

Post-lexical /s, z/-retraction in Manchester English

An ultrasound-tongue-imaging
and lip-camera study

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Introduction

- /s/-retraction is a widely-studied process in English sociolinguistics
 - a process that turns /s/ into a more [ʃ]-like sound (e.g. [ʃ]treet)
 - sound change in progress in many varieties of English



b. 1932



b. 1997



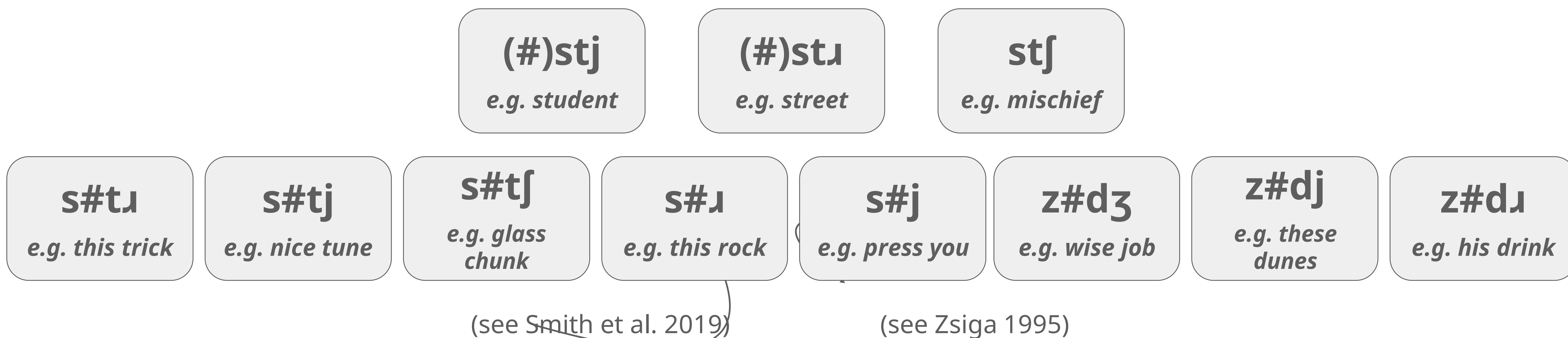
Motivation for this study

- /s/-retraction has been extensively researched, especially in recent years
- But these studies often focused on a relatively limited set of environments
- The envelope of variation is potentially much wider than this!



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**The articulatory
phonetic angle**



**The sociolinguistic
angle**

The articulatory phonetic angle



Retraction is a commonly used label to capture this process but in reality this masks a great deal of variation and complexity in articulatory mechanisms

“If /s/ is moving toward [ʃ], it is important to fully explicate the phonetic changes that would be involved. It is proposed that they involve at least three phonetic parameters [...]

TONGUE PLACEMENT [...] TONGUE SHAPE [...] LIP SHAPE”

— Rutter (2011: 31)

The articulatory phonetic angle



Retraction is a commonly used label to capture this process but in reality this masks a great deal of variation and complexity in articulatory mechanisms

“It is also worth noting that changes in one of the phonetic parameters discussed above **may not necessarily co-occur** with changes in the other two. This is particularly true of the parameter **LIP-ROUNDING**, whose variance is likely to be quite independent from the activities of the **TONGUE**”

— Rutter (2011: 31)



**The articulatory
phonetic angle**



**The sociolinguistic
angle**

The sociolinguistic angle

Rapid and widespread change, occurring seemingly independently in a range of world Englishes and nearing completion in some varieties



- Despite extensive sociolinguistic study (e.g. Durian 2007; Gylfadottir 2015), there remain unresolved questions regarding:
 - the potential phonetic precursors of change (Janda & Joseph 2001; Stevens & Harrington 2016)
 - the triggering mechanisms (Shapiro 1995; Lawrence 2000; Baker et al. 2011; Bailey et al. 2022)

Research questions

1. What are the relative roles of the different articulatory gestures and their relationship with the acoustic output?
 - a. to what extent do we find inter-speaker variation?
 - b. do the gestures change at different rates over the course of this change?
2. How does the change behave in these different prosodic/phonological environments?
3. Is there any phonetic uniformity in how the natural class of sibilants behave in these retracting environments?

Proposed methods

Data collection

- Simultaneous:



**ultrasound tongue
imaging** of the
midsagittal plane

+



side-profile
**lip camera
recording**

+



audio recording

Proposed methods

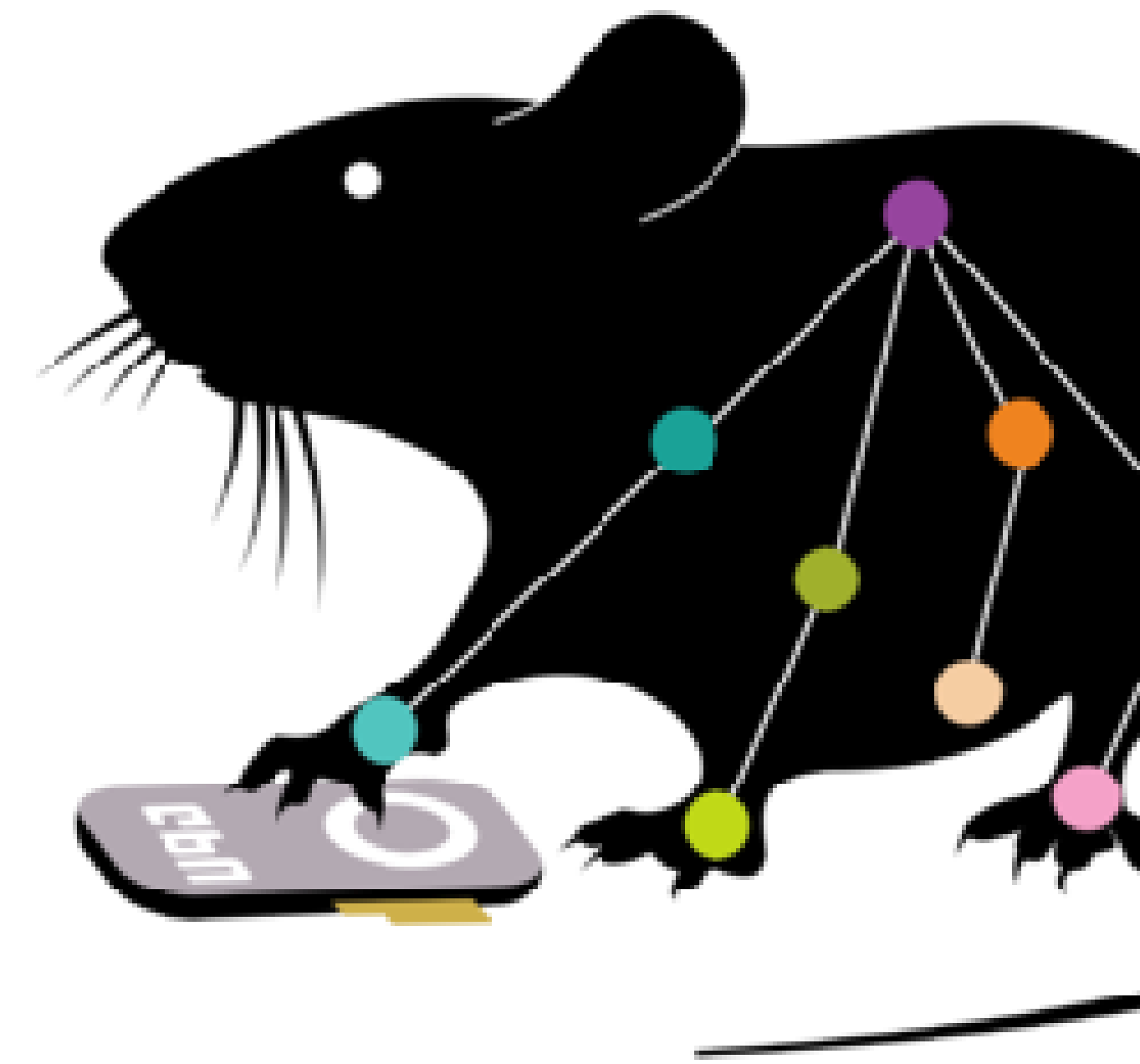
Data collection

- Add slide on workflow? i.e. export files from AAA, alignment using FAVE etc.

