Morpho-lexical Recognition Ability and Related Brain Regions in Individuals with Mild Cognitive Impairment, Alzheimer’s Disease, and Cognitively Normal Elderly

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Background

- Language functions are differentially vulnerable to normal aging and Alzheimer’s disease (AD).
  - Word finding ability and semantic processing – decline early
  - Syntax of language production - relatively preserved in AD
  - Changes in morpho-lexical processing in aging – not clear
- Brain regions associated with morphology in lexicon – not clear
- Finnish word forms – morphologically complex.
  - Finnish nouns can appear in at least a dozen different case forms. e.g., lasia - glass
  - lasin - the glass
  - lasiin – into the glass
  - lasissa – in the glass
- Finnish is ideal for measuring changes in morpho-lexical knowledge in normal aging and pathological aging.
  - Unlike English, knowledge of morphology in words can be differentiated from syntactic knowledge in Finnish.

Research Questions

- Does the ability of word recognition decline in patients with MCI or mild AD who speak Finnish?
- Which areas of the brain are associated with the ability of word recognition in adults with normal aging / dementia?

Methods

- Participants: Finnish speakers of Probable AD (n=19), MCI (n=22) and cognitively healthy older adults (n=17).
- Age / Education / Gender
- Diagnostics : Included comprehensive clinical, neuropsychological, CSF, & neuroimaging evaluations
  - NINCDS-ADRDA criteria for AD
  - Mayo Clinic Alzheimer’s Disease Research Center criteria for MCI
  - All procedures were performed in the Neurological department of University Hospital of Kuopio or at the Brain Research Unit of the University of Eastern Finland.
- Lexical decision task: Participants read each word and pressed a button to indicate whether it was a real word or not.
  - 177 real words (nominative singular forms of monomorphemic nouns)
  - 177 pseudo-words (follow the phonotactic rules of Finnish)
- Reaction Time (ms) and Accuracy (%) –ANOVA & Tukey Post Hoc

Results – Behavioral Data

- Homogeneity of Variance Tests (Ravene) - Not significant
- Accuracy: No group differences
  - real words (F(2,56) = 2.33, p = .107)
  - pseudo-words (F(2,56) = 2.49, p = .092)
- Reaction Time: Significant group differences.
  - Tukey Post Hoc: AD > MCI = Control
  - AD group took significantly longer time than healthy control to recognize real words (p = .015) and pseudo-words (p = .030).
  - Difference between MCI and control approaching significance in real words (p = .080) and pseudo-words (p = .084).

Results – Cortical Thickness

- Significant correlation between cortical thickness and RT/ACC
- Across all groups: Bilateral superior temporal gyri
- AD
  - Real words: L. superior temporal gyrus & R. pars orbitalis
  - Pseudo-words: L. superior temporal gyrus & R. pars triangularis
- Healthy Control: Real words: L. lingual gyrus
- MCI: no significant regions

Conclusion and Discussion

- Accuracy scores did not differentiate 3 groups - a less sensitive measure than RT.
- Reaction time shows group differences.
  - Only AD group was significantly slower than control: Individuals with AD needed longer time to read and accurately process words.
  - The word recognition ability still remain intact in people with MCI (even though it is getting slower).
- Word recognition task with RT may be a useful diagnostic tool.
- The thinning of the superior temporal gyrus bilaterally predicted slower word recognition.
- The speed of healthy elderly’s recognition of words was associated with brain regions related to visual/letter processing and identification of words. On the other hand, the speed of AD patients’ recognition depended on regions associated with language and executive functions.

Further analysis

- Phonology vs. morphology in word recognition
- Individual variance
- Differences in word type (regular vs. irregular)