New ways of analysing ~~variation~~ sibilant palatalisation

The acoustics and articulation of post-lexical /s, z/-retraction in Manchester English

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Introduction

- Most studies of sibilant palatalisation have focused on /s/-retraction
  - a process that turns **/s/** into a more **[ʃ]**-like sound
  - e.g. *street* /stɹiːt/ → [ʃtɹiːt] or [ʃtʃɹiːt]
  - 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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(#)stj
e.g. student

(#)stɹ
e.g. street

stʃ
e.g. mischief

s#tɹ
e.g. this trick

s#tj
e.g. nice tune

s#tʃ
e.g. glass chunk

s#ɹ
e.g. this rock

s#j
e.g. press you

z#dʒ
e.g. wise job

z#dj
e.g. these dunes

z#dɹ
e.g. his drink

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

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

- Existing articulatory studies using ultrasound and lip-camera data highlight the important role of lip rounding
  - Smith et al. (2019) include /s,z#ɹ/ among their target environments and find a larger role of lip rounding than of tongue shape/position
  - Thielking (2022) likewise finds a strong correlation between lip rounding and retraction word-initially in Glasgow English

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; Bailey et al. 2022)

Research questions

1. What are the relative roles of the different articulatory gestures and their relationship with the acoustic output?
2. Is there inter-speaker variation in the (magnitude of the) roles played by these different gestures, and are they changing at different rates during the progress of this sound change?
3. How does the change behave in these different prosodic/phonological environments?
4. 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

