Elevating Discourse Analysis: Automating Turn-Level Measurements to Characterize Effects of Memory Loss on Conversational Stories

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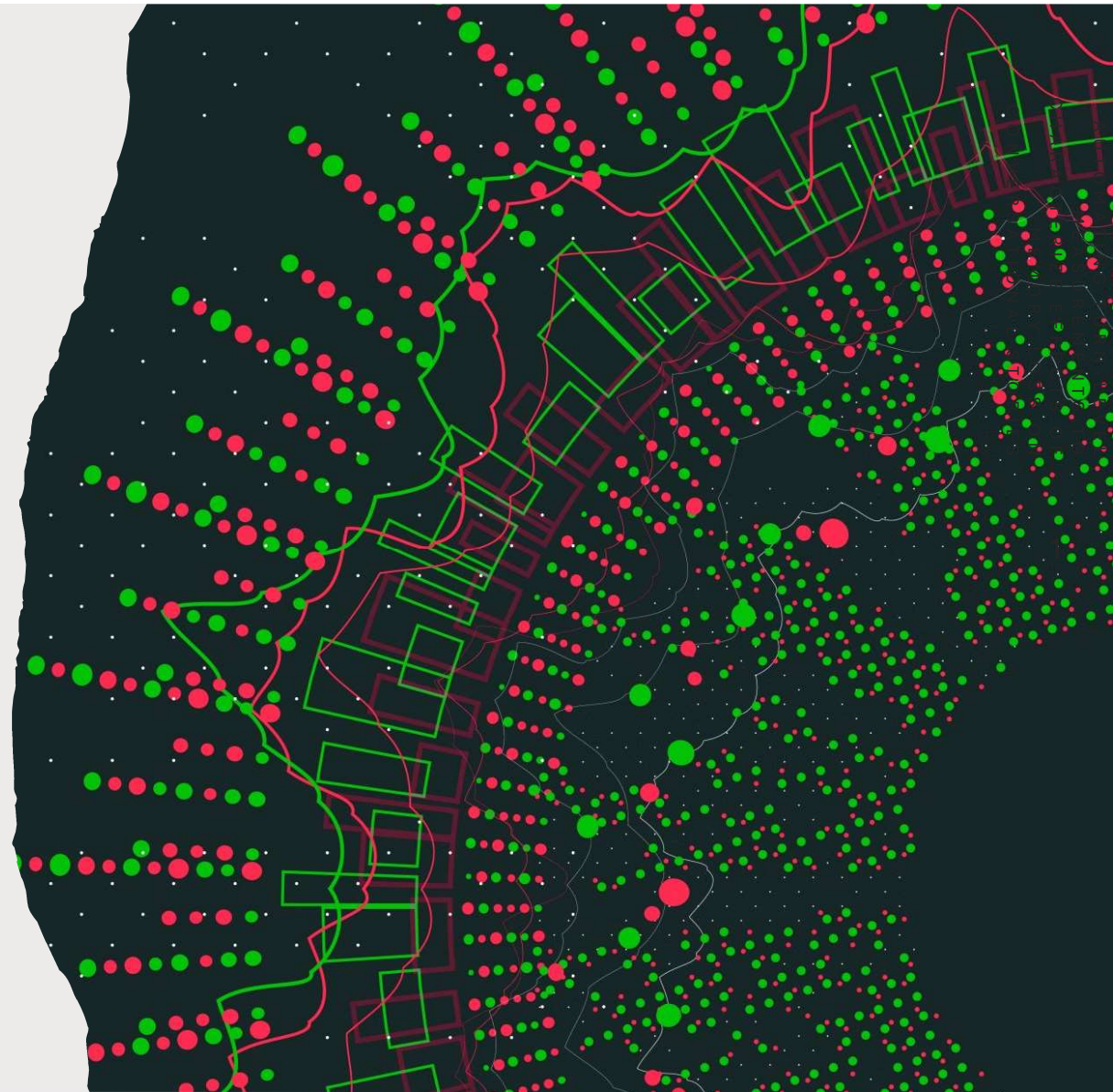**48** PUBLICATIONS   **1,497** CITATIONS

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ASHA 2024

Elevating Discourse Analysis: Automating Turn-Level Measurements to Characterize Effects of Memory Loss on Conversational Stories

Presentation by:

Katie Ekström Grenon, Ardyn Olszko, Michael Cannizzaro, David Jangraw

University of Vermont

WELCOME & ACKNOWLEDGEMENTS

SOCKS
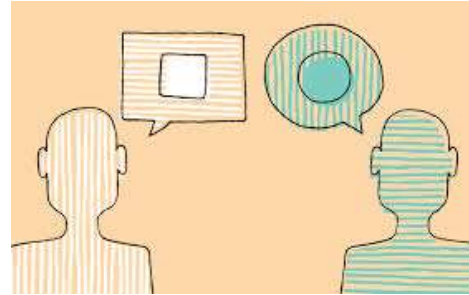The Science of Online Corpora, Knowledge, and Stories

GLASS BRAIN LAB
Naturalistic Neuroengineering

DEEPGREEN

VERMONT NSF EPSCoR
ADVANCING GEOGRAPHIC DIVERSITY IN STEM

OVERVIEW

State of the art discourse assessment for CCIs

Memory loss impacts structural cohesion and coherence

Conversational stories and the StoryCorps Archive

Analyses reflect group differences:
    response contingency, topic maintenance

RESEARCH CONTEXT: LANGUAGE SAMPLE ANALYSIS

Problems:

1. Manual transcription & annotation

2. Lack of generalizable norms

    (Frith et al., 2014; Liu et al., 2023; Sohlberg et al., 2019)

Progress:

- Computational power and sophistication
- Tools and datasets, including Batchalign (Liu et al., 2023) & TalkBank (MacWhinney, 2019)
- Industry-driven NLP and ASR capabilities

Needs:

Larger, more diverse corpus of spoken discourse

RESEARCH CONTEXT: ECOLOGICAL VALIDITY

Problems:

1. Interpersonal dimension crucial

2. Are conversational stories too variable?

   (Bara, 2010; Fusaroli et al., 2014; Mandelbaum, 2013; Schegloff, 1991)

State of the (Quantitative) Art:

Monologic narratives, story retells

Research Question:

Can a dyadic measurement framework capture communication differences associated with CCI in conversational stories?

