

An articulatory study of /s/-retraction

How does **this change** behave
across word boundaries?

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UKLVC14 - University of Edinburgh
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What is **this** change?

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

e.g. Columbus, OH (Durian 2006); Philadelphia, PA (Gylfadottir 2015); Raleigh, NC (Wilbanks 2017); Louisiana (Rutter 2011); Georgia (Philips 2001); Austin, TX (Ahlers 2020); Estuary English (Altendorf 2003); Colchester (Bass 2009); Edinburgh (Sollgan 2013); Scotland (Stuart-Smith et al. 2019); Glasgow (Thielking 2023); Manchester (Bailey et al. 2022)

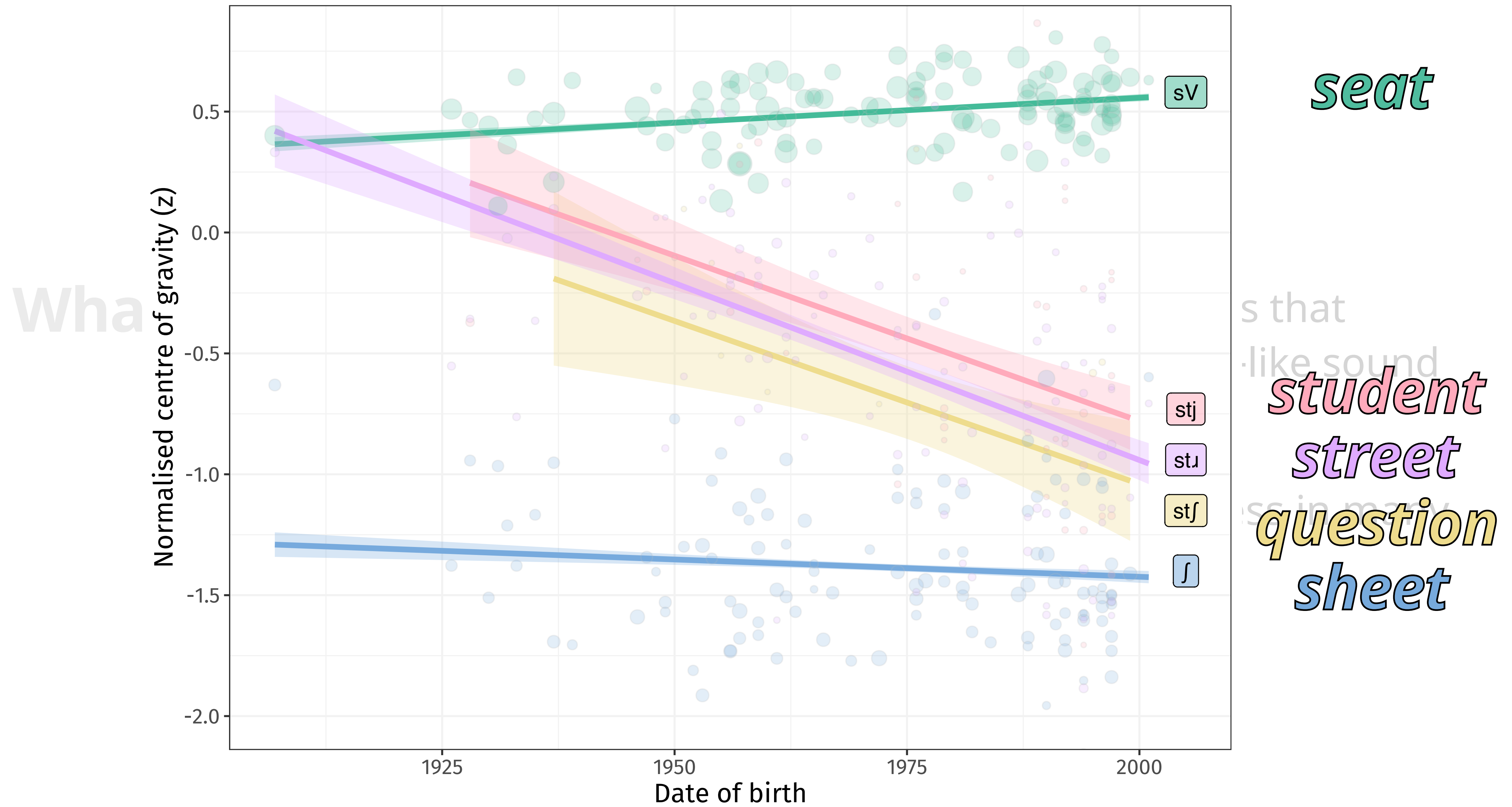
b. 1932

b. 1997



What is **thish** change?

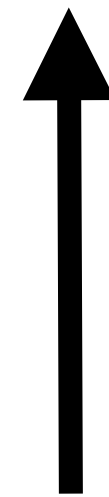
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What is this change?

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

What is **thish change**?



but it also happens
across word boundaries!

- **/s/-retraction**: a process that turns **/s/** into a more **[ʃ]**-like sound (e.g. **[ʃ]treet**)
- sound change in progress in many varieties of English
- studies have focused on word-internal retraction

Opening the envelope of variation



Opening the envelope of variation

- Studying a wider range of environments will lend insight into a number of questions, including the role of /ɹ/ (vs. affrication) in triggering retraction (Shapiro 1995; Lawrence 2000; Baker et al. 2011; Bailey et al. 2022)

(#)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

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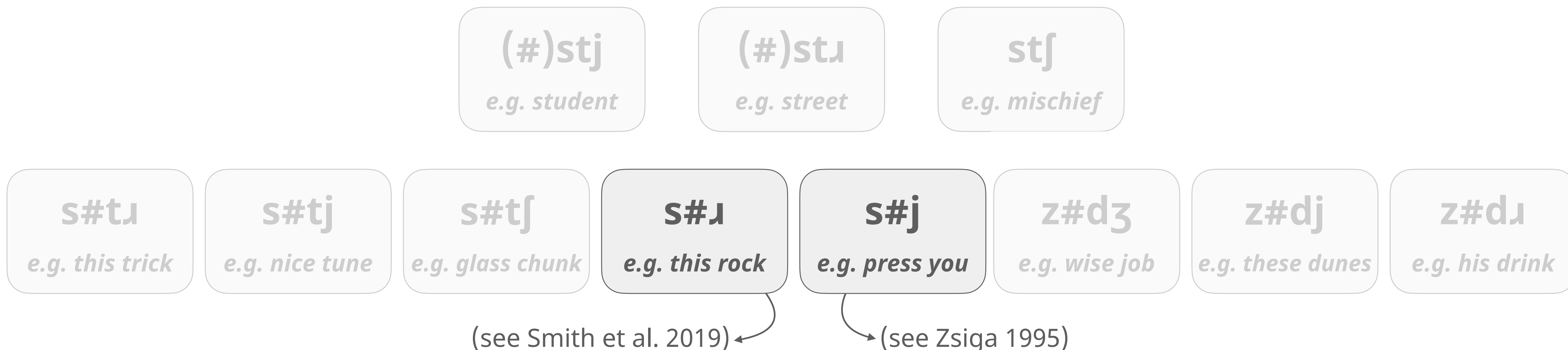
e.g. these dunes

z#dɹ

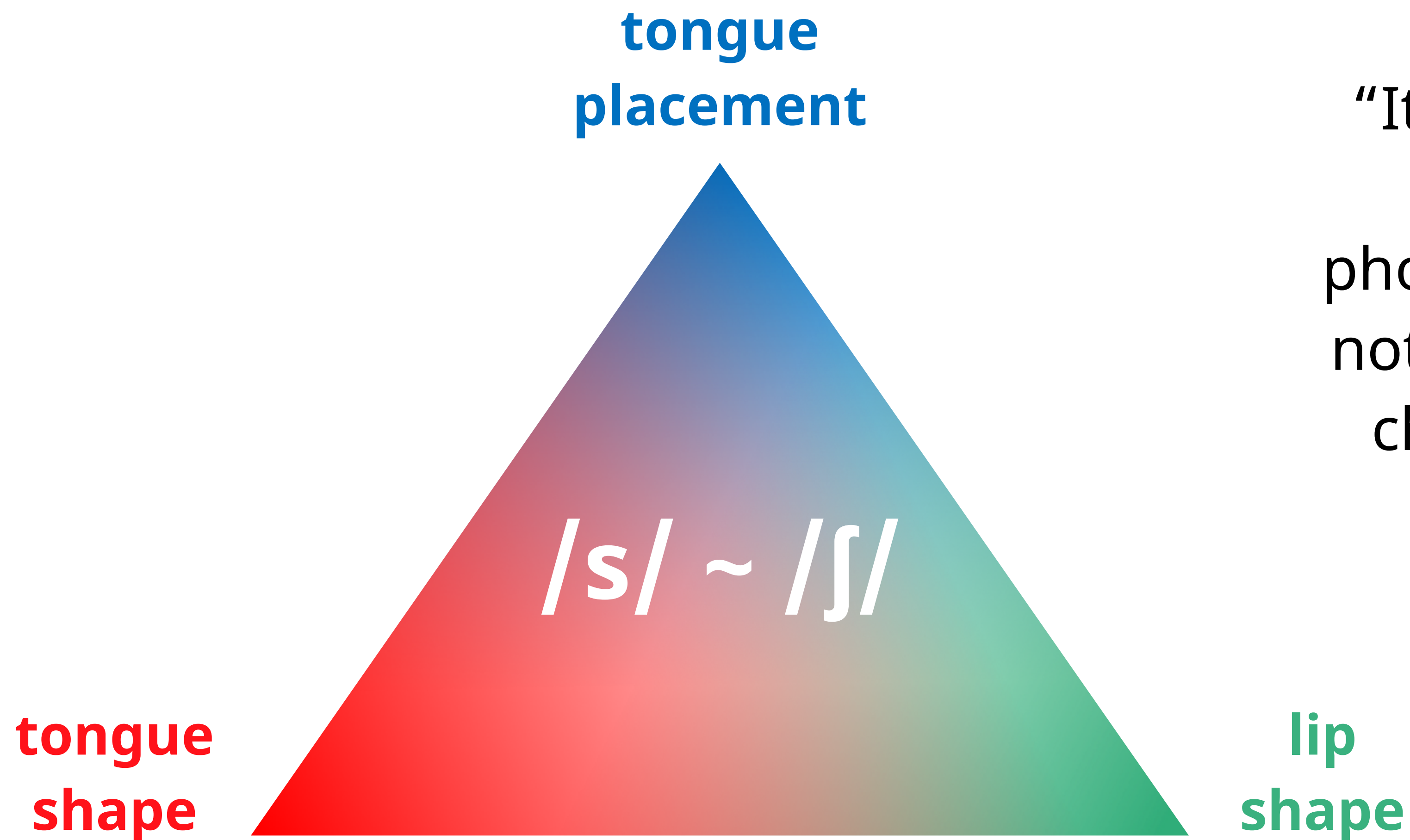
e.g. his drink

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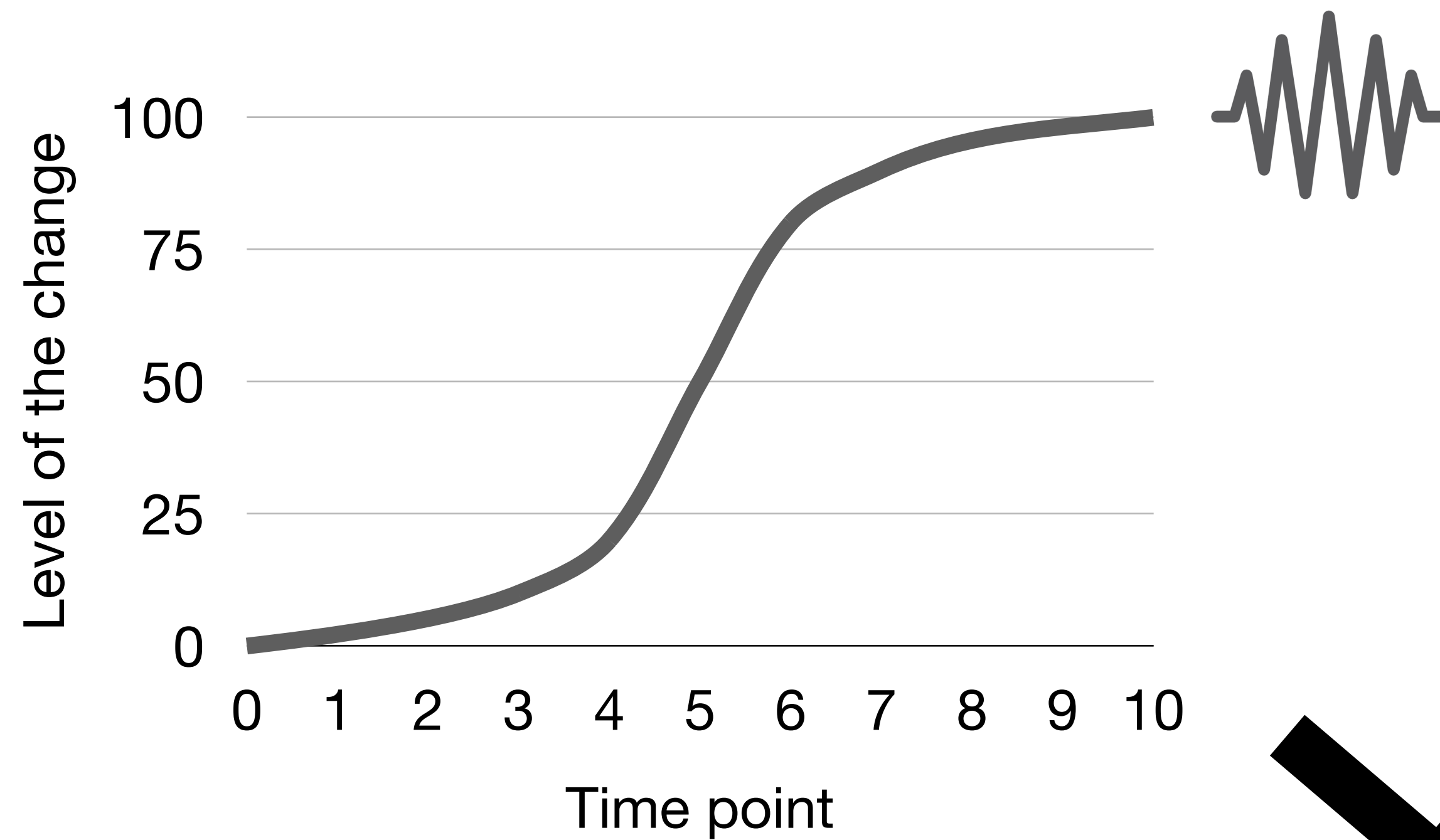


