The Purpose of the Study

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- The purpose of this study is to apply a machine-learning approach to analyze the noun-verb semantic distance of AD in a sentence construction task using the DementiaBank.
- We further analyzed verb clusters with those nouns and investigated whether the verb clusters are associated with demographic factors (age, education, and dementia severity).

Methods

- We extracted the data of 99 probable AD on the sentence construction task from the DementiaBank (Becker et al., 1994). Table 1 provides demographic information of participants.

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<td><strong>Age (yr)</strong></td>
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<tr>
<td>Mean (SD)</td>
<td>71.86 (±8.30)</td>
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<td>Range</td>
<td>53-88</td>
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- Participants were asked to construct a sentence with given words (pencil, tree) which is similar to Altmann’s (2004).

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- To investigate the differences in semantic distances of different text corpora, we performed an independent samples t-test on the semantic distances for the two groups (DementiaBank vs. Wikipedia [Blog]).

Analyses

1. Semantic Distance Analysis

- To investigate the differences in semantic distances of different text corpora, we performed an independent samples t-test on the semantic distances for the two groups (DementiaBank vs. Wikipedia [Blog]).

2. Verb Clustering and Regression Analysis

- To identify whether the verb clusters are associated with demographic factors (age, education, and dementia severity), we conducted a stepwise logistic regression.

Results

1. Semantic Distance Between the Target Noun and Verb

1) DementiaBank vs. Wikipedia Database

- For the analysis of the ‘pencil’, the noun-verb semantic distance, as indexed by the cosine similarity, was statistically higher in the DementiaBank than Wikipedia ($t_{(96)} = -5.050, p = 5.881e-7$).
- This indicates that the semantic distance between the noun and verb is closer in the DementiaBank than the Wikipedia.
- For the ‘tree’, the cosine similarity was statistically higher in the DementiaBank than Wikipedia corpora ($t_{(94)} = 7.888, p = 3.053e-8$).

2) DementiaBank vs. Blog Database

- For the analysis of the ‘pencil’, the cosine similarity was statistically higher than Blog ($t_{(299)} = -3.702, p = 2.764e-4$); therefore, the DementiaBank had a higher proportion of verbs with semantic distances.
- For the ‘tree’, the cosine similarity is statistically higher in DementiaBank than the Blog ($t_{(296)} = 5.289, p = 1.526e-7$).

2. Verb Clustering and Regression Analysis

- We found that education has a significantly positive ($b = 0.661, Wald = 6.871, p = 0.009$) effect on the choice of ‘write’ (baseline) or ‘be’ verb for the ‘pencil’, but a marginally positive ($b = 0.325, Wald = 3.533, p = 0.059$) effect on the choice of verb ‘write’ (baseline) or ‘be’ for the noun ‘pencil’.
- For MMSE scores, we found a significantly negative ($b = -0.294, Wald = 6.674, p = 0.01$) effect on the choice of verb, either ‘write’ (baseline) or ‘be’, for the ‘pencil’ and a significantly positive ($b = 0.274, Wald = 3.921, p = 0.048$) effect on the choice of either ‘be’ (baseline) or ‘grow’ for the noun ‘tree’.

Conclusions

- The current study found that the semantic distance between nouns and verbs is shorter in AD populations compared to the existing big databases.
- Furthermore, the semantic weight of verbs that AD participants used in a sentence construction task was significantly related to the severity of dementia, indicating that people with AD tend to use more light verbs as their disease progresses.
- We applied machine-learning techniques to the open-access big database under the framework of examining linguistically finite deficits in AD patients’ sentence production.

References

Noun-Verb Semantic Distance Analyses in Sentence Production of Alzheimer’s Disease

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²The Center for Intelligent and Interactive Robotics, Korea Institute of Science and Technology, Seoul, Korea
³Department of Human-KIST Bio-convergence, Hanyang University, Seoul, Korea

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<th>Gender (male: female)</th>
</tr>
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<tbody>
<tr>
<td>Mean (SD)</td>
<td>71.86 (±8.30)</td>
<td>11.84 (±2.765)</td>
<td>19.13 (±4.139)</td>
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</tbody>
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| Range | 53-88 | 6-20 | 8-27 |

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References


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