NARRATIVE SUPERSTRUCTURE

Story Grammar

1. Setting

2. Initiating Event

3. Internal Response

4. Attempt

5. Consequence

6. Reaction

Coherent stories show evidence of propositional cohesion.

(Merritt & Liles, 1987; Mozeiko et al., 2011)

COHESION AND COHERENCE

Cohesion is the dependent relationship between two language elements where the interpretation of one relies on the understanding of another.

OR

Gill wore a blue hat. He looked fantastic!

Gill wore a blue hat. The color evoked tranquility.
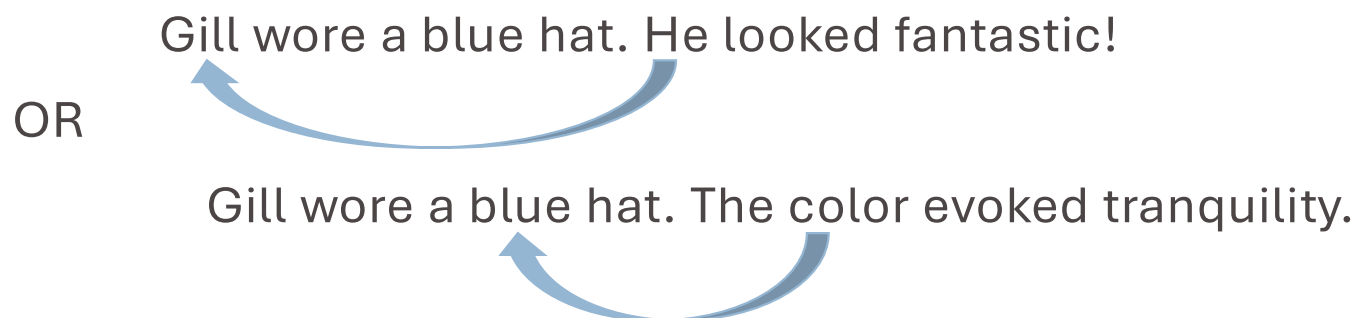
Global coherence is the overall meaning of discourse which is developed through the integration of cultural knowledge, shared experience, inference, and textual elements.

(Halliday & Hasan, 1976 p.48; Kurczek & Duff, 2011)

CONVERSATIONAL NARRATIVE SUPERSTRUCTURE

Provisional Model of Conversational Story Superstructure

1. Story Launch/Pre-sequence   (Both)

2. Indication of Stance   (Teller)

3. Event Recount   (Both)

4. Evidence of Story Uptake   (Listener)

5. Reiteration of Stance   (Teller)

6. Acknowledge Stance   (Listener)

Preferentially affiliative

*** Expected listener contributions occur during segments 1, 3, 4 & 6

Coherent conversational stories should show evidence of INTER-PERSONAL cohesion.

(Mandelbaum, 2013; Norrick, 2000; Ochs & Capps, 2001; Rühlemann, 2013)

duration

DURATION OF STORIES DOES *NOT* SUBSTANTIALLY VARY BY GROUP
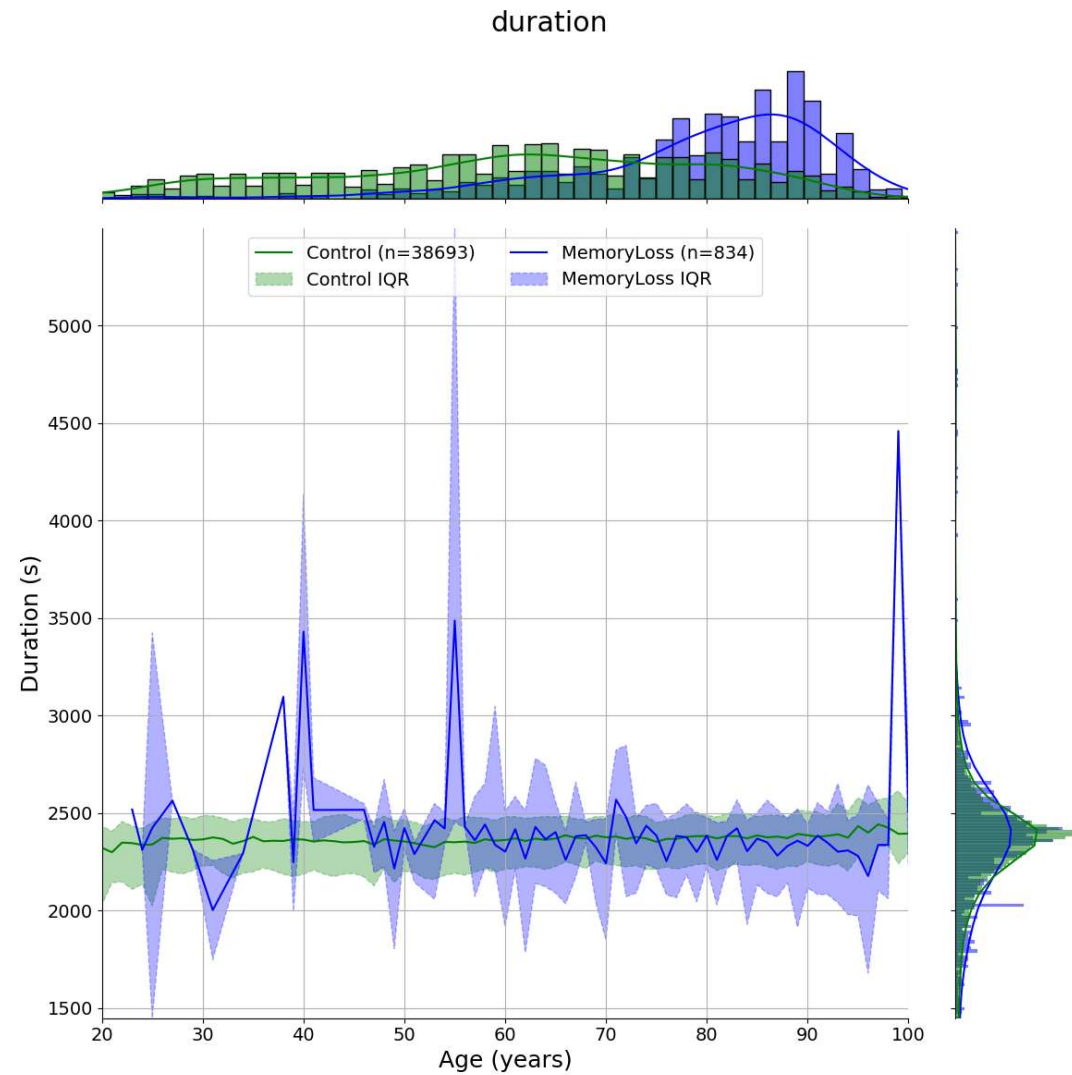
LOOK HOW MEMORY LOSS *DOES* IMPACT TURN STRUCTURE!