Articulation of the /s/~/ʃ/ continuum isn't just a move from alveolar to postalveolar **place of articulation** – it can also involve **tongue grooving** and **labialisation**



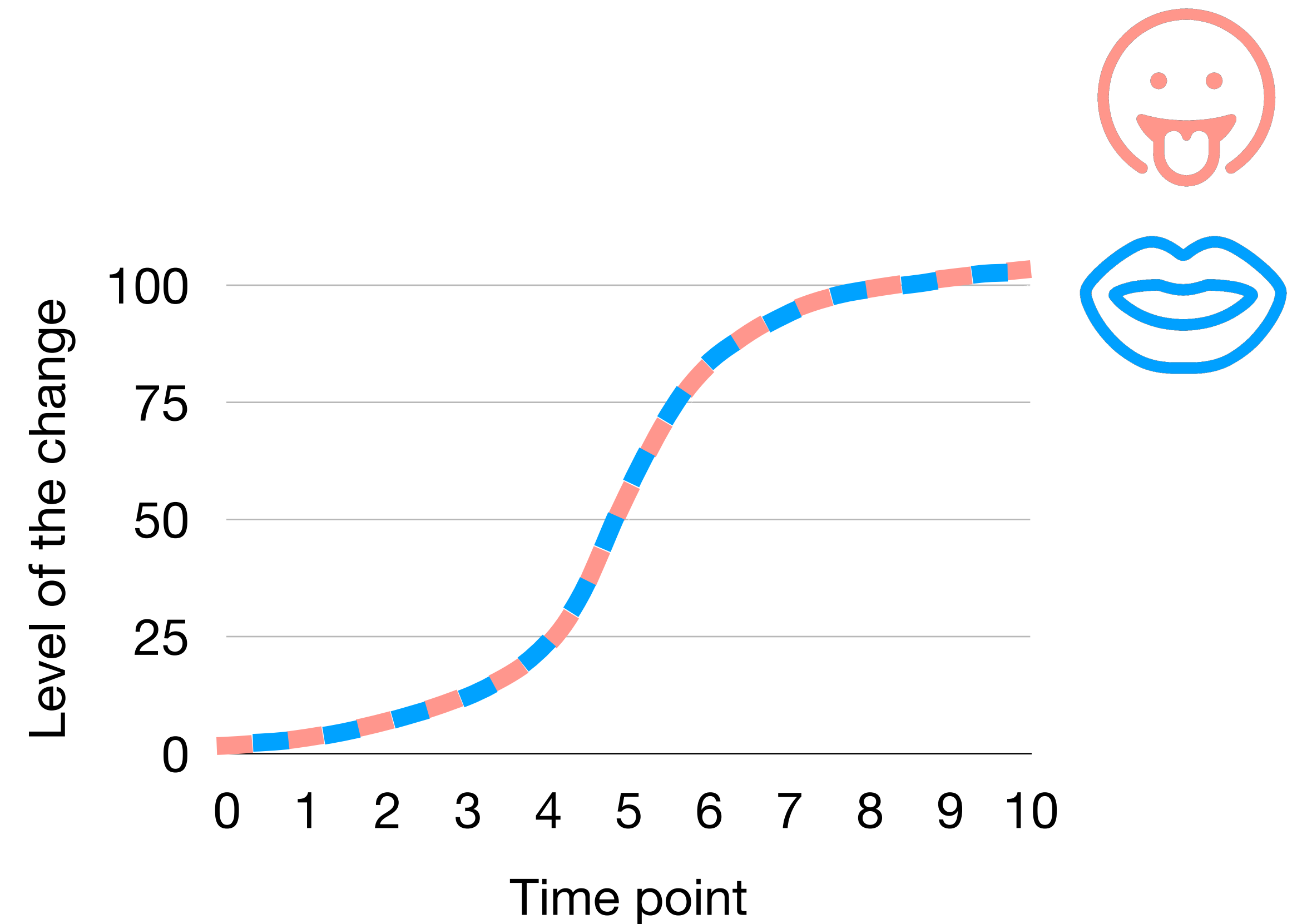
“It is also worth noting that changes in one of the phonetic parameters [...] may not necessarily co-occur with changes in the other two”

– Rutter 2011: 31

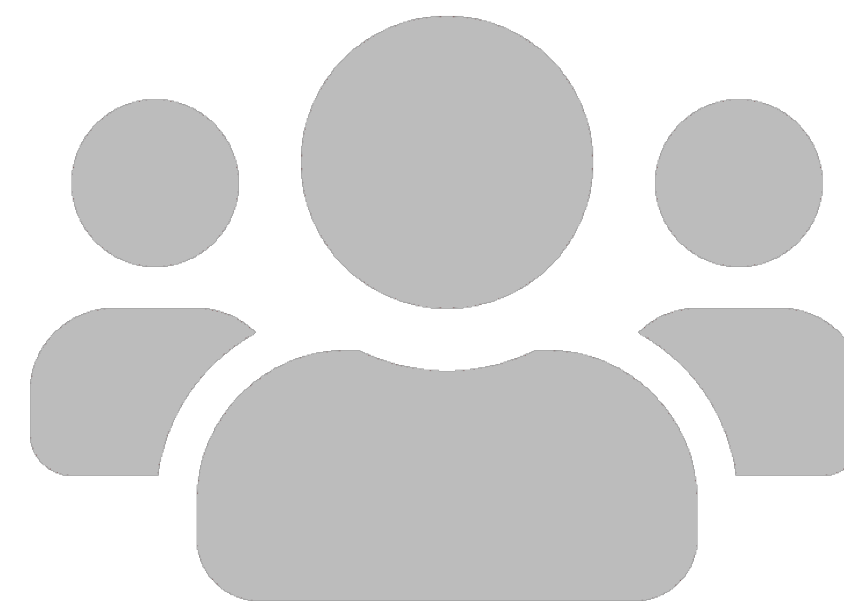
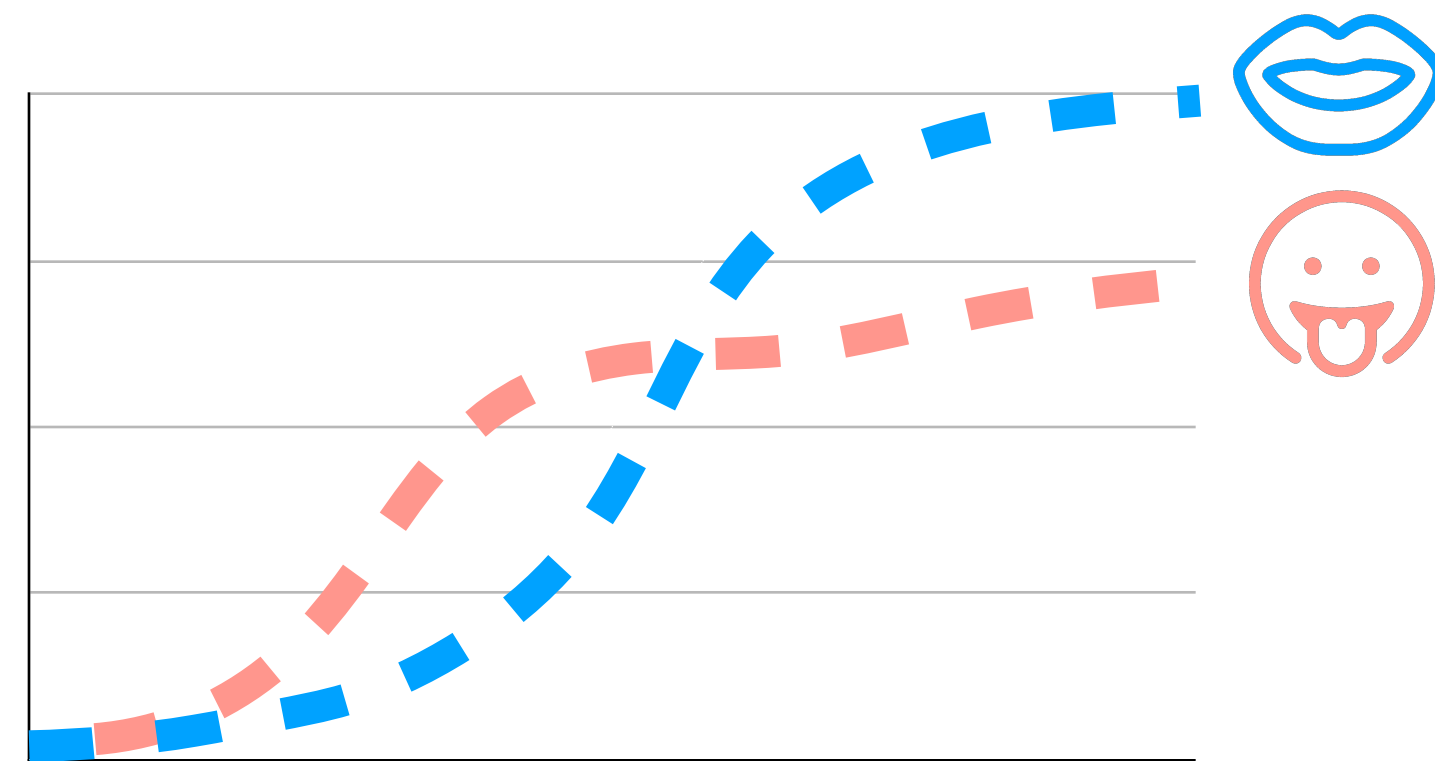
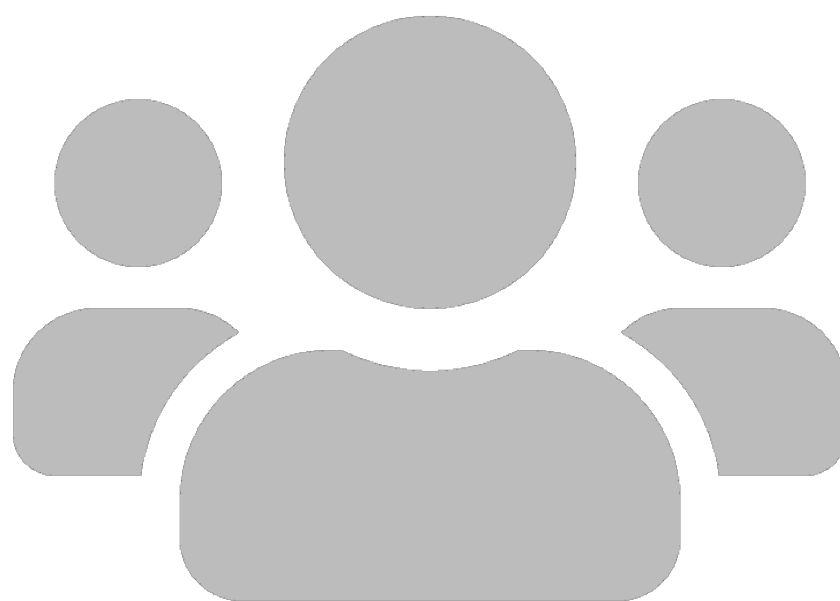
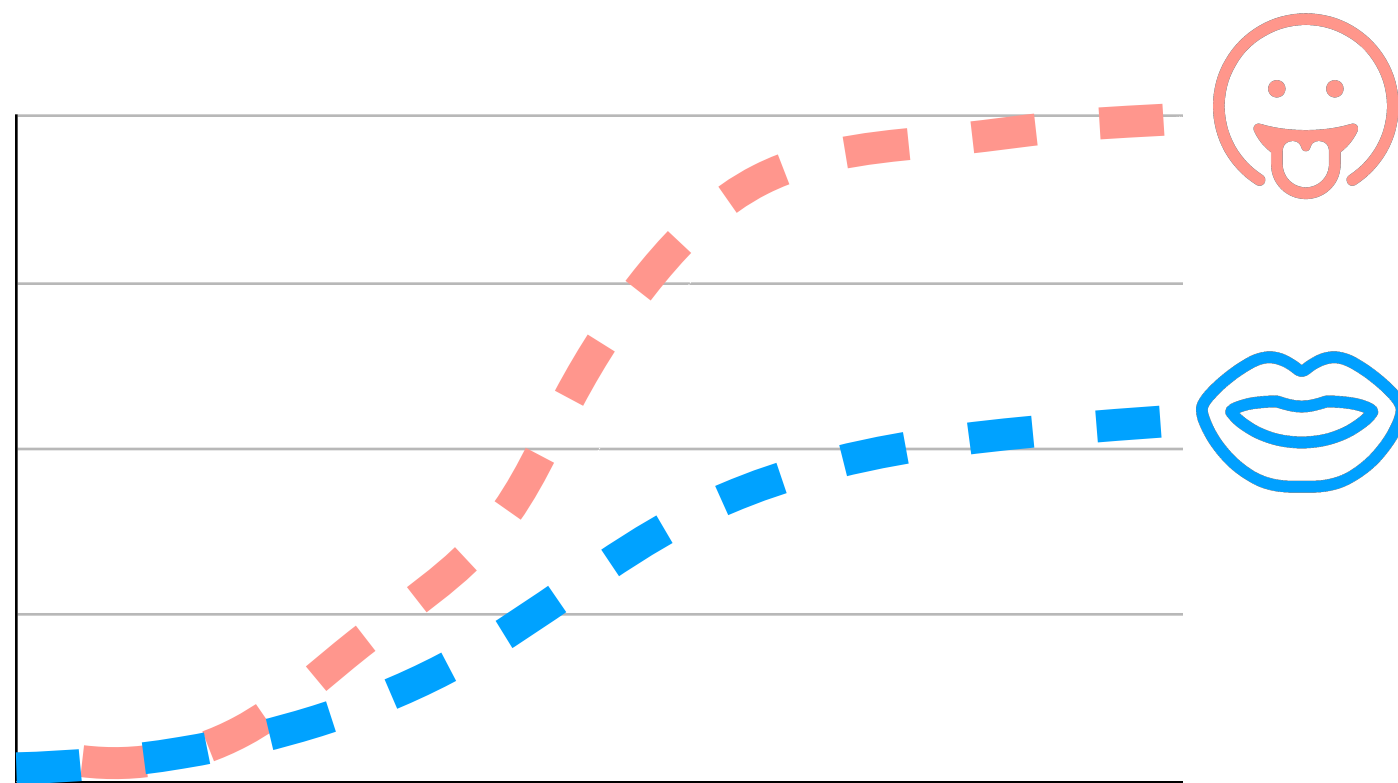
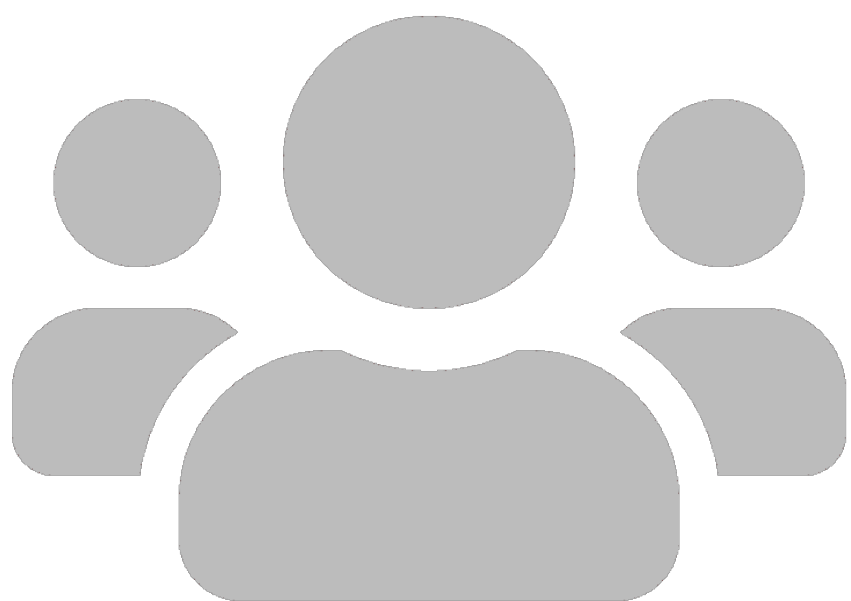
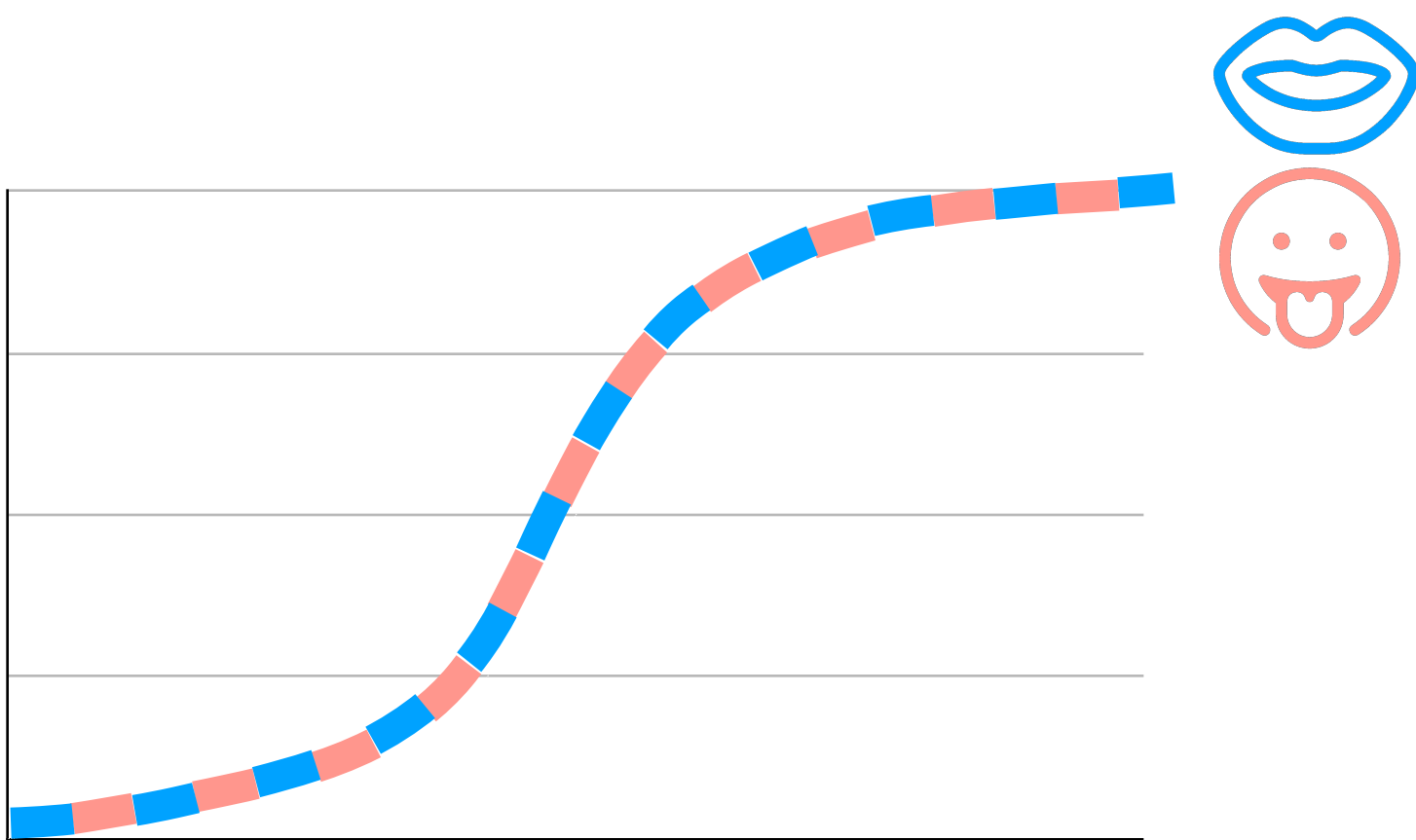


