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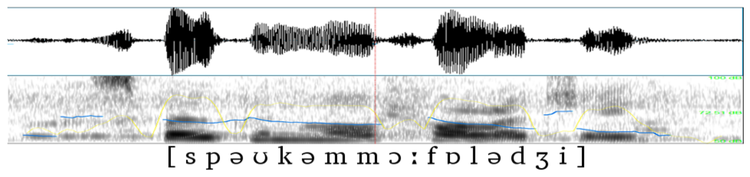

Relative functional load determines co-articulatory movements of the tongue tip

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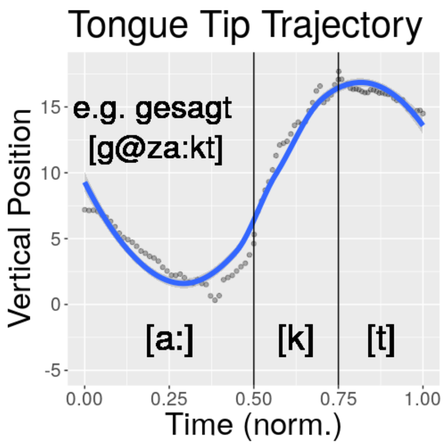
Main Point

Does the presence of a morphological boundary influence co-articulatory tongue movements?

→ YES . . . but the **relative semantic informativity of sublexical units** turns out to be the crucial factor.

Question



	geschafft	*Fachschaft*
Morph.	*ge-schaff-t*	*Fach-schaft*
Syl.	[gə-ʃaft]	[fax-ʃaft]

Same: Syllable structure

Different: Morphological structure

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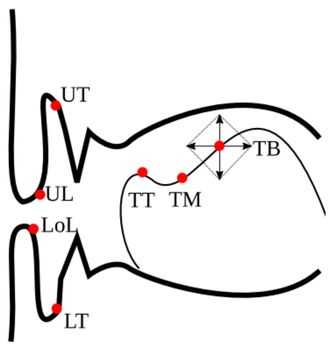
Do articulatory trajectories differ across morphological conditions?

Methods

- **Corpus**
  - Karl Eberhards Corpus[1]
  - Spontaneous speech
  - Electromagnetic Articulography (EMA)
  - Vertical/Horizontal movements
  - Tongue Tip/Body
  - Midsagittal plane
- **Target words**
  - Word-final segment-trigrams
  - Stem vowel = [a(ː)]
  - Suffix = [-t].
  - 1 or 0 intervening segment.
- **Random effects**
  - Speaker
  - Intervening segments
  - Segments before/after target trigrams
- **Predictors**
  - Time (normalized)
  - Frequency
  - Tongue type (Tip vs Body)
  - Morphological status
  - Segment duration
  - **Relative Functional Load** [3, 2, 5, 4]



Relative Functional Load

Functional Load

$$\text{FuncLoad}_{\text{sublex,word}} = \text{cor}(\vec{s}_{\text{sublex}}, \vec{s}_{\text{word}})$$

How much a sublexical unit (sublex) contributes to the target meaning.

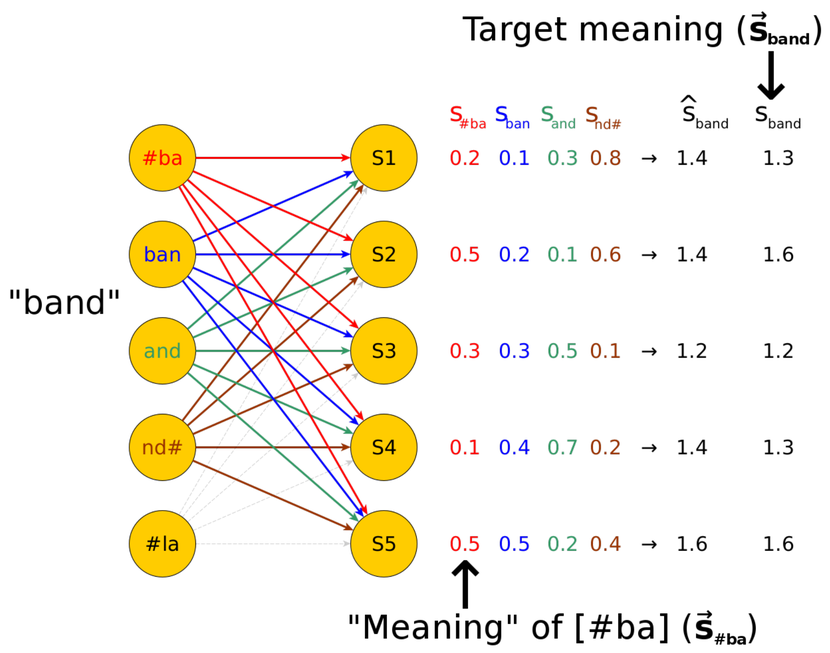
e.g. $\text{FuncLoad}_{-mal-,\text{bemalt}}$ (**Stem** FuncLoad)

e.g. $\text{FuncLoad}_{-alt-,\text{bemalt}}$ (**Suffix** FuncLoad)

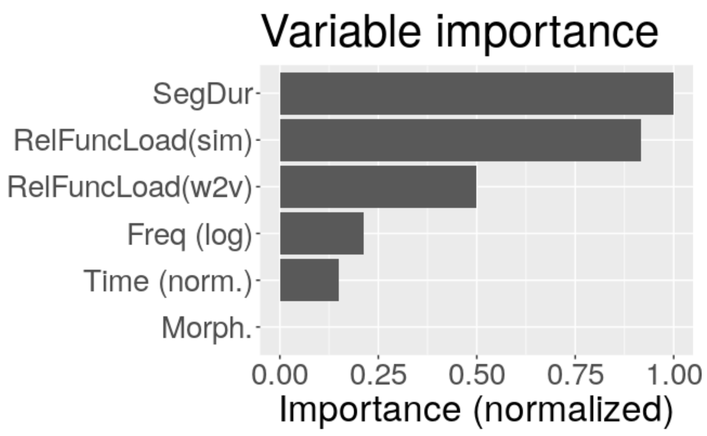
Relative Functional Load

$$\text{RelFuncLoad}_{\text{word}} = \text{FuncLoad}_{\text{stem,word}} - \text{FuncLoad}_{\text{suffix,word}}$$

Quantifies whether stem or suffix contribute more to the target meaning.