Proposed methods

Data processing

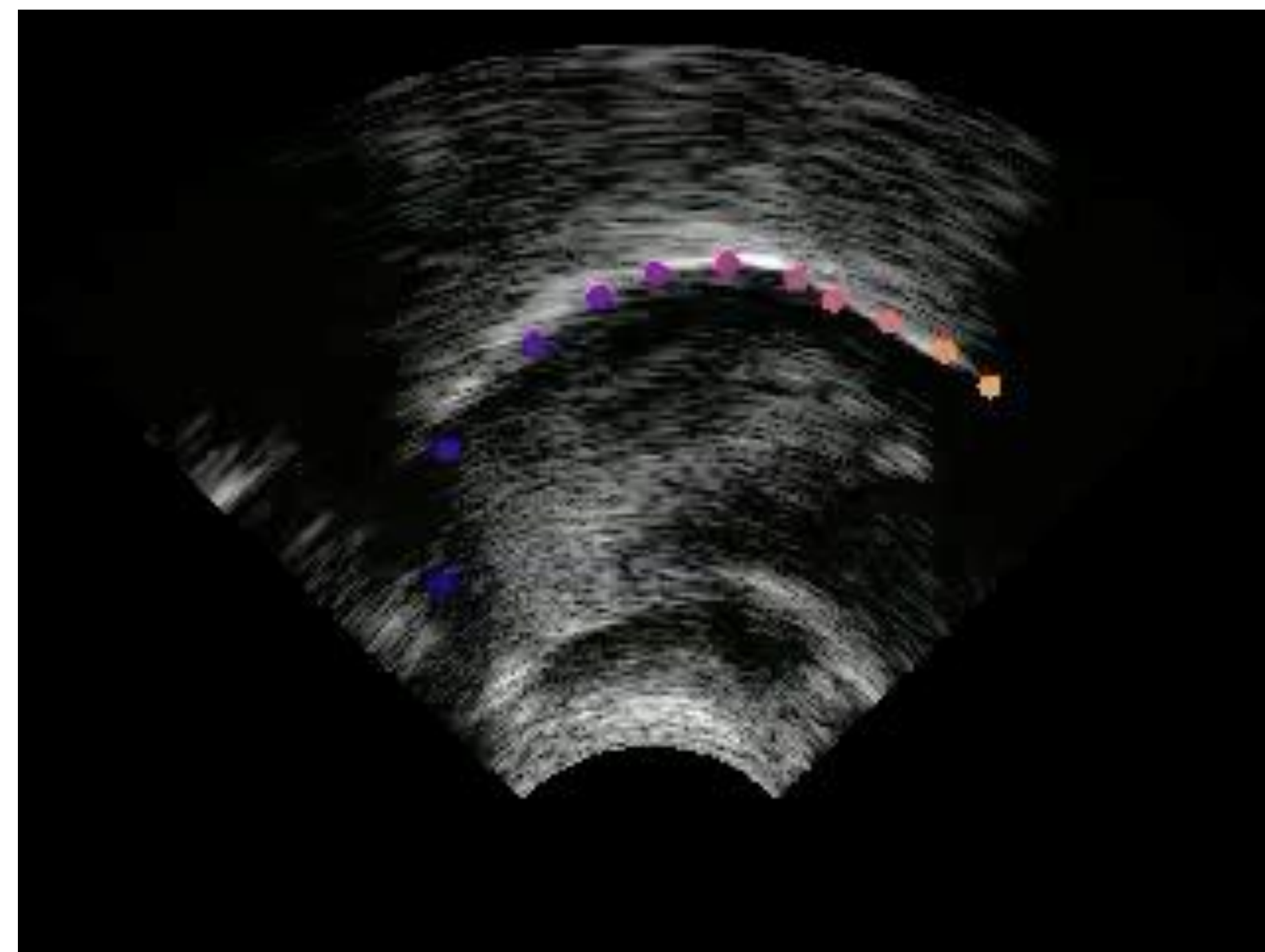
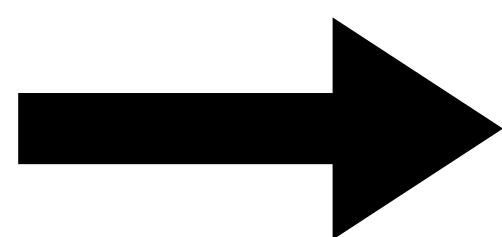
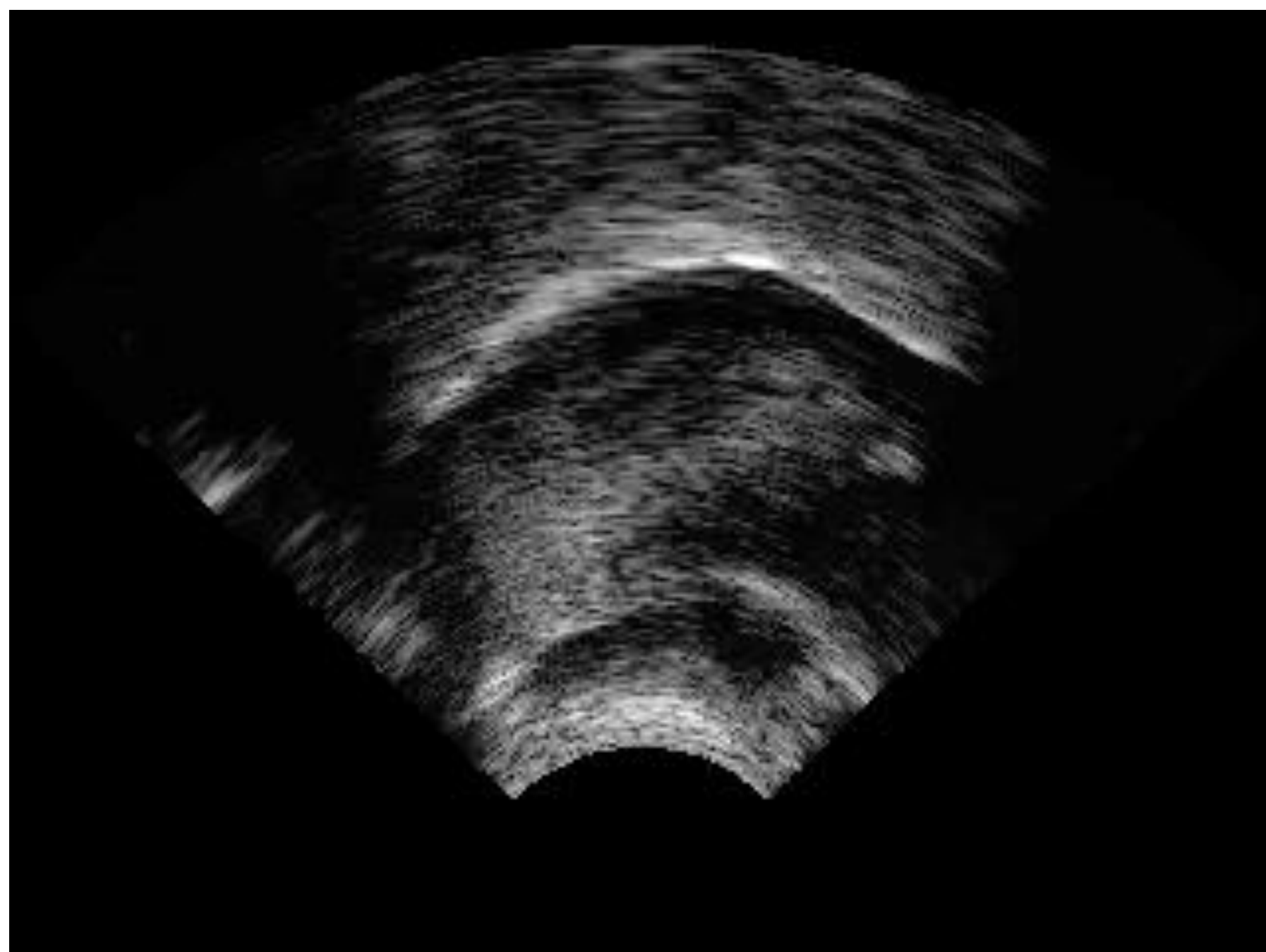
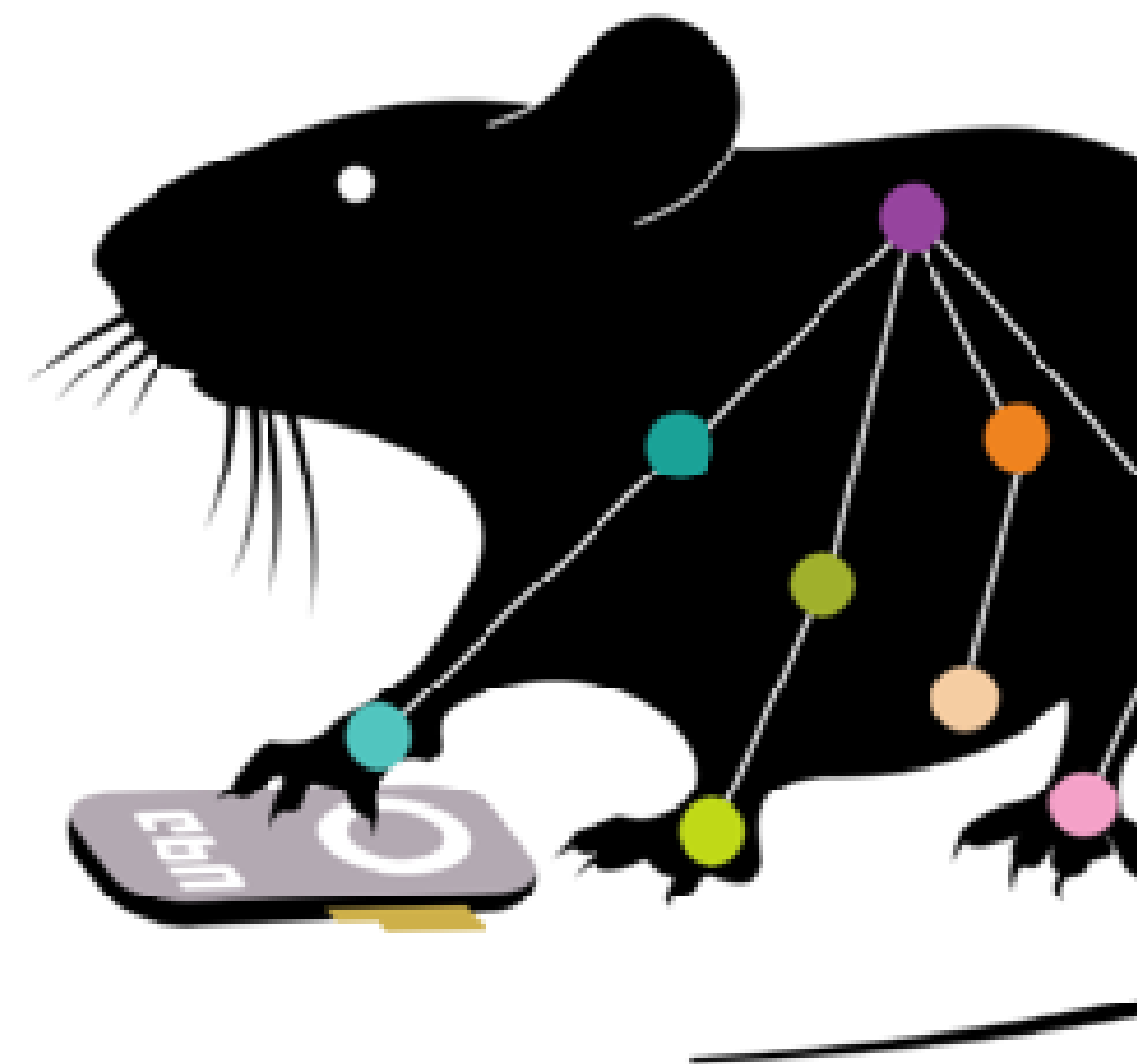
- **DeepLabCut** - new method of processing ultrasound recordings (Wrench & Balch-Tomes 2022)
 - open-source software originally designed for use with animals
 - markerless pose estimation using machine learning techniques to track tongue splines
 - identifies 11 parts along the tongue (plus the hyoid, short tendon and mandible) and tracks them for each frame of video