turn_count
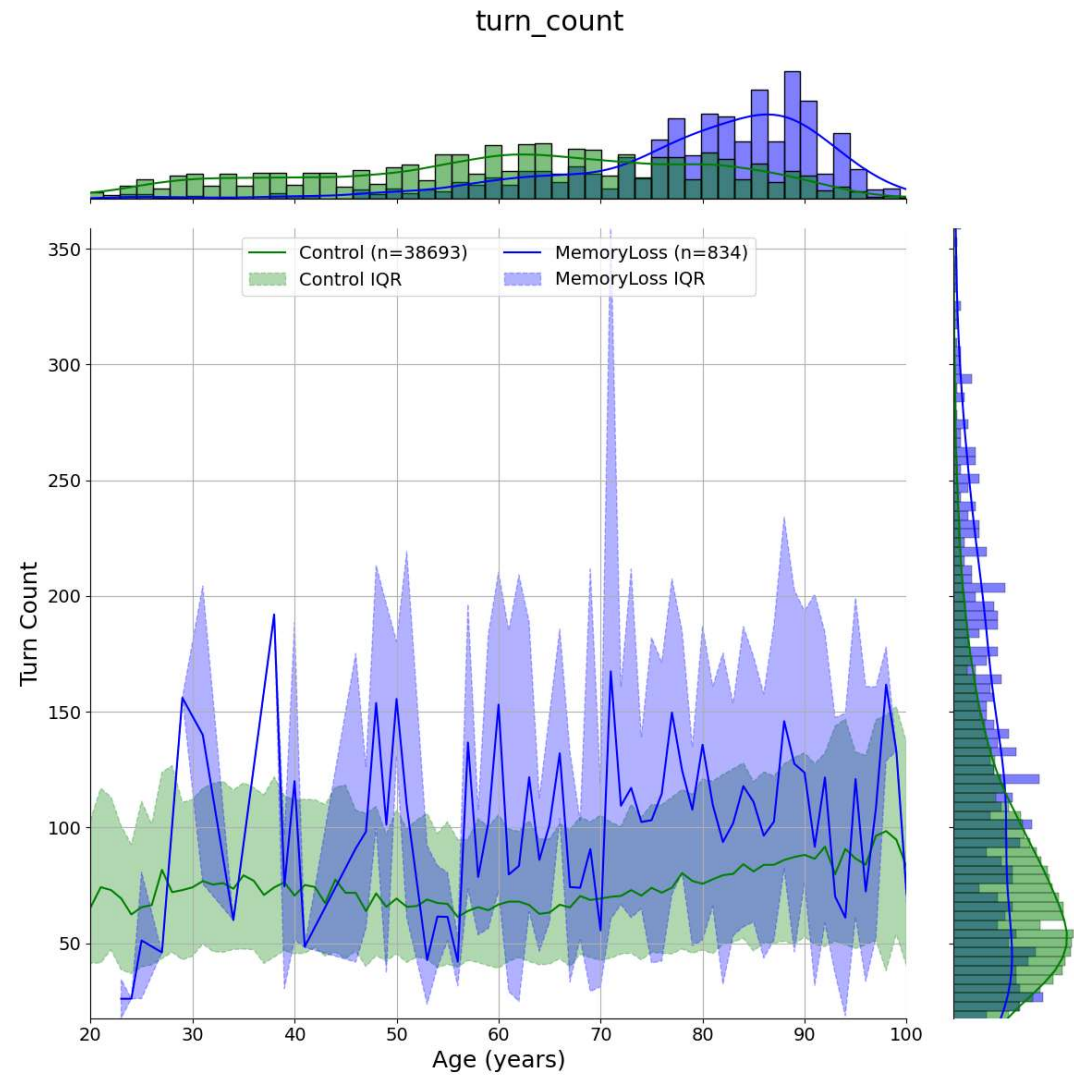
METHOD: RECORD SELECTION

StoryCorps Archive

- 76, 161 Conversational Stories (audio)
- English language
- Dyadic
- 45% F, 28% M
- Mean age 50 years (20)

MEMORY LOSS INITIATIVE

- Self-selected group of story-tellers
- Self-reported etiologies

    Alzheimer's

    CVA

    Traumatic brain injury

    Parkinson's disease

    et cetera

Etiological heterogeneity →

   expect a range of language differences

EFFECTS OF MEMORY LOSS ON CONVERSATIONAL STORYTELLING

**Lexical access** | anomia, mild cognitive impairment | **Microstructural** productivity

Working & short-term memory | TBI, concussion | **Macrostructural** cohesion, propositional complexity