+

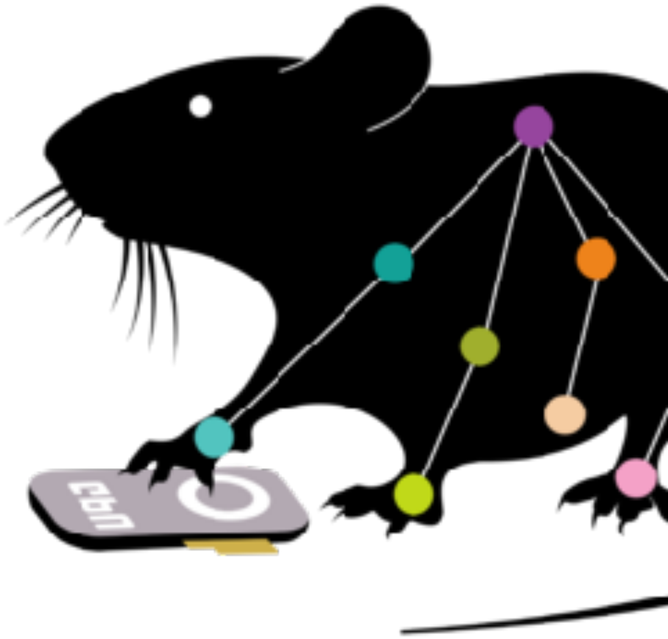
side-profile **lip camera recording**

+

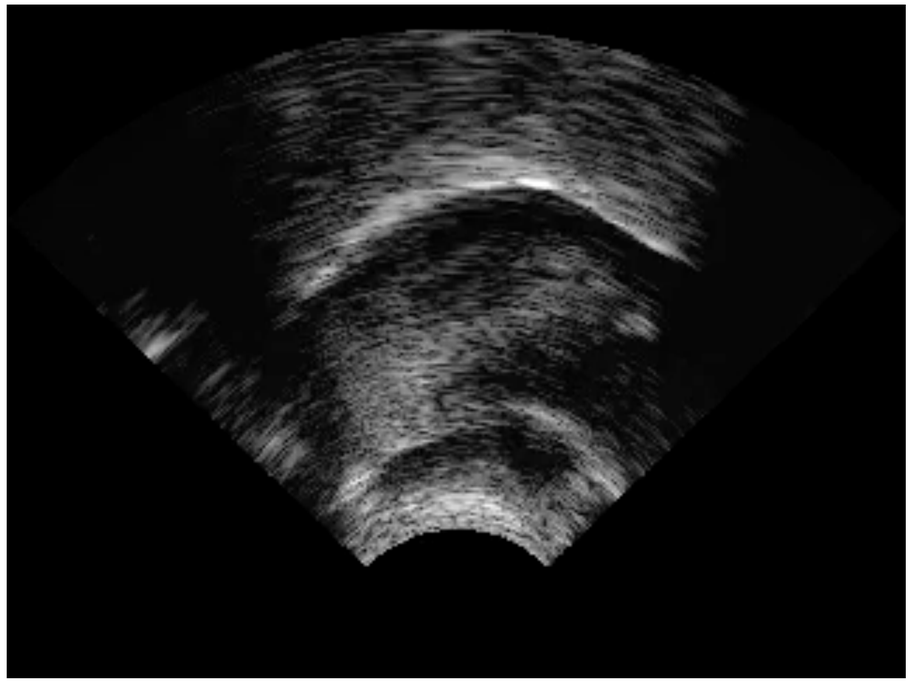
audio recording

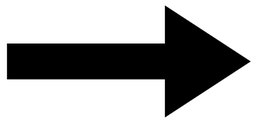
Proposed methods

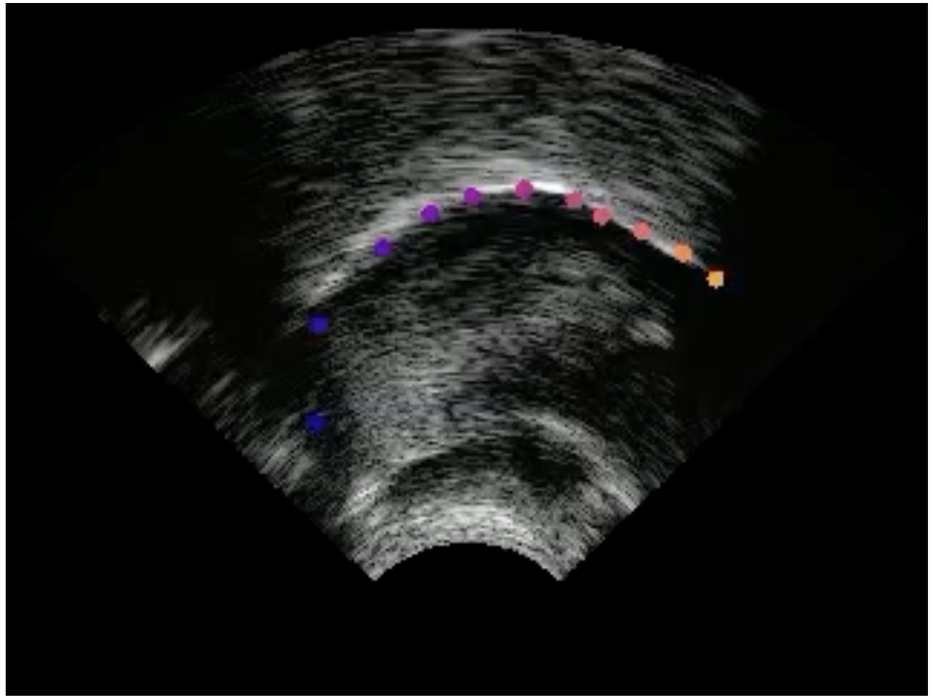
Data processing



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





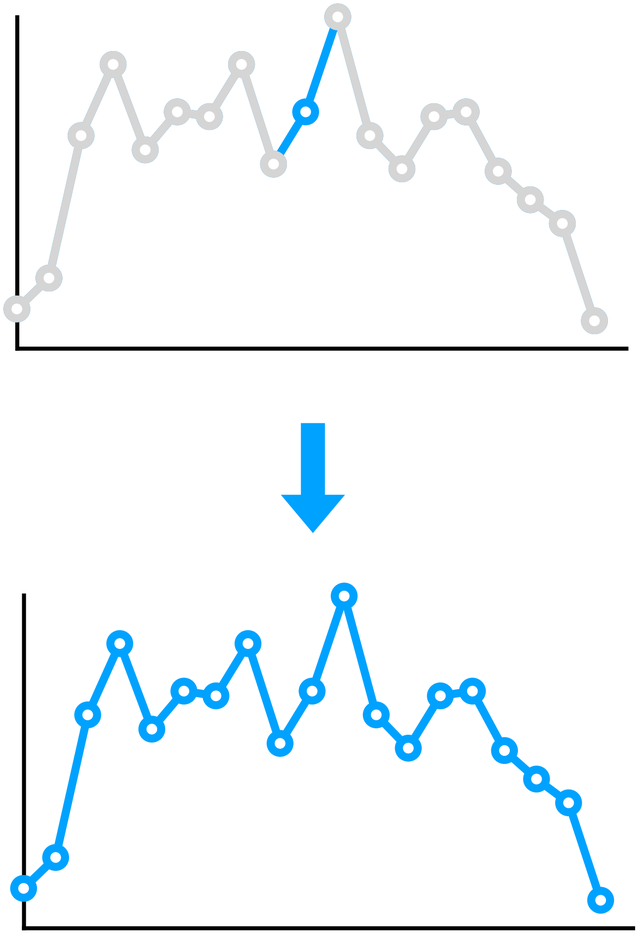


Proposed methods

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...

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

Proposed methods

Stimuli design

			/s/	/stɹ/	/stj/	/ʃ/
I said…	th/ə/	/uː/	soup	stroop test	student	chute
		/iː/	seat	street	—	sheet
		/ɒ/	sock	strop	—	shot