Tracking the acoustics of a sound change

Tracking the articulatory gestures involved in sound change



Articulatory variation, individuals, and the community



Methods

Data collection

- Similar to other articulatory work on /s/-retraction (Smith et al. 2019; Thielking 2022), we collect simultaneous:



**ultrasound tongue
imaging of the
midsagittal plane**

+



**front-facing
lip camera
recording**

+

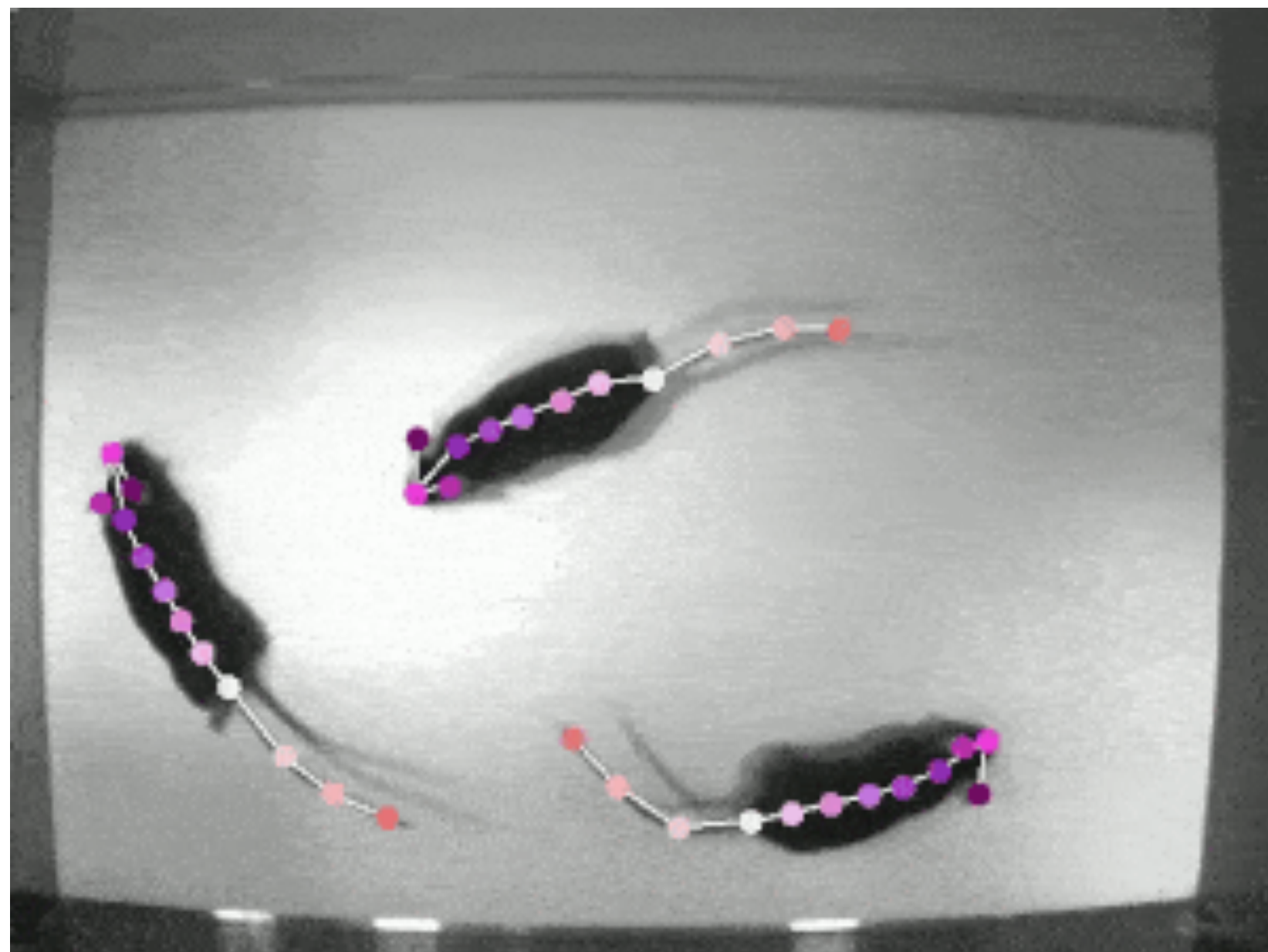


audio recording

Methods

Data processing

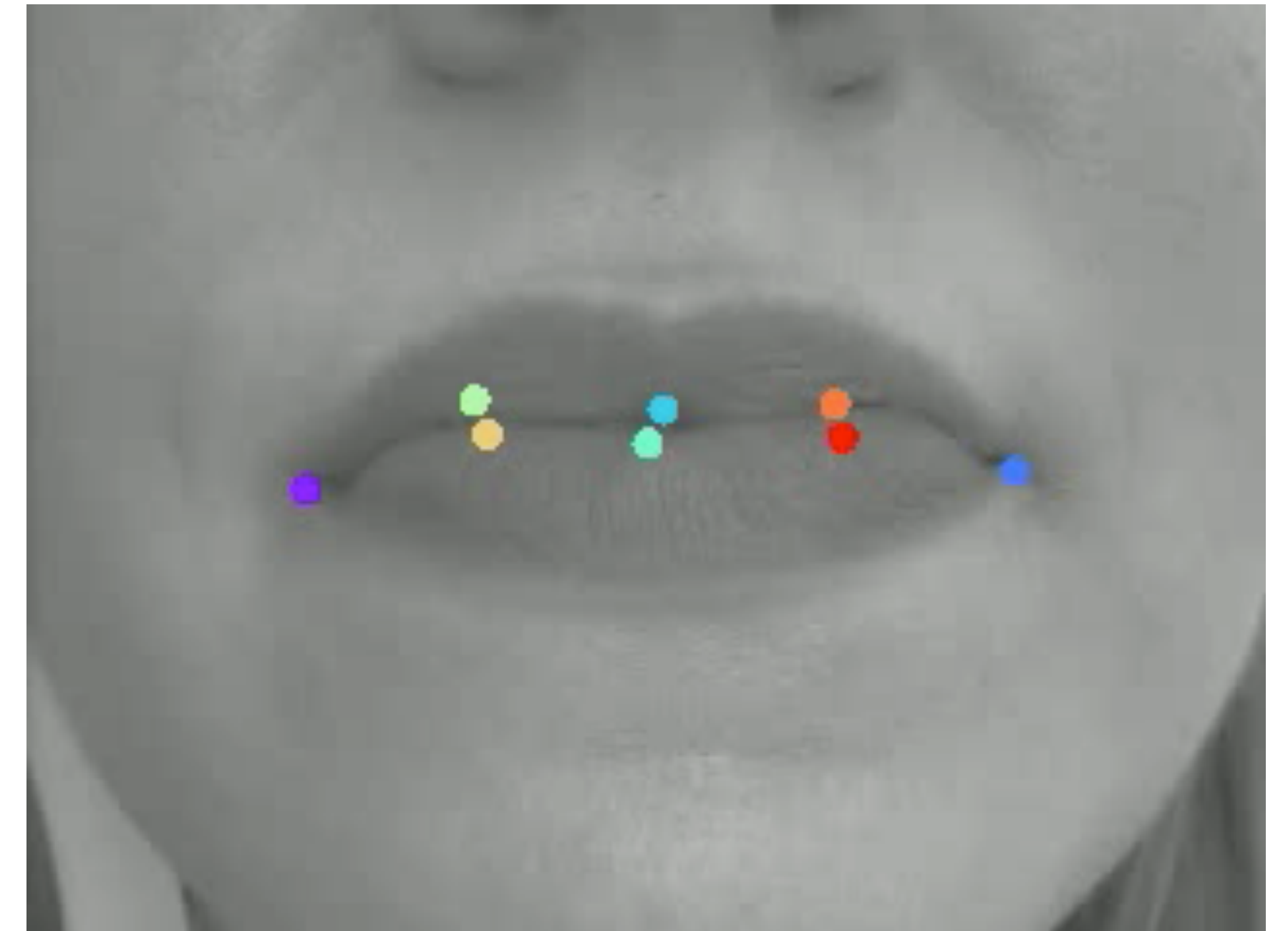
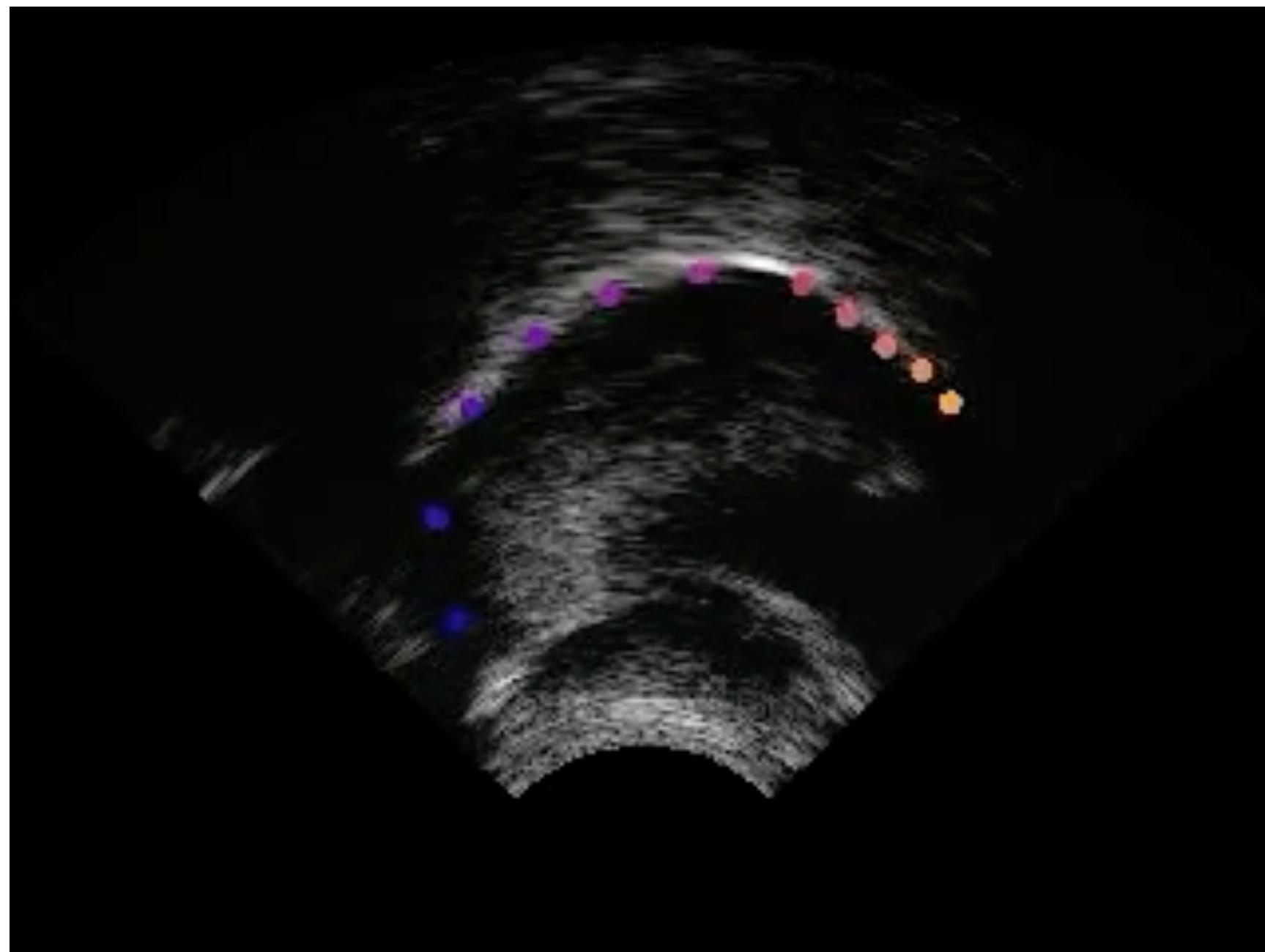
- **DeepLabCut** - new method of processing ultrasound recordings using machine learning and markerless pose estimation (Wrench & Balch-Tomes 2022)