Proposed methods

Data processing

- **DeepLabCut** - new method of processing ultrasound recordings using machine learning and markerless pose estimation (Wrench & Balch-Tomes 2022)

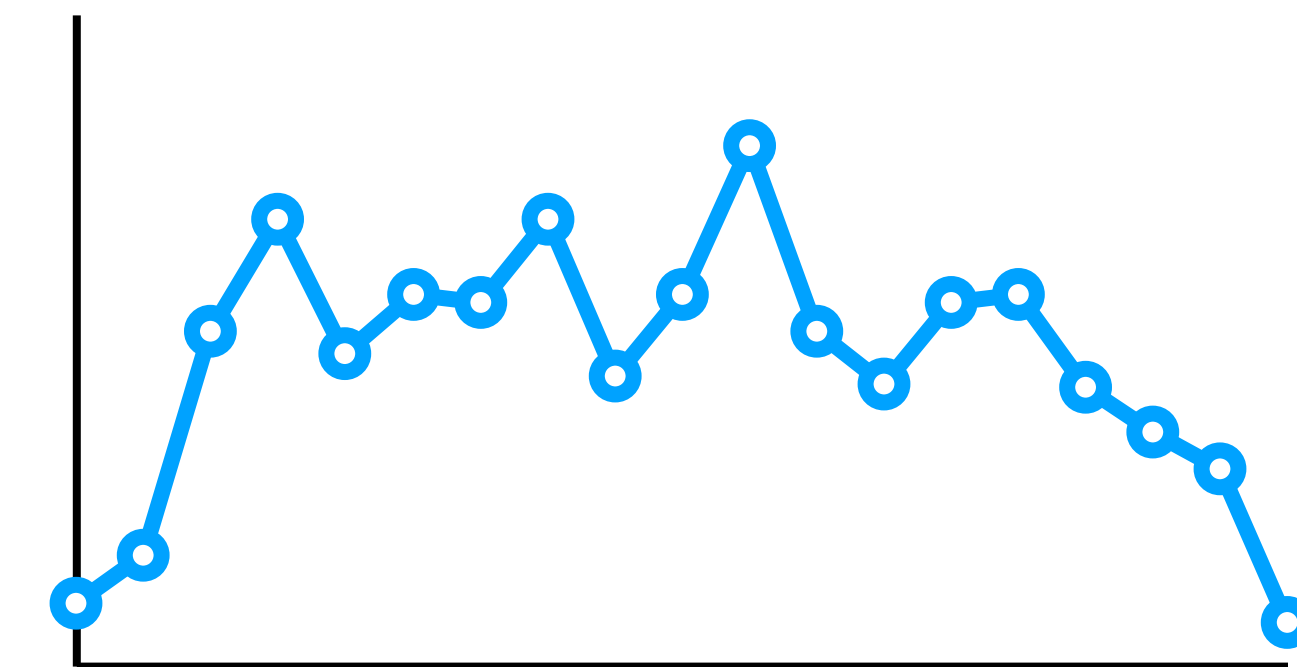
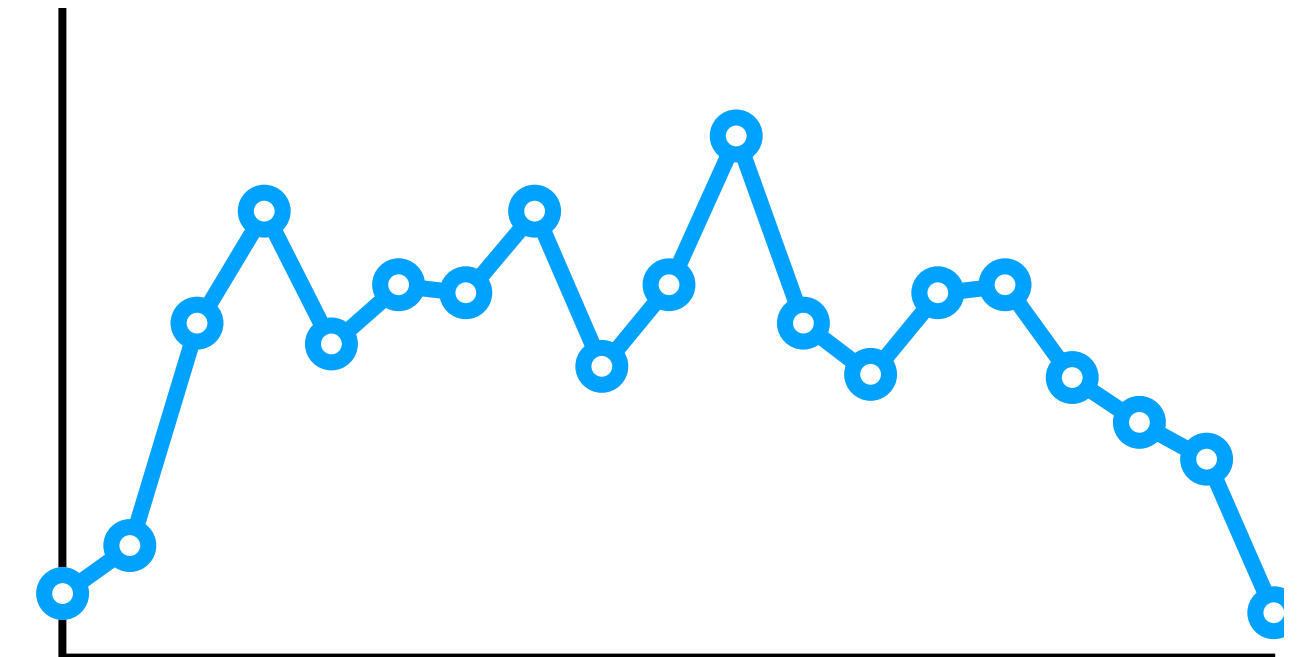


