The First Quantum Computing Model Using Hadamard Random Walk and Grover Search for Semantic Memory in Neurodegenerative Diseases

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Previously, the Hadamard Random Walk was shown as a viable way for representing the maximum-likelihood estimate of the semantic fluency task, an important metric for assessing the semantic memory retrieval of subjects for finding therapeutic cures in neurodegenerative diseases. However, semantic memory also relies on the executive function of brain search, a component neglected in current classical/quantum random walk models. To compensate for this deficiency, Grover Search is experimented in tandem with Hadamard Random Walk to explain how brain search pathways work within the semantic fluency task. By showing how both quantum algorithms must not be isolated, but instead used simultaneously to accurately match behaviors that suit with the specific activation area, age, and diagnosis of various neurodegenerative conditions, we show how manipulating parameters within this version of the semantic memory model connects to the Efficiency Hypothesis Theory: Hadamard Random Walk is responsible for the implicit memory (subconscious) within the left frontal lobe, while the Grover Search is responsible for the explicit memory (conscious) within the right frontal lobe. The computational and biological establishment between two quantum algorithms and two types of memory will allow not only a complete understanding of the two required components of semantic memory, but also early diagnosis of patients' brains, simply by recreating the outputs of the semantic fluency task onto the semantic memory model circuits. Systems that take advantage of such quantum systems will pioneer groundbreaking devices that potentially simulate the brain's complexity during the semantic fluency task, reducing reliance on fMRI scans.

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