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SFB 1252 PROMINENCE IN LANGUAGE

Boundary tones in German *wh*-questions and *wh*-exclamatives: a cluster-based approach

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Background:
Cluster analysis and its application to F0 contours

Challenges in analyzing F0 contours

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- Datasets of recorded speech: collections of small continuous differences
- Goal of annotation: assigning coarse-grained phonological categories to pitch contours
- Any given dataset contains more interesting variation than is visible in the annotation.
- Cluster analysis can help investigate this variation by:
  - Focusing on surface form of F0 contour
  - Reducing the impact of annotators' subjective impressions

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Cluster analysis: background

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- Full details in Kaland (2021)
- Type of CA that we use: hierarchical clustering (i.e. no pre-specified number of clusters)
- Interactive, iterative process:
  1. Cluster analysis
  2. Inspection of (interim) results
  3. (Adjusting the number of clusters / subsetting the data / …)
  4. Cluster analysis → inspection → …
- Interpretation of results requires domain knowledge.

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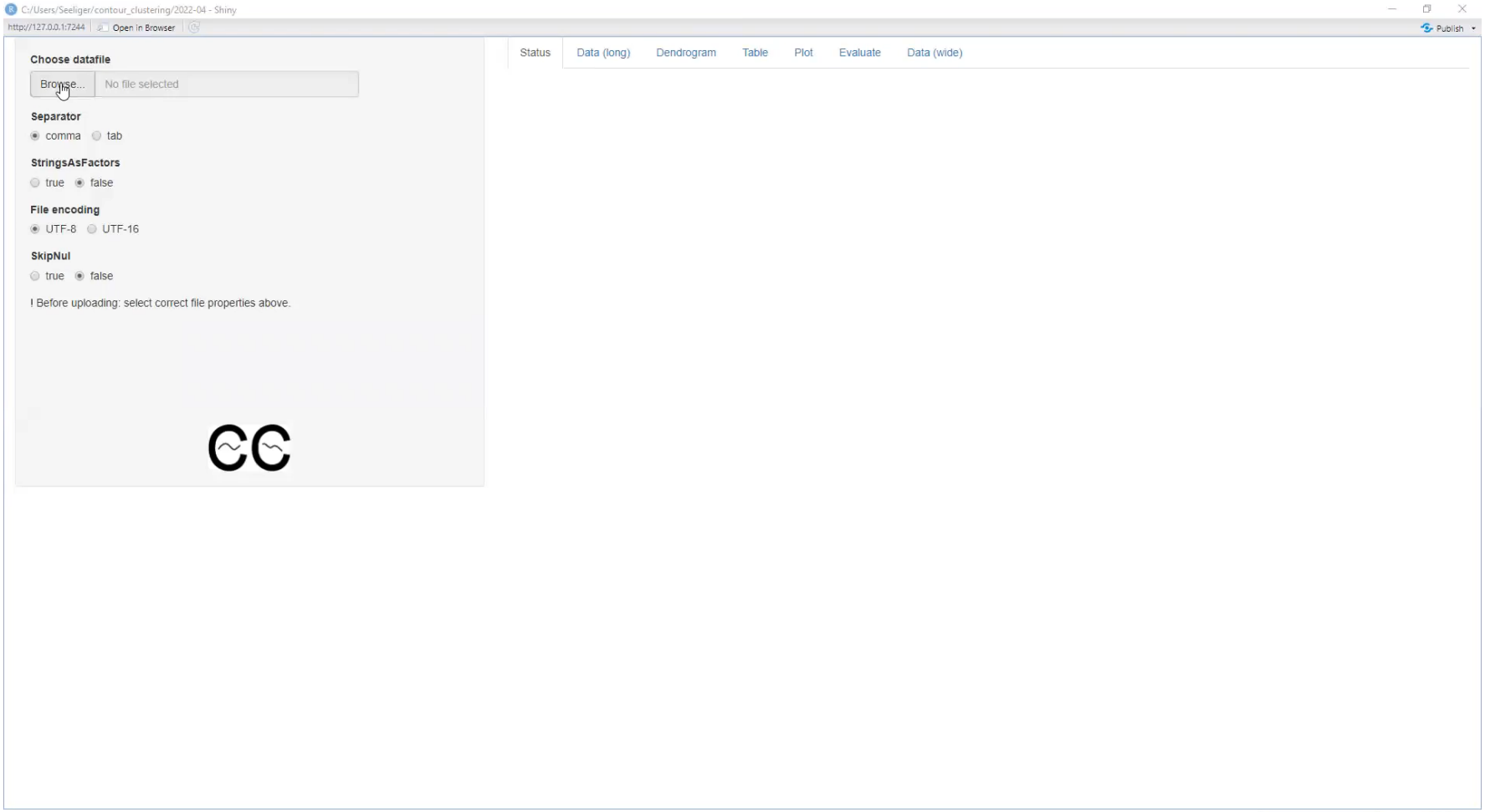
The clustering app



The app is available at:
https://constantijnkaland.github.io/contourclustering/

Annotation requirements

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- Praat textgrids delineating the unit of analysis:
  - Whole utterance(s)
  - Specific words
  - Final n syllables of the utterance
  - …
- Today's case study: two units of analysis combined
  - Whole utterance
  - Final two syllables
- Each contour thus belongs to two clusters.

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Case study:
Boundary tones in German *wh*-questions and *wh*-exclamatives

Materials and design

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- Production study (read speech) on German *wh*-exclamatives (1) and (embedded) *wh*-questions (2):

(1) Wo die schon überall Sirenen ge**testet hat**!
'The many places where she has already tested sirens!'

(2) (Weißt du zufällig,) wo die schon überall Sirenen ge**testet hat**?
'(Do you happen to know) where she has already tested sirens?'

- The study is a follow-up to Repp (2020).

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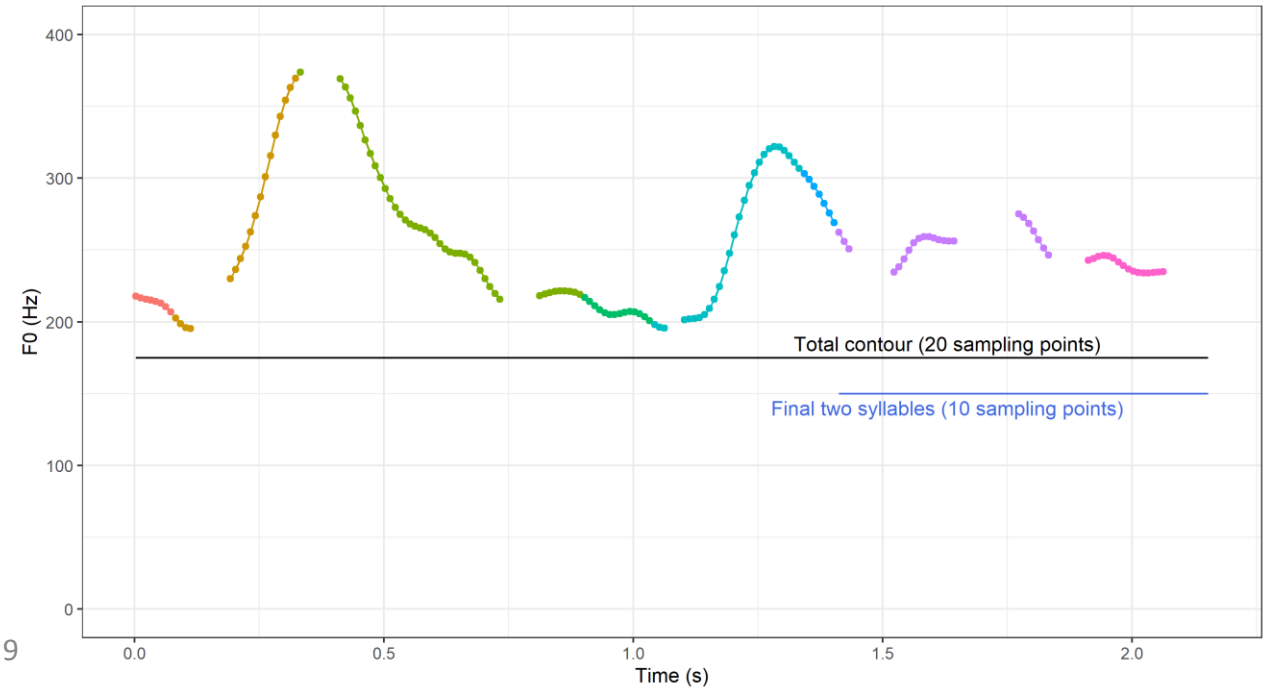
Object of the analysis: plateaus

- During annotation, we noticed in the data:
  - Many medium-high plateaus
  - Many contours with ambiguous final falls/rises
- Could cluster analysis help tease these apart?



GToBI inventory of plateaus

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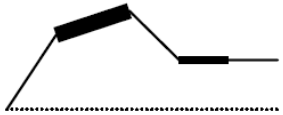
- GToBI describes two non-rising plateaus:

Level	4	(L+)H* H-(%)		Incompleteness Ritual expression	**AN**dererSEITS...[6] *But then again...* Guten **MOR**gen![3] *Good morning!*
Stylised Step Down	7	(L+)H* !H-%		Calling contour	**BE**CkenBAUer!

from Grice, Baumann & Benzmüller (2005)

- A late-falling plateau is considered, but said not to occur in Standard German:

H-L% 

from Grice & Baumann (2002)