Proposed methods

Data processing

Dynamic analysis across the sibilant duration rather than focusing on the more commonly analysed midpoint

- distinguish between gradient phonetic effects vs. categorical/phonological implementation



Proposed methods

Stimuli design

I said...

		<i>/s/</i>	<i>/stɹ/</i>	<i>/stj/</i>	<i>/ʃ/</i>
<i>th/ə/</i>	<i>/u:/</i>	soup	stroop test	student	chute
	<i>/i:/</i>	seat	street	—	sheet
	<i>/ɒ/</i>	sock	strop	—	shot

Proposed methods

Stimuli design

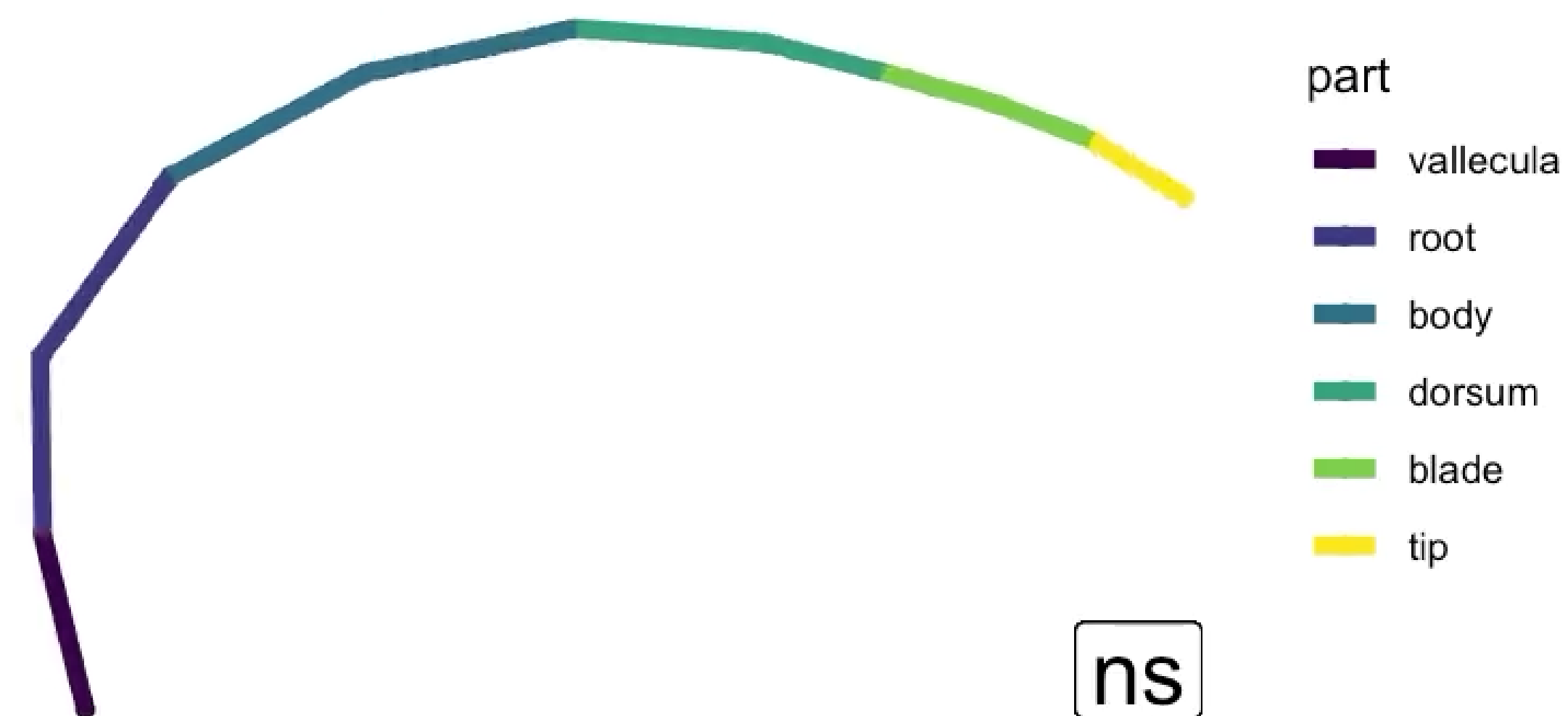
I said...

		<i>/ʃ, ʒ/</i>	<i>/tʃ, dʒ/</i>	<i>/tɹ, dɹ/</i>	<i>/tj, dj/</i>	<i>/ɹ/</i>	<i>/j/</i>
thi <i>/s/</i>	<i>/uː/</i>	shoe	chew toy	trooper	tube	room	youth
	<i>/iː/</i>	sheep	cheese	tree	—	reed	yeast / year
	<i>/ɒ/</i>	shop	chopper	trolley	—	rock	yacht
the <i>/z/e</i>	<i>/uː/</i>	—	jewels	druids	dunes		
	<i>/iː/</i>	gilets	jeeps	dreams	—		
	<i>/ɒ/</i>	genres	jobs	drops	—		

Preliminary results

- Pilot data for two speakers:
 - both 30-year-old males from Greater Manchester
- Three weeks ago: *cool animated plots* 😊
- Now: some actual (preliminary) results!