Episodic & declarative memory | Alzheimer's, amnesias | **Superstructural** elements such as episodic completeness and temporal organization

GEOGRAPHIC DIVERSITY- CONTROLS

StoryCorps Archive: Control

Story Count
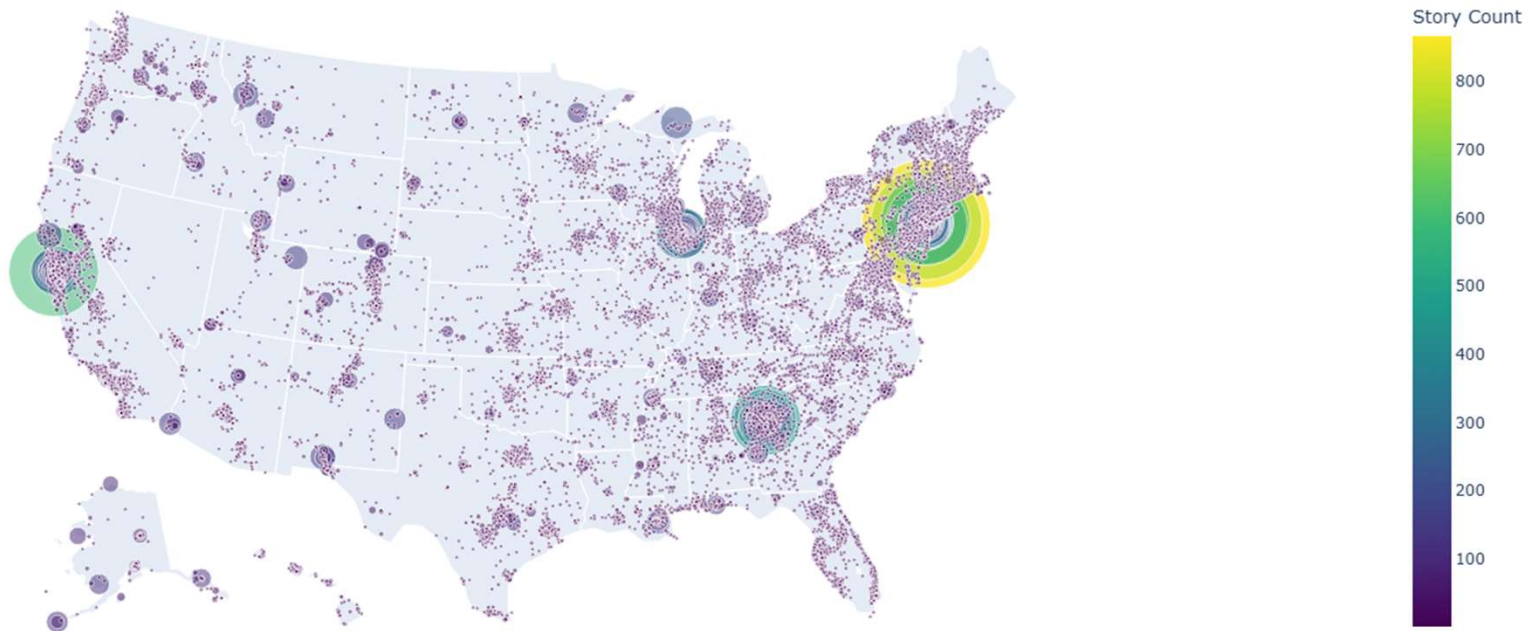
You can add your own story at https://storycorps.org/discover/memory-loss-initiative/

MEMORY LOSS INITIATIVE
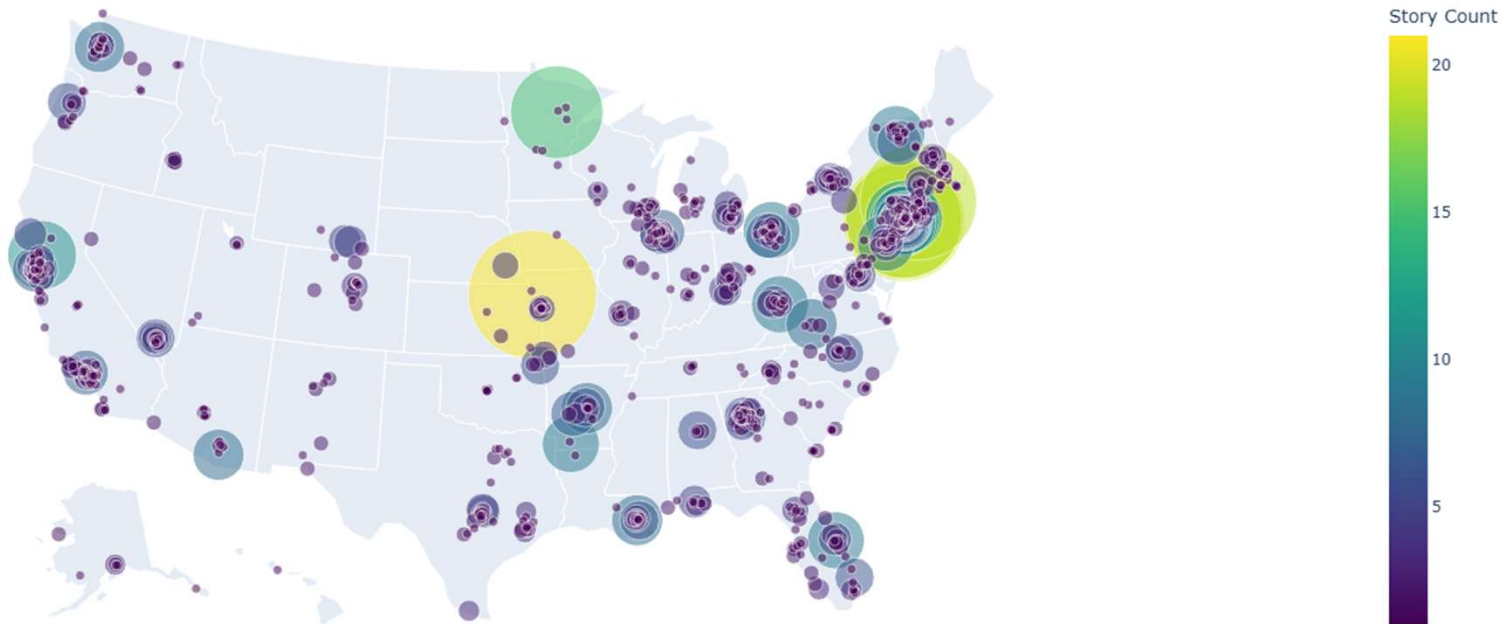
For more background on the Memory Loss Initiative: Savundranayagam, M., Dilley, L., & Basting, A. (2011). StoryCorps' Memory Loss Initiative: Enhancing personhood for storytellers with memory loss. *Dementia, 10, 415-433. https://doi.org/10.1177/1471301211408123*