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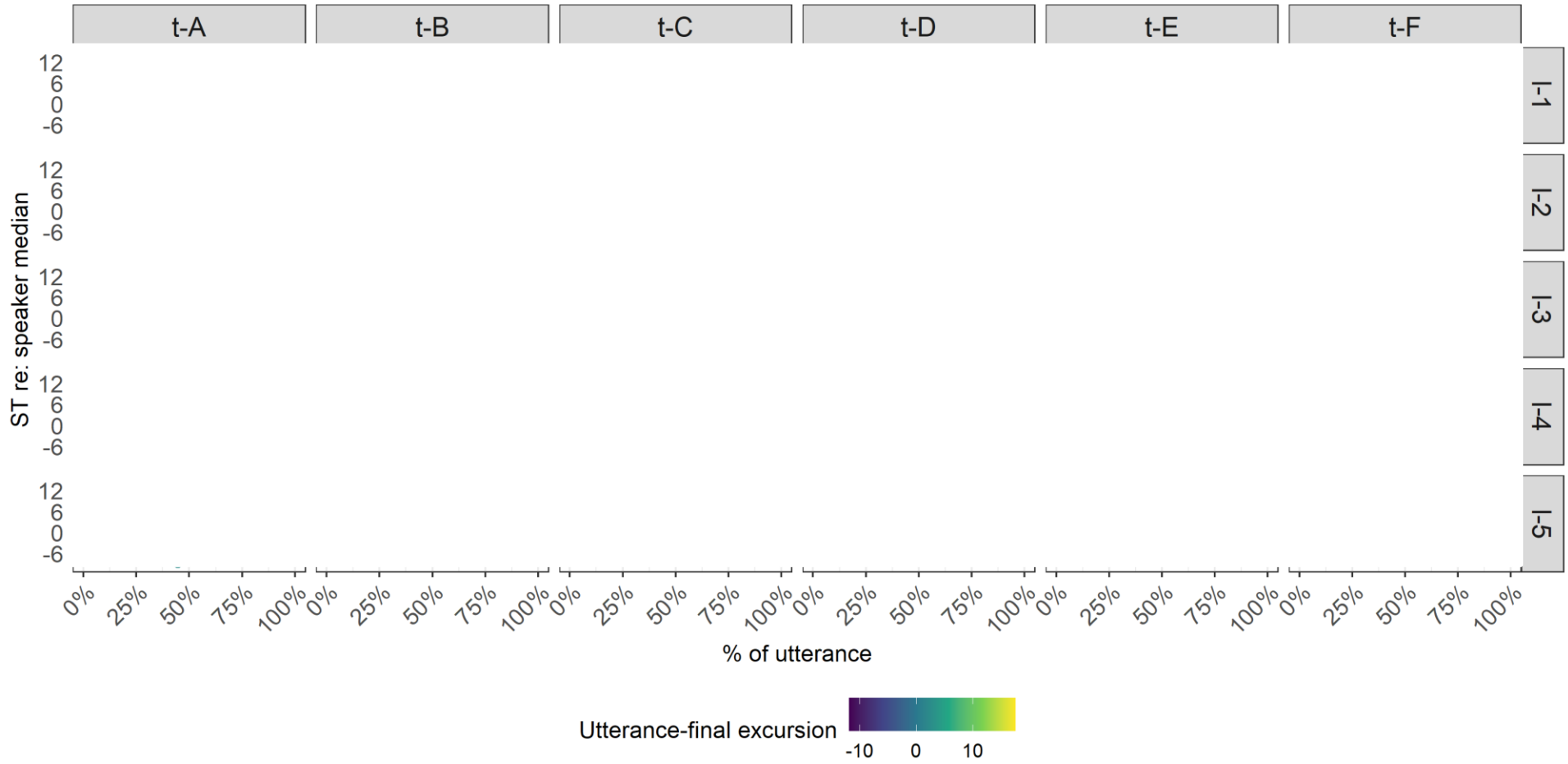
All clusters: overview



All clusters: overview

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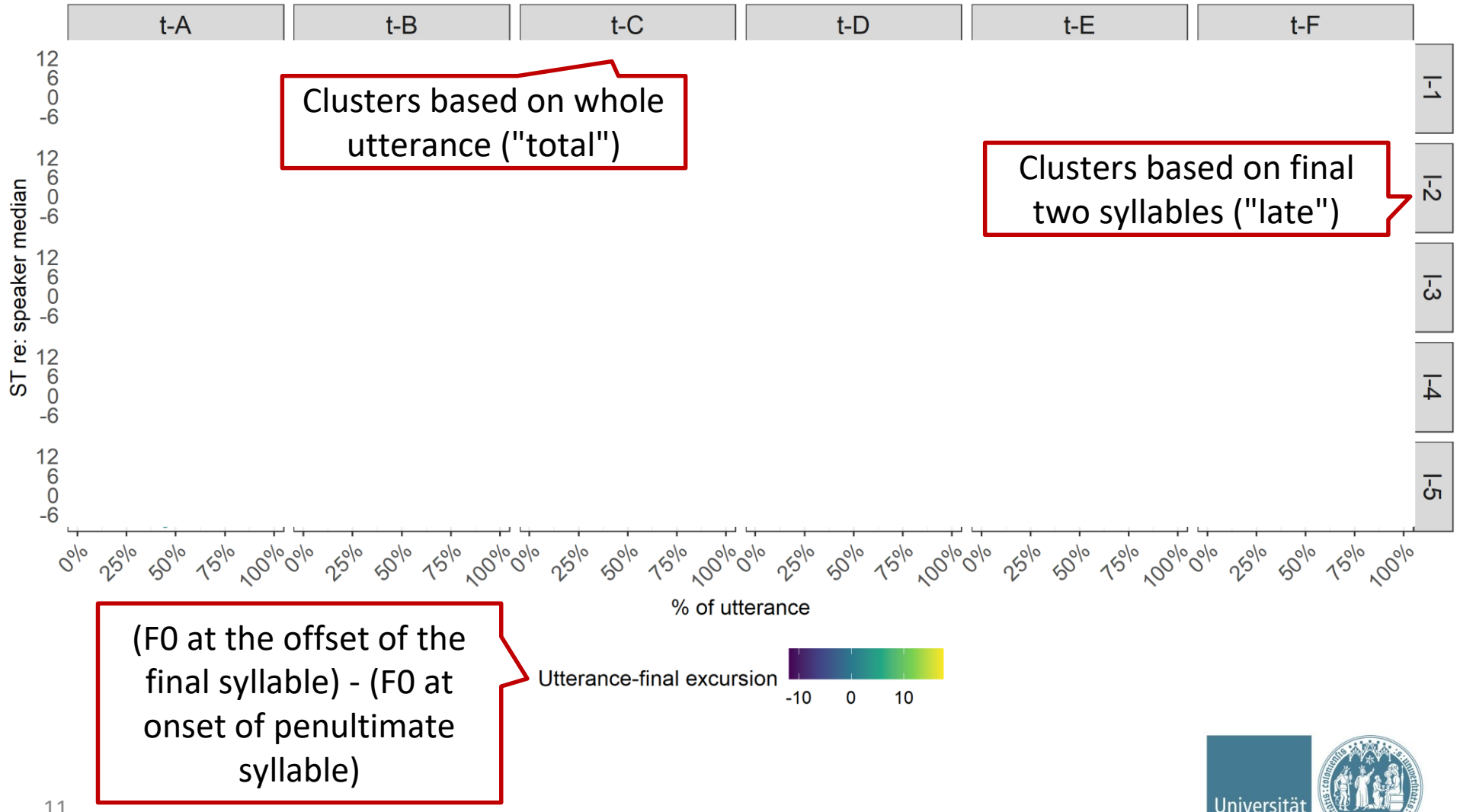

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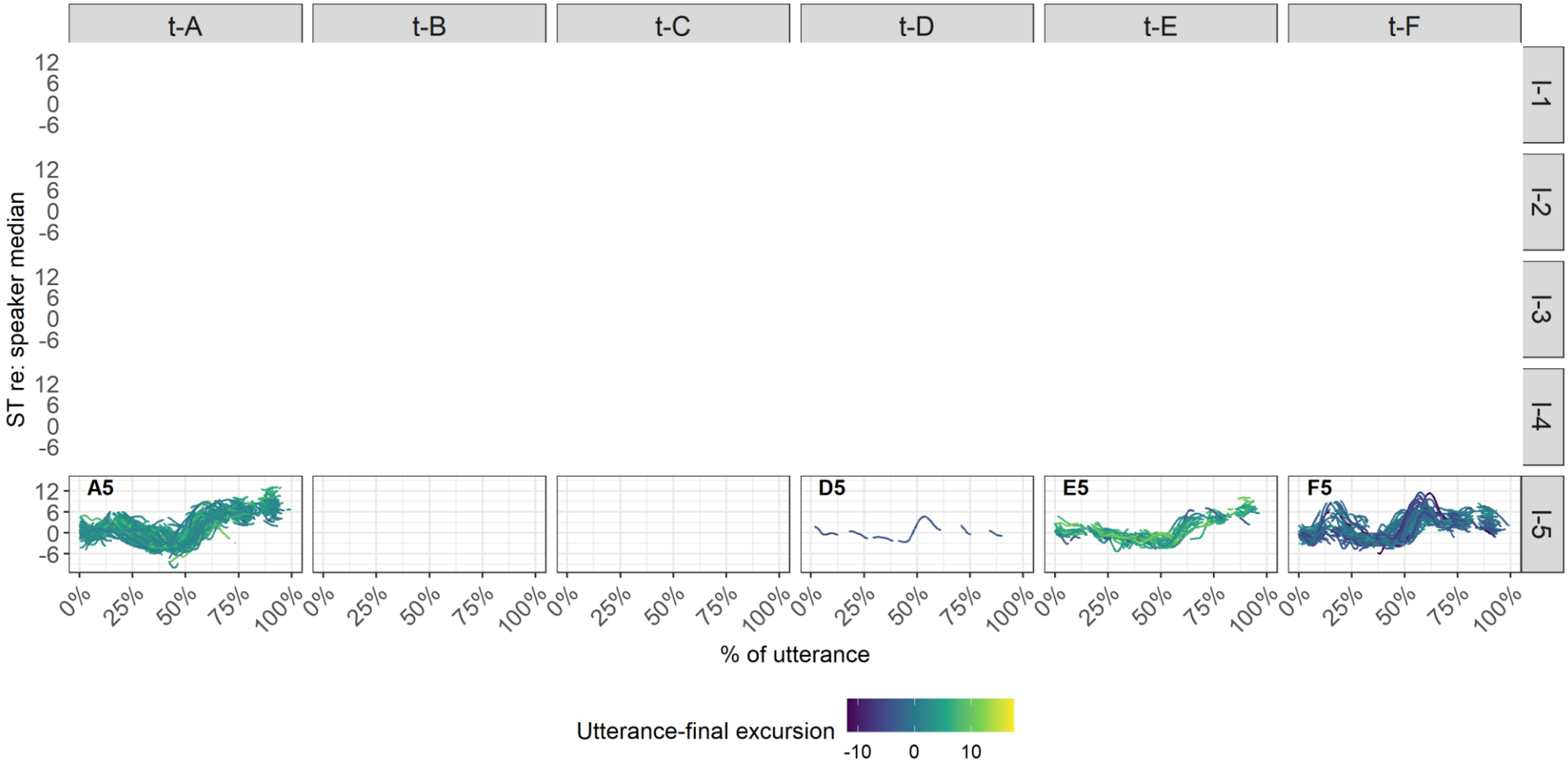
All clusters: overview