Methods

Data processing

- **Pre-trained model** for tracking 11 points along the surface of the tongue
- **Self-trained models** for tracking 8 points along the upper/lower lip



Methods

Stimuli design

post-lexical retraction

I said...

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

Methods

Stimuli design

word-initial retraction

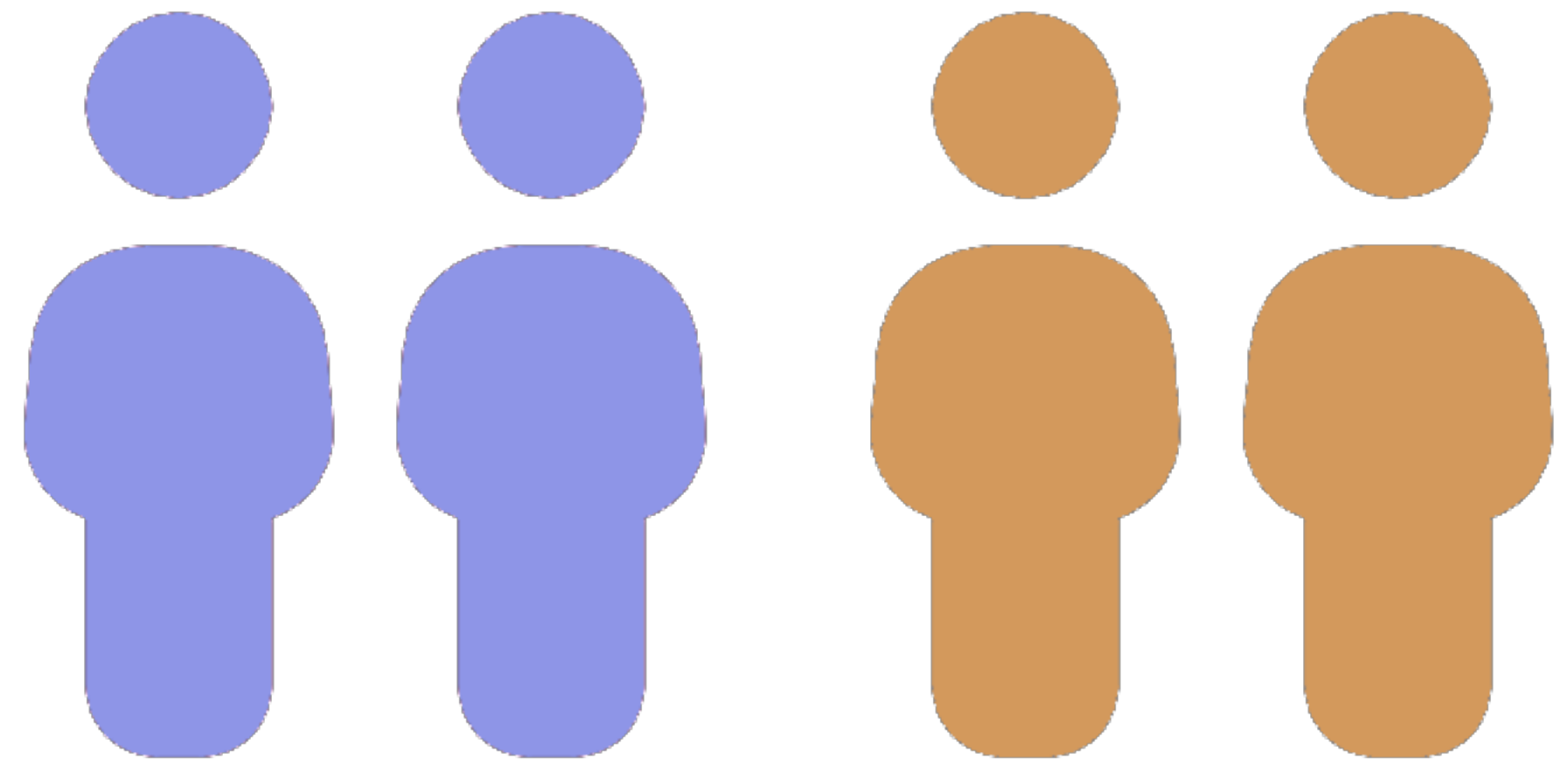
I said...

		/s/	/stɹ/	/stj/	/ʃ/
th/ə/	/uː/	soup	stroop test	student / stupid	chute
	/iː/	seat	street	—	sheet
	/ɒ/	sock	strop	—	shot
		/z/			/ʒ/
	/uː/	zoo			jus
	/iː/	zine			gilet
	/ɒ/	zombie			genre

Methods

Population sample

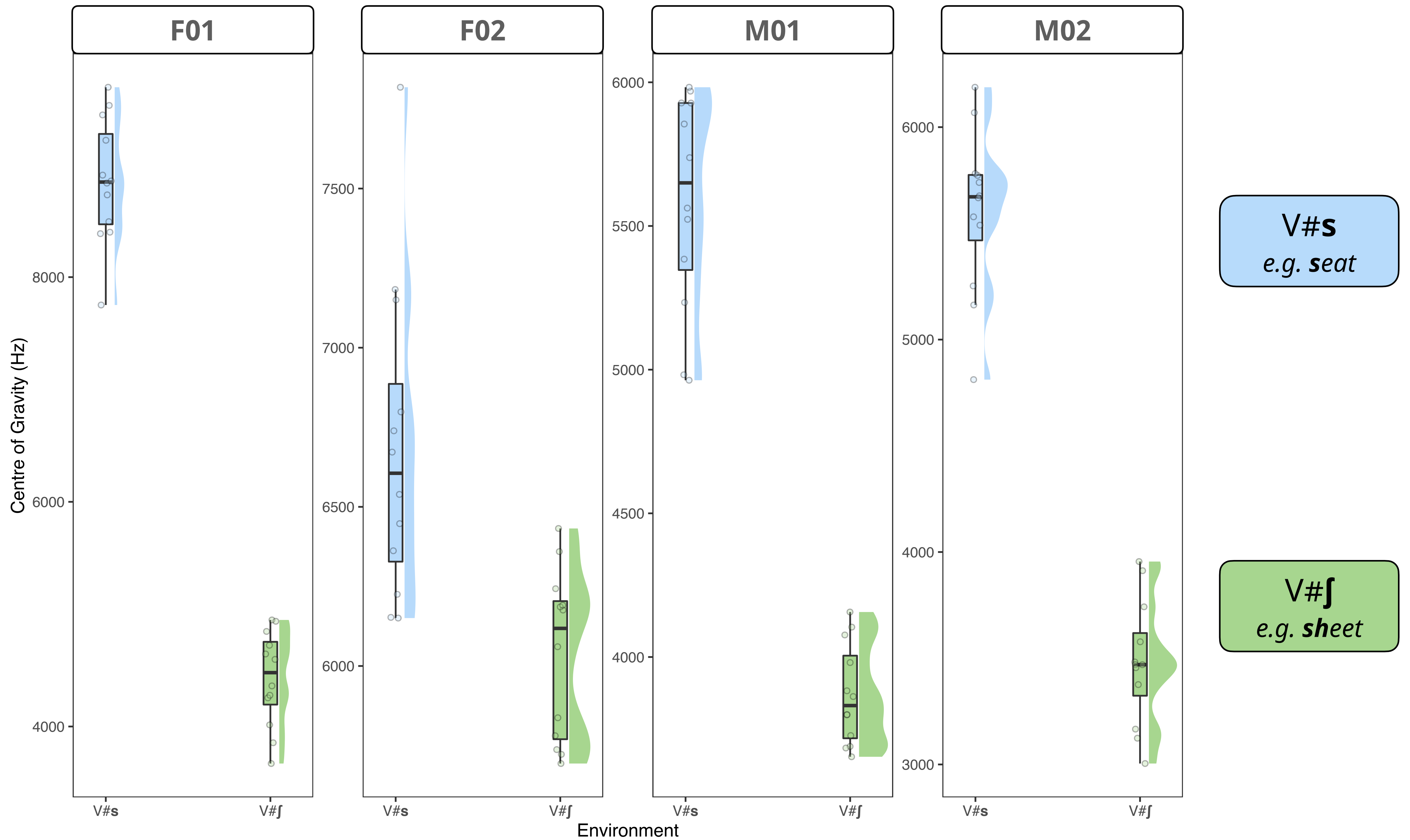
- 4 speakers recorded and analysed so far
 - 2x M from Manchester
 - 2x F from Blackburn
 - all aged 28–30
- Highly complex time-series dataset: roughly 1 million rows of observations *per speaker*