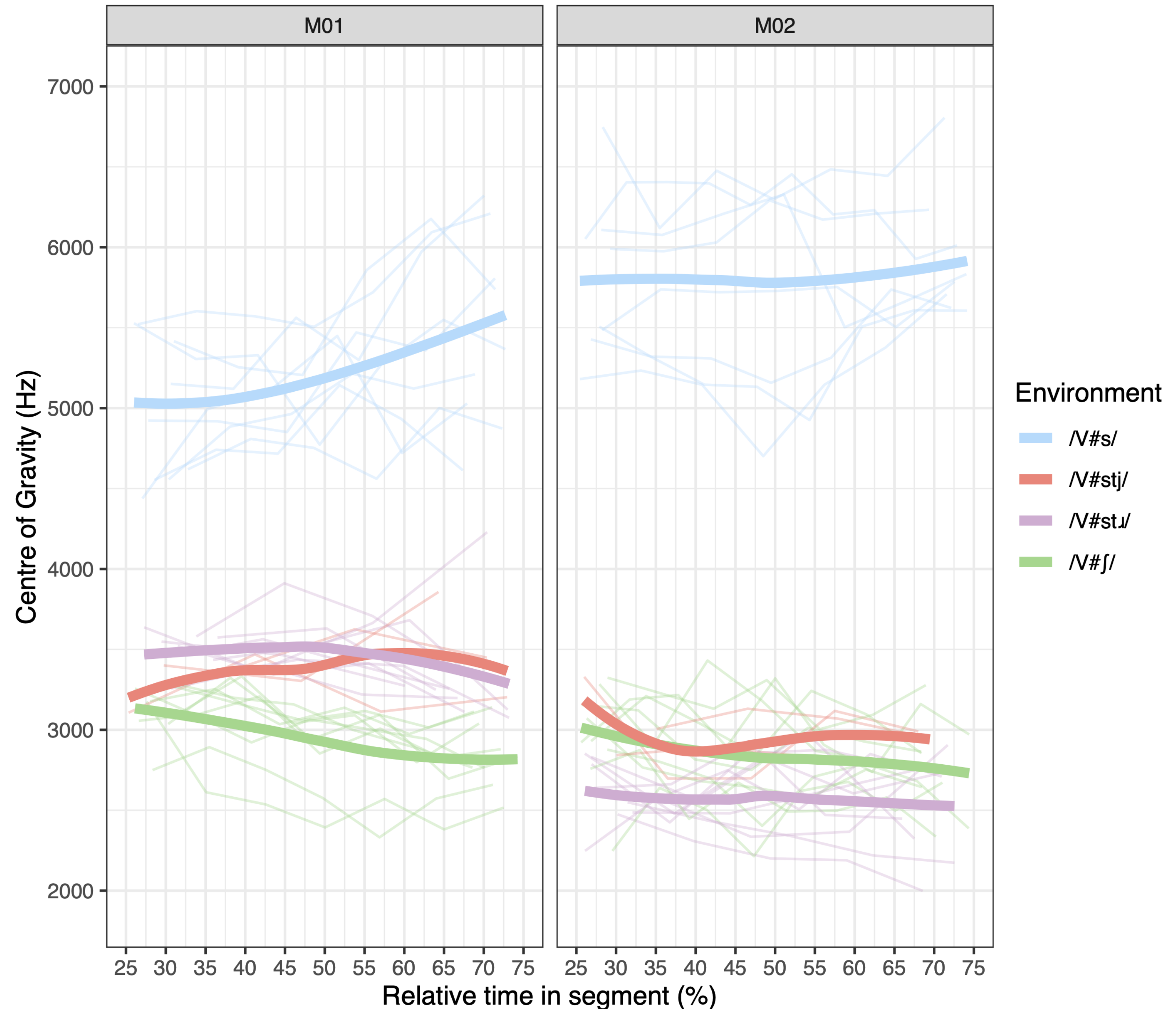
Frame: 51
I said this chew toy



Acoustic results

Word-initial /s/ contexts

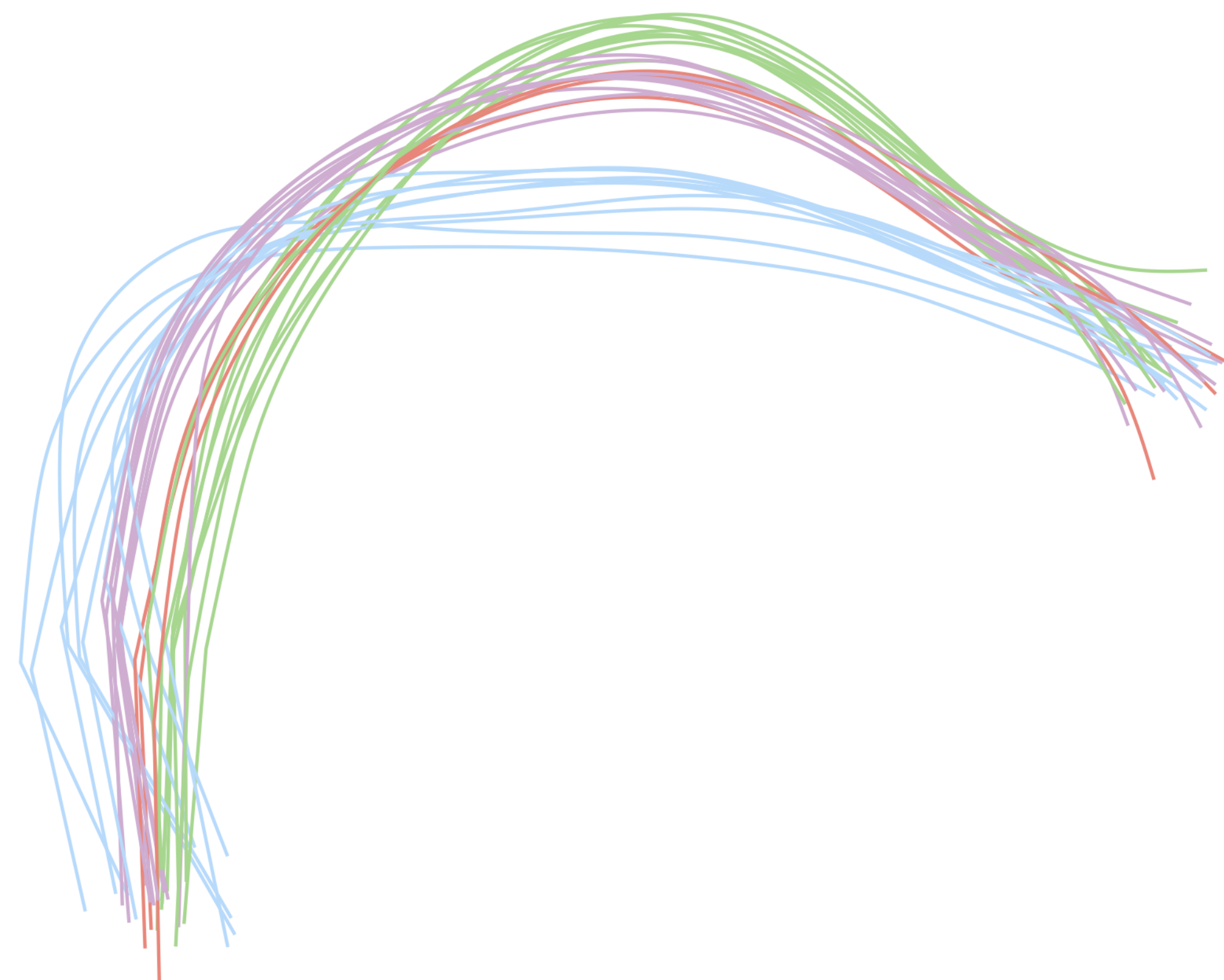
- Both speakers show clear acoustic retraction in terms of CoG
- Clustering of /str/ and /stj/ for both speakers, and quite stable across the segment
- Although for M02 /str/ even more 'hushy' than /j/



