Conversation in the Wild: Automating Analysis for Cognitive-Communication Impairments

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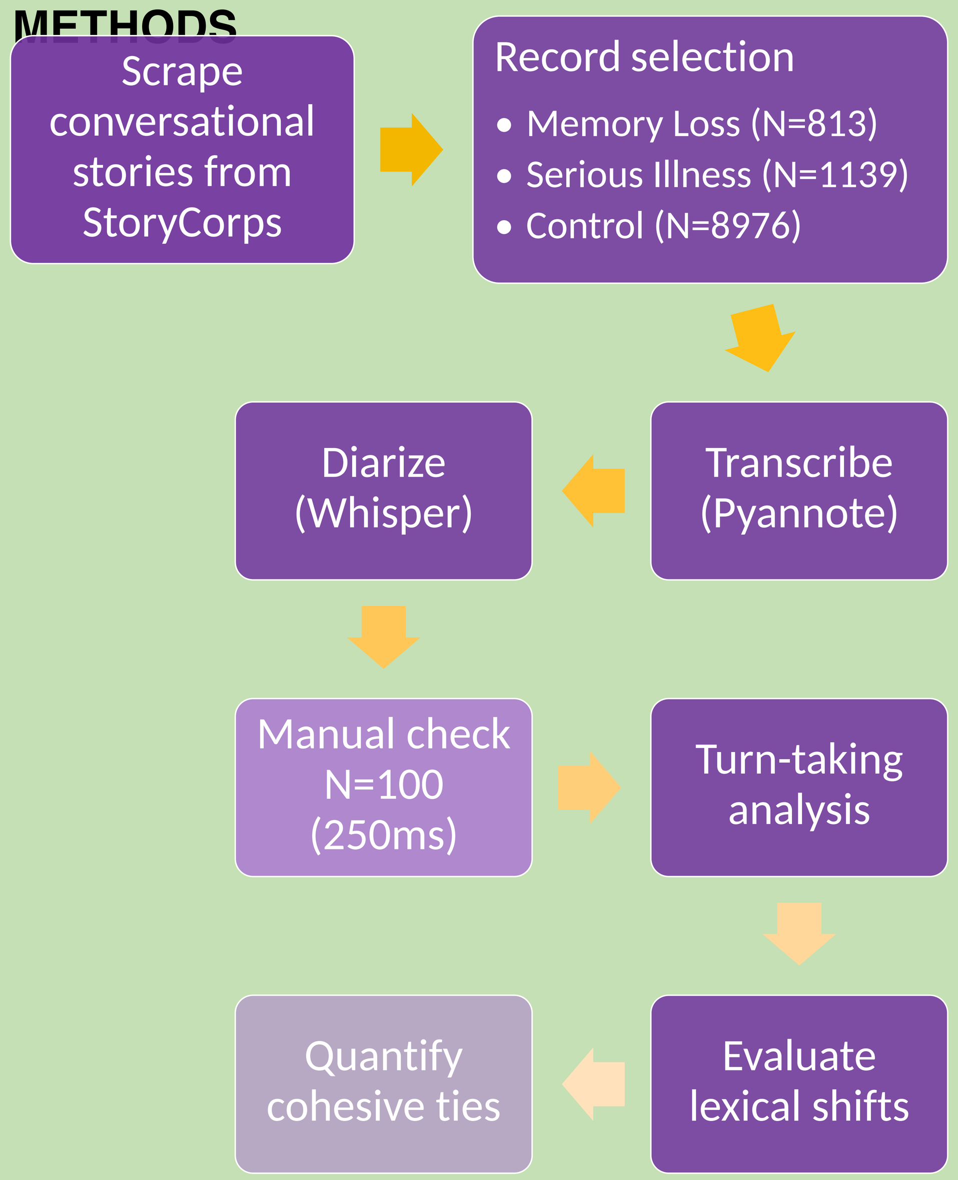
INTRODUCTION

- Brain injury can impact conversational communication. (MacDonald, 2017)
- Assessment and treatment contexts should mirror patient-centered, real-world goals. (Leaman & Archer, 2023)
- Small data sets and behavioral complexity currently limit clinical evaluation strategies. (Sohlberg et al., 2019)

We sought to quantify clinically relevant features of natural conversation that could be normed and automated for diagnostic assessment of CCI.