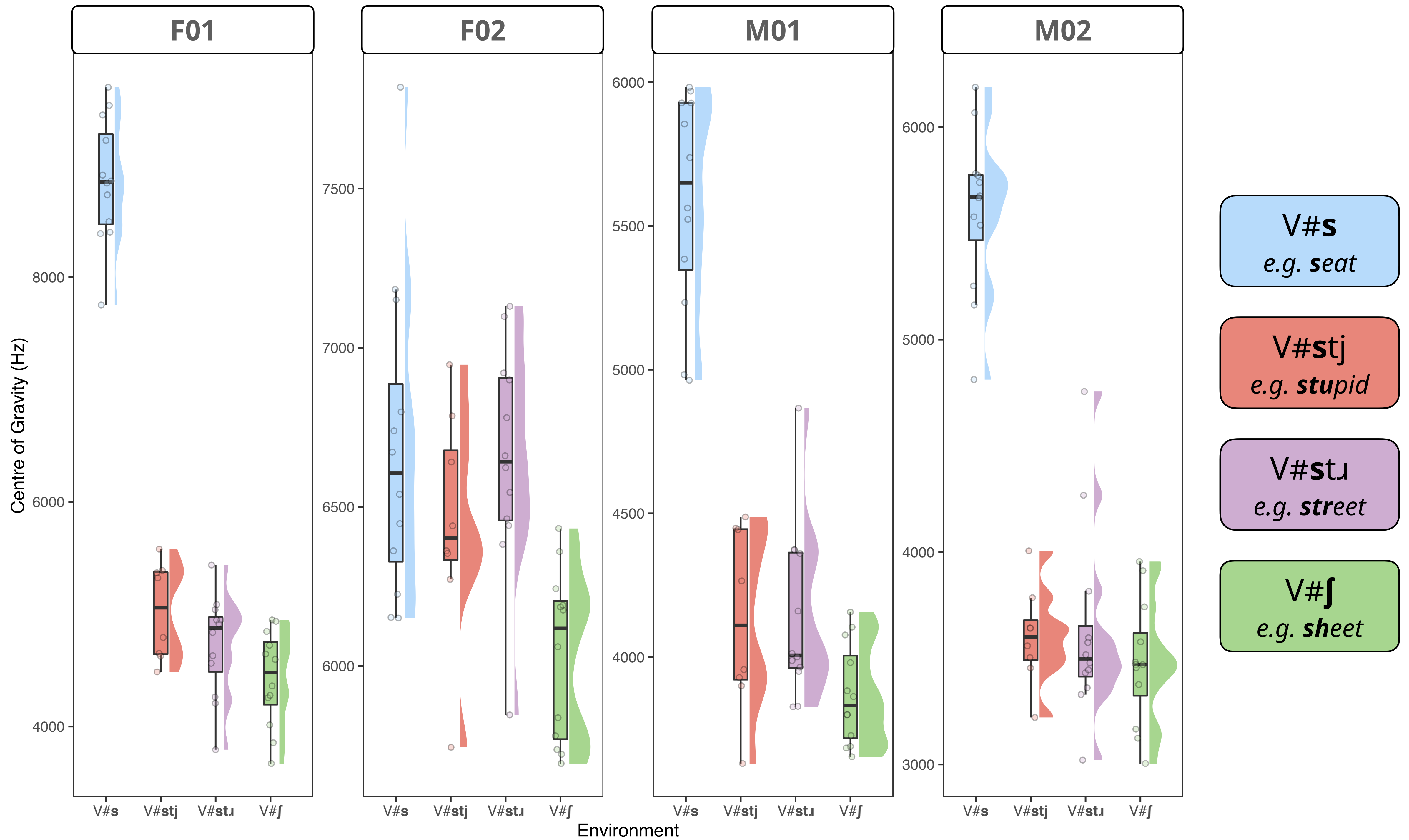


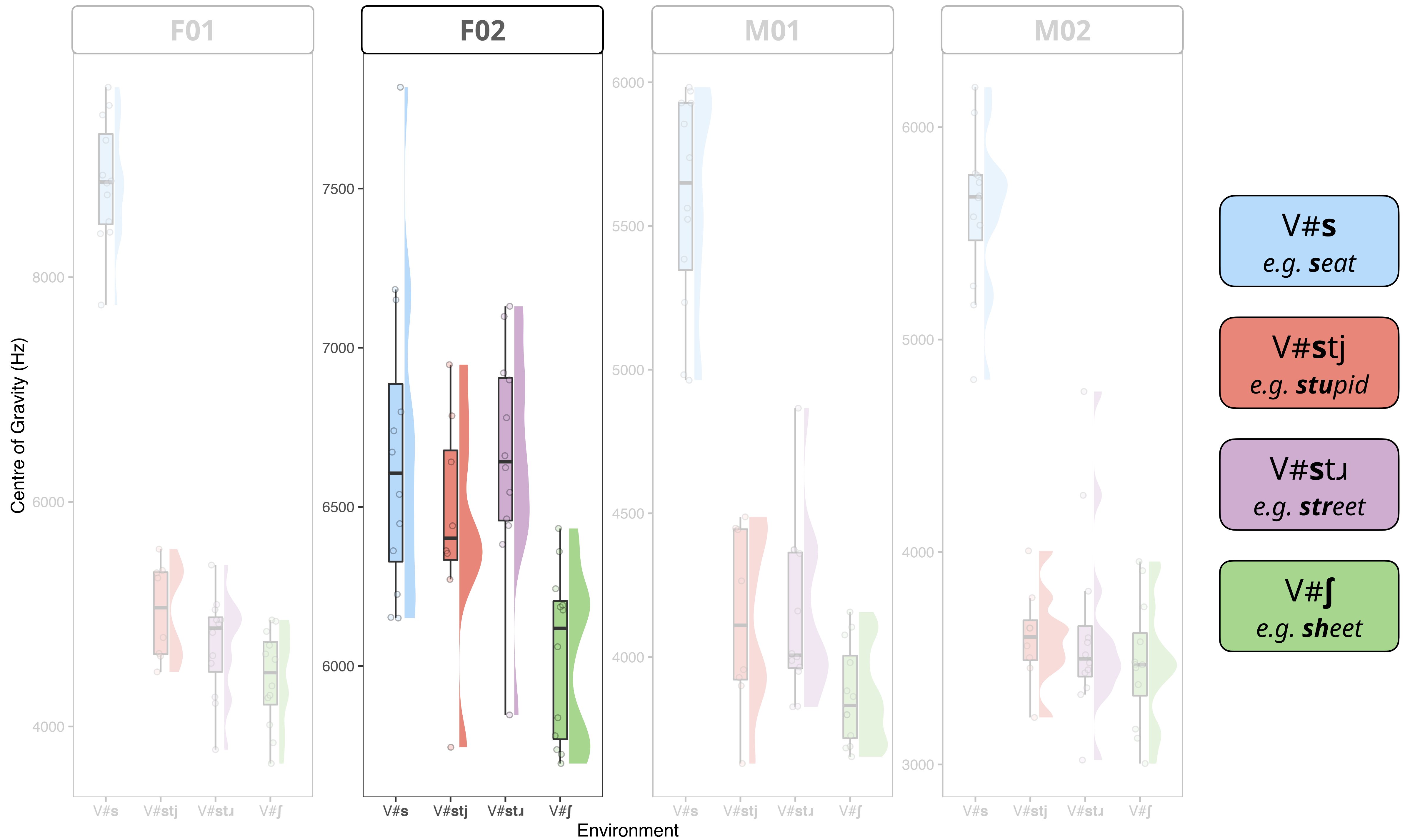
Acoustics

word-internal retraction





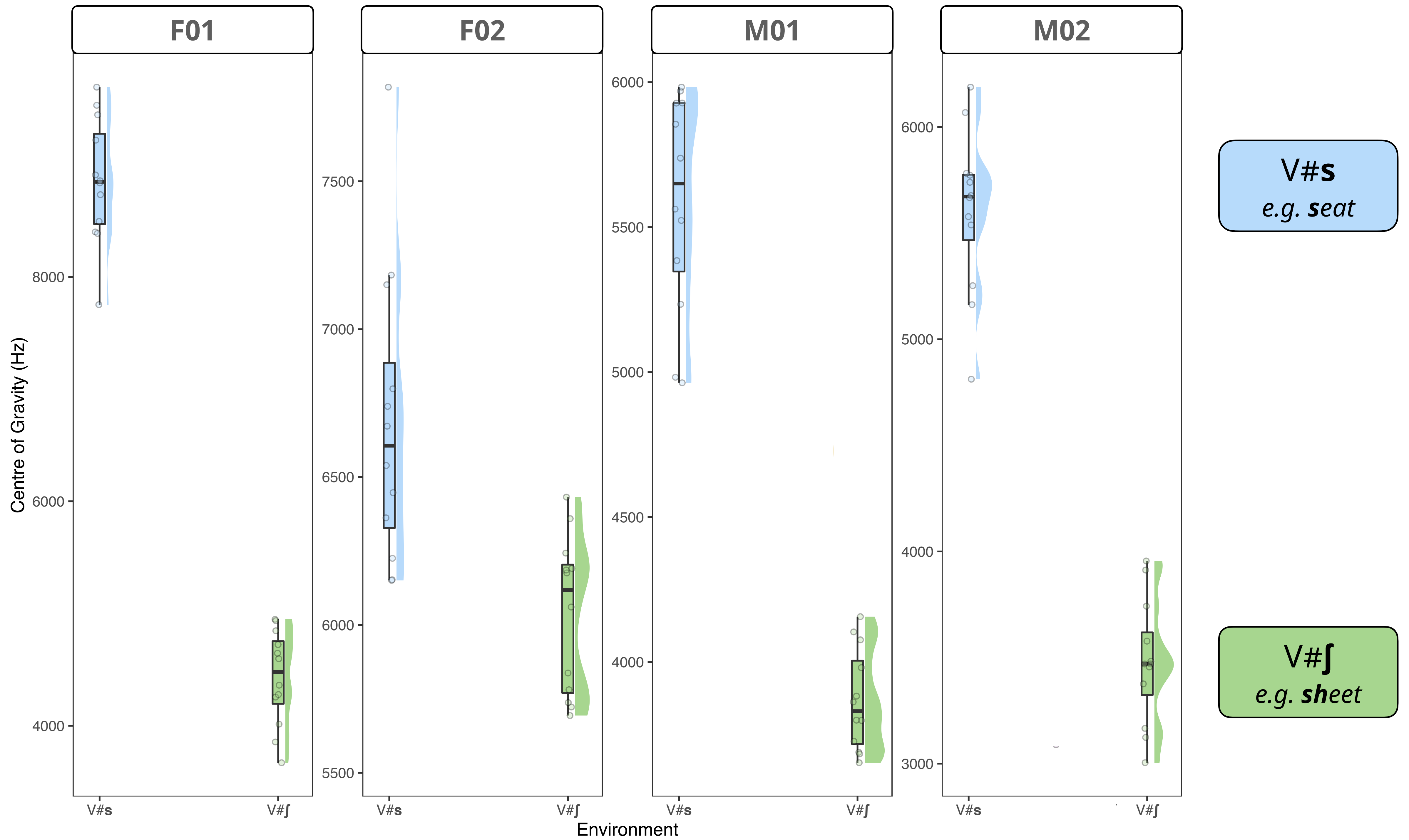


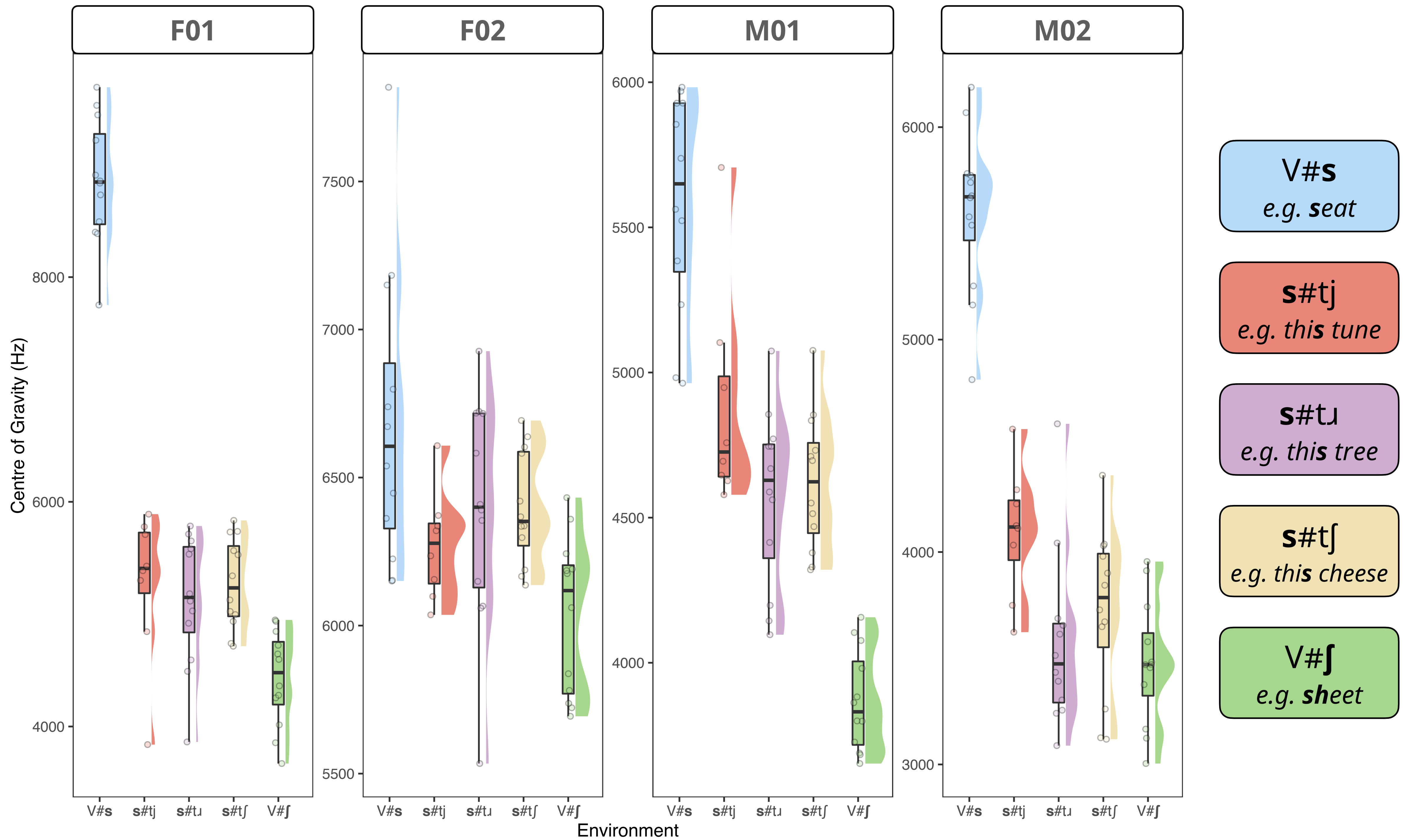