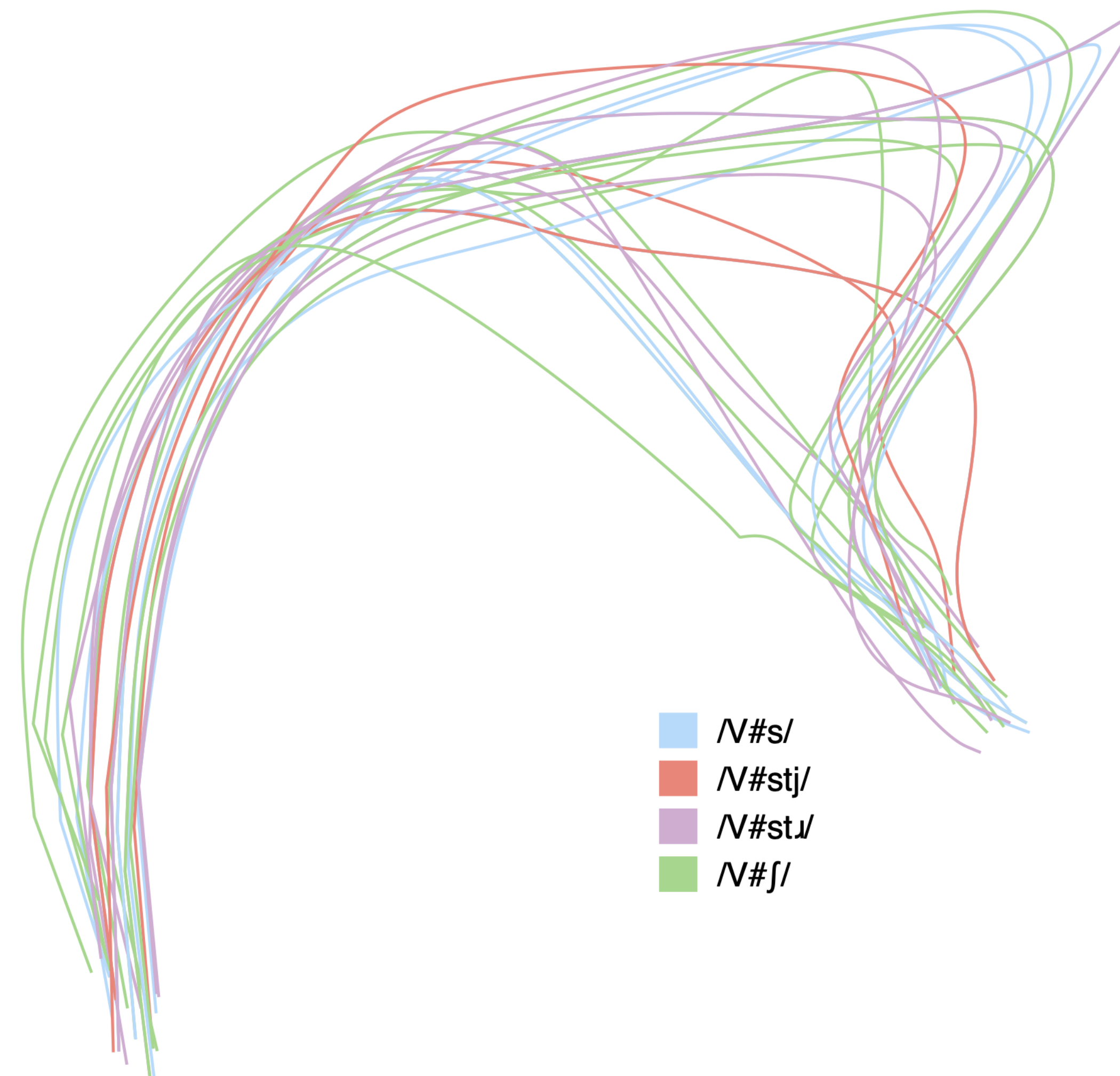
Articulatory results

Word-initial /s/ contexts

M01



M02

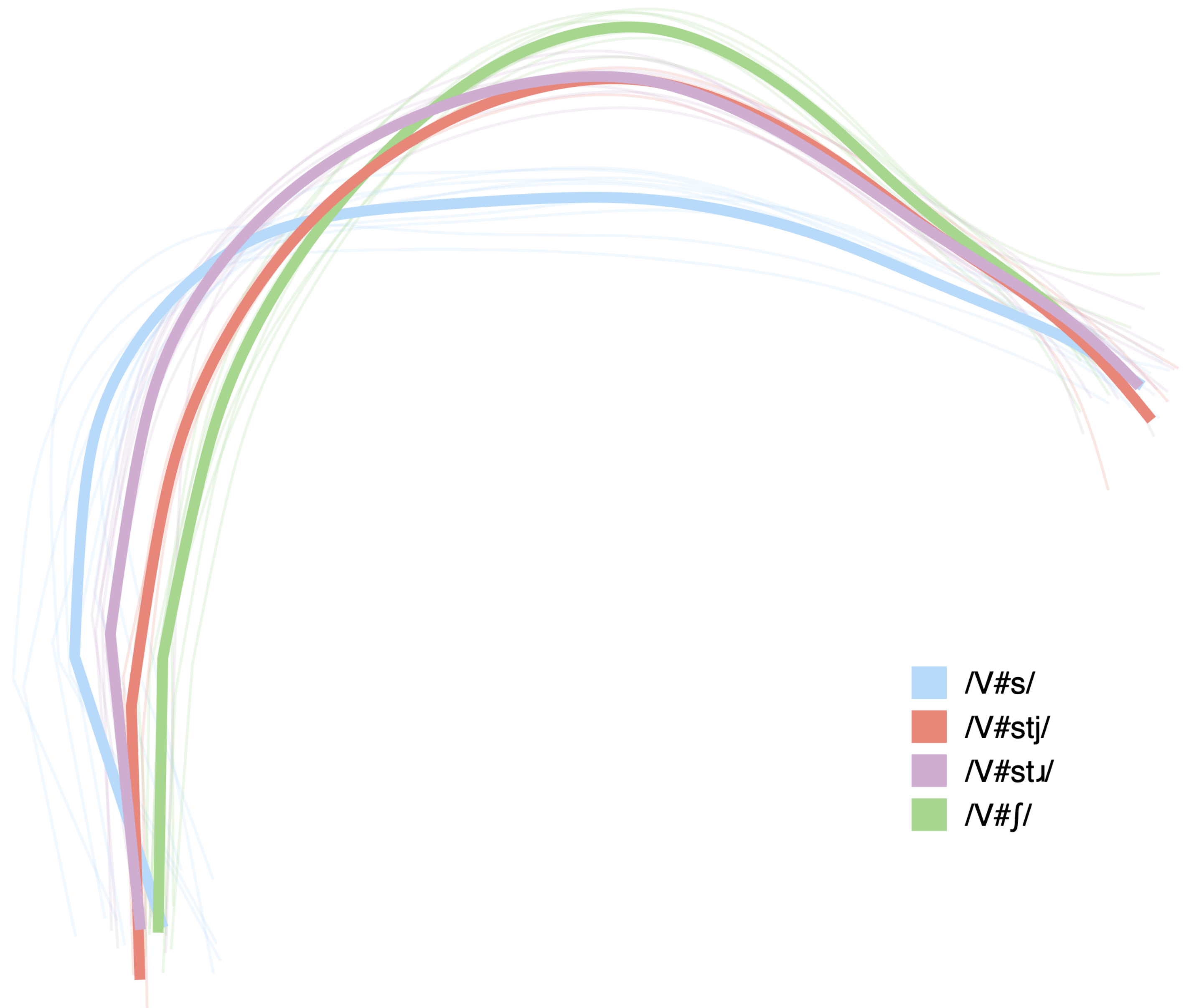


- *N#/s/*
- *N#/stj/*
- *N#/stɹ/*
- *N#/j/*

Articulatory results

Word-initial /s/ contexts

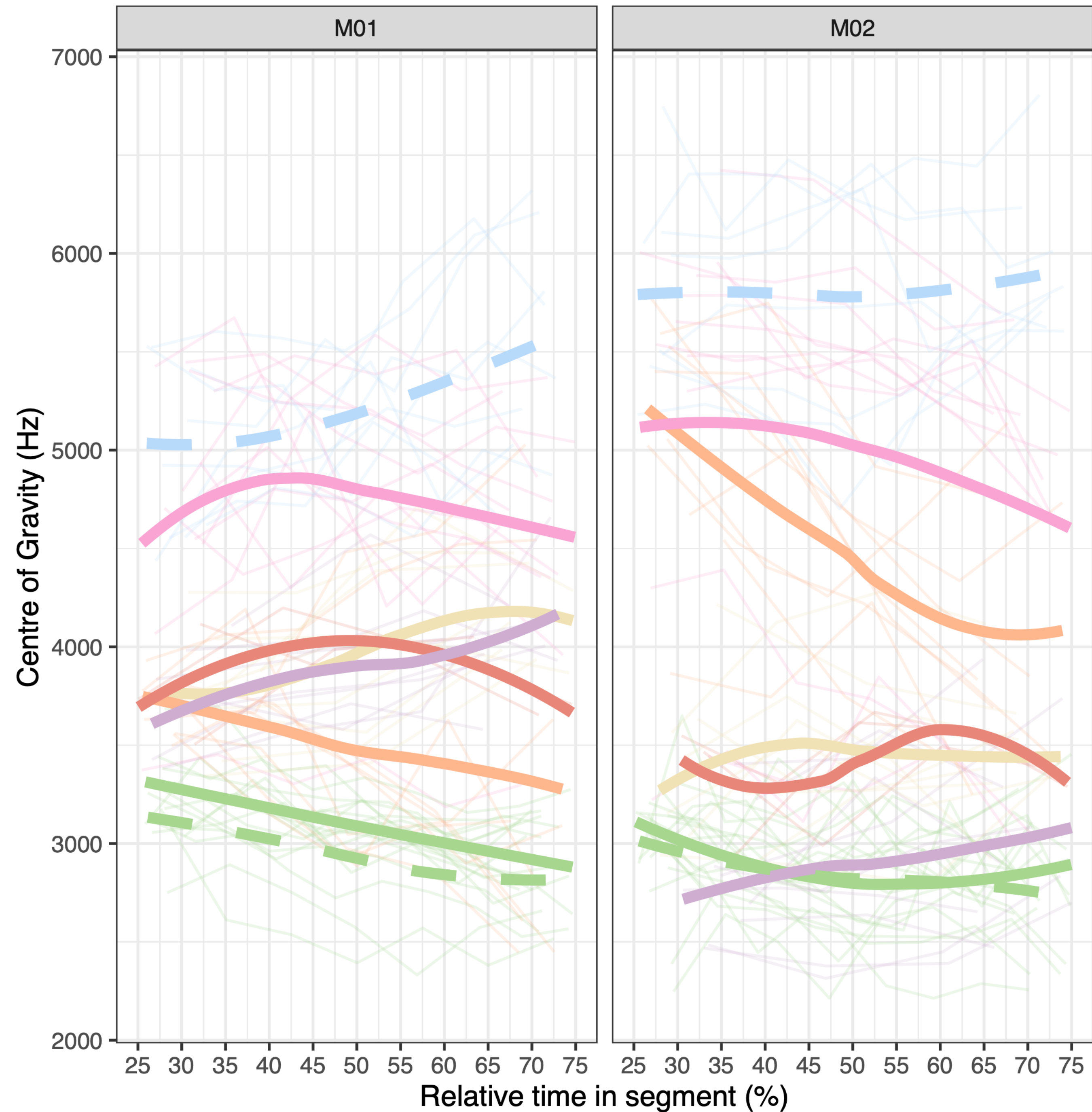
