

Semantic Interference as an Early Cognitive Marker of Mild Cognitive Impairment: A Systematic Review and Meta-Analysis

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Introduction

- Mild Cognitive Impairment (MCI)
 - Transitional stage between normal aging and Alzheimer's disease (AD)
 - Early detection is critical for intervention and disease monitoring
- Limitations of Traditional Memory Tests
 - Delayed recall measures often fail to detect subtle deficits in early disease stages
- Semantic Interference Paradigms
 - Require learning semantically categorized information
 - Followed by exposure to a competing semantically related list
 - Place memory systems under competitive load
- Key Measures
 - Proactive Semantic Interference (PSI)
 - Failure to Recover from PSI (frPSI)
 - Semantic intrusion errors
- Study Objective
 - This systematic review and meta-analysis examines whether semantic interference deficits reliably distinguish individuals with MCI from cognitively normal controls, and whether these deficits exceed traditional delayed recall impairments within the same samples.

Methods

- Study Selection
 - Inclusion criteria required studies that:
 - Included peer-reviewed human studies
 - Participants aged ≥ 55 years
 - Compared MCI and cognitively normal control groups
 - Used a semantic interference paradigm
- Task Paradigm
 - Participants learn semantically categorized material followed by a competing semantically related list, allowing measurement of:
 - Proactive Semantic Interference (PSI)
 - Failure to recover from PSI (frPSI)
 - Intrusion errors
- Meta-Analysis
 - Effect sizes calculated using Hedges' g
 - Random-effects models used to estimate overall group differences
 - Heterogeneity assessed using I^2 statistics
- Secondary Analysis
 - Compared magnitude of semantic interference impairment vs traditional delayed recall deficits within the same samples when available.

Empirical Basis for Hypotheses

- Prior studies using semantic interference paradigms show that individuals with amnesic Mild Cognitive Impairment (aMCI) demonstrate:
 - Greater proactive semantic interference (PSI)
 - Impaired recovery from interference (frPSI)
 - Higher rates of semantic intrusion errors
- These deficits are associated with:
 - Atrophy in Alzheimer's-vulnerable brain regions
 - Particularly medial temporal and temporoparietal regions
- Semantic interference measures have also been shown to:
 - Predict progression from MCI to dementia
 - Remain predictive after controlling for amyloid burden and hippocampal volume

Semantic Interference Paradigm

List A (Original List)

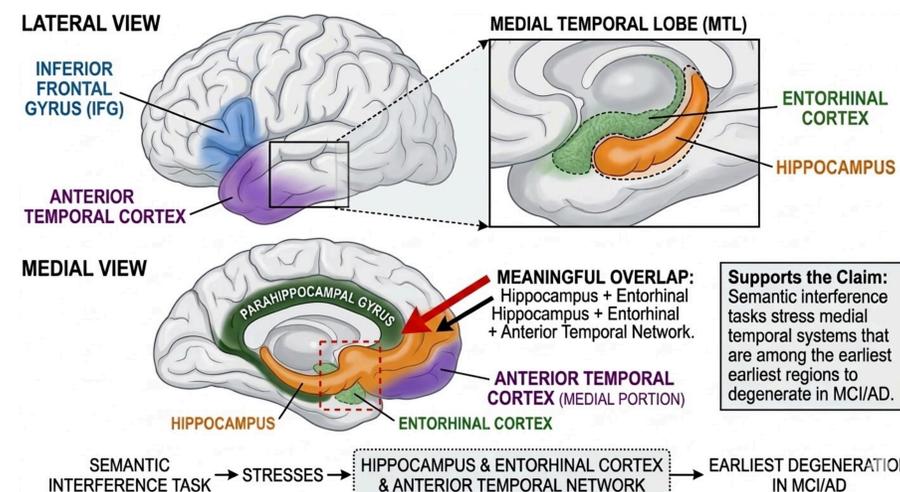
- Apple
- Banana
- Orange
- Grape

List B (Competing List)

- Peach
- Mango
- Plum
- Kiwi

References

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Discussion and Future Application

- If semantic interference demonstrates consistent impairment in MCI, these findings support its potential role as an early Alzheimer's-related vulnerability marker.
- Implications
 - May improve early cognitive screening tools
 - Detect subtle memory network dysfunction earlier than traditional recall tests
 - Inform development of more sensitive neuropsychological batteries
 - Clinical Relevance
 - Because MCI represents an actionable stage of disease progression, improved early detection may:
 - Support earlier clinical intervention
 - Improve patient selection for clinical trials
 - Enable earlier therapeutic strategies
 - Future Directions
 - Future work should examine:
 - Standardization of semantic interference tasks
 - Integration with neuroimaging and biomarker measures
 - Longitudinal studies evaluating prediction of Alzheimer's progression

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