliminating stimulus-evoked firing. Together, these features position IILSPs as a more parsimonious and biologically grounded substrate for shared neural subspaces.