METHOD: RECORD SELECTION

Demographic	Control (N = 38,693)	Memory Loss (N = 834)
Age (years), M (SD)	51 (20)	67 (19)
Sex ,* n (%) total records	46% F 28% M	59% F 26% M
Story duration (M minutes)	40	38
Token count (M # of words)	5839	4736
Rate of speech (M words/min)	146	124
Type/Token Ratio (mov. avg.)	0.70	0.68
# Connectives/ # words	0.08	0.07

METHOD: RECORD SELECTION

- Age-matching
- 60% confirmatory split

Memory loss n = 427

Control group n = 4514

speech_rate

ASHA 2024 Analysis

StoryCorps Archive

Audio

Transcripts

TAACO Metrics

Transcripts with TAACO Metrics
Control: ~39,774
Memory Loss: 987

Down-select to English language transcripts with 2 speakers

Group selection: Age matching based on distribution of transcripts with oldest age between 18-115

Transcripts with TAACO Metrics and Ages
Control: ~38,783
Memory Loss: ~834

Down-select to English language transcripts with 2 speakers

Down-select to only include transcripts with oldest age between 18-115

Metric Distributions, Bootstrap Differences

Age-Matched Exploratory
Control: 3,009
Memory Loss: 285

Age-Matched Confirmatory
Control: 4,514
Memory Loss: 427

~40%

~60%

Full Exploratory
Control: 15,620
Memory Loss: 289

Full Confirmatory
Control: 23,432
Memory Loss: 435

Demographics Summary

TAACO Age Norm Curves
Control: 38,748
Memory Loss: 834

Other Metrics Age Norm Curves
Control: 38,693
Memory Loss: 834

METHOD: ANALYSIS

- The Tool for the Automated Analysis of Cohesion (TAACO)
  - Unit of analysis: conversational turn (both partners pooled) →
    - topic maintenance, response contingency, interpersonal coordination
  - Lexical cohesion across (2-3) turns
  - Semantic cohesion across (2-3) turns

- Age-matched 60% confirmatory split

- Two-sided percentile bootstrap testing

- Benjamini-Hochberg false discovery rate correction with an alpha level of 0.05

(Crossley et al., 2019; Schillinger et al., 2021; Rousselet et al., 2023)

RESULTS: POINT ESTIMATES

All six metrics

    no overlapping confidence intervals

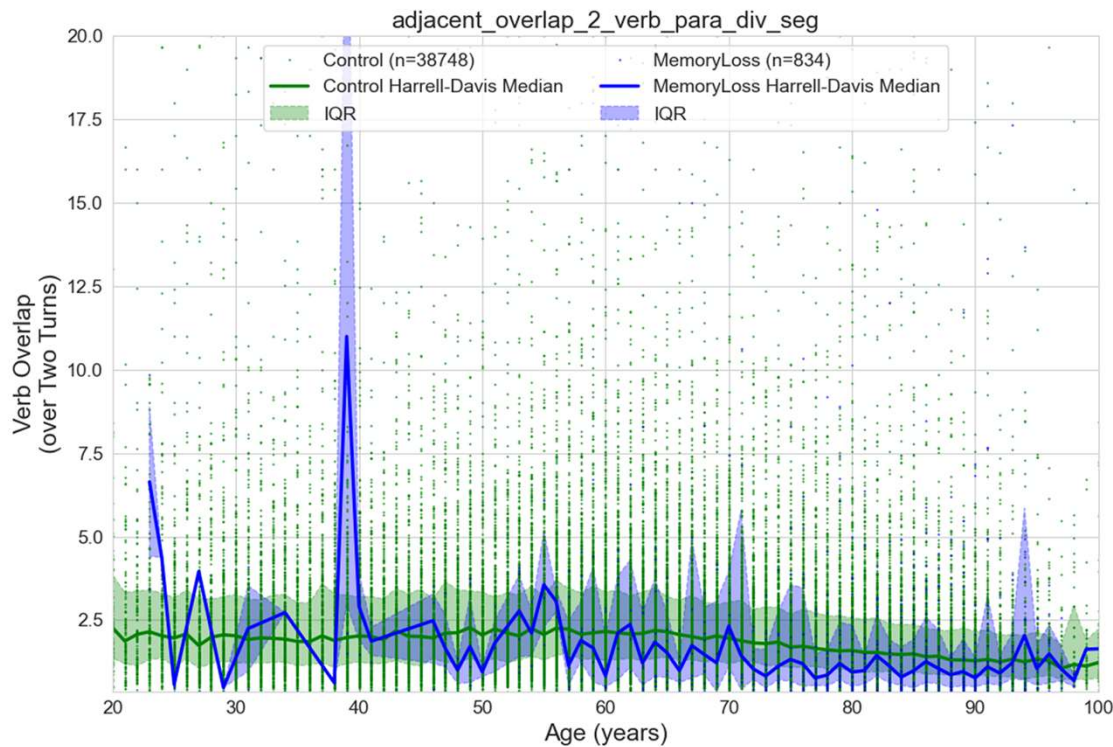   two-tailed p values < .001

MEDIAN AND IQR BY AGE

    interpartner cohesion declines with increasing age

    median values are lower in the ML than control group

    trajectories are separated

RESULTS: LEXICAL COHESION

adjacent_overlap_2_verb_para_div_seg

Control (n=38748) MemoryLoss (n=834)
Control Harrell-Davis Median MemoryLoss Harrell-Davis Median
IQR IQR

y-axis: Verb Overlap (over Two Turns)
x-axis: Age (years)

