Naturalistic expository discourse processing in school-aged children and adults

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Introduction

- Grasping the larger meaning of discourse is crucial for academic success in the classroom
- However:
  - Only few studies investigated the neural architecture involved with discourse processing in **typically developing children**[1]
  - Most naturalistic discourse processing studies use event and character-oriented **narratives**, rather than topic-oriented **expository discourse** encountered in classrooms
- While NARRATIVE DISCOURSE seems to rely on the **right hemisphere** to establish coherence across sentences[1,2], studies investigating EXPOSITORY DISCOURSE found **no such effects**[3,4]

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Goal and Questions

To gain a deeper understanding of the neural architecture of naturalistic expository discourse processing we model local and global operations involved in establishing discourse coherence across both hemispheres, and establishing their relative temporal dynamics

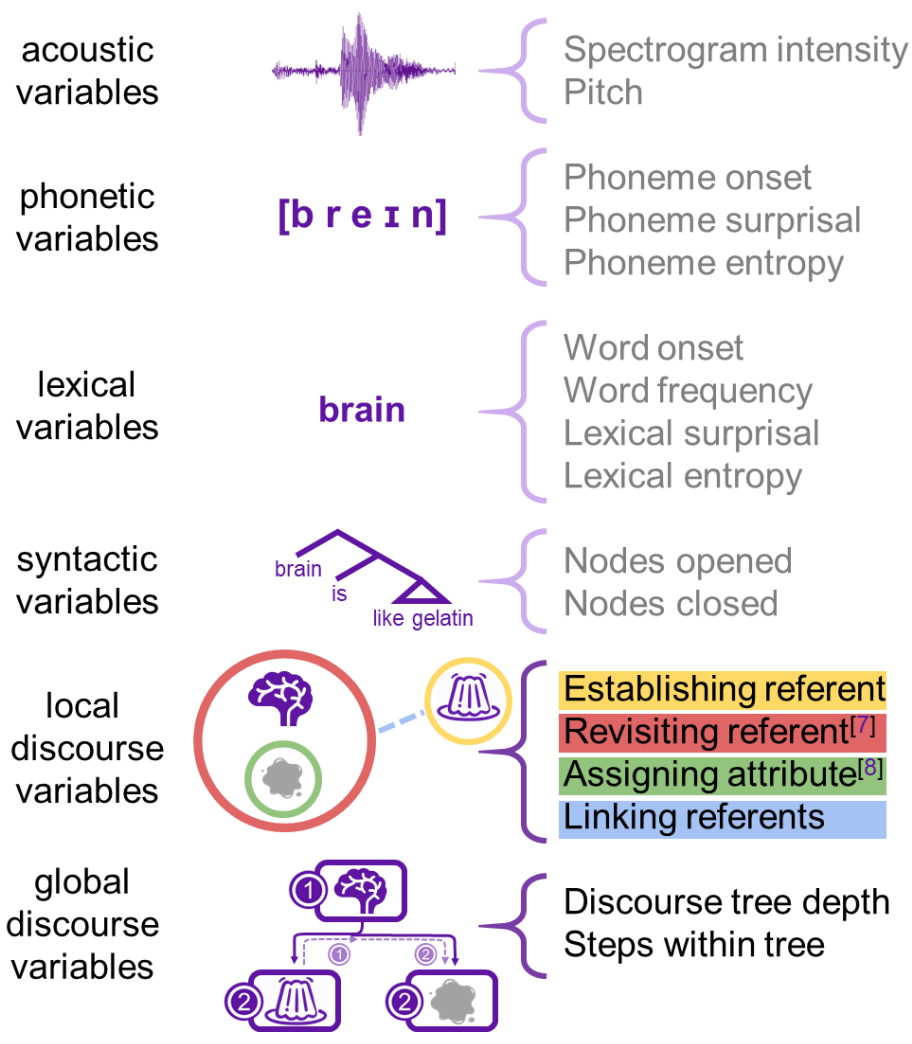
Q1: Which predictors of discourse explain MEG data acquired during expository processing?
Q2: Is there any hemispheric dominance involved in establishing discourse coherence?
Q3: Does lateralization and sensitivity of discourse complexity interact with age?