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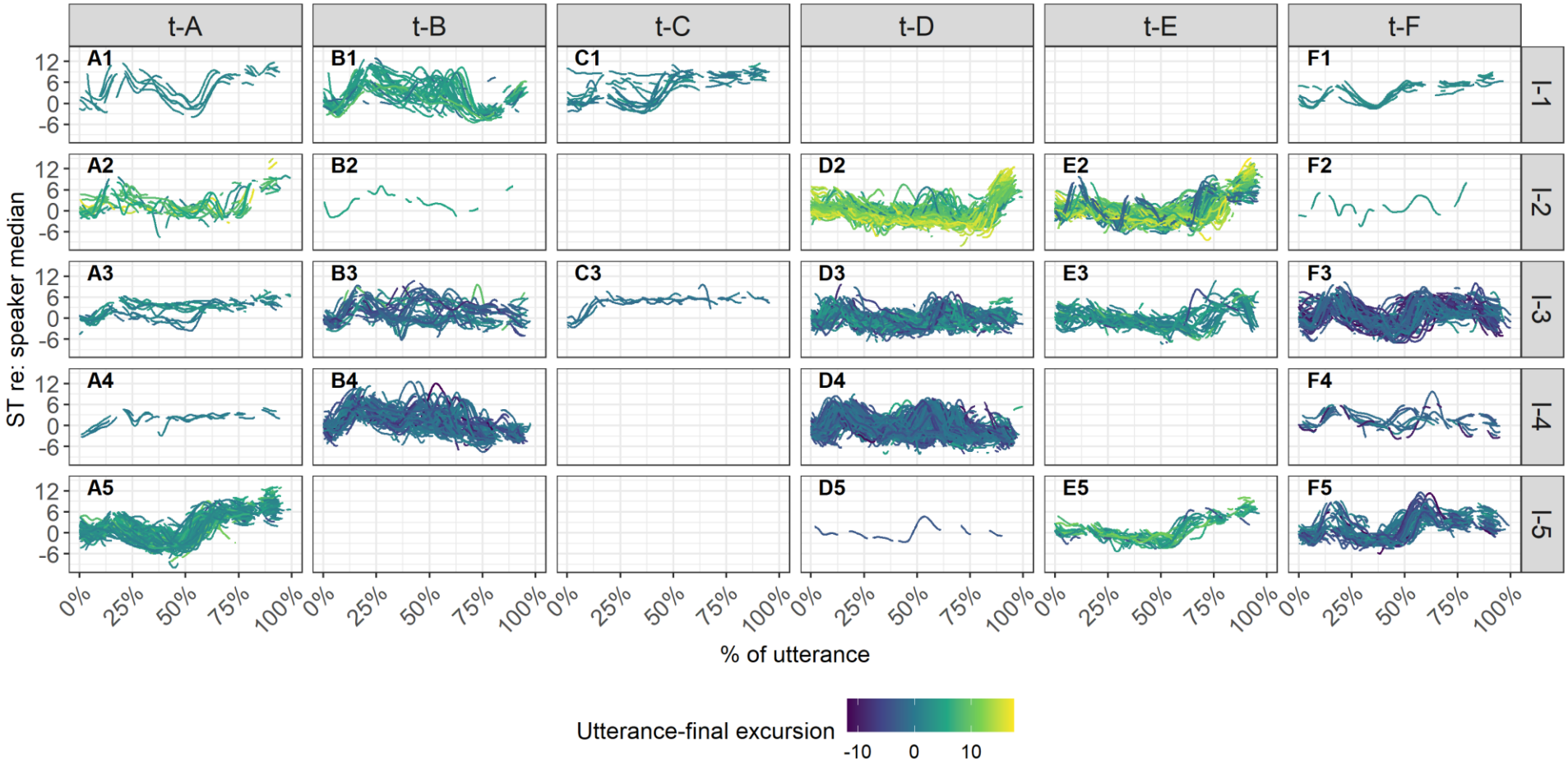

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All clusters: overview

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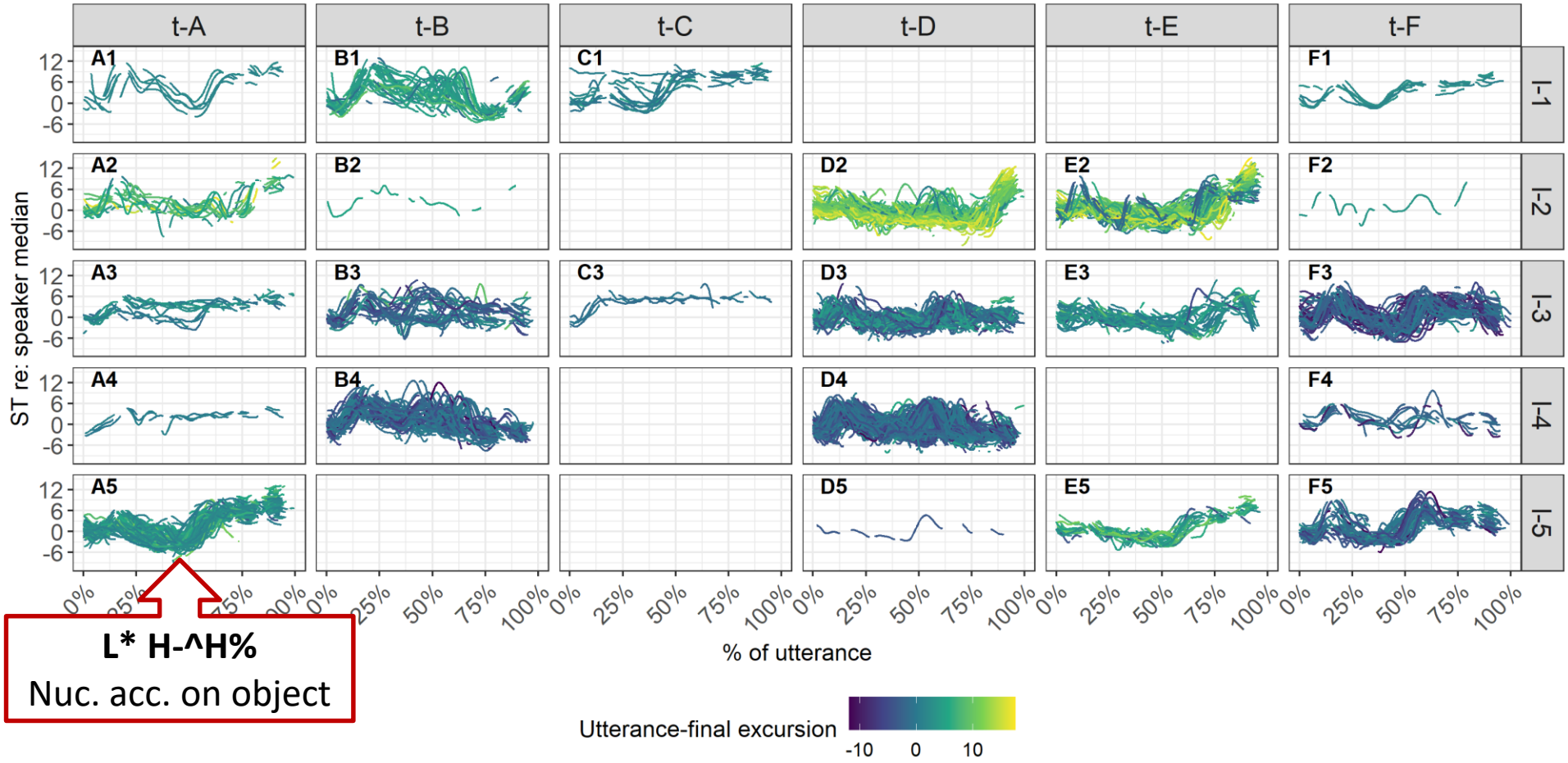

L* H-^H%

Nuc. acc. on object

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All clusters: overview

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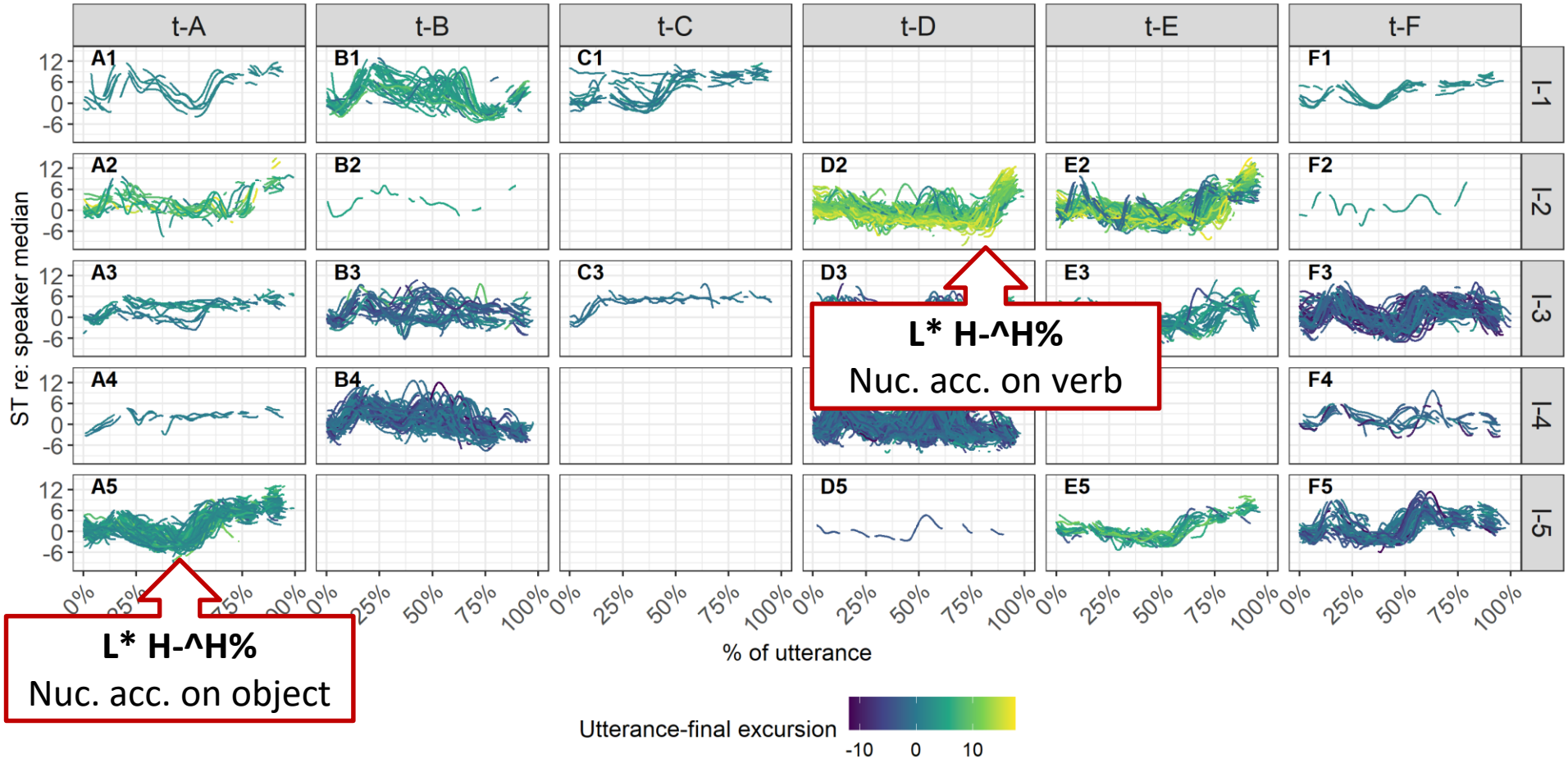