- Similar pattern in lingual articulation, reflecting acoustics
- /str/ and /stj/ somewhere in between the tongue shapes of /s/ and /ʃ/, but closer to the latter (at least in tongue body, more intermediate in root)



Acoustic results

Post-lexical /s/ contexts

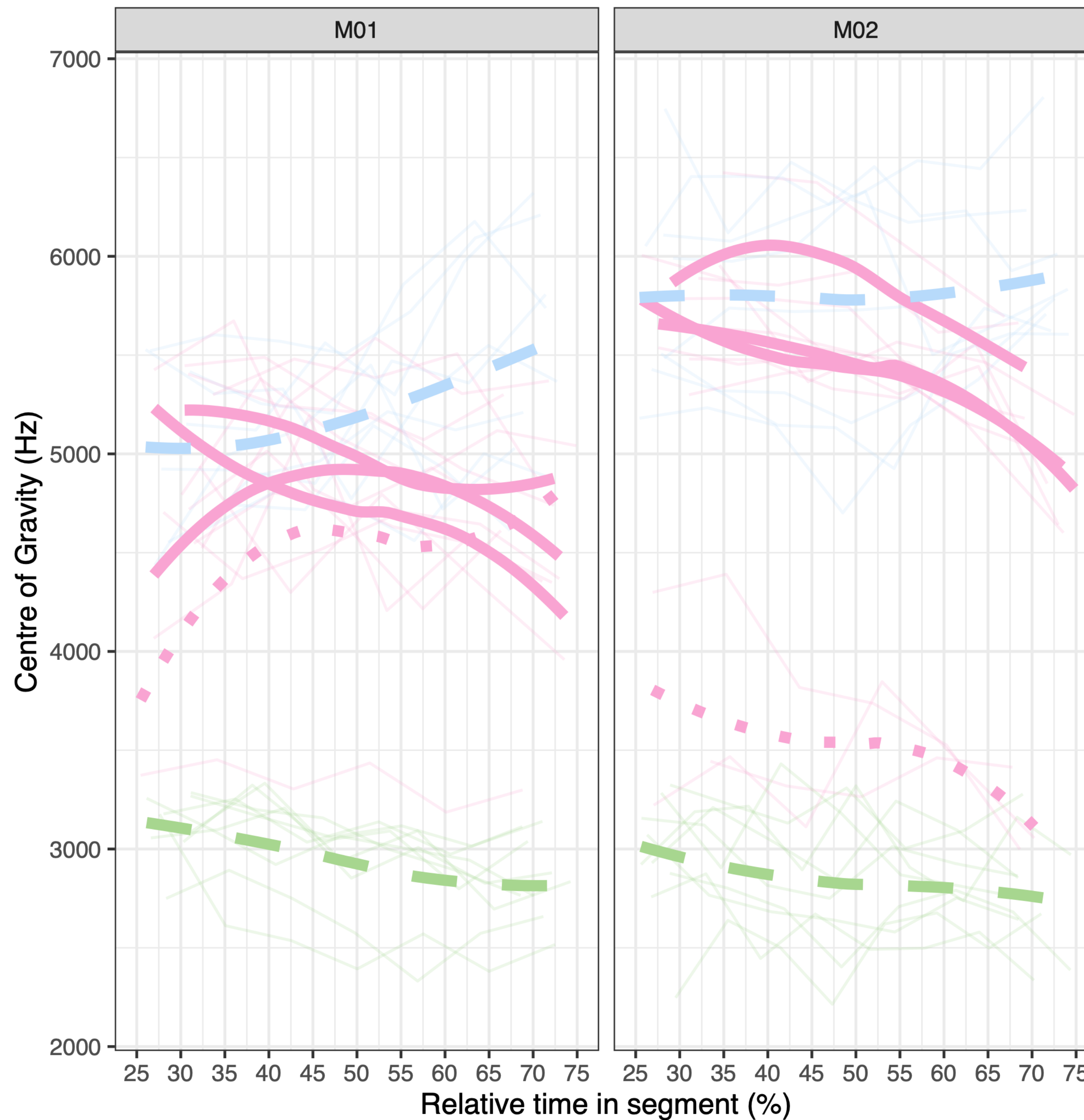
• ...