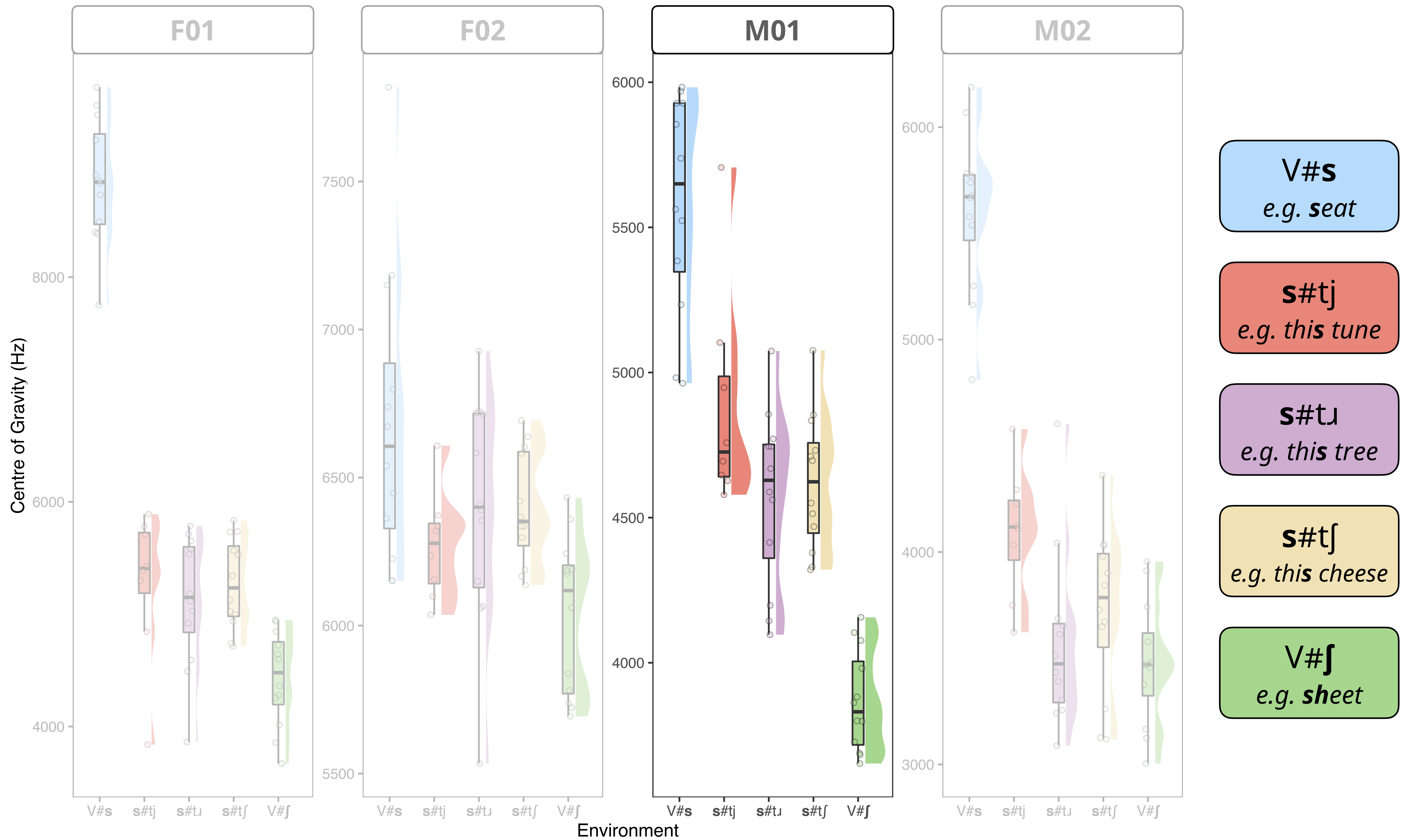
Acoustics

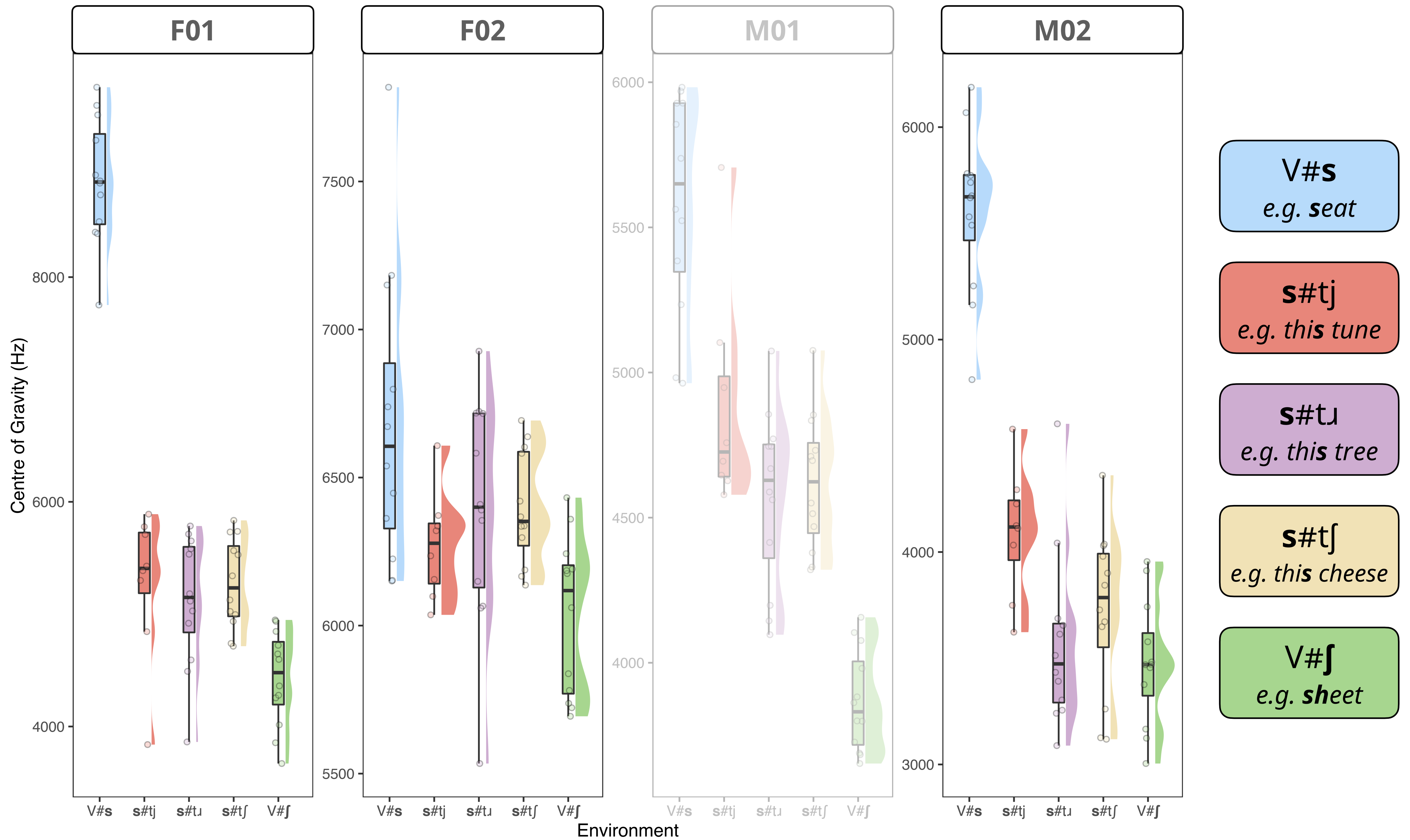
post-lexical retraction

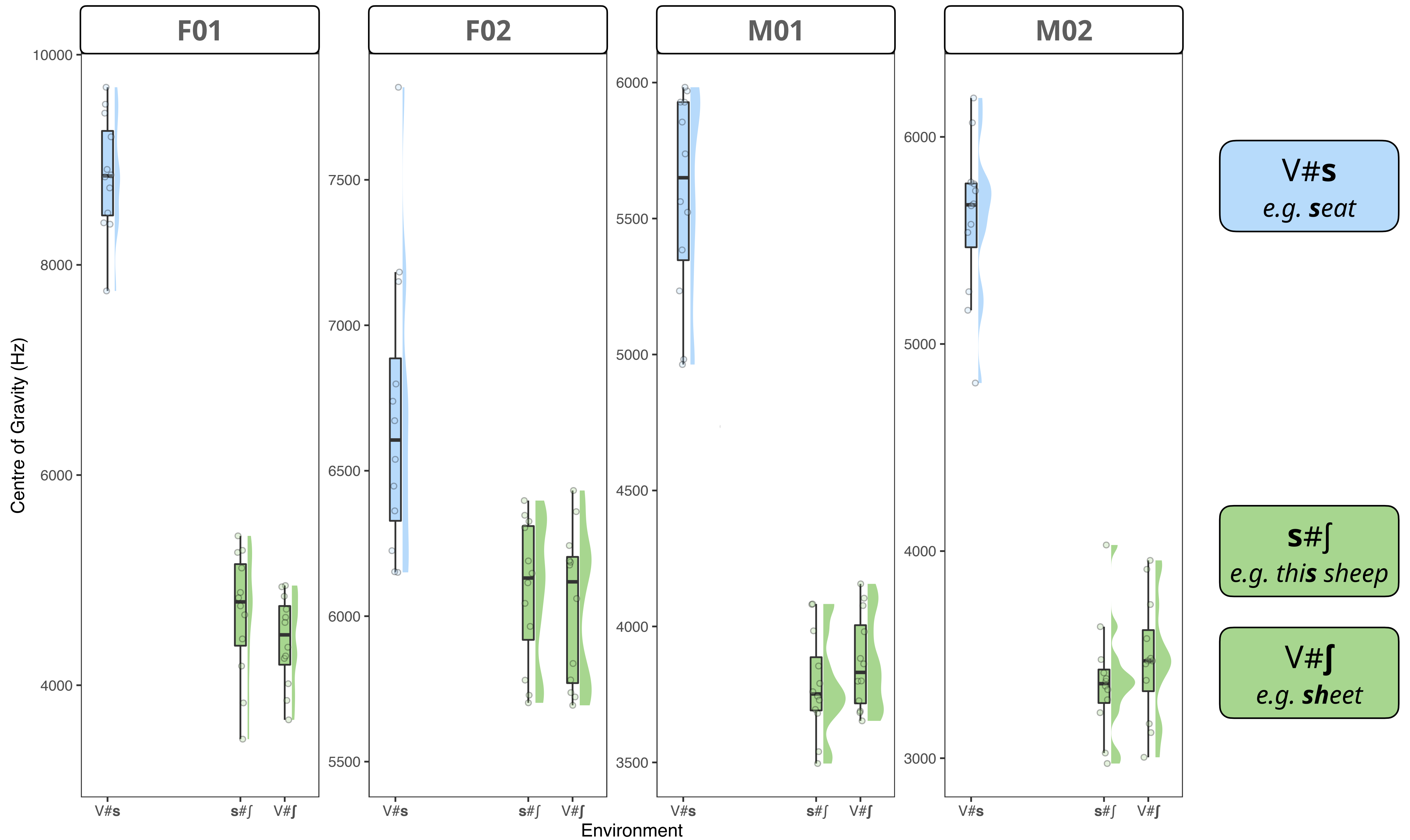