Theoretical significance

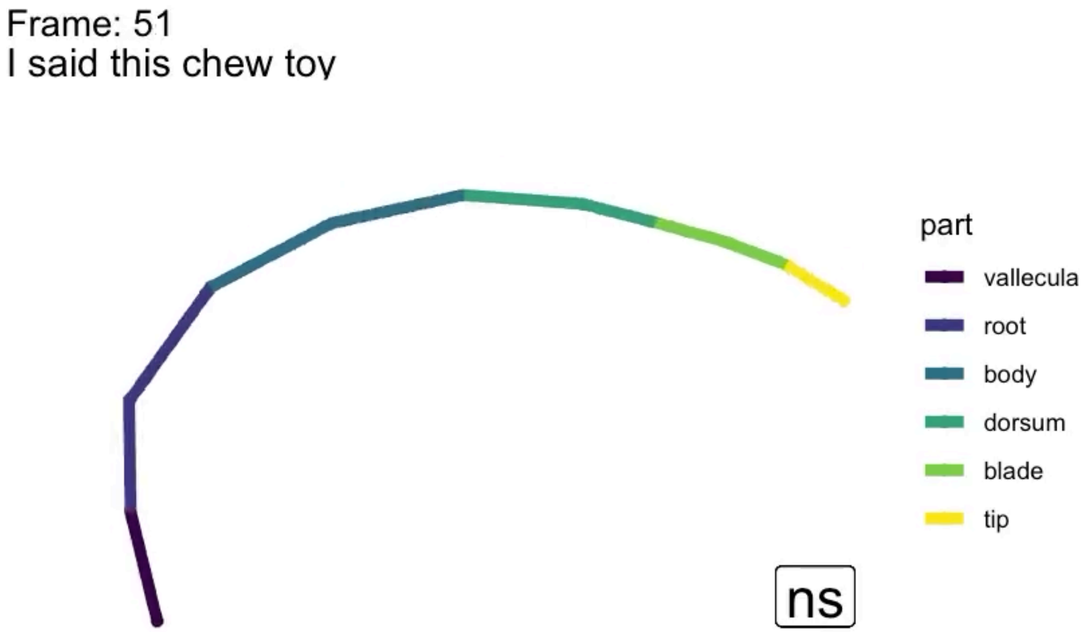
Contributing to our understanding of:

- 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 (1990) 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 /ɹ/? (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

What we've got so far

- A fully-developed workflow for processing and analysing tongue splines from DeepLabCut
- Some neat animated plots using `gganimate` in R!
- Next steps: analysing lip camera data; correlating articulatory gestures with the acoustic signal; recording more speakers

Watch this space!



Questions for NWAV

📧 **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?