Stimuli and Procedure

- Partial sample of 11 adults (M=31.2, SD=11.8, range=19-53) and 7 children (M=8.6, SD=1.35, range=7-10)
- Listened to 4 three-minute audio segments (YouTube: SciShow Kids)
  → teaching about the human body (i.e. the brain, sleep, goosebumps and dizziness)
- 1 kHz Magnetoencephalography (MEG) data; 157 channels; bandpass 0.1-200 Hz
- Independent Component Analysis (ICA) applied to filter known noise sources
  → e.g. eyeblinks and heartbeats
- Data downsampled by a factor of 10

Coding

- All stories were annotated for various linguistic predictor variables (Figure 1A)
  - CONTROL VARIABLES: acoustic, phonetic, lexical and syntactic
  - DISCOURSE VARIABLES: local operations (Figure 1B) and global complexity (Figure 1C)



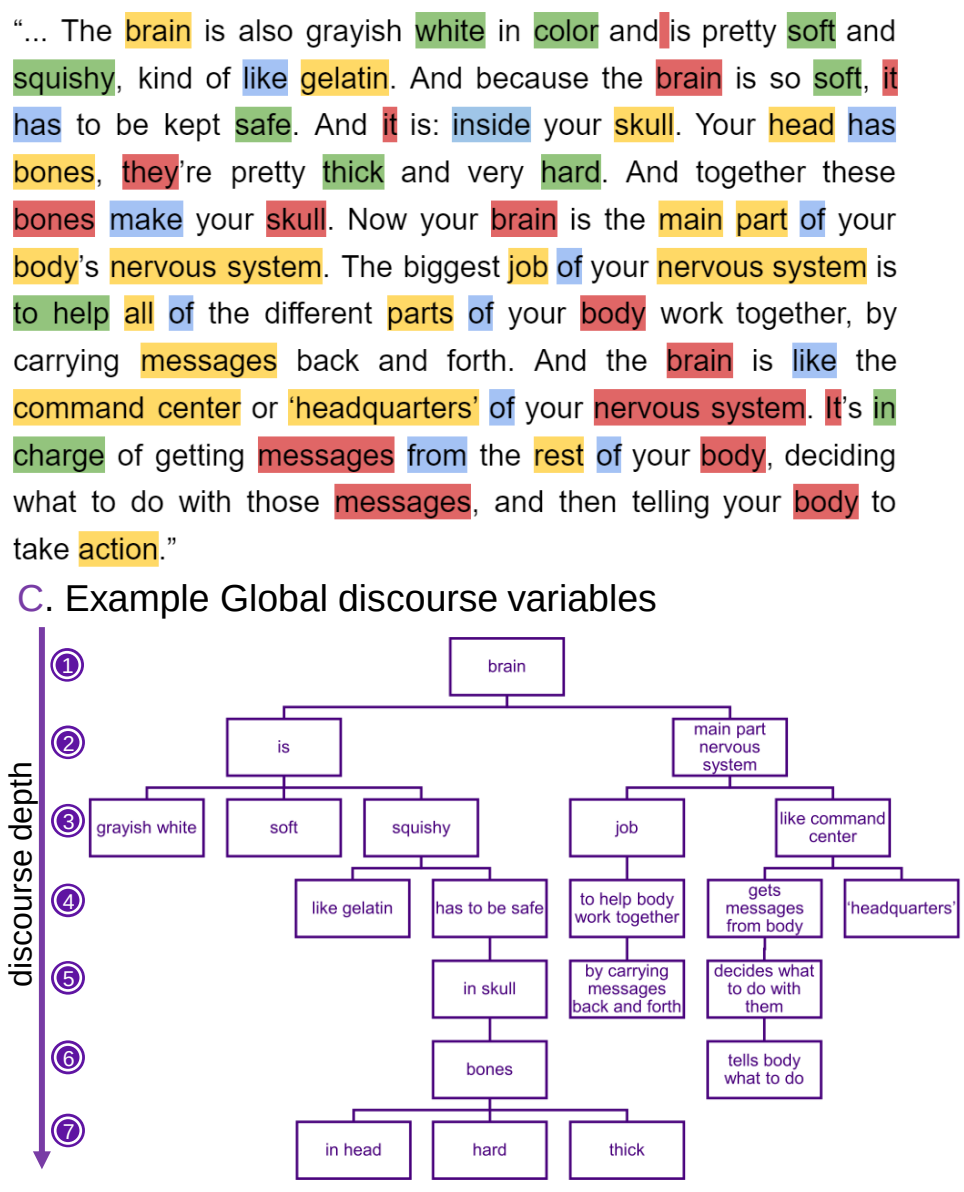


Figure 1 Annotated linguistic predictor variables; A. Overview all variables. Example B. local and C. global variables