METHODS



Computations were performed on the Vermont Advanced Computing Center supported in part by NSF award No. OAC-1827314.

RESULTS

- MemoryLoss turn fq (min) > Control $p<0.001$
- MemoryLoss turn length < Control $p<0.001$

Difference between partners' turn length (sec):

- MemoryLoss Spkr Diff > Control $p<0.001$
- MemoryLoss Spkr Diff> Legacy $p=0.001$

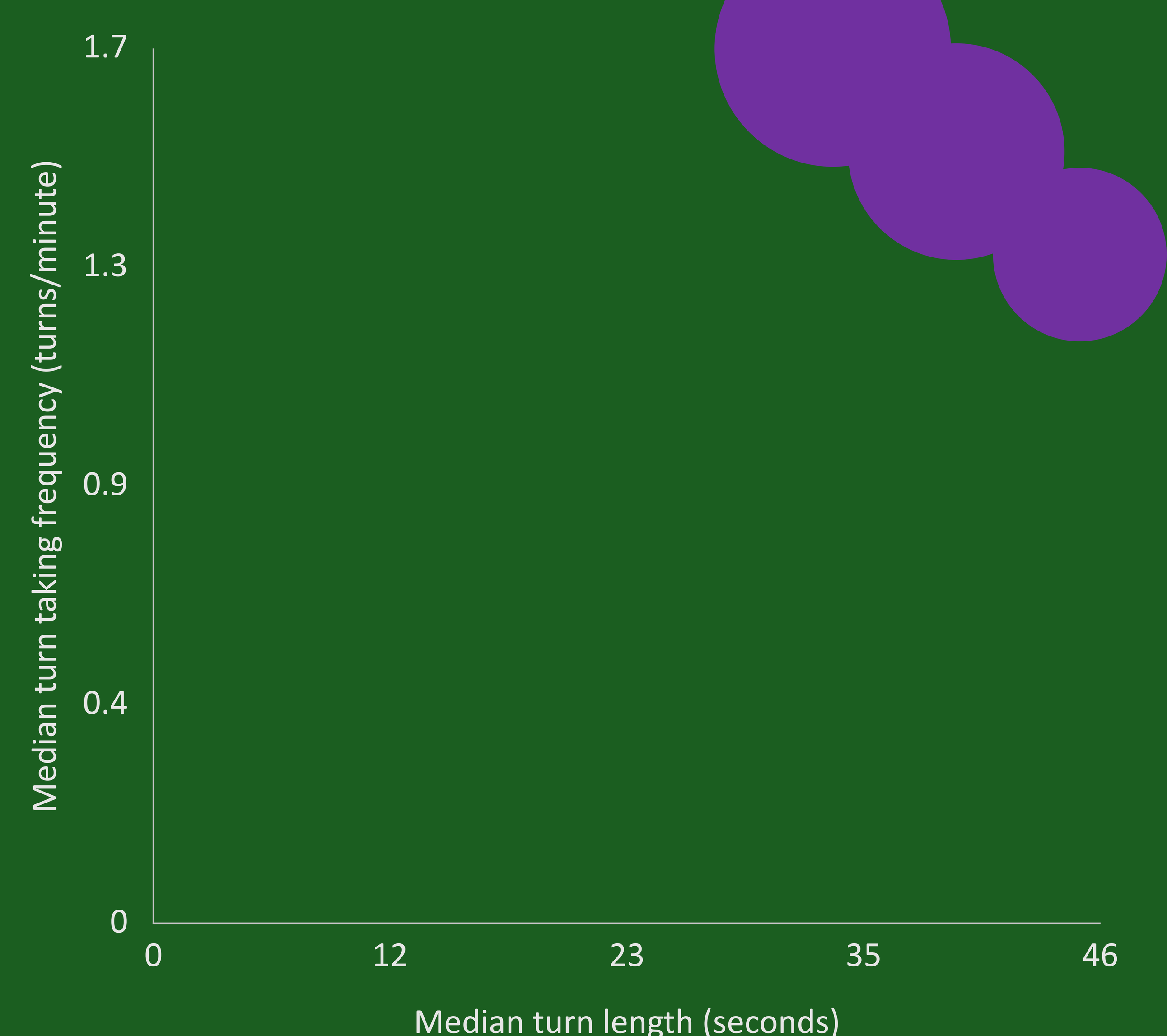
DISCUSSION

Automated measurement of dyadic communication provides critical insight into the emergent **interactional behaviors** that characterize natural conversation. These data are not obtainable through traditional monologic assessment.

