



Hold that thought: Linguistic features of spontaneous discourse production predict working memory in people with aphasia



KU LEUVEN

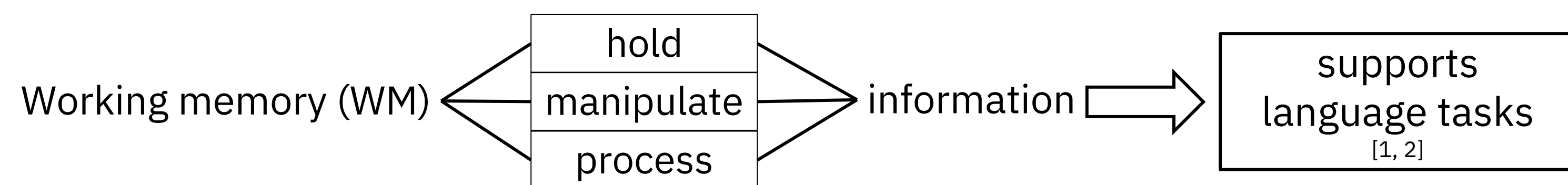
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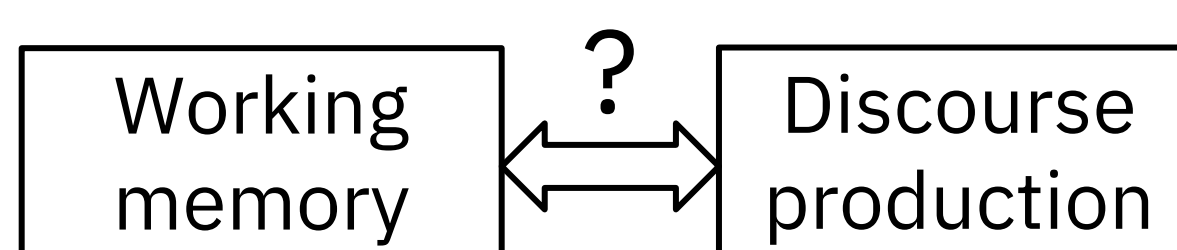
Introduction



- In individuals with aphasia, WM can be impaired
 - Leads to decreased performance on classic language evaluation tasks and discourse production [3, 4]
- Discourse analysis: quantify lexical-semantic, phonological and grammatical aspects of language in an ecologically valid context
- Prior work has investigated the relation between WM and discourse production [4]
 - But: few participants, only one discourse task, manual coding of discourse features
- Further investigation of the link between WM and discourse measures could benefit from automatic coding of language features

Research Questions

1. Can properties of spontaneous speech predict working memory performance in people with aphasia?
2. If so, can the relevant discourse properties be computed entirely automatically?



Methods

- **Participants:** N = 258 people with aphasia, from AphasiaBank database [5]
- **Spontaneous speech production tasks:** from AphasiaBank standardized protocol
 - 11 unique prompts across 3 prompt categories: *story retelling* (1), *expository narrative* (6), *picture description* (4)
 - Only prompts with at least 20 participant transcripts were included
 - Only transcripts with at least 50 words were included
- **Working memory tasks:** Sentence repetition tasks from AphasiaBank protocol
 - Sentence length span: maximum length of correct repetitions of sentences

