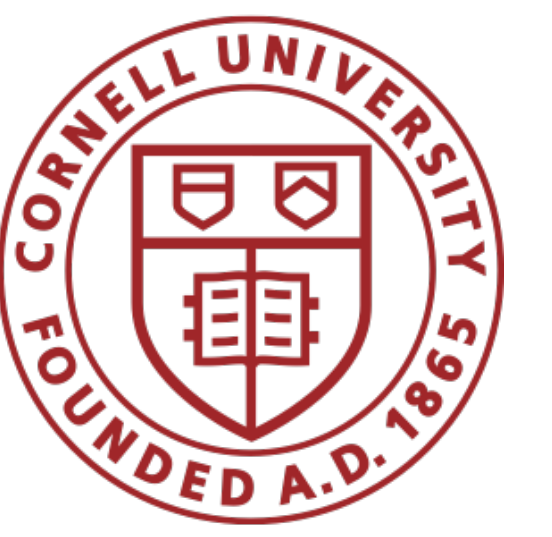
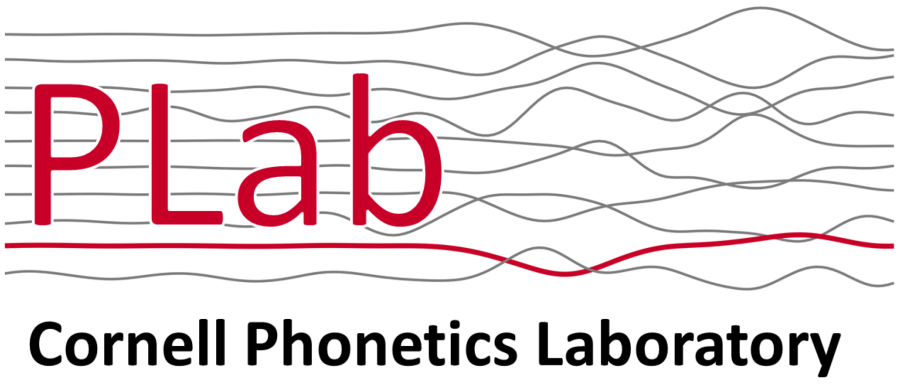


Temporal localization of syntactically conditioned prosodic information

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Introduction

- When in time do speakers locate prosodic correlates of syntactic contrast in acoustic and articulatory signals?
- Prosodic information that distinguishes non-restrictive relative clauses (NRRC) and restrictive relative clauses (RRC) is investigated.
- The two types of RCs are commonly argued to differ in prosodic phrase structure (e.g. Selkirk, 2005).

NRRC

[[A Mr. Hodd.]_{ip} [who knows Mr. Robb.]_{ip}]_{ip} [[often plays tennis.]_{ip}]_{ip}