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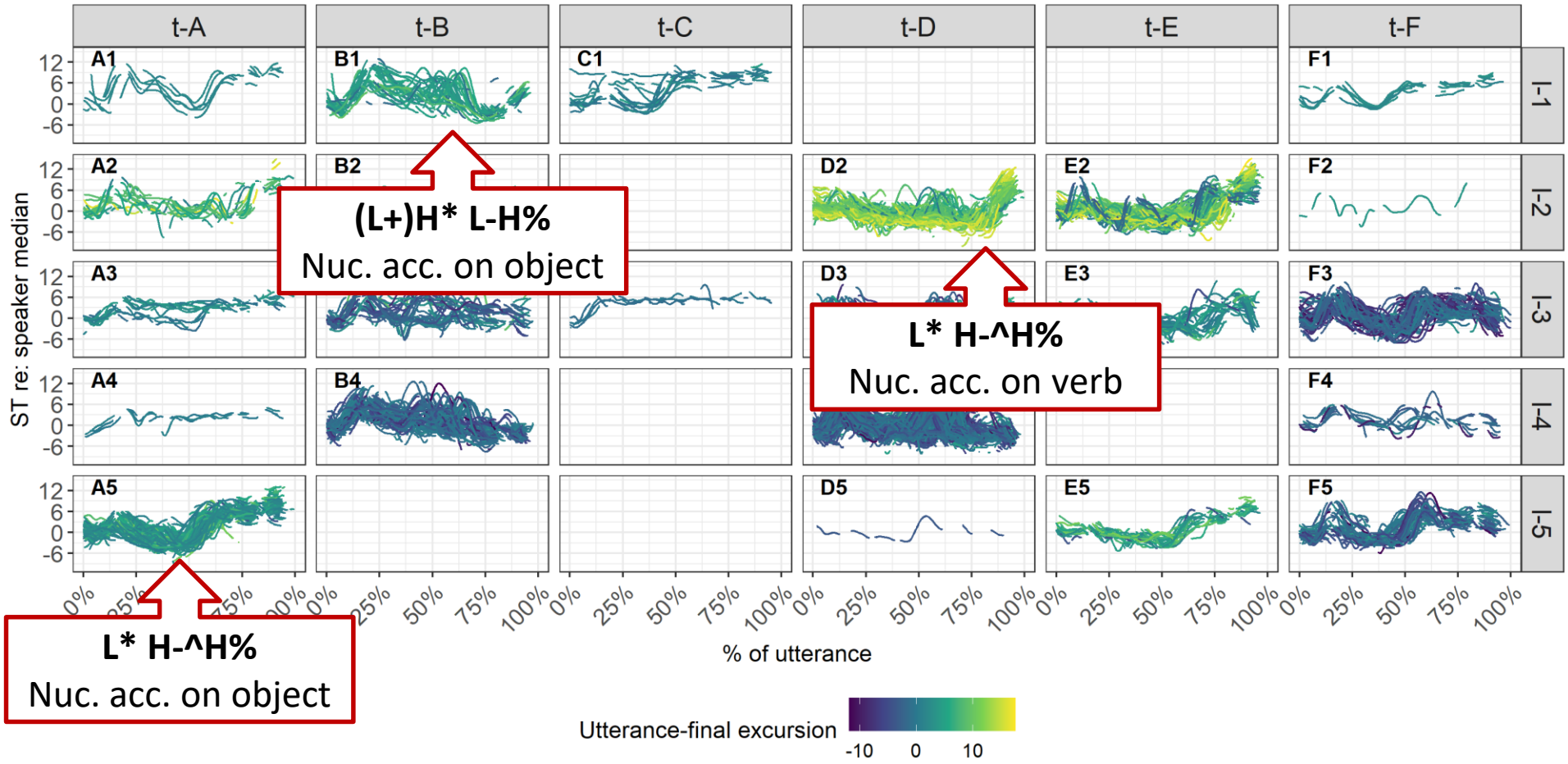
All clusters: overview



All clusters: overview

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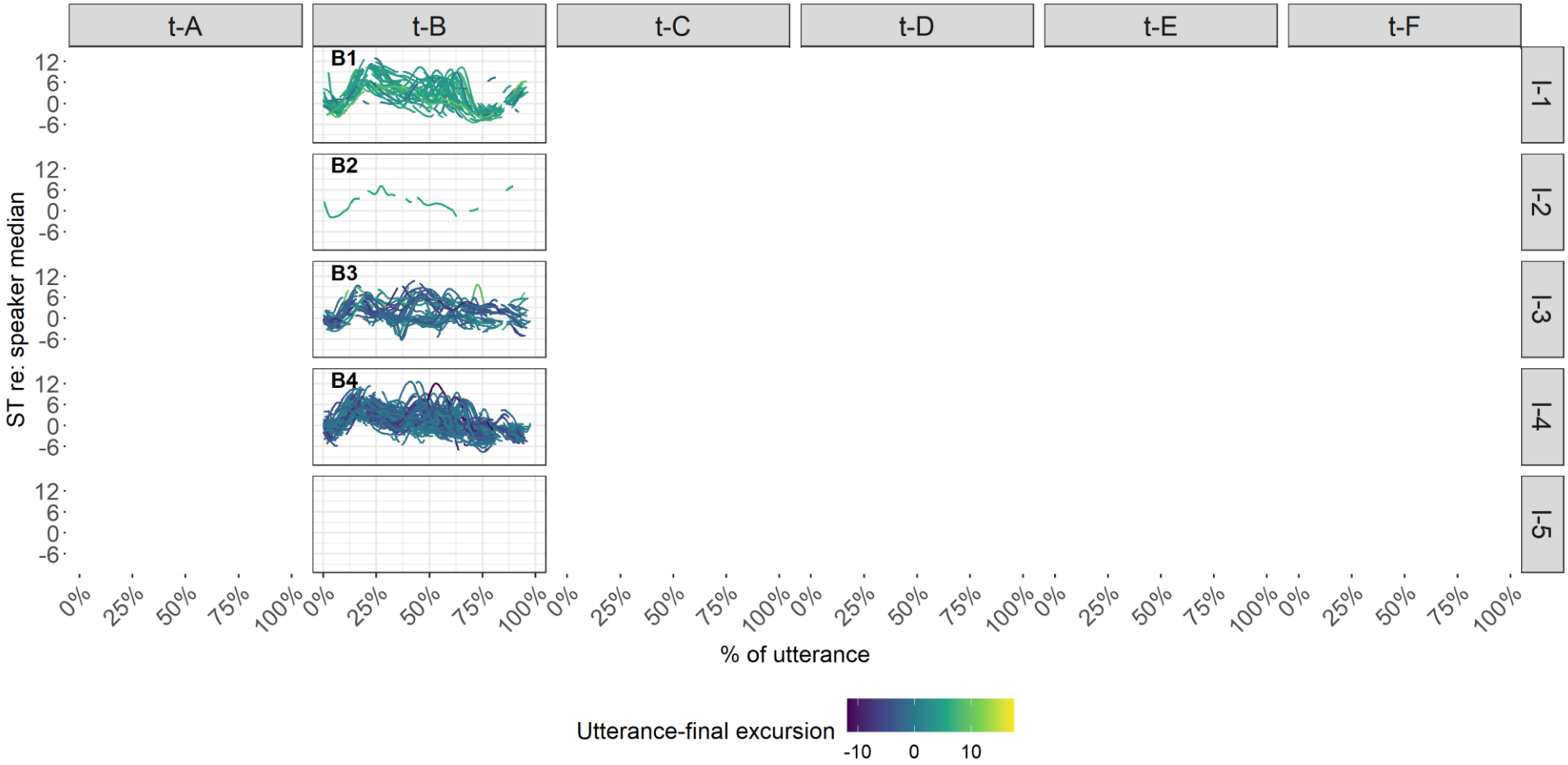