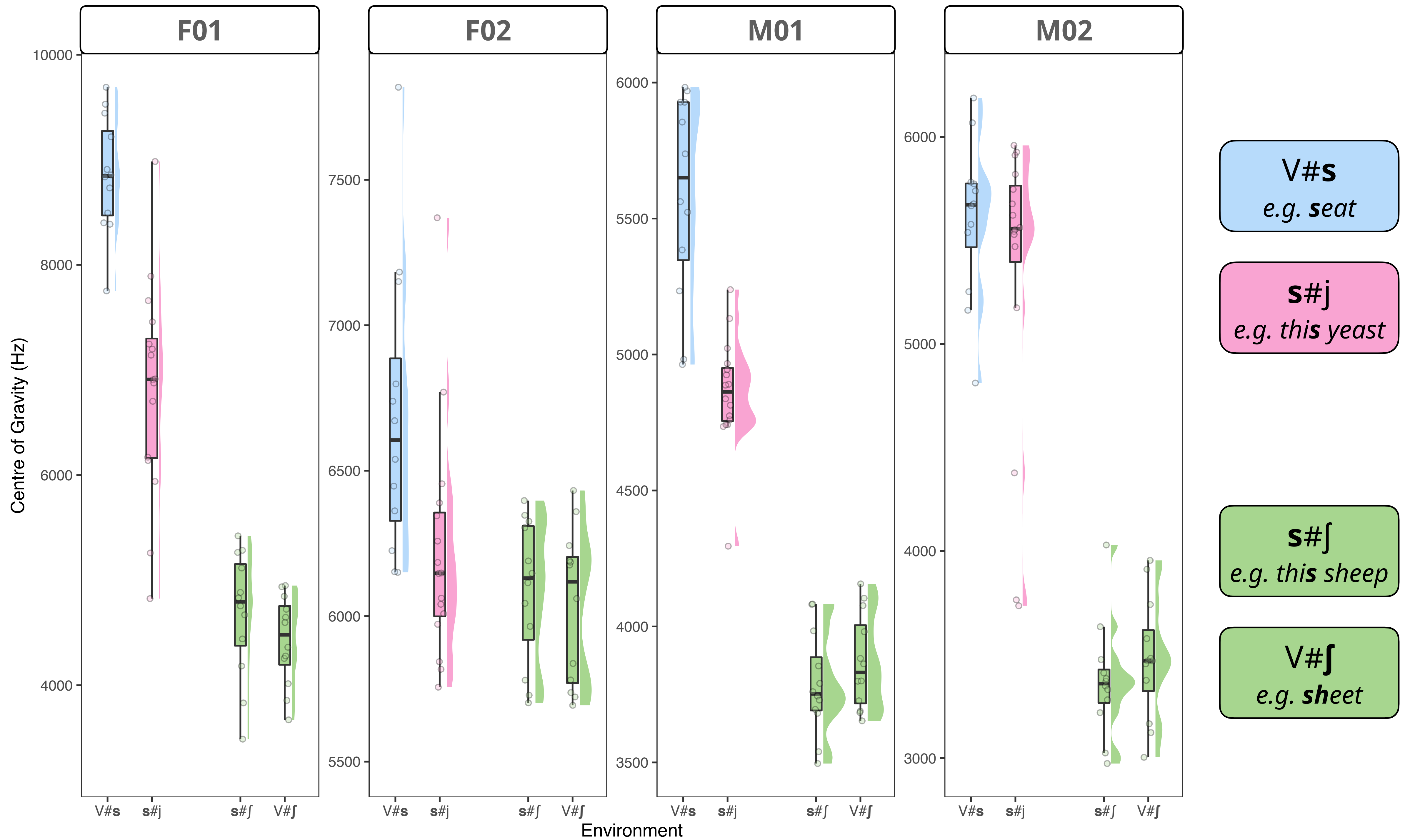


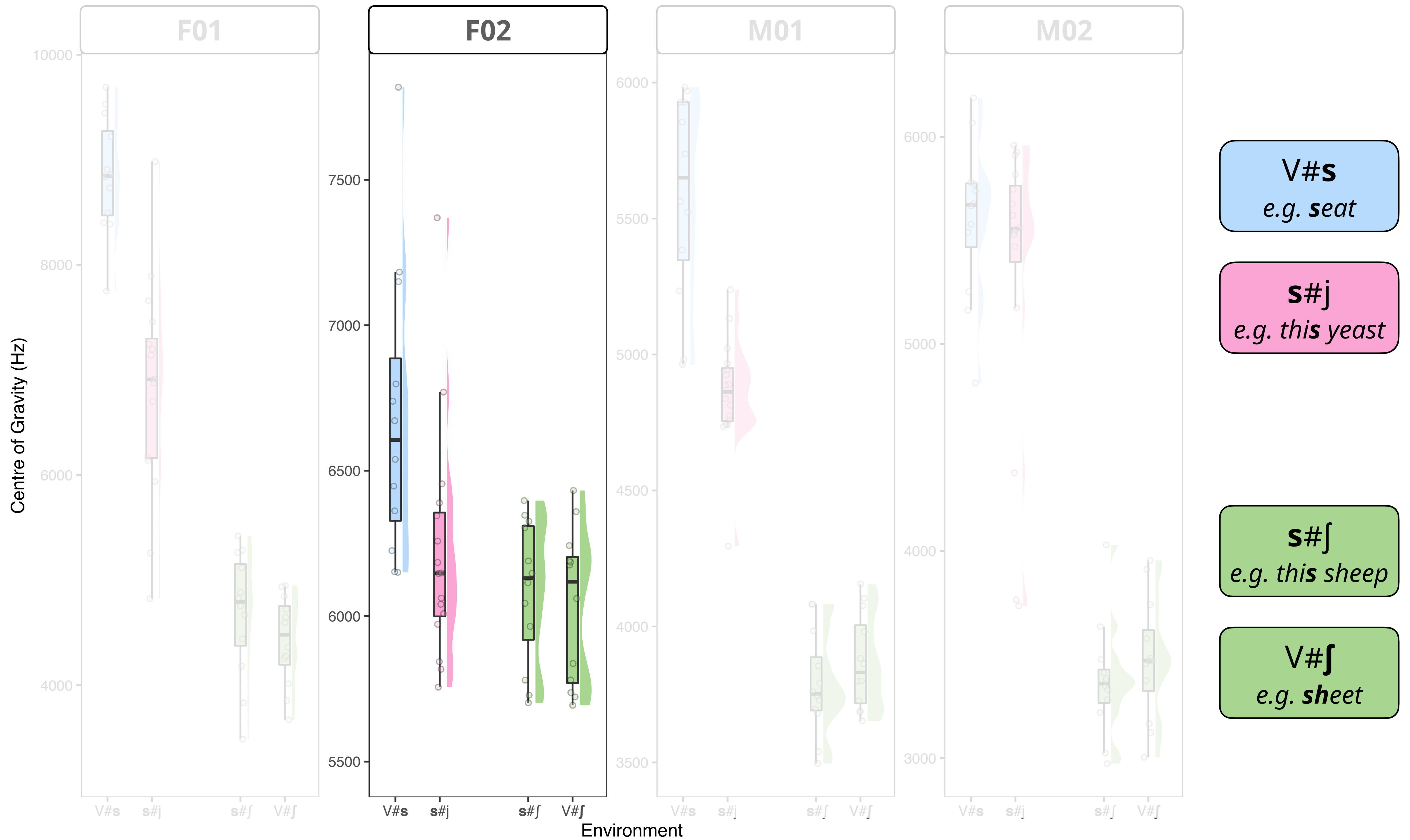


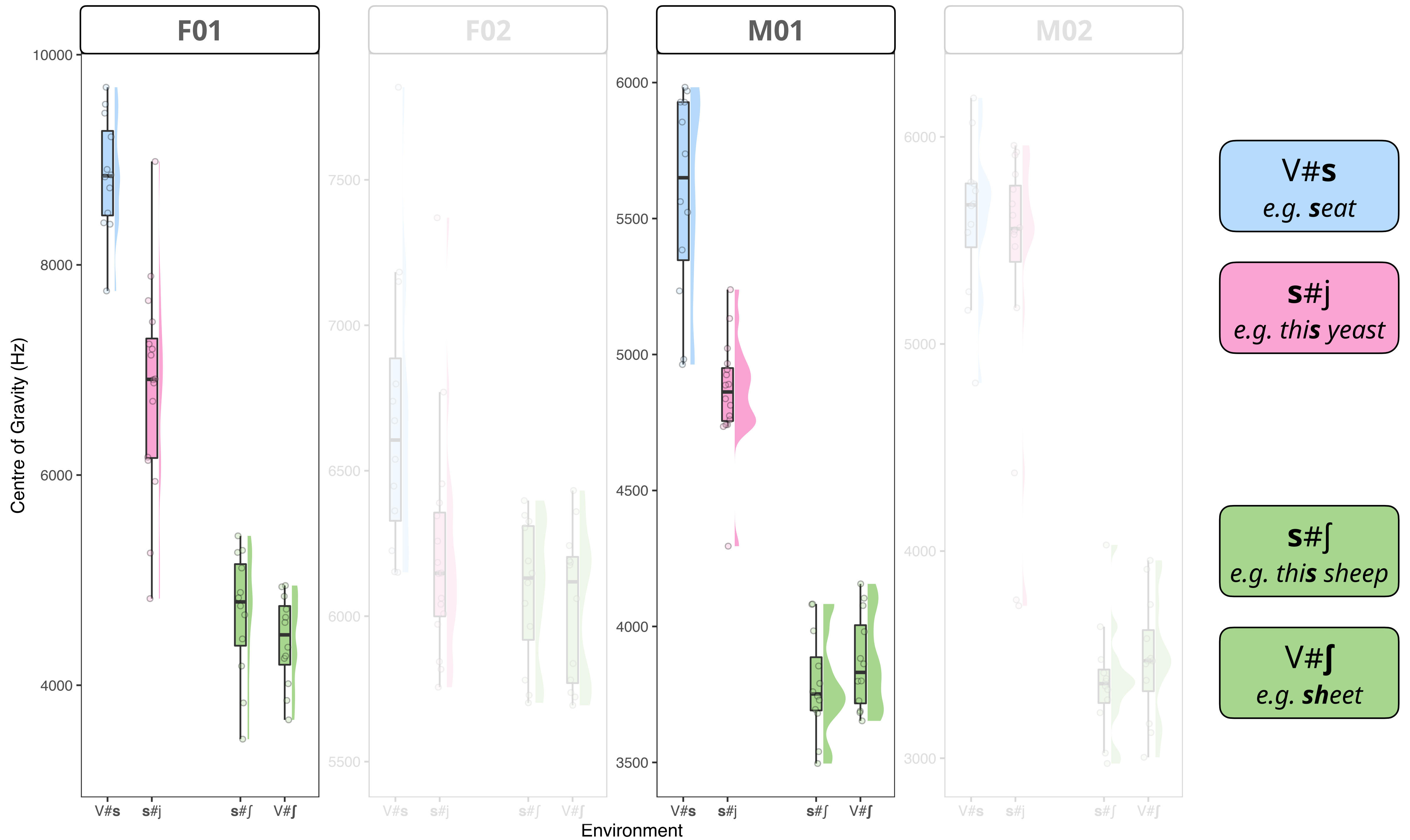


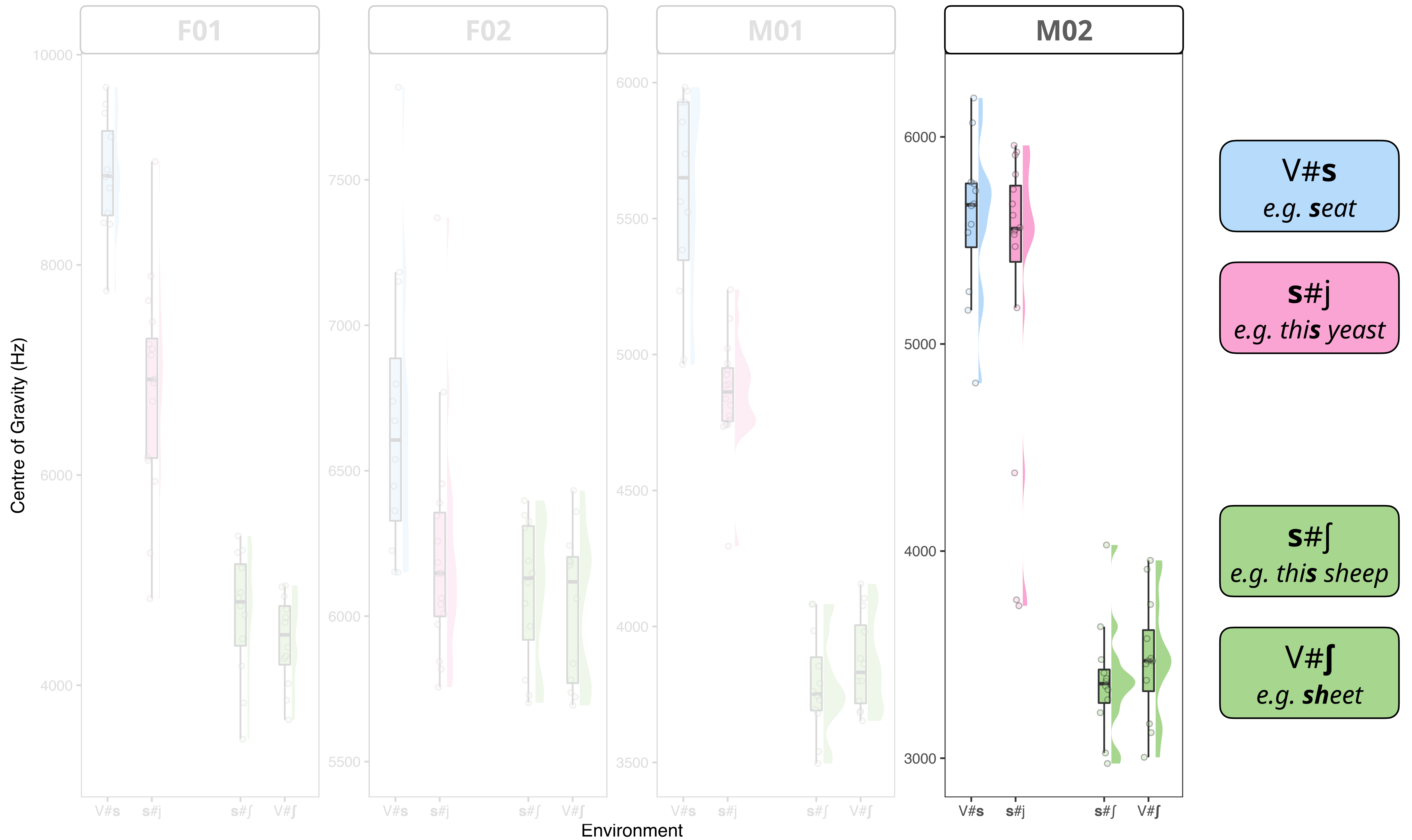


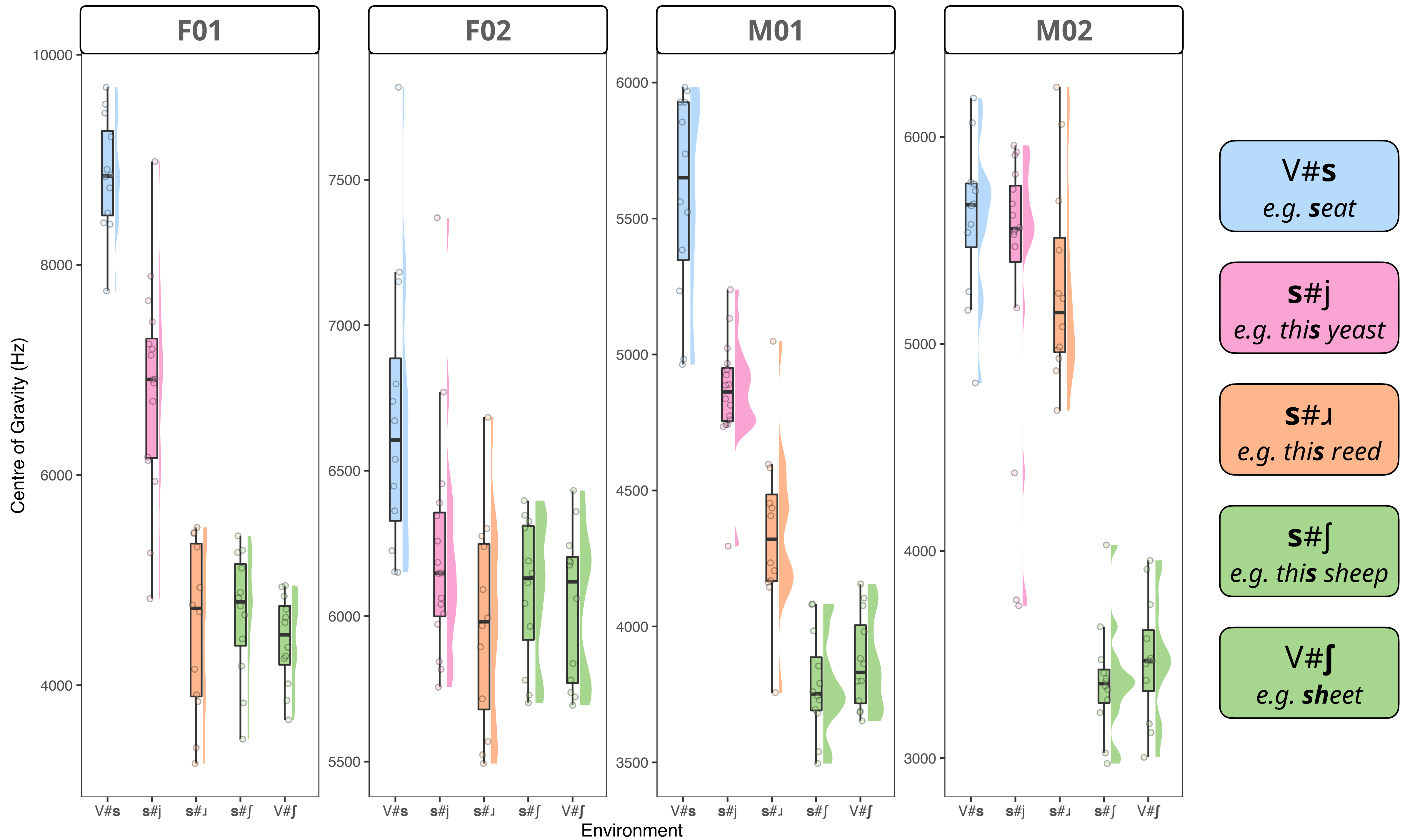