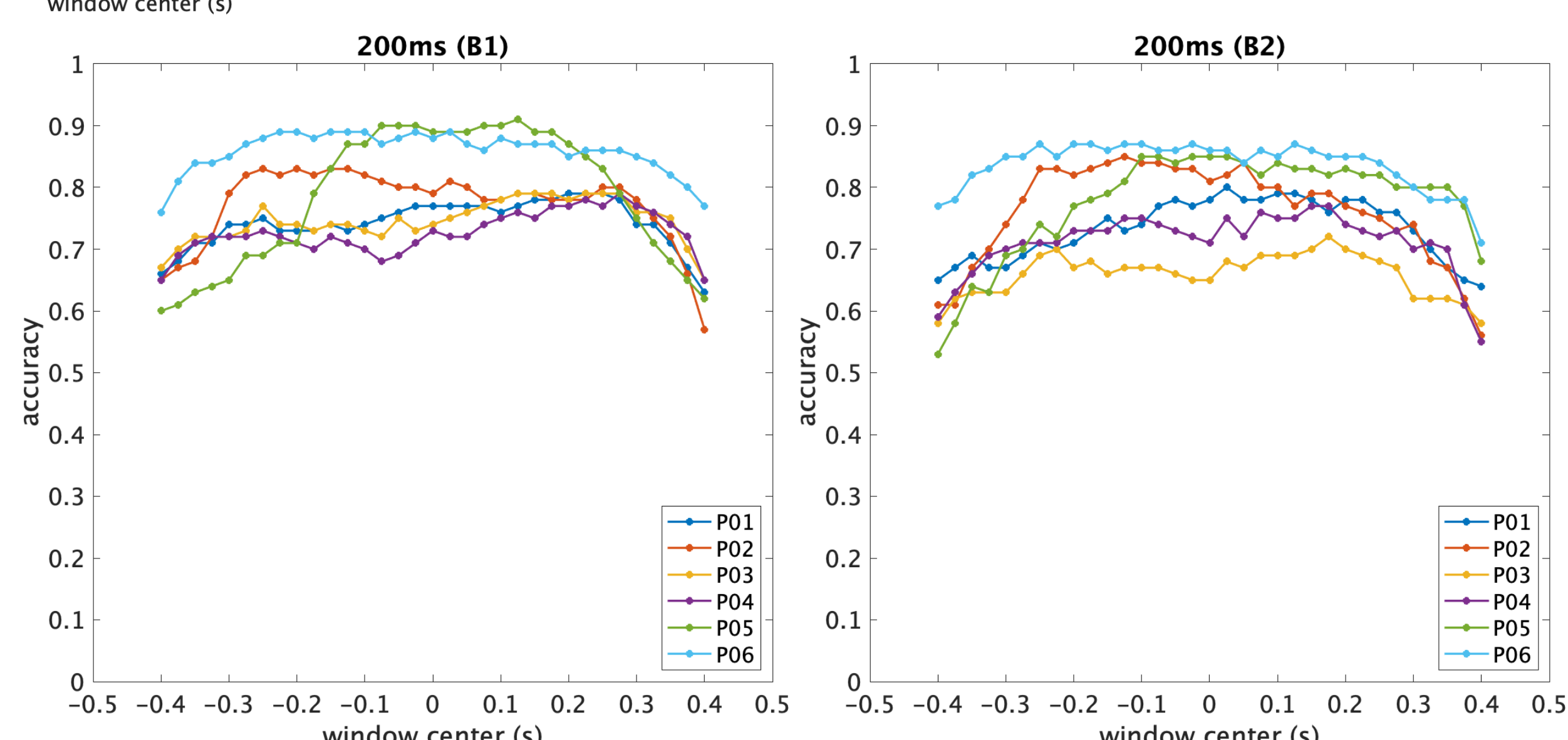
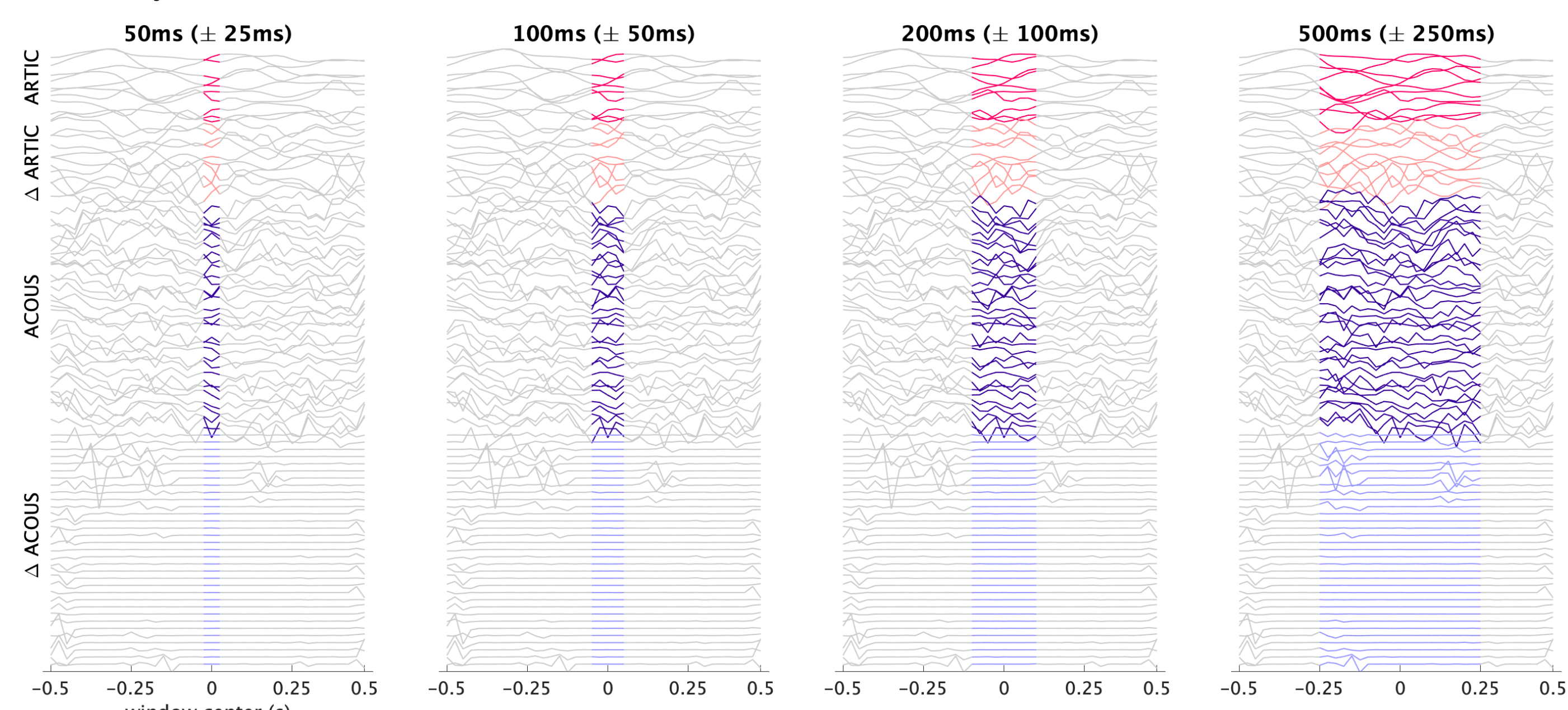
RRC