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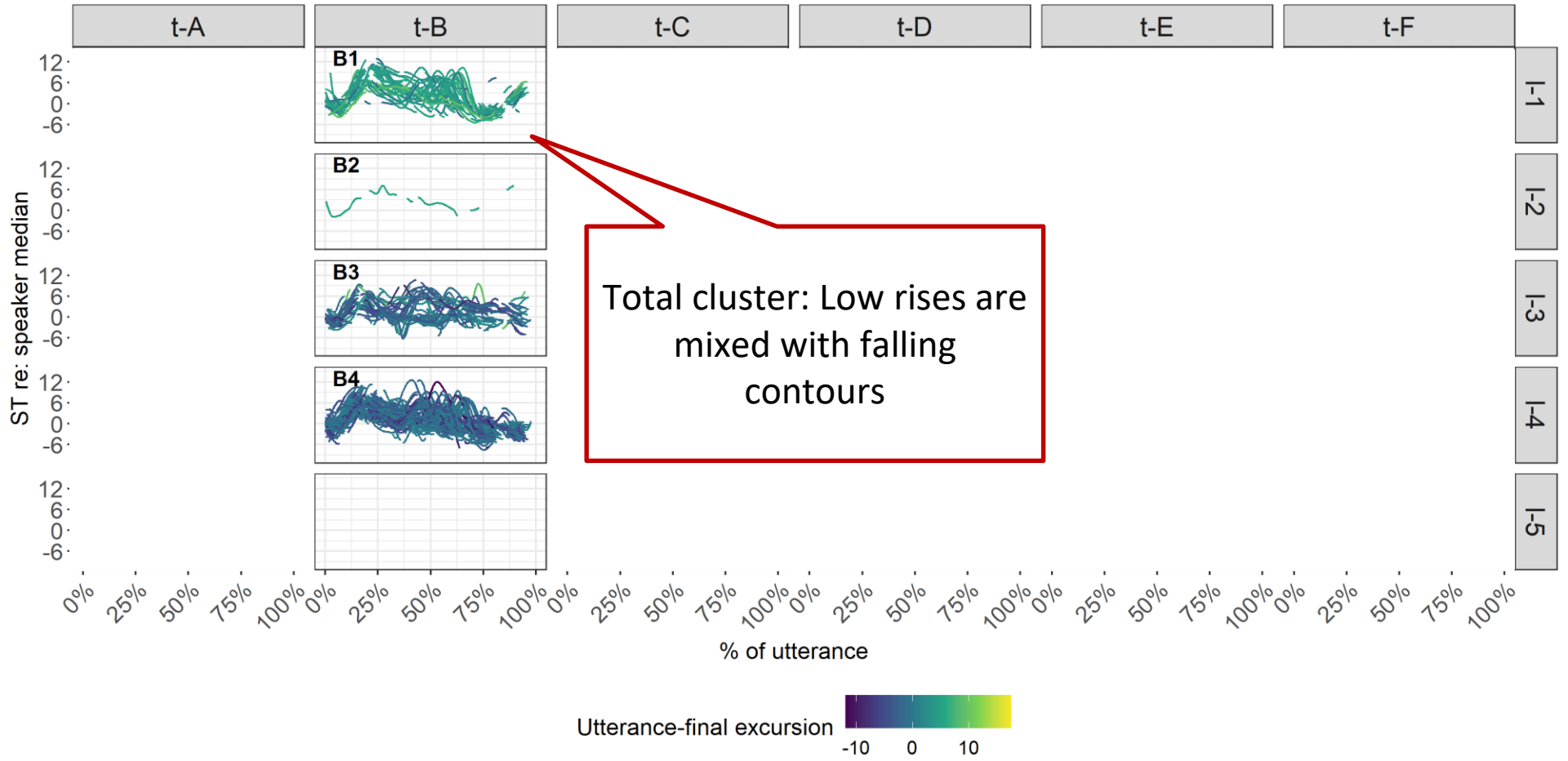
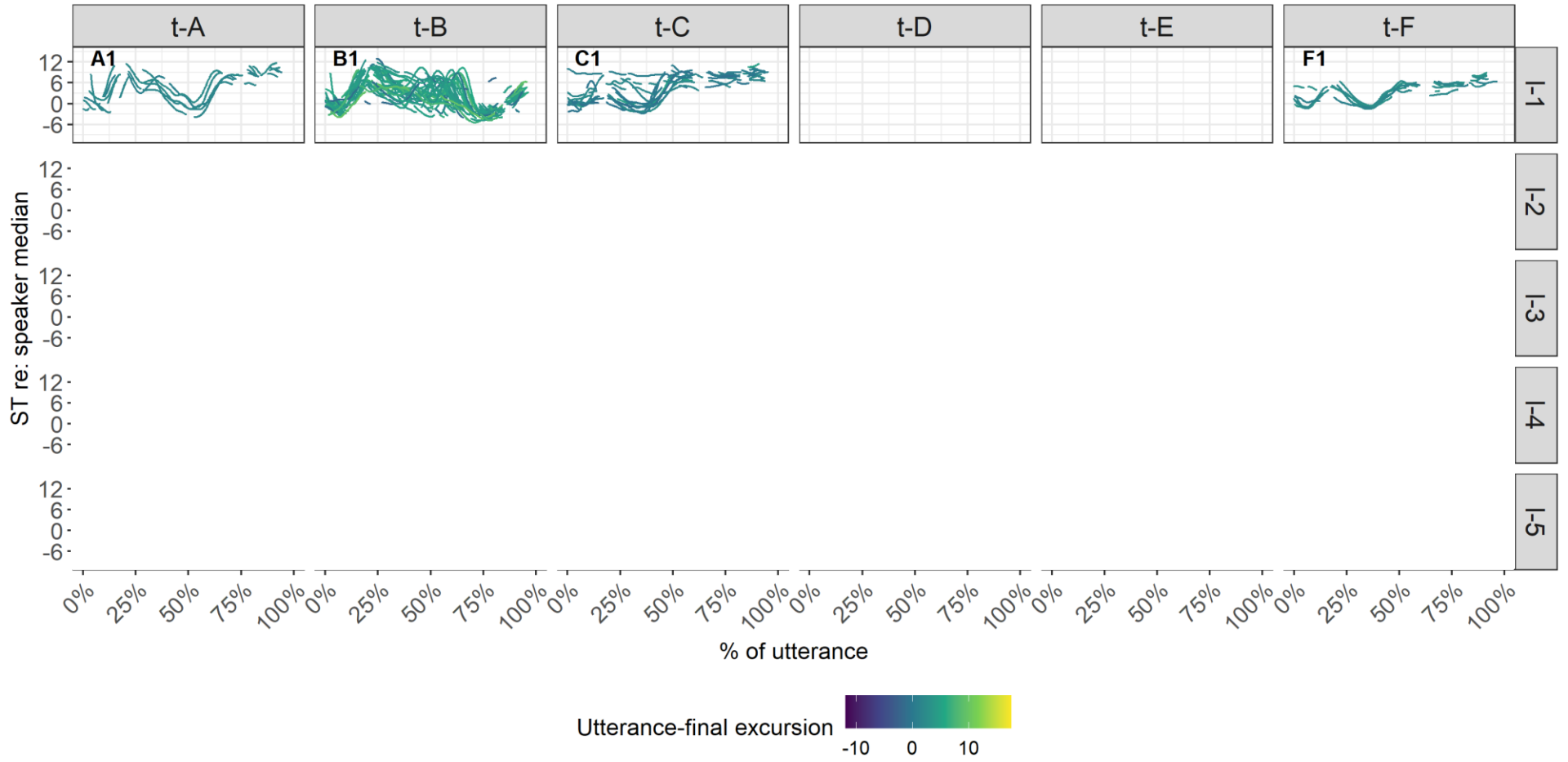
All clusters: overview



All clusters: overview



All clusters: overview

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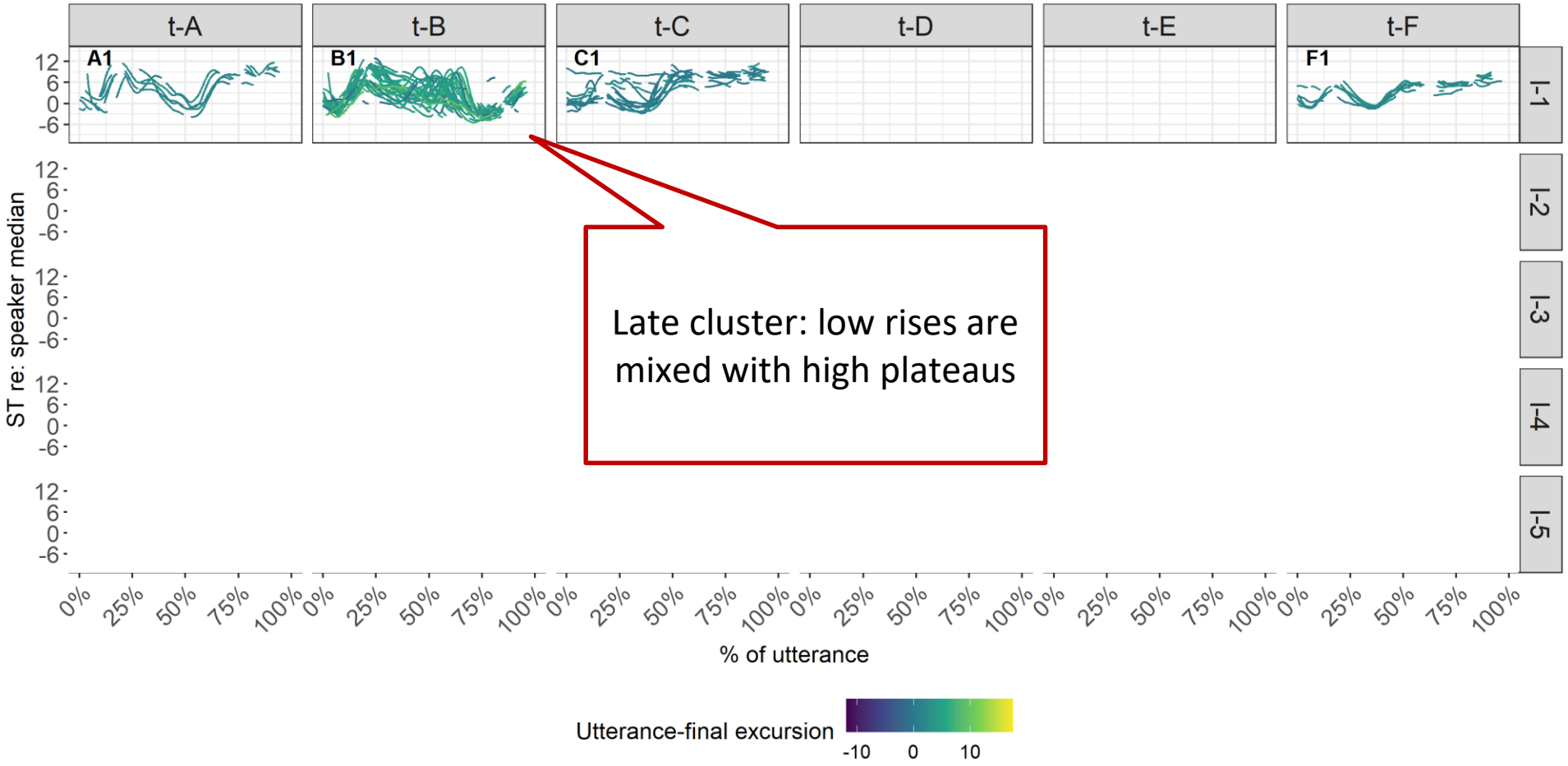