CONCLUSION

We show potential for meaningful naturalistic clinical discourse-norming with **generalizable**

Memory loss changes the **interactional** dynamics of personal story **conversations.**



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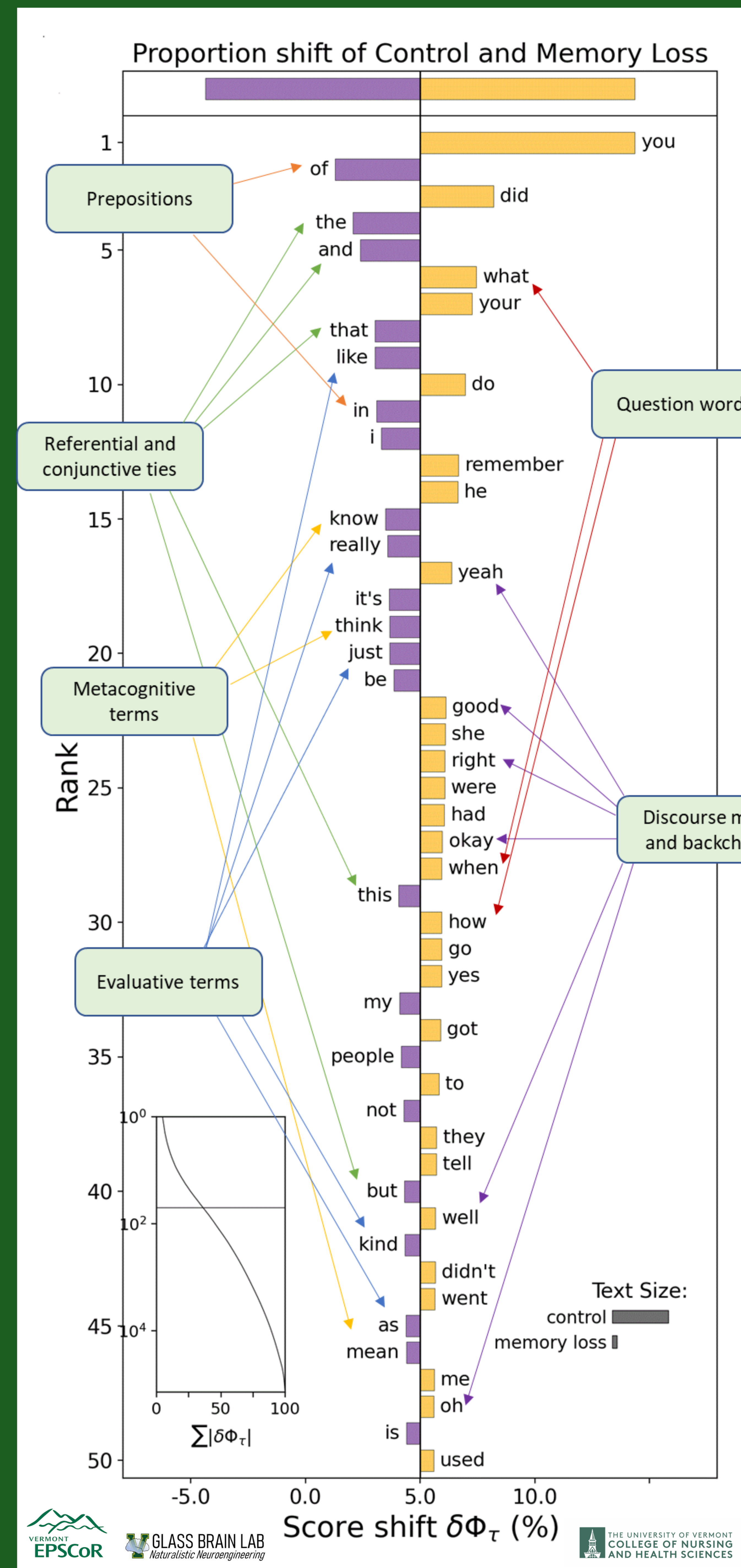

