Is lexical processing influenced by how words are experienced by multiple sensory modalities in Alzheimer’s disease?

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Introduction

The intervention of sensorimotor processes in lexical-semantic representation is widely highlighted [1]. However, there is still very little work supporting this view of cognition in healthy and pathological aging. The aim of this study is to explore the impact of perceptual strength (PS) - the extent to which a word can be experienced by multiple sensory modalities, i.e. visual, auditory, haptic, gustative and olfactory [2] in visual word recognition in Alzheimer’s disease (AD). We would like to explore if high PS words could be processed faster and more accurately because they are semantically richer, contrary to low PS words which would be processed less quickly and precisely.

Population

- Healthy control (HC)
  - N= 36
  - 73.78 years ± 7.26
  - MMSE 29.1 ± 79

- Mild stage of AD (AD1)
  - N= 22
  - 77.5 years ± 6.85*
  - MMSE 22.91 ± 1.57*

- Moderate stage of AD (AD2)
  - N= 20
  - 80.8 years ± 6.65*
  - MMSE 16.65 ± 1.39*

* Differ significantly from HC

Task

Lexical decision task

- 56 stimuli of interest:
  - 28 Low (L)PS words
  - 28 High (H)PS words* [3]
  + 56 non-words (fillers)

- Accuracy (ACC) + Reaction Times (RTs)

Cognitive assessment: global (MMSE), executive (BREF), episodic memory (5 words test), and lexical-semantic (TCD-MA, Mini-QCS, phonological and semantic fluency)

Results

We ran a linear/logistic mixed effects model that predicted RTs and ACC to compare 1) HC vs AD1 and 2) HC vs AD2.

1) HC vs AD1

ACC : non significant (p>.05)
RTs :
- Condition [\(\chi^2(1) = 1.82, p = .177\)]
- Group [\(\chi^2(1) = 23.86, p < .001\)]
- Interaction [\(\chi^2(1) = 8.09, p = .004\)]

* Impact of demographic variables: age effect (p<.001)
but no condition*age (p=.05), group*age (p=.006)

2) HC vs AD2

ACC : non significant (p>.05)
RTs :
- Condition [\(\chi^2(1) = 0.00, p = .971\)]
- Group [\(\chi^2(1) = 60.46, p < .001\)]
- Interaction [\(\chi^2(1) = 0.03, p = .869\)]

* Impact of demographic variables: age effect (p=.020)
but no condition*age (p>.05), group*age (p=.043)

Discussion

In this study, we found a group*condition effect for HC vs AD1 showing that AD1 processed LPS and HPS differently, whereas this was not the case in HC. The lack of distinction between the 2 conditions in HC would occur because older adults have such extensive sensorimotor experiences with the concepts that they reach a ceiling effect in PS processing. However, the semantic degradation of AD1 reveals this distinction. The semantically richer words (HPS words) are probably processed faster because they are better preserved, leading to faster activation because the connections between semantic and orthographic units are greater for these words (feedback activation framework [4]). Conversely, less semantically rich words (LPS words) are processed slowly in AD1 because they are more vulnerable given their impoverished semantic representation. Complementary analysis corroborate the fact that it is cognitive deterioration (in particular lexical-semantic and executive) that influences the results, i.e. a PS effect condition would appear only when cognitive scores fall. No results were observed in AD2 probably because of the more severe lexical-semantic degradation. The analyses also excluded an effect of demographic factors on outcomes.