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All clusters: overview

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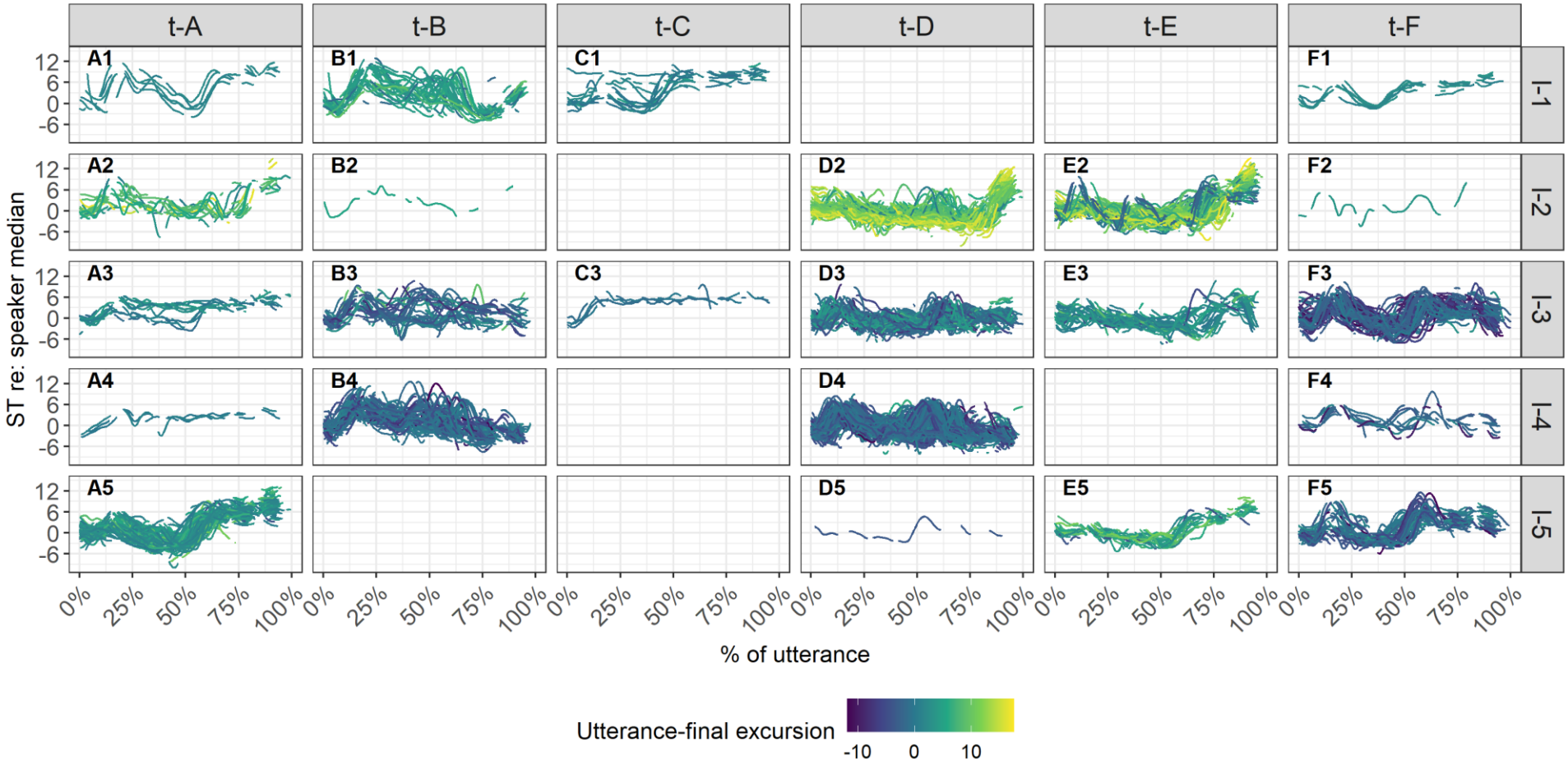

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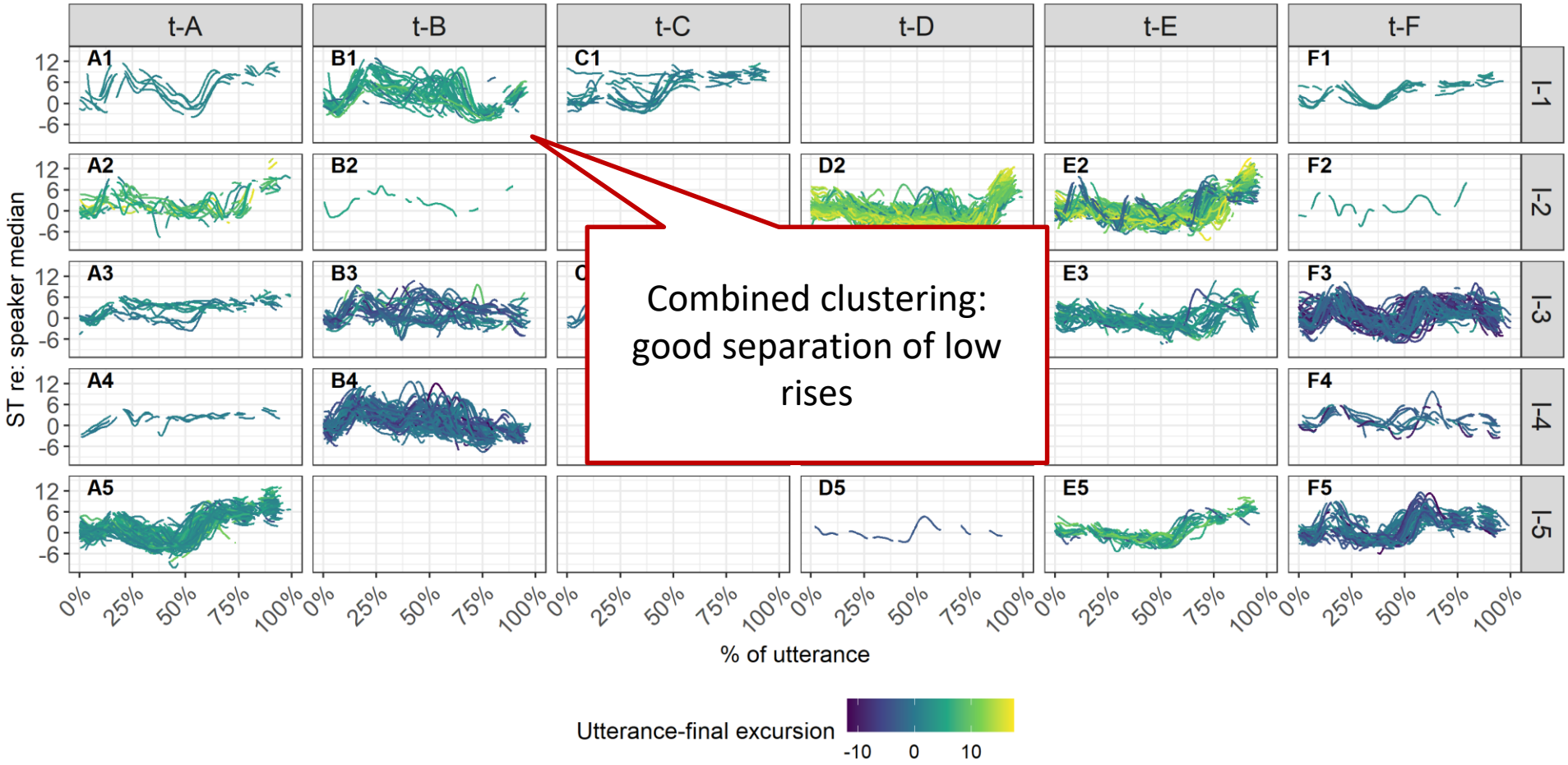
All clusters: overview

SFB 1252 PROMINENCE IN LANGUAGE



Combined clustering: good separation of low rises

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All clusters: overview

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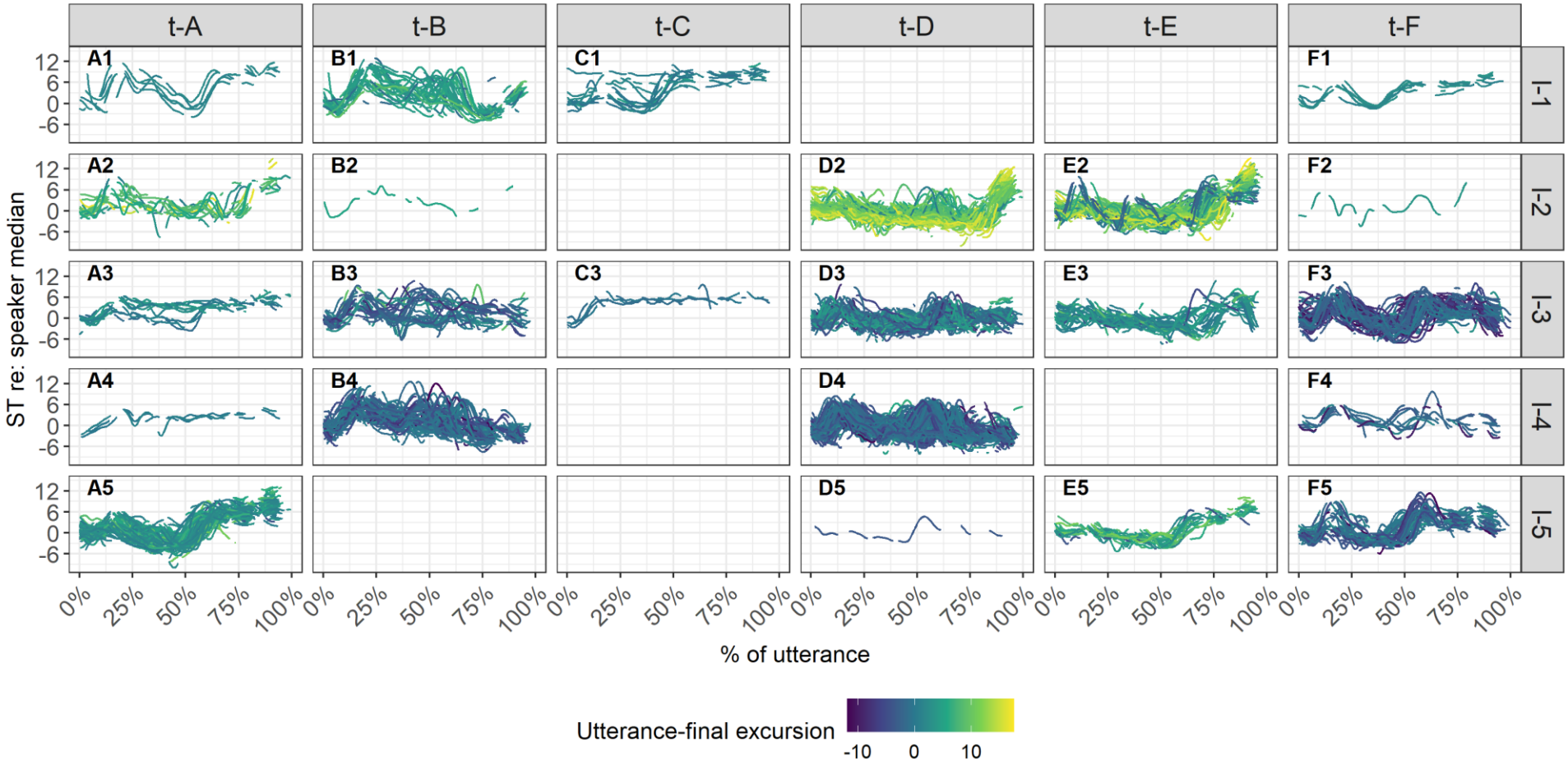