Model and Analyses

- All stories were annotated for various linguistic predictor variables (Figure 1A)
  - CONTROL VARIABLES: acoustic, phonetic, lexical and syntactic
  - DISCOURSE VARIABLES: local operations (Figure 1B) and global complexity (Figure 1C)
- Data from each MEG sensor is modeled as a sum of all predictors, each passed through its own linear system (modeled as a temporal response function, or TRF; Figure 2)[5,6].
- For the left and right sensor space, we use regularized regression to compute the TRFs that best explain the data for each sensor, then find the latencies at which each predictor of interest significantly contributes to the model fit

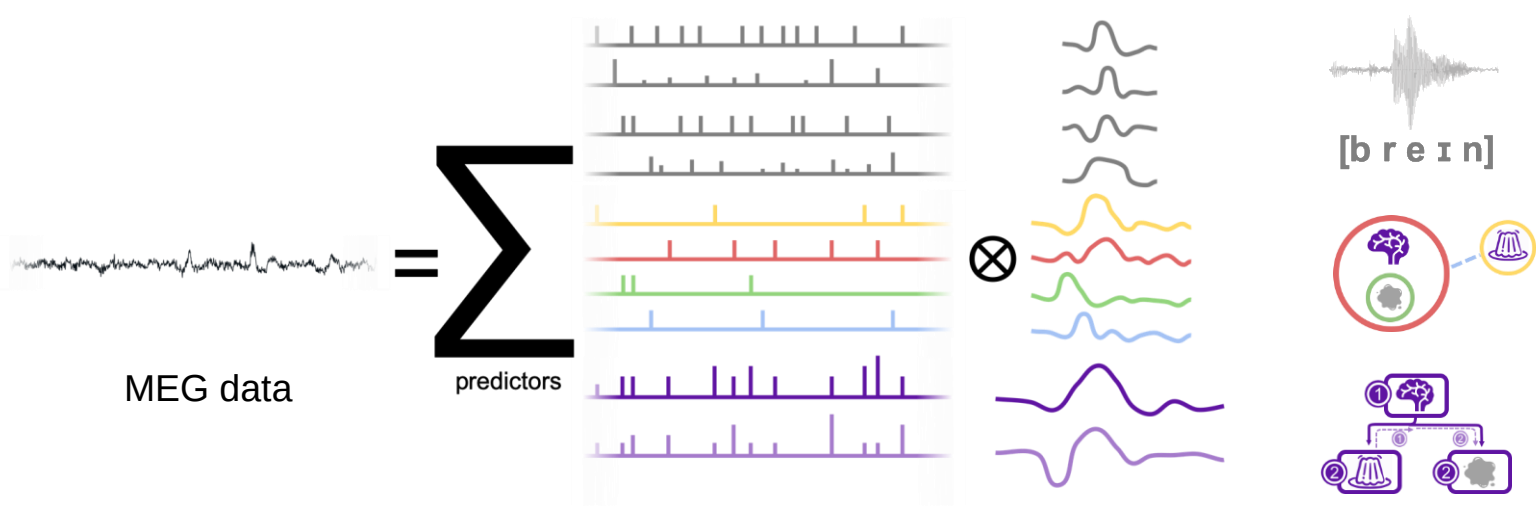


Figure 2 Main analysis method. For each sensor (left), data are regressed against predictors and corresponding TRFs.

Summary

- Using a combination of high temporal resolution MEG recordings, naturalstic speech and a model-based analysis, we aim to investigate the lateralization of establishing discourse coherence in adults and children.
- Project still in sandbox phase, any comments or suggestions are much appreciated!

References

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