TAACO METRIC
progressive two-turn overlap, verb lemmas (turn normed)

CALCULATION
number of verb lemma types that occur at least once in the next two turns divided by number of turns in text (except last two turns)

GROUP	Mdn [LL, UL]
Control	1.94 [1.89, 2.0]
Memory Loss	1.18 [1.05, 1.29]

RESULTS: LEXICAL COHESION

adjacent_overlap_2_adv_para_div_seg
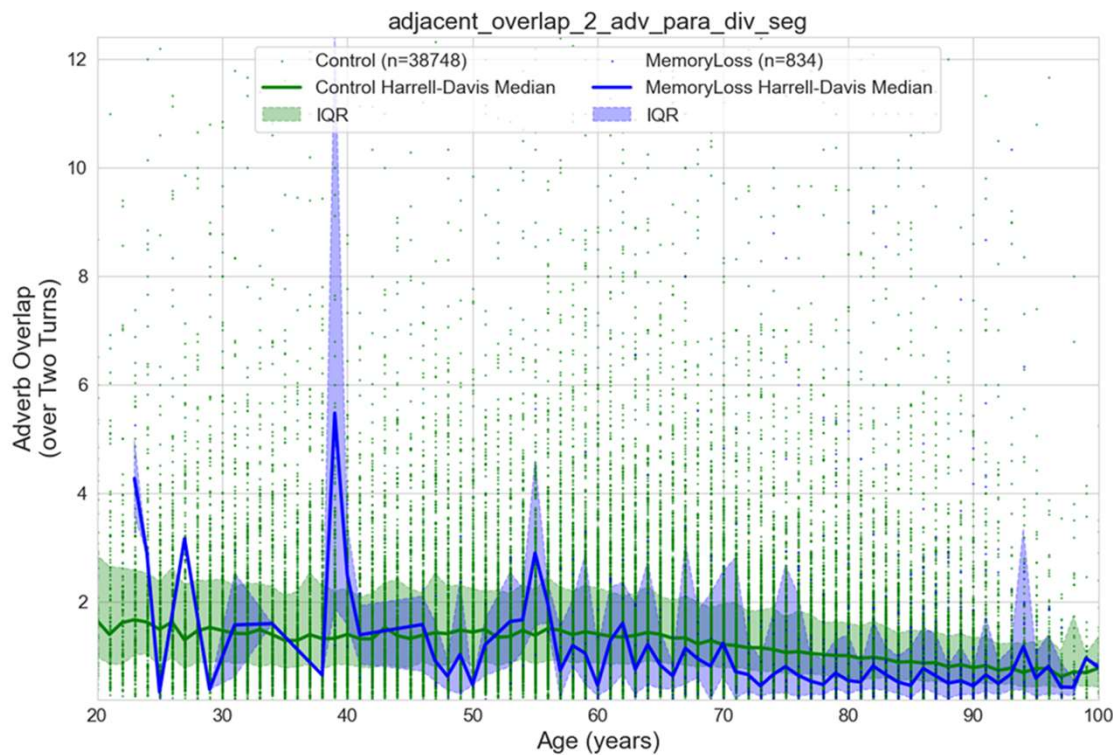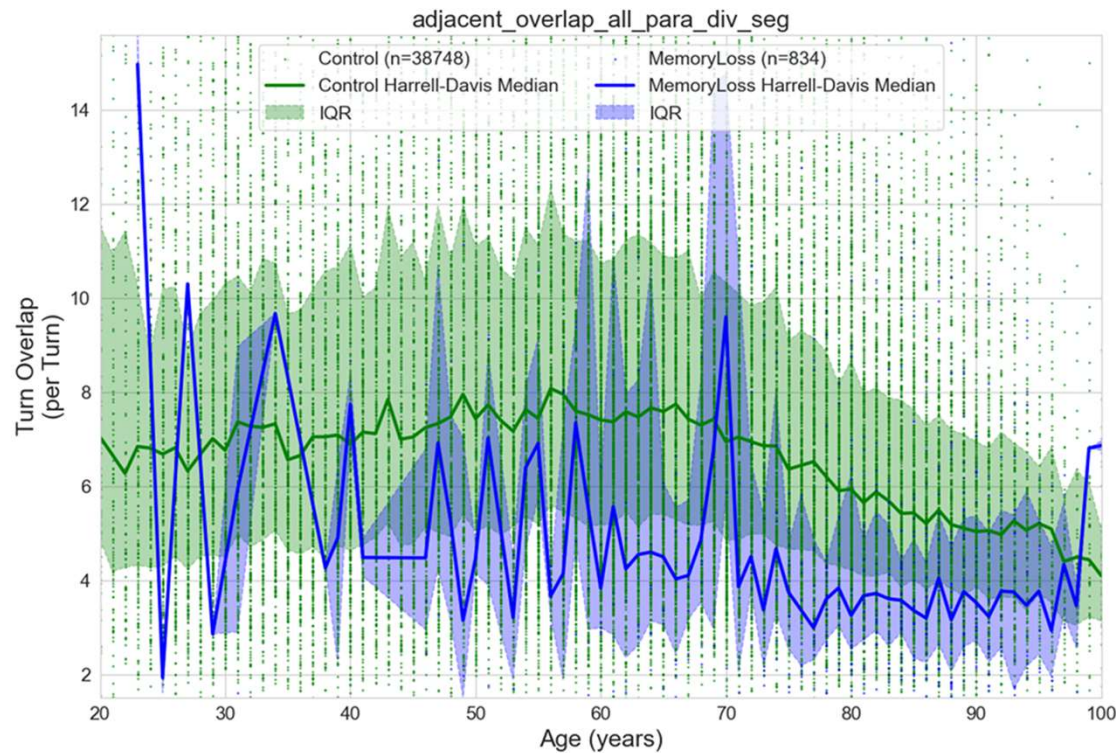
TAACO METRIC
progressive two-turn overlap, adverb lemmas (turn normed)