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All clusters: overview

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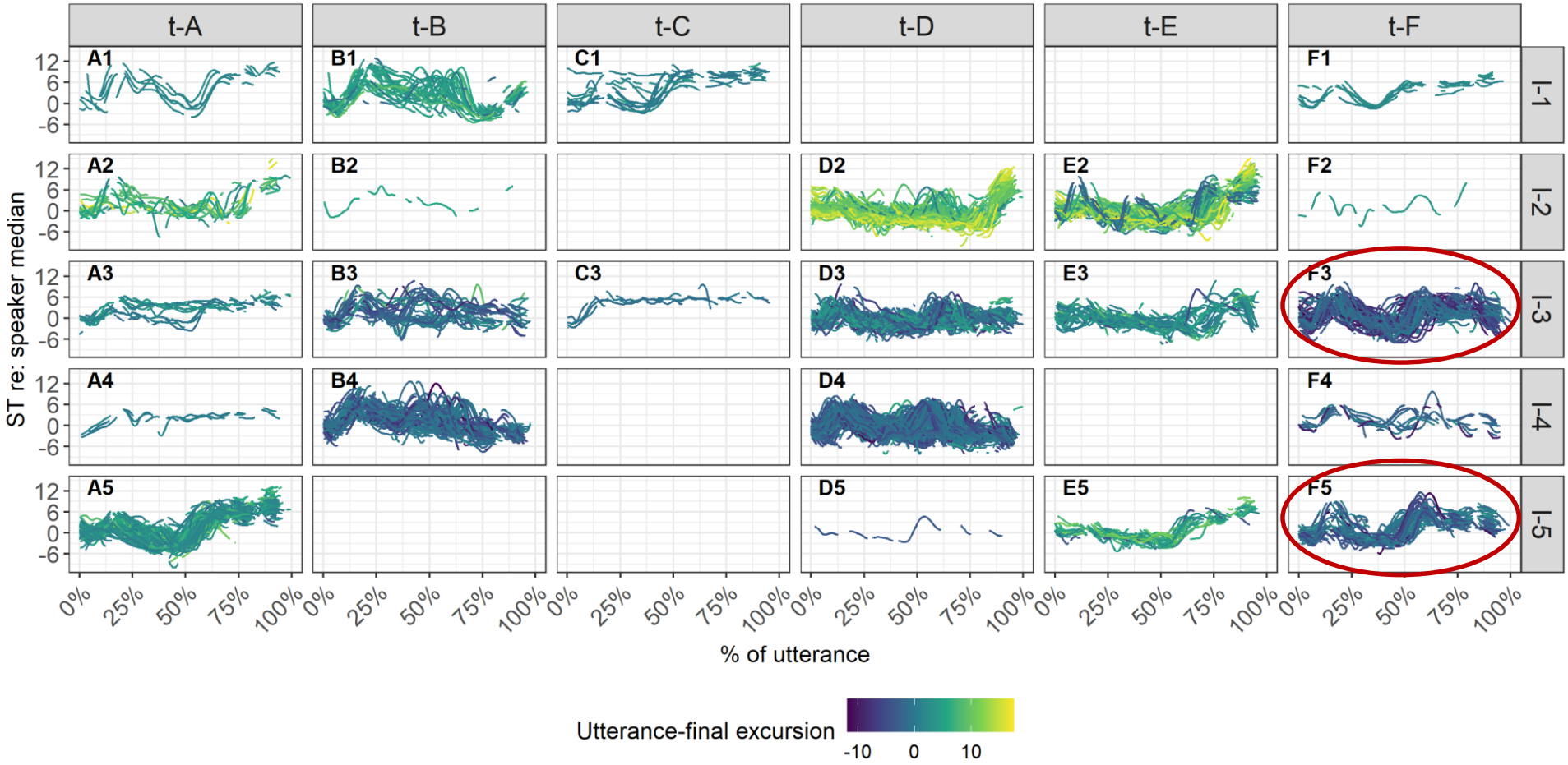

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Zooming in on the plateaus

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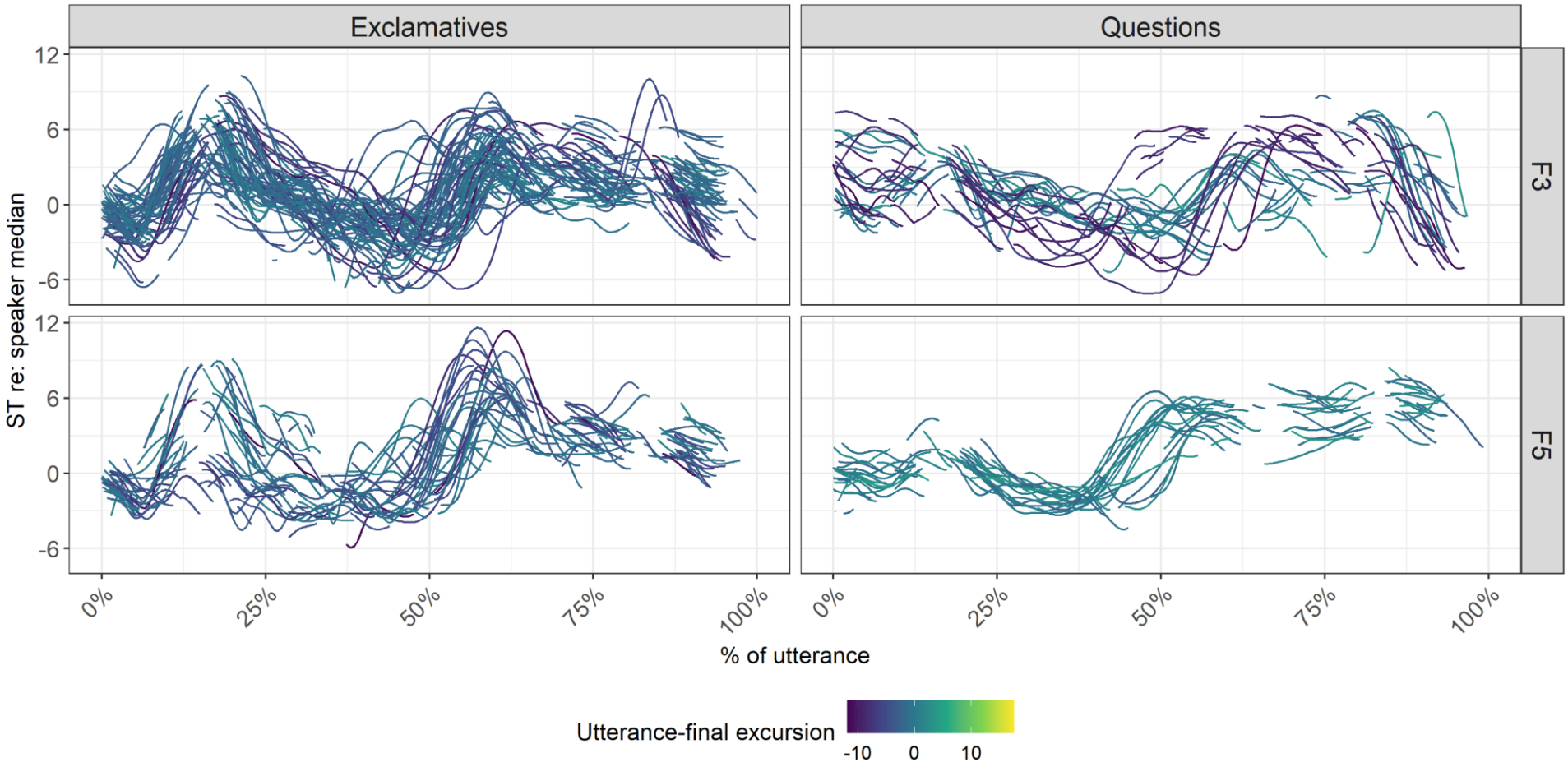

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Cluster F3

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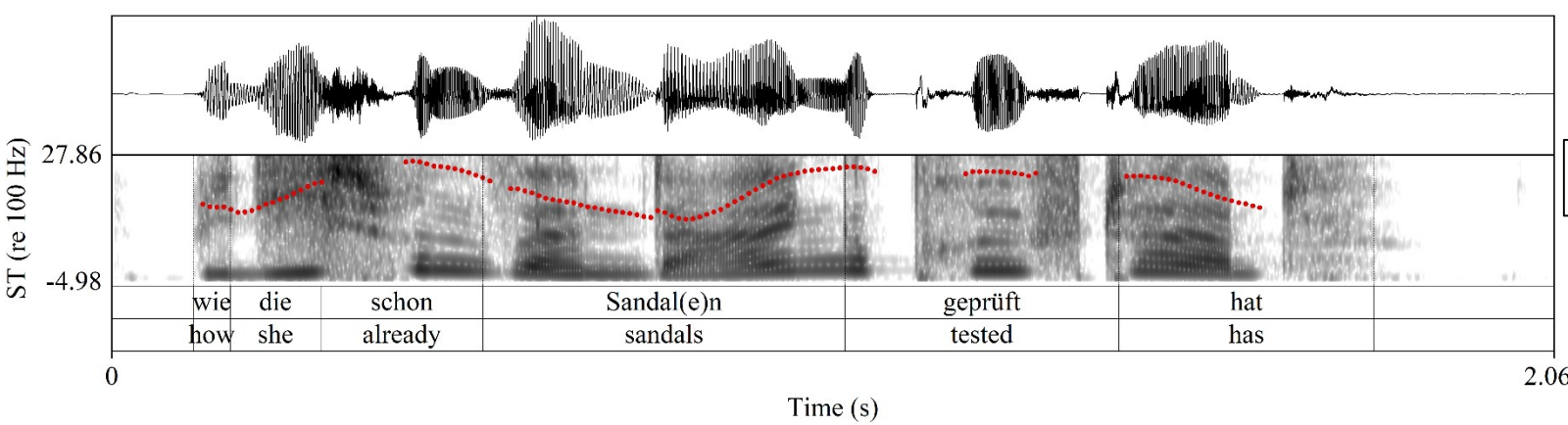
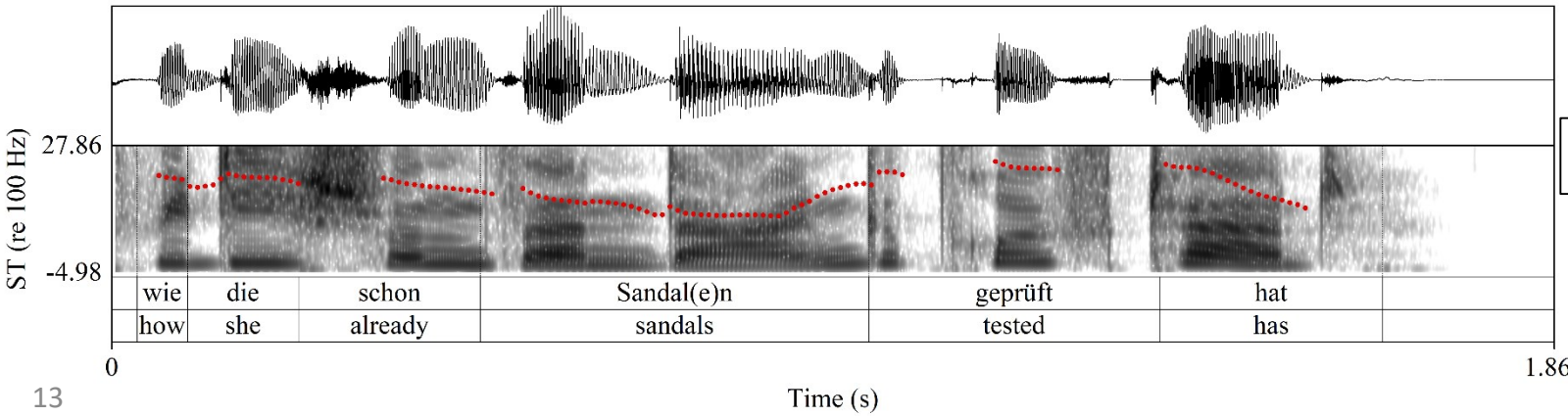
- F3 contains many late falls:



Exclamative



Question

Cluster F3: analysis

- The late falls are best analyzed as H-L%.