Analysis

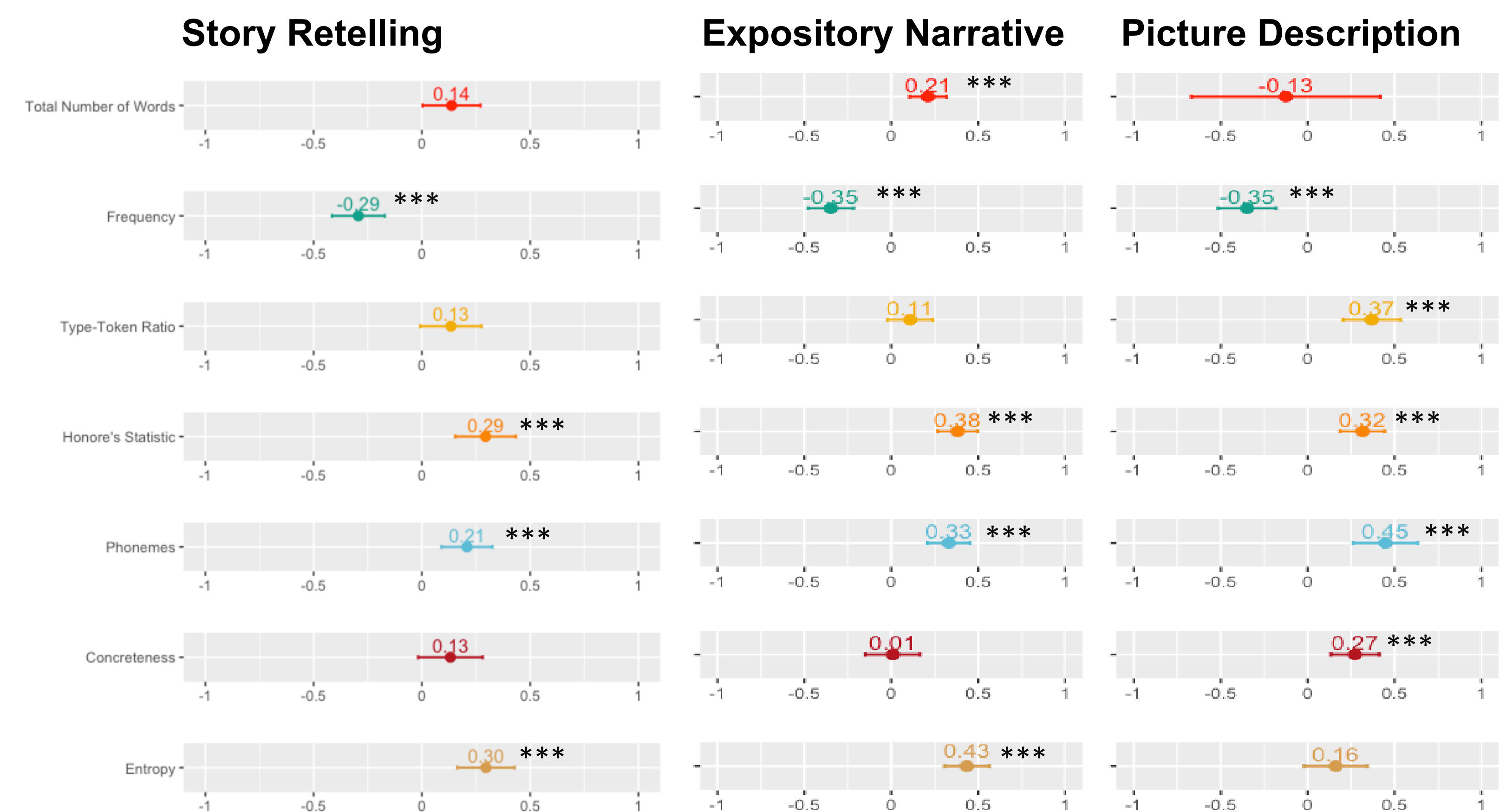
- **Linguistic features:** phonetic, lexical, and discourse properties, calculated automatically
 - Total number of produced words, lexical frequency, lexical diversity (type-token ratio), lexical richness (Honoré's statistic), average number of phonemes per word, concreteness, linguistic surprisal (Shannon entropy)
- **Working memory score:** percentage of correctly repeated words averaged across two sentence repetition tasks
- **Statistical models:**
 - Multiple linear regressions with linguistic features as predictors and WM score as outcome variable
 - 3 separate models run, one for each set of transcripts from each prompt category
 - Simple linear regressions to investigate how well each linguistic feature was individually correlated with WM score

References

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5. MacWhinney, B., Fromm, D., Forbes, M., & Holland, A. (2011). AphasiaBank: Methods for Studying Discourse. *Aphasiology*, 25(11), 1286–1307.
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Results

- **Multiple Linear Regressions:** Discourse features computed on all three speech production prompt tasks significantly predicted WM capacity.
 - Picture description: $\text{adj.}R^2=0.19$, $p<0.001$
 - Expository narrative: $\text{adj.}R^2=0.24$, $p<0.001$
 - Story retelling: $\text{adj.}R^2=0.19$, $p<0.001$
- **Simple Linear Regressions:** Effects of individual predictors varied with prompt type. Lexical frequency, lexical richness (Honoré's statistic), and number of phonemes per word were individually predictive of WM scores for all three speech prompt types.



*** = significant at $p \leq 0.001$ after correcting for multiple comparisons using the Benjamini-Hochberg method

Conclusions

WM capacity in individuals with aphasia can be predicted by automatically-computed measures of spontaneous speech

- Specific predictors of WM capacity differed by prompt type
- Lexical richness, lexical frequency, and semantic distance were relatively consistent predictors of WM capacity across prompt types, suggesting more semantically loaded measures may be more reliable across prompts
- Extends previous research establishing effect of prompt type on discourse measures in aphasia [4, 6]
- Further highlights relationship of WM to discourse measures

Future Directions

- More precise measures of WM capacity that don't rely on verbal ability can help clarify relationship of WM to discourse measures
- Offers possibility of WM training in speech therapy improving discourse production

Acknowledgements

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