[[The Mr. Hodd who knows Mr. Robb.]_{ip} [often plays tennis.]_{ip}]_{ip}

- This predicts that NRRC/RRC will differ mainly in the vicinity of the phrase boundaries before (B1) and after (B2) the relative clause.
- A neural network-based analysis is conducted following the approach in Tilsen (2020). Multi-dimensional data around phrase boundaries which include articulatory and acoustic signals and their differences are used as an input to neural networks.

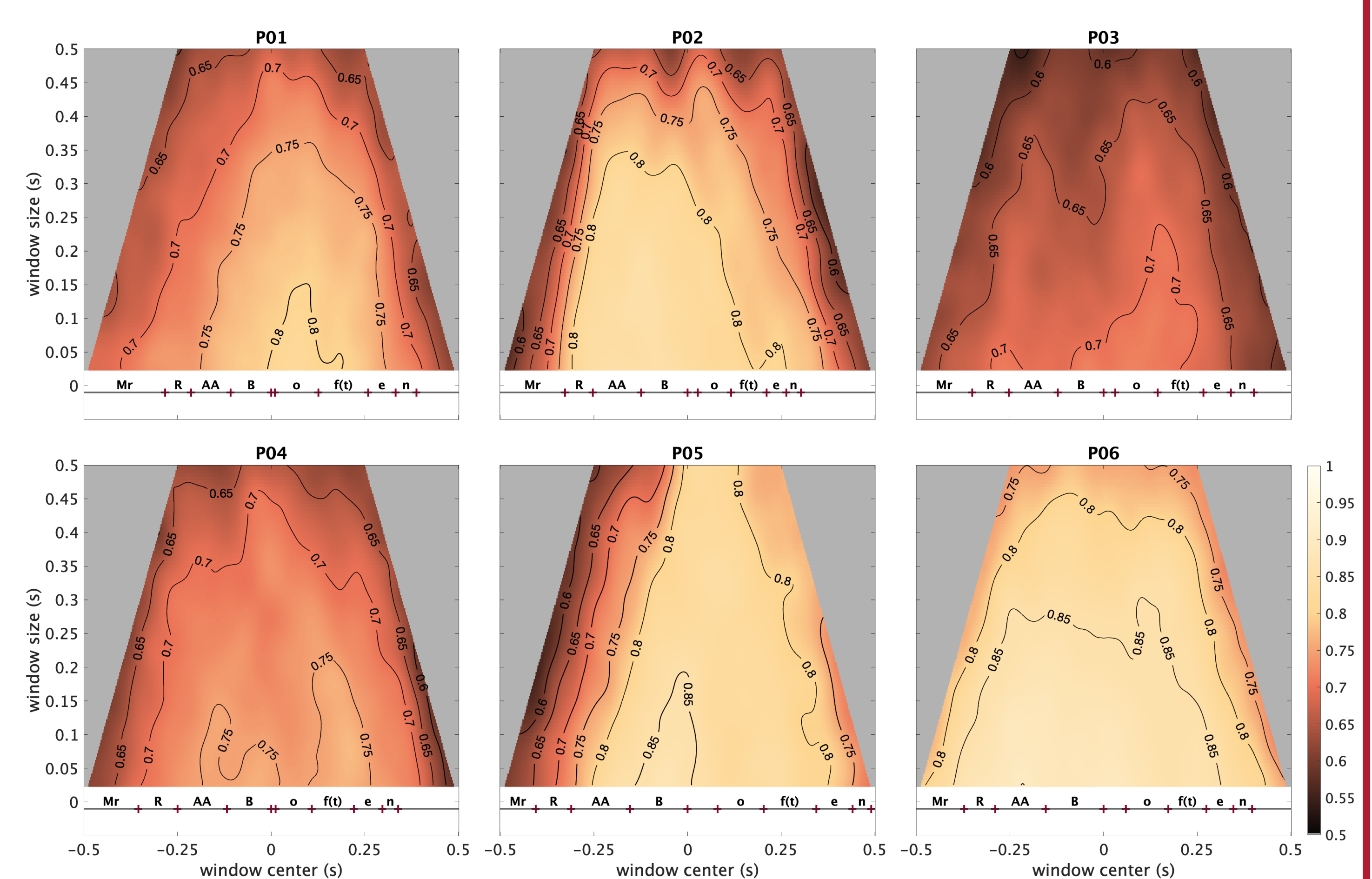
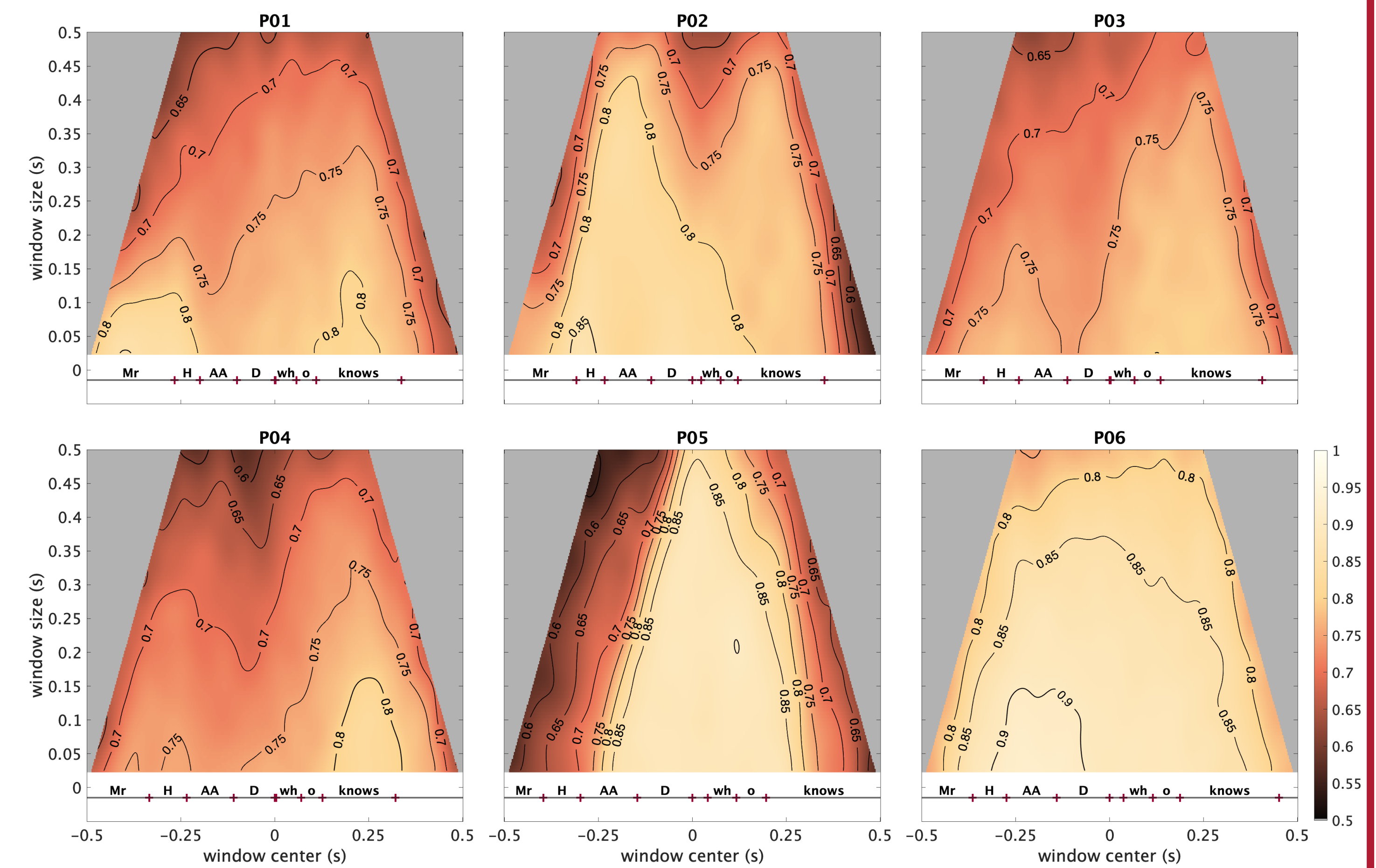
Methods