Statistical Evaluation



GAM 1 (Freq & Morph) vs GAM2 (RelFuncLoad)

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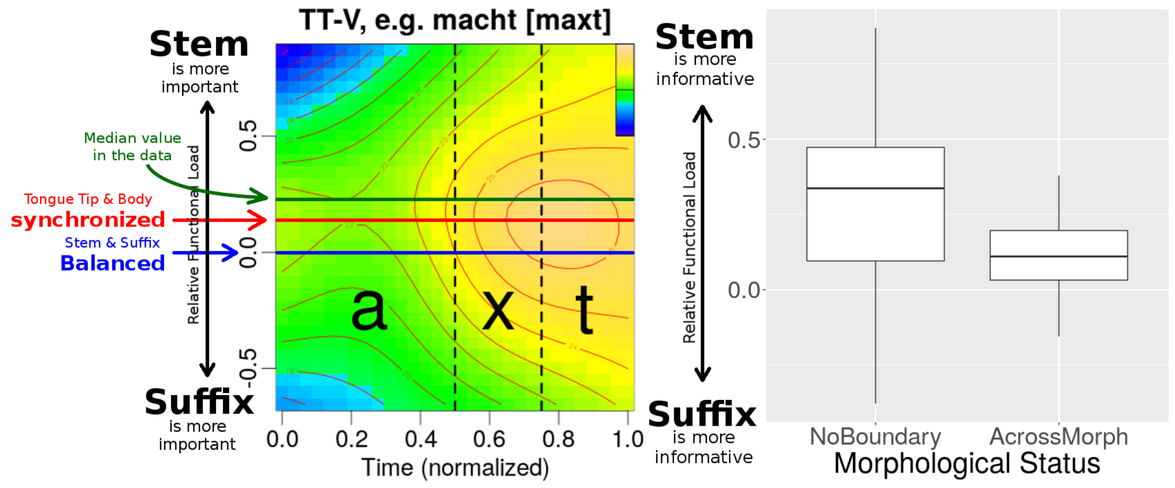
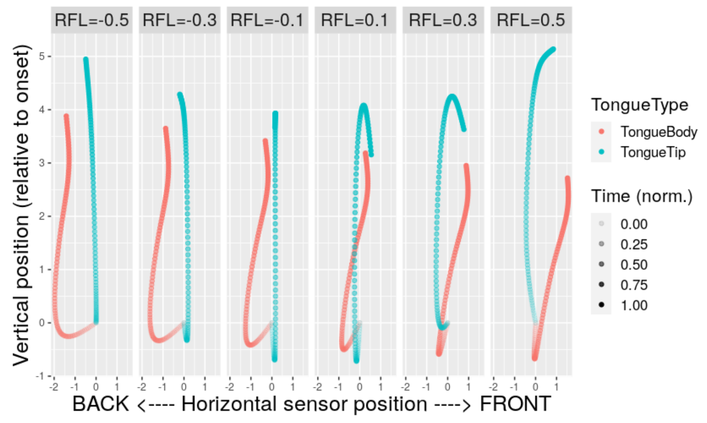
GAM 2 has **fewer parameters**

AND

improved fit





1. Importance of stems and suffixes (RelFuncLoad) is balanced

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Smoothest articulation

2. RelFuncLoad

⇓

may be **an underlying source** of the **morphological status effect**.

Form and Meaning in Complex Words: semantics all the way down!

References

[1] Denis Arnold and Fabian Tomaschek. The Karl Eberhards Corpus of spontaneously spoken southern German in dialogues — audio and articulatory recordings. Tagungsband der 12. Tagung Phonetik und Phonologie im deutschsprachigen Raum, pages 9–11, 2016.

[2] Harald Baayen, Yu-Ying Chuang, and James P. Blevins. Inflectional morphology with linear mappings. The Mental Lexicon, 13(2):230–268, 2018. ISSN 1871-1340. doi: 10.1075/ml.18010.baa.

[3] R. Harald Baayen, Yu-Ying Chuang, Elnaz Shafaei-Bajestan, and James P. Blevins. The Discriminative Lexicon: A Unified Computational Model for the Lexicon and Lexical Processing in Comprehension and Production Grounded Not in (De)Composition but in Linear Discriminative Learning. Complexity, pages 1–39, 2019. ISSN 10990526. doi: 10.1155/2019/4895891.

[4] Yu-Ying Chuang, Melanie J. Bell, Isabelle Banke, and R. Harald Baayen. Bilingual and multilingual mental lexicon: a modeling study with Linear Discriminative Learning. Language Learning, pages 1–73, 2020. doi: 10.31234/osf.io/adtyr.

[5] Elnaz Shafaei-Bajestan, Masoumeh Moradipour-Tari, and R. Harald Baayen. LDL-AURIS: Error-driven Learning in Modeling Spoken Word Recognition. PsyArXiv (Preprent), 2020. doi: 10.31234/osf.io/v6cu4.