Acoustic results

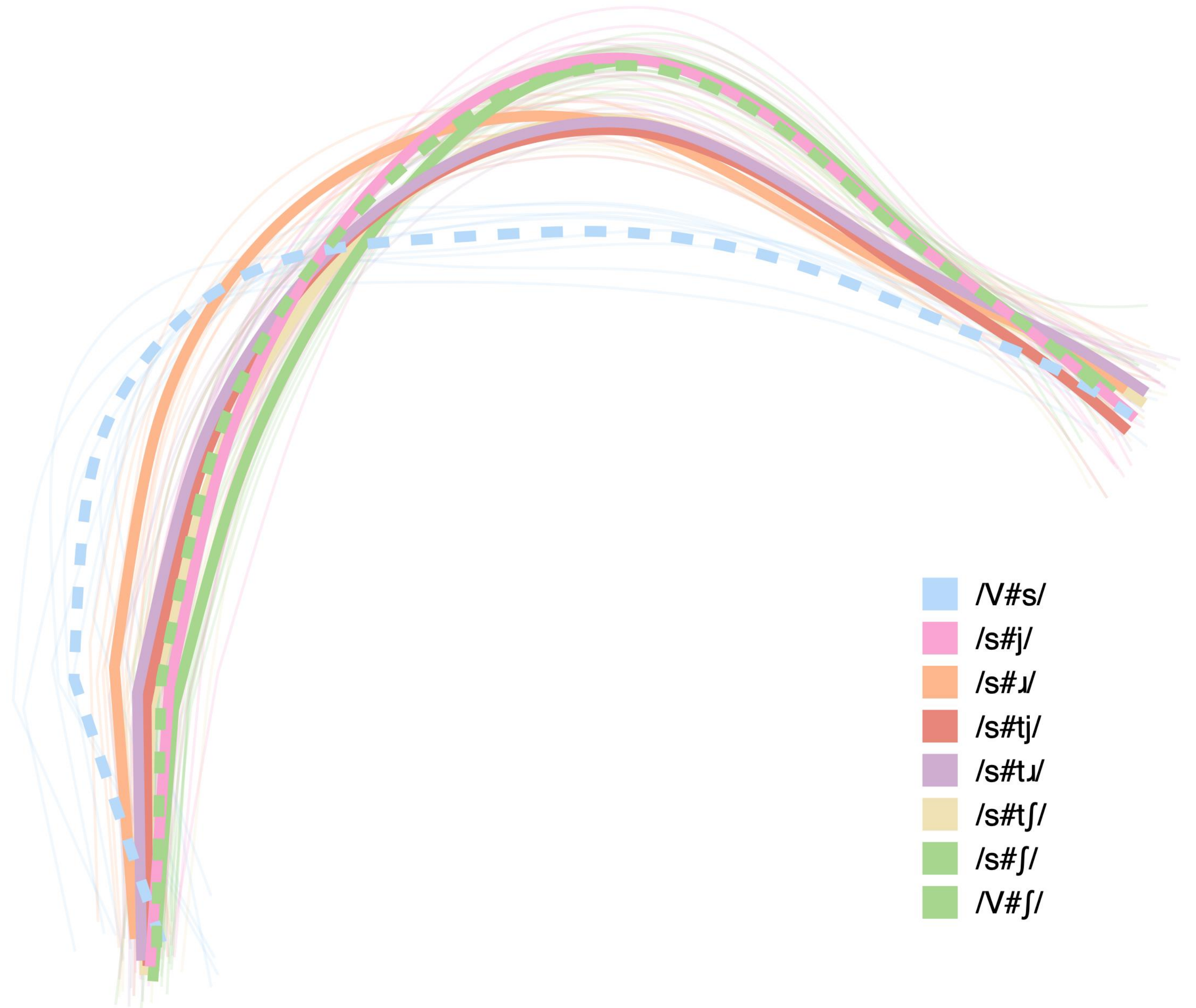
Post-lexical /s/ contexts

• ...



Articulatory results

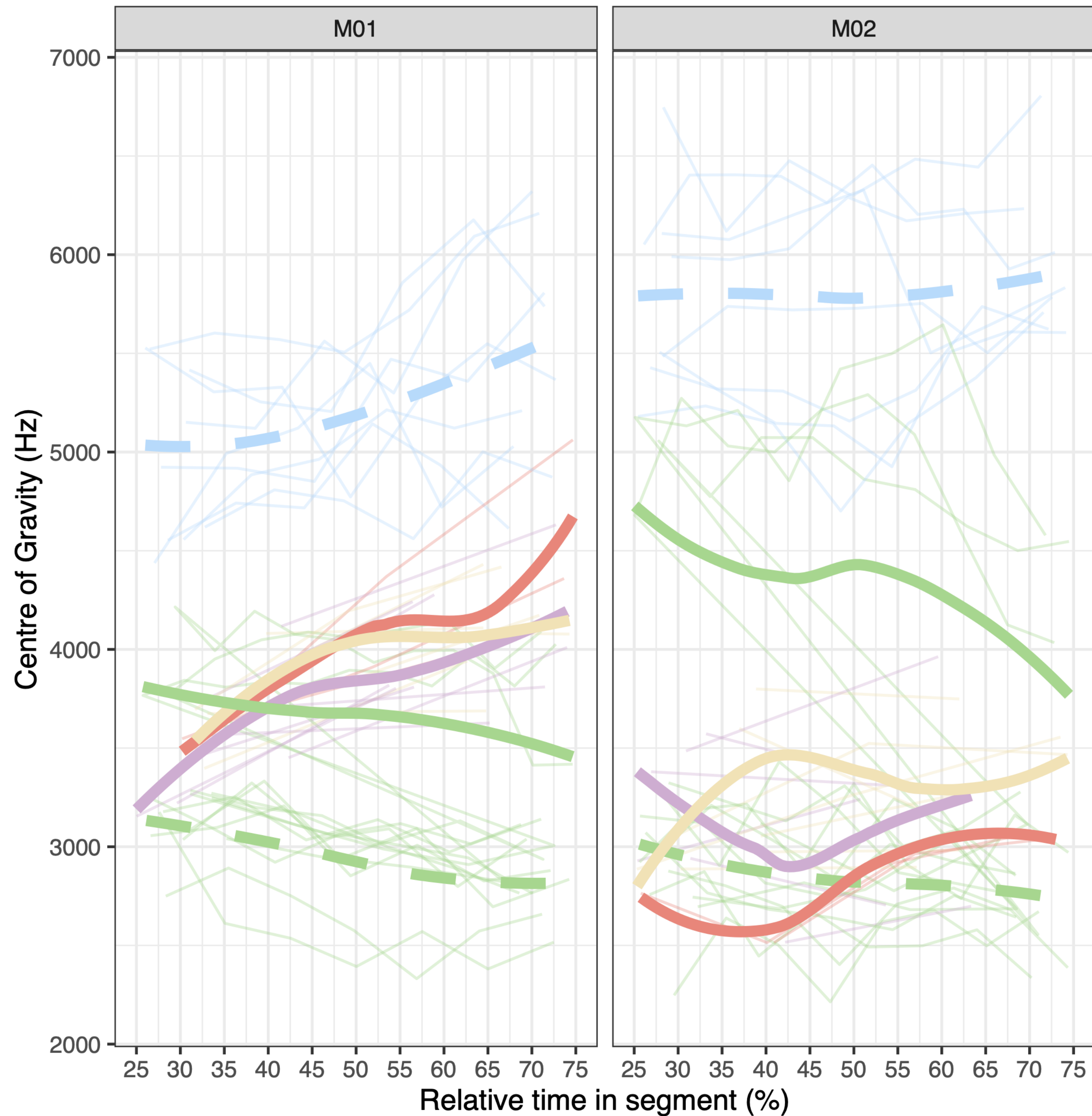
Post-lexical /s/ contexts



Acoustic results

Post-lexical /z/ contexts

• ...



Theoretical significance

Contributing to our understanding of:

- post-lexical vs word-level behaviour in **pathways of sound change** (e.g. Bermúdez-Otero 2015 on the LIFE CYCLE OF PHONOLOGICAL PROCESSES)
 - see Zsiga (1995) on categorical retraction in word-internal *pressure* but gradient in *press you*
- competing accounts over the **triggering mechanisms** behind /s/-retraction
 - non-local assimilation to /ʃ/? (Shapiro 1995; Baker et al. 2011)
 - local assimilation to following /t/-affrication? (Lawrence 2000; Bailey et al. 2022)
- the role of **generalisation** in the spread of a sound change and its targeted environments
 - comparing retraction of /s/ and /z/, which have different positional distributions
 - see also Chodroff & Wilson (2022) on phonetic uniformity in sibilant production

Thanks!

Questions for you!

✉ Email us!

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data
collection/
analysis

camera orientation: lip
rounding vs protrusion?

other **methods** of analysing
acoustics/articulation?

any **additional environments** to
include?

expanding from just DET+N
constructions? (e.g. varying **prosodic
boundaries** between /s/ and trigger)

stimuli
design

theoretical
significance

any other **connections to
literature** that we've
overlooked?

References

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