- L*+H L-% does not fit:

Rise-Fall (Late Peak)	2	L*+H L-%		Self-evident assertion Emotionally committed or sarcastic assertion	Das **WEISS** ich SCHON![6] *I already know that!* Der Blick ist ja **FA**belhaft![3] *The view is fantastic!*

from Grice, Baumann & Benzmüller (2005)

  - Expectation: low & level pitch on final syllable
  - Observation: fall aligned with final syllable
  - The plateaus cover up to three syllables.
  - ➢ Two high pitch targets: one following the accent (part of the accent), one on the last syllable (part of the boundary tone)

Cluster F5

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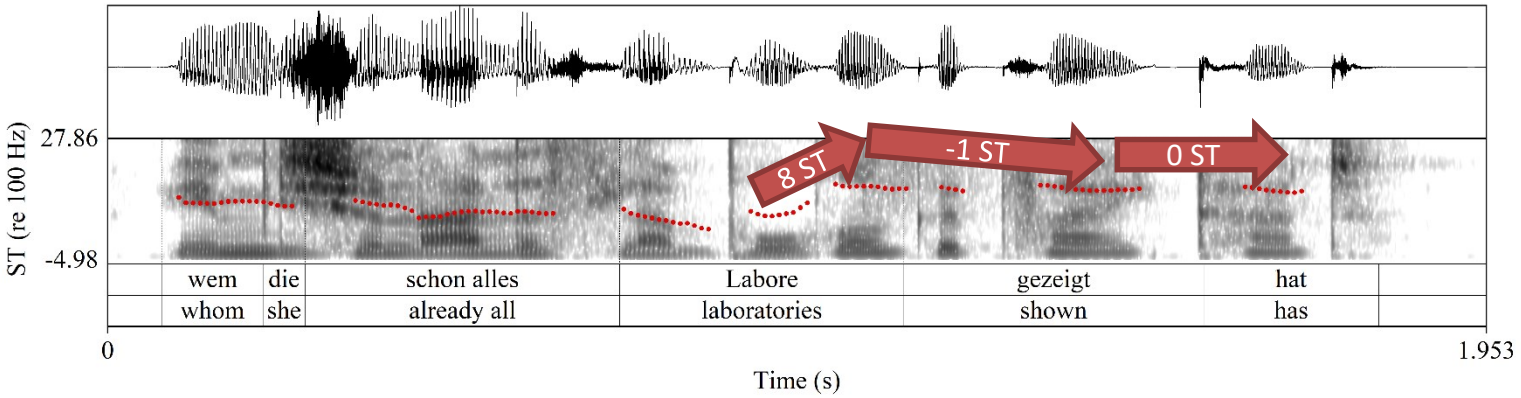
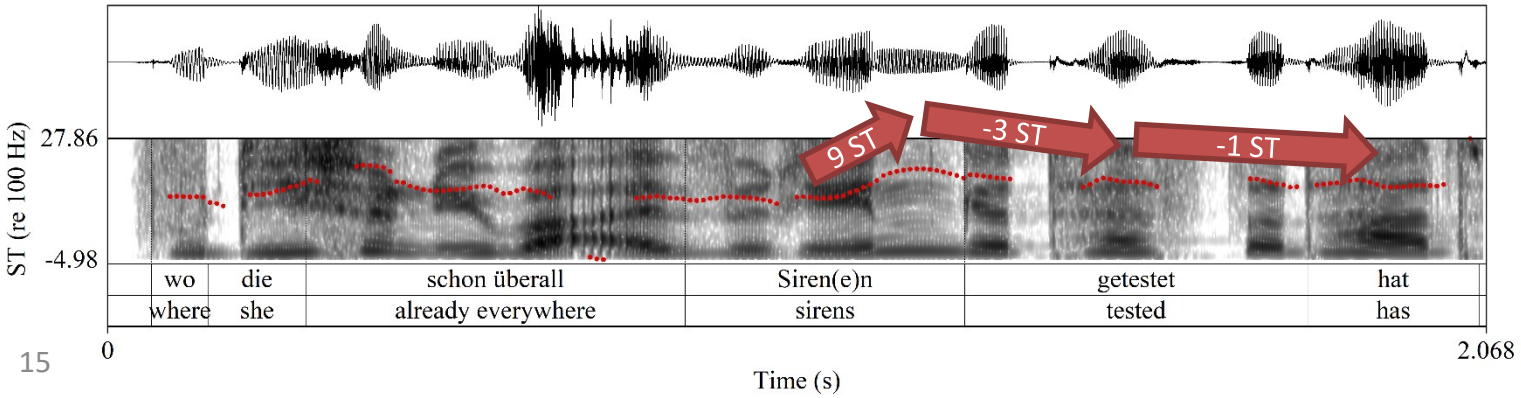
- Questions: high plateaus without upstep



- Exclamatives: half-completed falls



Cluster F5: analysis

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- Questions: H-% (NB: corresponds to MAE-ToBI H-L%)
  - Auditory impression: not a continuation rise
  - Recent research: H-% occurs commonly in polar rhetorical questions (Braun et al., 2019) and negated questions with low negation (Arnhold et al., 2021).
  - H-% vs. H-^H%: different functional load than H-% vs. L-%?

Level	4	(L+)H* H-(%)		Incompleteness (Biased?) questions Ritual expression	**AN**dererSEITS...[6] *But then again...* Guten **MOR**gen![3] *Good morning!*

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Cluster F5: analysis

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- Exclamatives: most contours *look* like L+H* !H-%.
- Tonal sequence of the calling contour
- Auditory impression: not the calling contour
- Instead, speakers sound amazed or impressed (connection to meaning of exclamatives?)
- Alternatively: calling contour has been connected with routine by Ladd (1978).
- Target utterances were all about repeated occurrences.

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Conclusion

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- Cluster analysis can be successfully applied to F0 contours.
- It can help find contour types that might otherwise go unnoticed.
- In this case study on German *wh*-structures, we found several subtypes of high plateaus.
- These plateaus seem to have forms and/or intonational meanings that go beyond the core GToBI inventory.

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References

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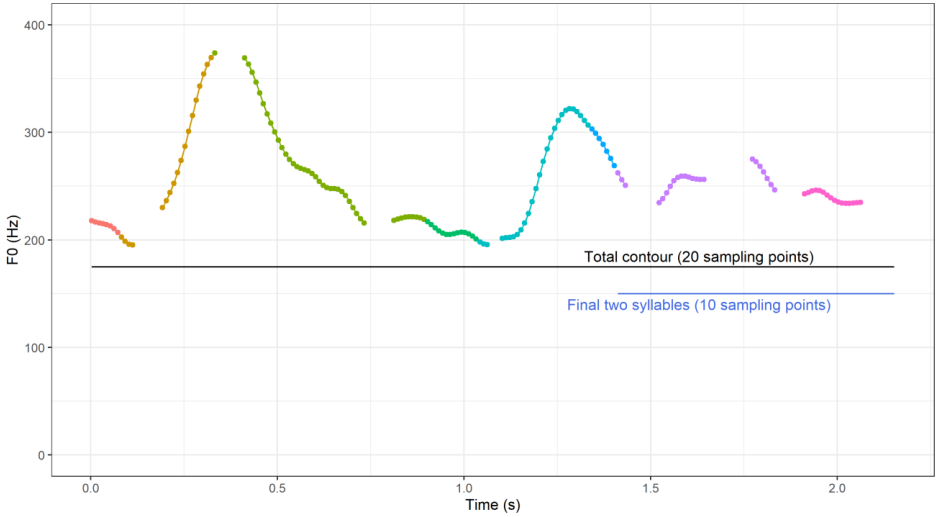
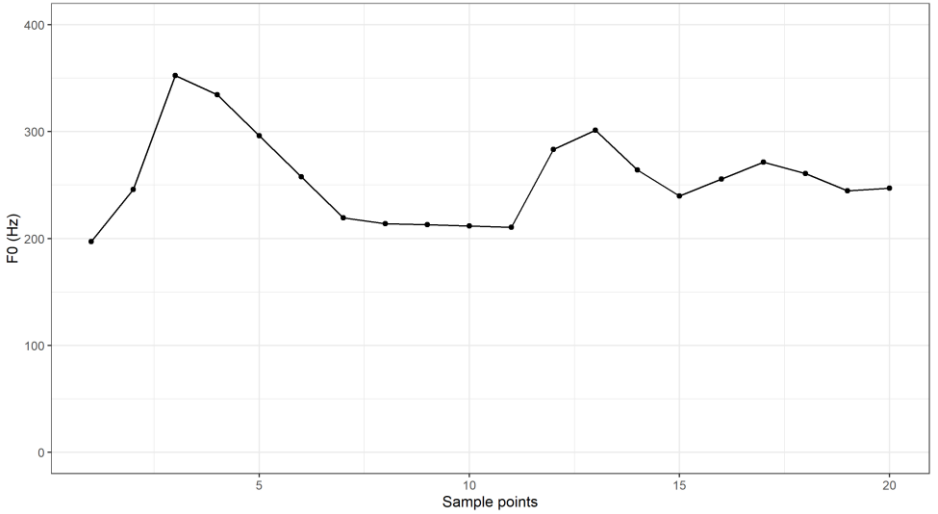
- Repp, Sophie. 2020. The Prosody of Wh-exclamatives and Wh-questions in German: Speech Act Differences, Information Structure, and Sex of Speaker. *Language and Speech* 63. 306–361.

Stylization of contours: example





Cluster analysis: specifics

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- Agglomerative cluster analysis (bottom-up)
- Complete linkage as linkage criterion
- Speaker-standardization is required.
- Clustered objects must be of the same length: F0 contour is interpolated (resolution of interpolation can be specified).
- The number of measures per contour can be specified.

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