THE WEEDS

Our dataset: >30,000 conversations @ Library of Congress. "To collect, archive, and share the stories of people from all backgrounds because everyone's stories deserve to be heard."

Standard clinical dataset: DementiaBank research corpus including "Cookie Theft" monologs. Largest study thus far included 243 control/309 dementia samples recruited from research studies.

TURN TAKING DYNAMICS

Group	Turn Freq	Turn Length	Length Diff
Memory Loss	1.7	33	50
Serious Illness	1.5	39	42
Control	1.3	45	27

"Turn freq" is the median # turns/minute. "Turn Length" is the median length of turns, in seconds. "Length diff" is the median difference in average turn length between partners, in seconds.

DATA DRIVEN ANALYSIS

ML conversations are characterized by increased use of partner cues including framing questions and backchannel responses that structure concepts and encourage a speaker to continue. This is also evident in "You" > "I"

ML conversations also show signs of ↓ syntactic and conceptual complexity. In comparison to controls, there are fewer demonstrative and conjunctive ties, fewer prepositions, and less present tense and evaluative language.

IN PROCESS

Word and diarization error rates, speaker labeling, age & sex matching using propensity scores, validation set analysis.

STRENGTHS AND LIMITATIONS

Secondary analysis limits control over task instructions, recording environment, and demographic info. Automated transcription and diarization affect accuracy.

Promisingly, we obtained significant, meaningful findings even amidst the noise. This suggests that field deployment of an automated assessment could remain feasible and acceptably precise even without ideal implementation.

FUTURE DIRECTIONS

TBI group via metadata
Acoustic measures
Dynamic conversational synchrony

REFERENCES

MacDonald, S. (2017). Introducing the model of cognitive-communication competence: A model to guide evidence-based communication interventions after brain injury. *Brain Injury*, *31*(13-14), 1760-1780. https://doi.org/10.1080/02699052.2017.1379613

Leaman, M. C., & Archer, B. (2023). Choosing Discourse Types That Align With Person-Centered Goals in Aphasia Rehabilitation: A Clinical Tutorial. *Perspectives of the ASHA Special Interest Groups*, *8*(2), 254-273. https://doi.org/doi:10.1044/2023_PERSP-22-00160

Sohlberg, M. M., MacDonald, S., Byom, L., Iwashita, H., Lemoncello, R., Meulenbroek, P., Ness, B., & O'Neil-Pirozzi, T. M. (2019). Social communication following traumatic brain injury part I: State-of-the-art review of assessment tools. *International Journal of Speech-Language Pathology*, *21*(2), 115-127. https://doi.org/10.1080/17549507.2019.1583280

StoryCorps, I. (2003-2022). *StoryCorps Archive*. Retrieved 4/24/2022 from https://archive.storycorps.org/

Radford, A., Kim, J. W., Xu, T., Brockman, G., McLeavey, C., & Sutskever, I. (2022). Robust speech recognition via large-scale weak supervision. *arXiv preprint arXiv:2212.04356*.

Bredin, H., Yin, R., Coria, J. M., Gelly, G., Korshunov, P., Lavechin, M., Fustes, D., Titeux, H., Bouaziz, W., & Gill, M. P. (2020, 4-8 May). Pyannote.Audio: Neural Building Blocks for Speaker Diarization. IEEE International Conference on Acoustics, Speech and Signal Processing,

Gallagher, R., Frank, M., Mitchell, L., Schwartz, A., Reagan, A., Danforth, C., & Dodds, P. (2021). Generalized word shift graphs: a method for visualizing and explaining pairwise comparisons between texts. *EPJ Data Science*, *10*. https://doi.org/10.1140/epjds/s13688-021-00260-3