- Articulatory and acoustic data were collected from 6 native speakers of English.
- Participants read NRRC/RRC sentences (see above) at various speeds, which were elicited with a moving visual analog rate cue.
- Neural network input: 20 articulatory + 66 acoustic dimensions
 - Articulatory: horizontal/vertical positions of five articulator sensors (TT, TB, JAW, UL, LL) and each of their velocities
 - Acoustic: 33-dimensional broadband spectrogram and their first differences
 - Articulatory and acoustic data were extracted in 25ms steps, aligned to B1 or B2, and normalized by dimension within each participant.
- Neural network analysis
 - Classification accuracy of biLSTM networks was examined.
 - Train: randomly selected half of the data (rate, syntactic structure, target word coda were balanced); Test: the rest of the data
 - To temporally localize information, the size and center of the input signal were systematically varied.
 - 1) Window center: 41 centers for each B1/B2 – starting from the segmental boundary of the end of the target name (0ms), varied in 25ms step up to 500ms before/after the boundary.
 - 2) Window size: starting from 25ms window, increased in 25ms step up to 500ms. (for each center, only windows within the ± 500 ms analysis region were examined)
 - Analyses were done by-participant and repeated 20 times for each analysis window.



Results

- Two qualitatively different patterns were observed: prosodic information associated with the syntactic contrast was either 1) distributed broadly across the ± 500 ms analysis region or 2) more concentrated at specific locations.



D: Distributed; C: Concentrated

	P01	P02	P03	P04	P05	P06
B1	D	C	D	C	C	D
B2	C	C	D	D	C	D

- For concentrated cases, the region that the information was centered varied across participants: pre-boundary (P02 at B1/B2), post-boundary (P04 at B1, P01 at B2), and immediate region around the boundary (P05 at B1/B2).
- Participants did not show the same pattern across B1 and B2.

Discussion

- Prosodic information that distinguishes NRRC/RRC contrast was either widely distributed across phrase boundaries or concentrated at specific locations.
- Both patterns were observed at B1 and B2, although participants did not always show the same pattern across the two boundaries.
- Participants differed on where they locate critical syntactic information; this suggests that individuals do not necessarily employ the same syntax-prosody mapping.
- Furthermore, this study demonstrates that the neural network-based analysis method using high-dimensional data is a powerful tool to temporally localize information.

References Selkirk, E. (2005). Comments on intonational phrasing in English. *Prosodies: With special reference to Iberian languages* (pp.11-58). Tilsen, S. (2020). Detecting anticipatory information in speech with signal chopping. *Jphon*, 82.