CALCULATION
number of adverb lemma types that occur at least once in the next two turns divided by number of turns in text (except last two turns)

GROUP	Mdn [LL, UL]
Control	1.27 [1.23, 1.30]
Memory Loss	0.65 [0.58, 0.71]

RESULTS: LEXICAL COHESION
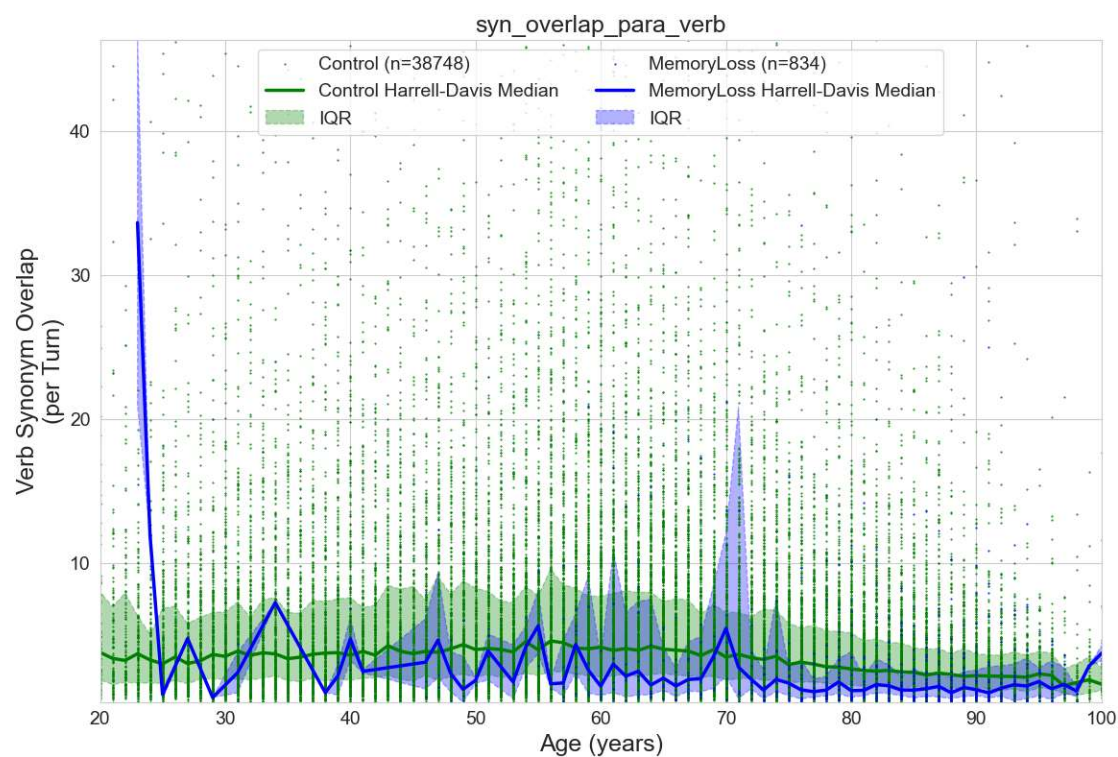

adjacent_overlap_all_para_div_seg

TAACO METRIC
progressive turn overlap, all lemmas (turn normed)

CALCULATION
number of lemma types that occur at least once in the next turn divided by number of turns in text (except last turn)

GROUP	Mdn [LL, UL]
Control	6.83 [6.69, 6.97]
Memory Loss	3.89 [3.61, 4.15]

RESULTS: SEMANTIC COHESION

syn_overlap_para_verb

Control (n=38748)   MemoryLoss (n=834)
Control Harrell-Davis Median   MemoryLoss Harrell-Davis Median
IQR   IQR

TAACO METRIC
synonym overlap, verb (turn)

CALCULATION
average turn to turn overlap of verb synonyms

GROUP	Mdn [LL, UL]
Control	3.56 [3.43, 3.68]
Memory Loss	1.48 [1.31, 1.67]

