Semblance hypothesis – A summary

Kunjumon Vadakkan, 2nd April, 2026

Conventional studies in neuroscience have largely relied on correlating findings across multiple levels of the system with a surrogate proxy, behavior, to study higher brain functions. While informative, this approach provides limited structural insight for developing a mechanistic under-standing of memory and its first-person properties. An alternative strategy is to compile constraints from all available data and solve for behavior; if a solution emerges, one can examine the solution or its immediate vicinity for features capable of generating internal experiential phenomena. Applying this approach, the semblance hypothesis identifies inter-postsynaptic linkages (IPLs) as a candidate solution. A critical challenge is the identification of an IPL mechanism capable of forming and operating on a millisecond timescale, requiring only a few nanometers of inter-membrane interaction. Such a mechanism may not conform to conventional biochemical processes, yet could pro-vide the rapid and precise connectivity necessary for memory reactivation. Importantly, while most variables are empirically grounded, IPLs remain unverified, rendering the hypothesis falsifiable: IPLs should be detectable as reversible spine–spine linkages, experimental manipulations should selectively affect associative recall, and lateral activation should occur independently of presynaptic input.

A conceptually similar mode of operation is observed in the attention heads of transformer architectures used in large language models (LLMs). Attention heads dynamically link and propagate activity between distributed units, selectively reinforcing relevant associations without altering underlying connection weights.

Analogously, IPLs could provide a biological mechanism for rapid and selective lateral interactions among postsynaptic elements, enabling the reactivation of distributed neural patterns on millisecond timescales. Just as attention heads allow transformers to functionally integrate widely separated representations within a multidimensional space, IPLs could link spines to recreate associative patterns, supporting behavior consistent with memory retrieval. In contrast to LLMs, lateral activation of interlinked spines may evoke units of first-person properties, which are expected to be integrated by oscillatory potentials. Consequently, the capacity of IPLs to generate first-person experiential properties suggests an operational advantage over LLMs. The analogy with LLMs at the level of behavioral output further illustrates how IPLs could enable efficient and high-fidelity in-formation integration within neural circuits.

This framework also conceptually aligns with Marvin Minsky's K-line theory, which proposes that memory consists of patterns of active "mental agents" that can be reactivated to reconstruct aspects of prior cognitive states. IPLs provide a potential biological instantiation of this idea by enabling distributed patterns to be reactivated at the postsynaptic level and by generating internal "semblances" of experience. Because the semblance hypothesis addresses both memory storage and the internal experiential content of memory while introducing only a single unknown variable, the IPL, this approach remains trac-table, falsifiable, and high leverage. Experimental exploration of IPLs offers a rare opportunity to directly link neural circuitry with subjective experience, providing a systematic pathway toward a mechanistic understanding of memory that could fundamentally transform neuroscience.