RESULTS: SEMANTIC COHESION

word2vec_1_all_para
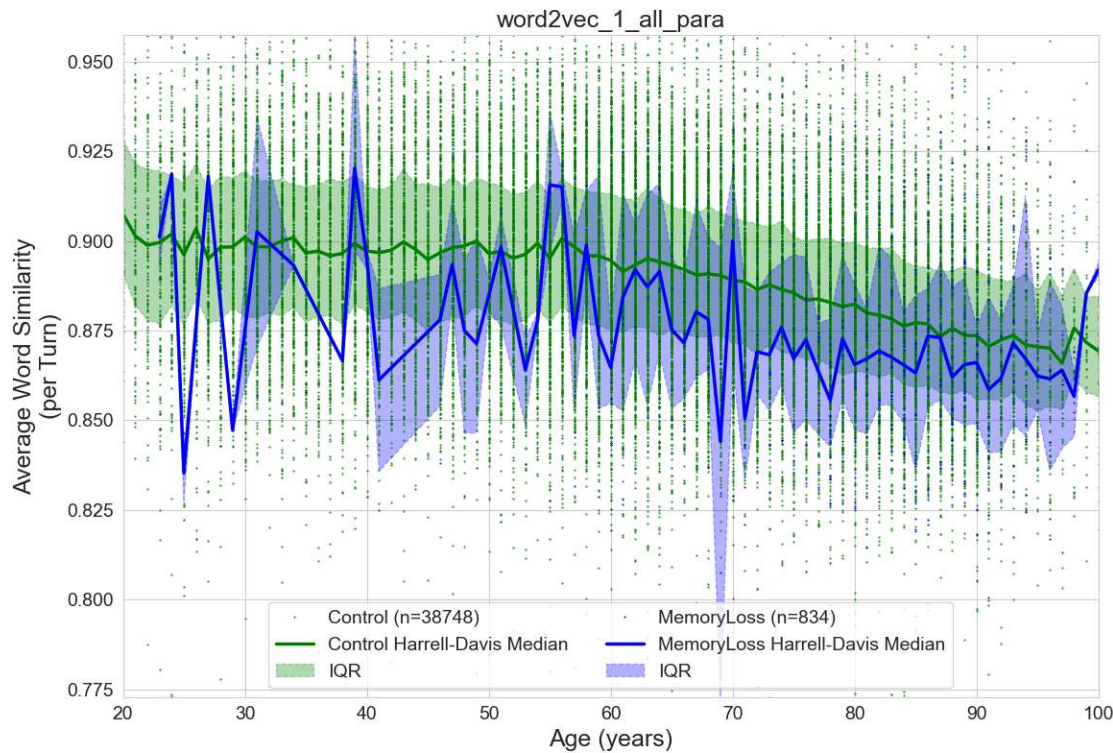
TAACO METRIC
word2vec similarity (adjacent turns)
(Mikolov et al., 2013)

CALCULATION
average word2vec similarity score
between all adjacent turns

GROUP	Mdn [LL, UL]
Control	0.89 [0.89, 0.89]
Memory Loss	0.87 [0.87, 0.88]

RESULTS: SEMANTIC COHESION
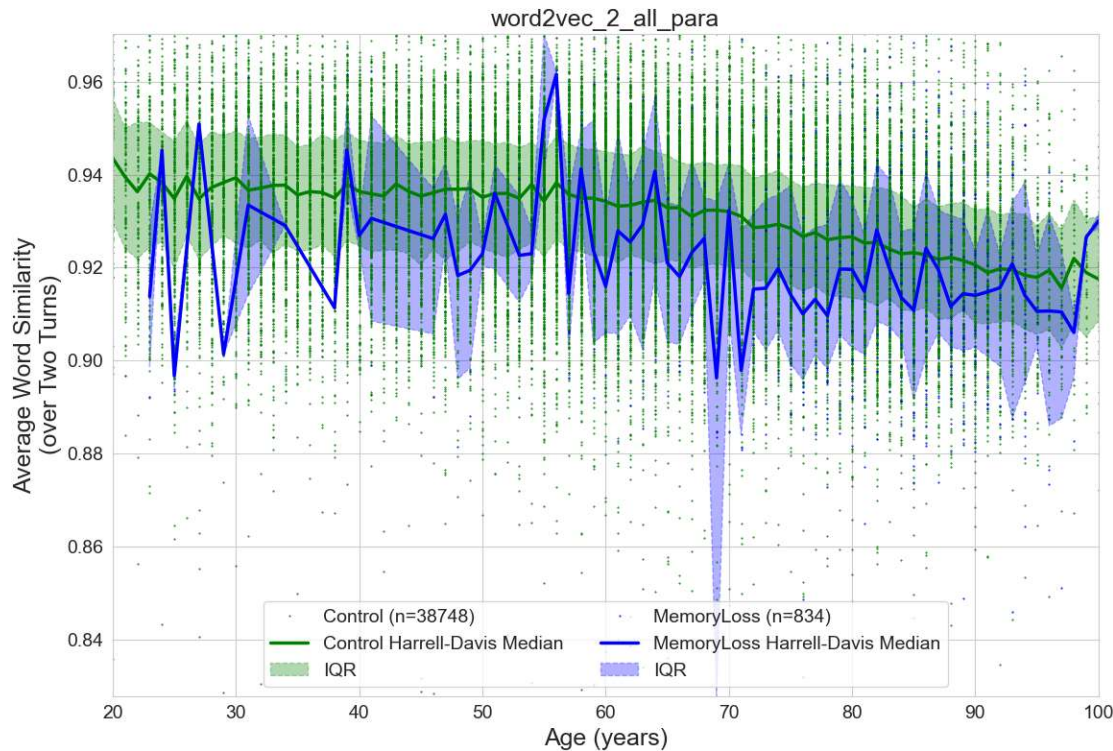
TAACO METRIC
word2vec similarity (two adjacent turns)

CALCULATION
average word2vec similarity score between all adjacent turns (with a two-turn span)

GROUP	Mdn [LL, UL]
Control	0.93 [0.93, 0.93]
Memory Loss	0.92 [0.92, 0.92]

DISCUSSION

Turn-level cohesion metrics differed between memory loss and control groups.

Expected dyadic results are consistent with literature on monologic discourse quality.

Lexical and semantic continuity across turns is associated with communication behaviors that have been difficult to quantify.

DISCUSSION

StoryCorps dataset is the larger, more diverse and ecologically valid corpus of spoken discourse we need to develop generalizable norms.

DISCUSSION

The language effects of an individual's memory loss are robust to the complexity of conversational discourse.

Measurements of discourse behaviors that RELY on dynamic, interpersonal response between partners also show substantial group differences that might be used for diagnosis and treatment planning.

DISCUSSION

Next steps:

- Describe normative parameters at scale

  ≈ 40,000 control transcripts available

- Stratify analyses by ML etiologies

- Collect new ML records for ↑ sample size and metadata

- Tune diarization & analyze conversation partners separately

- Apply fine-grained, temporally sensitive analyses

THANK YOU FOR ATTENDING!

Questions?

Your thoughtful questions and comments will help us develop our tools and inquiries in a way that maximizes the benefits of this research.

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