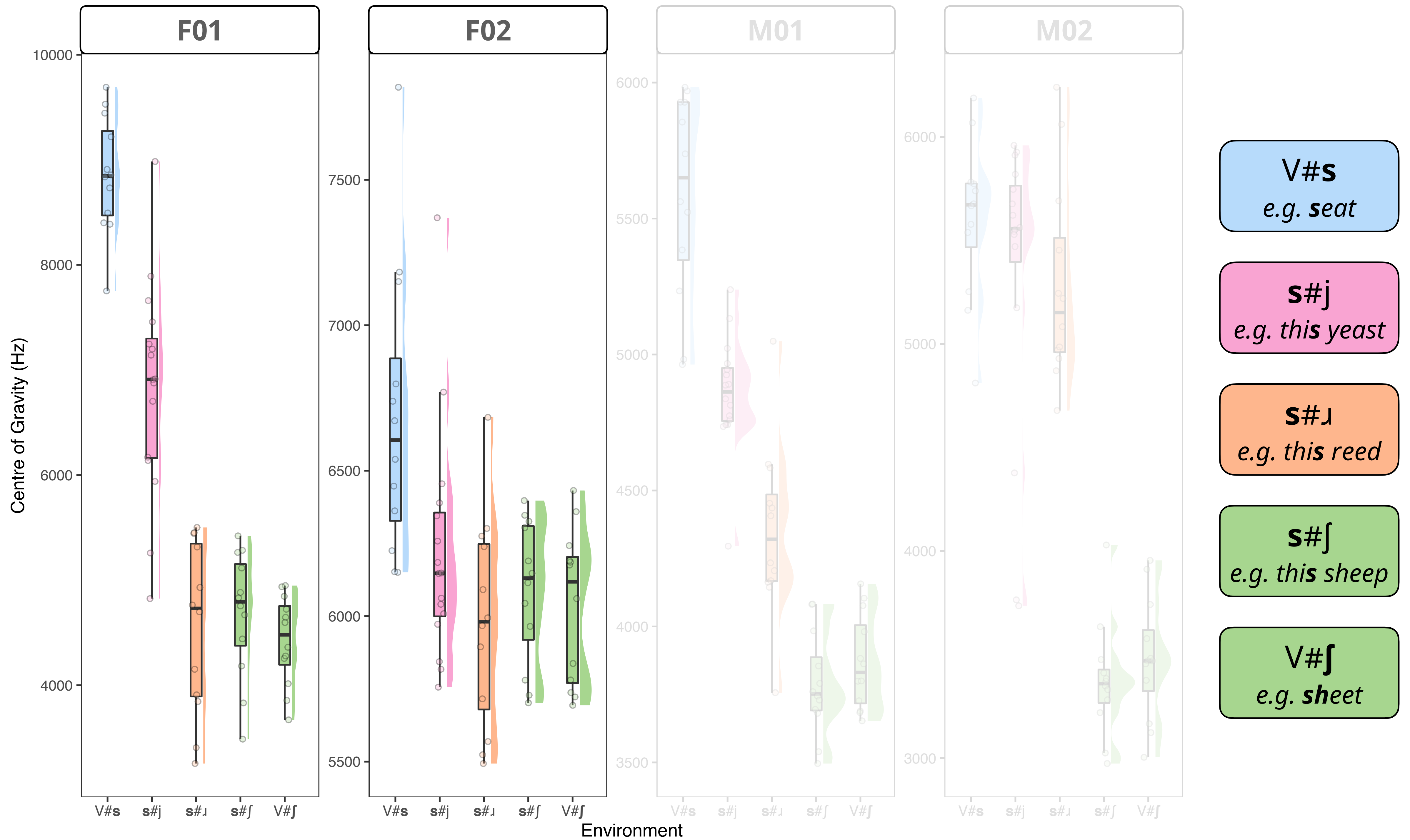


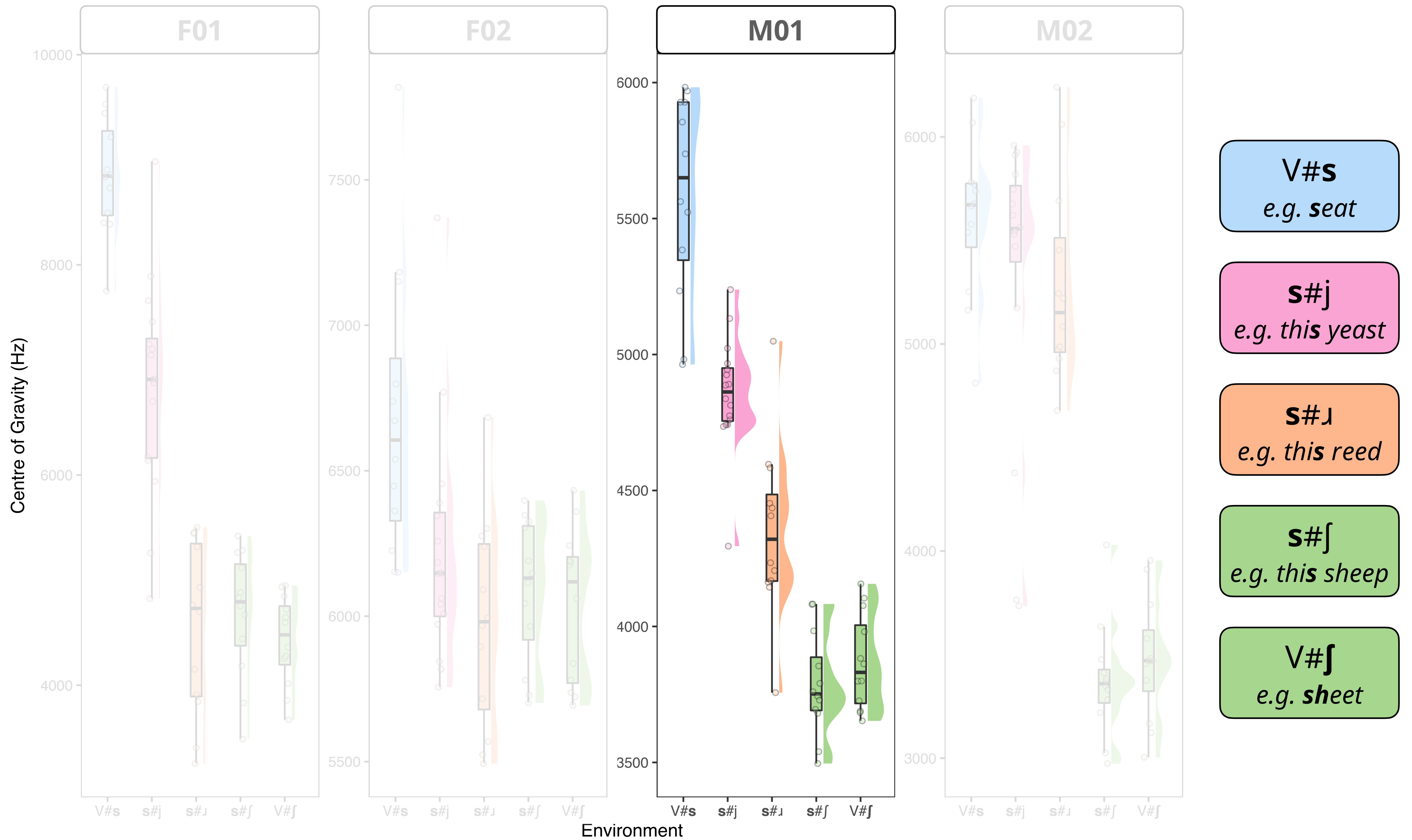


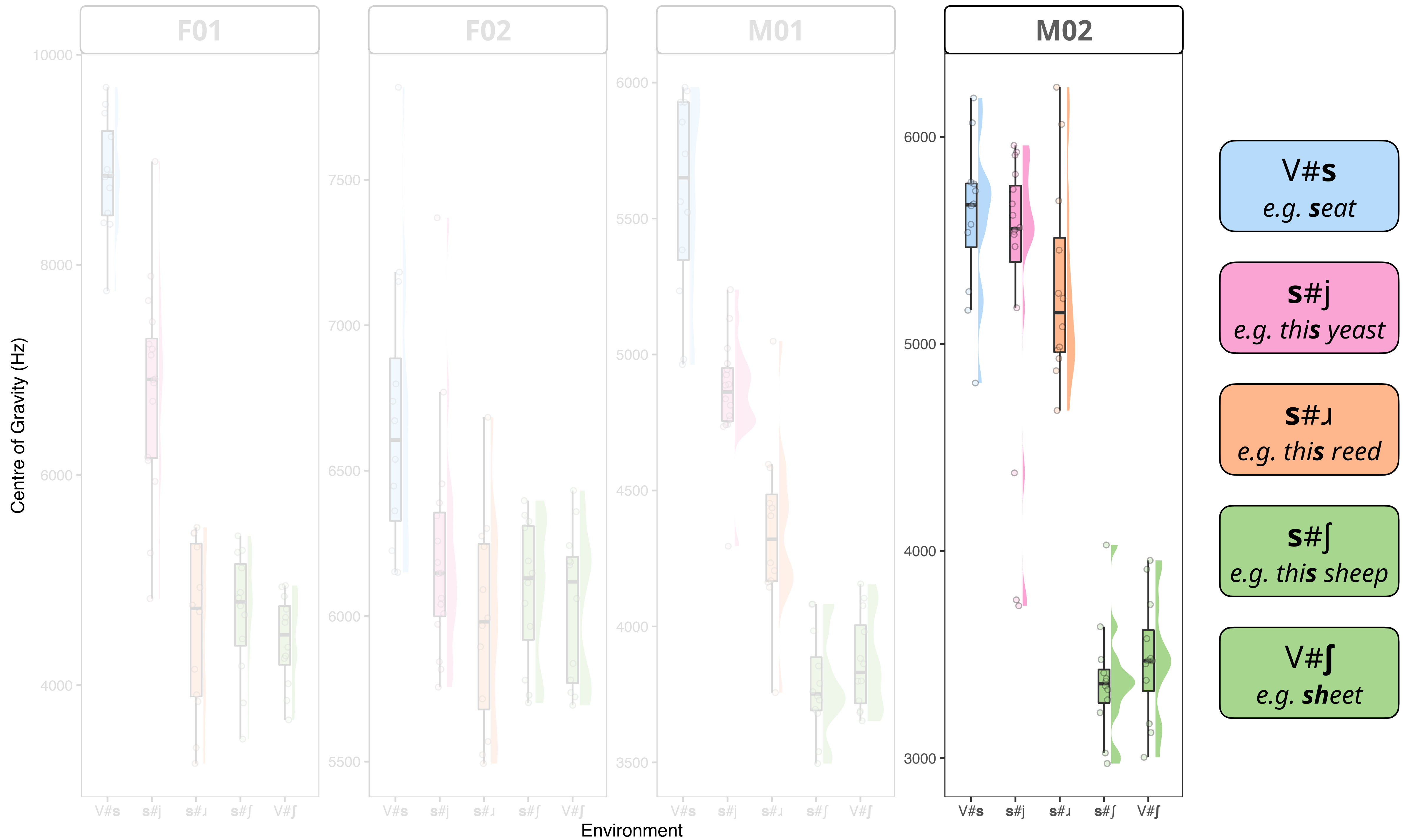








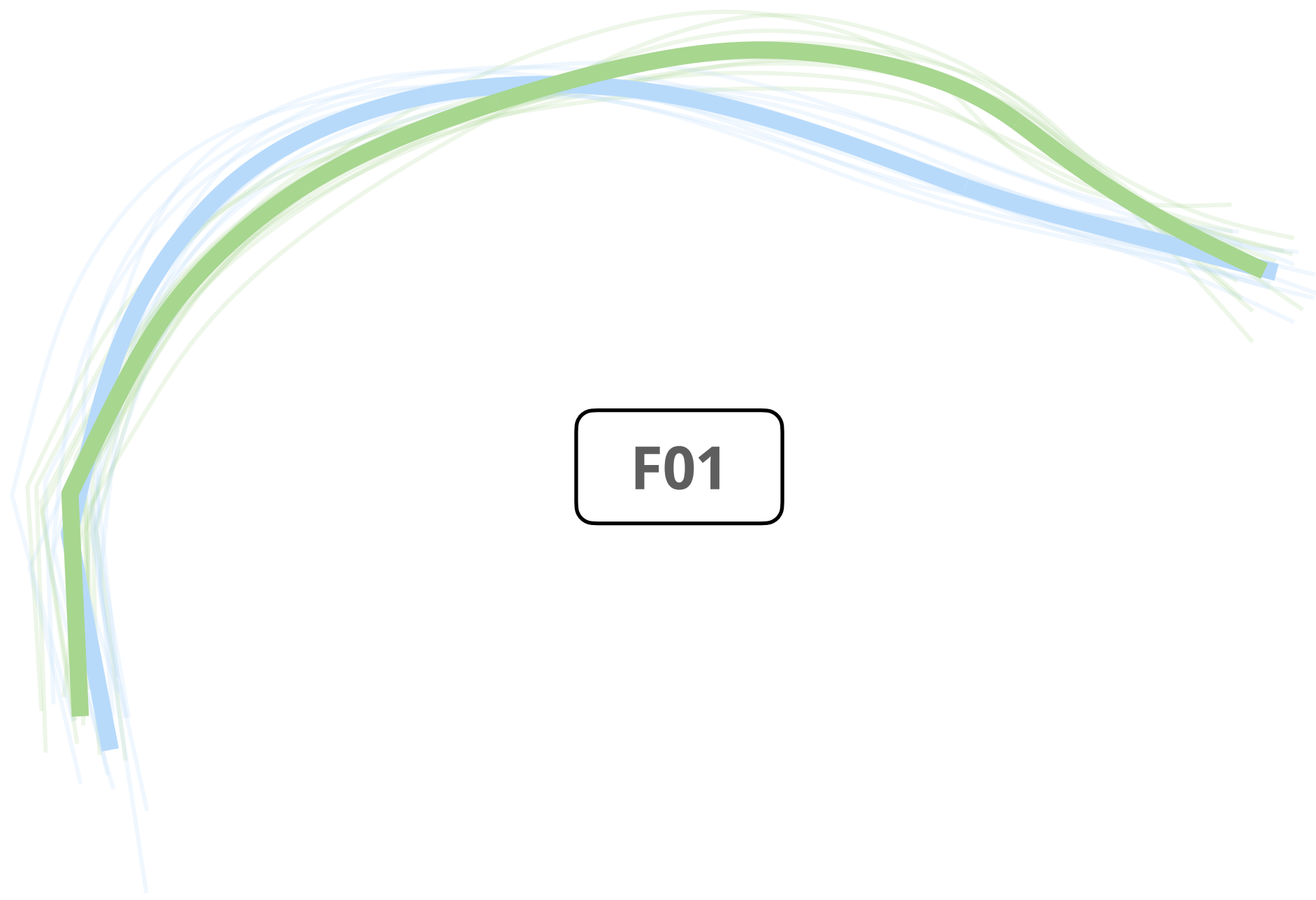




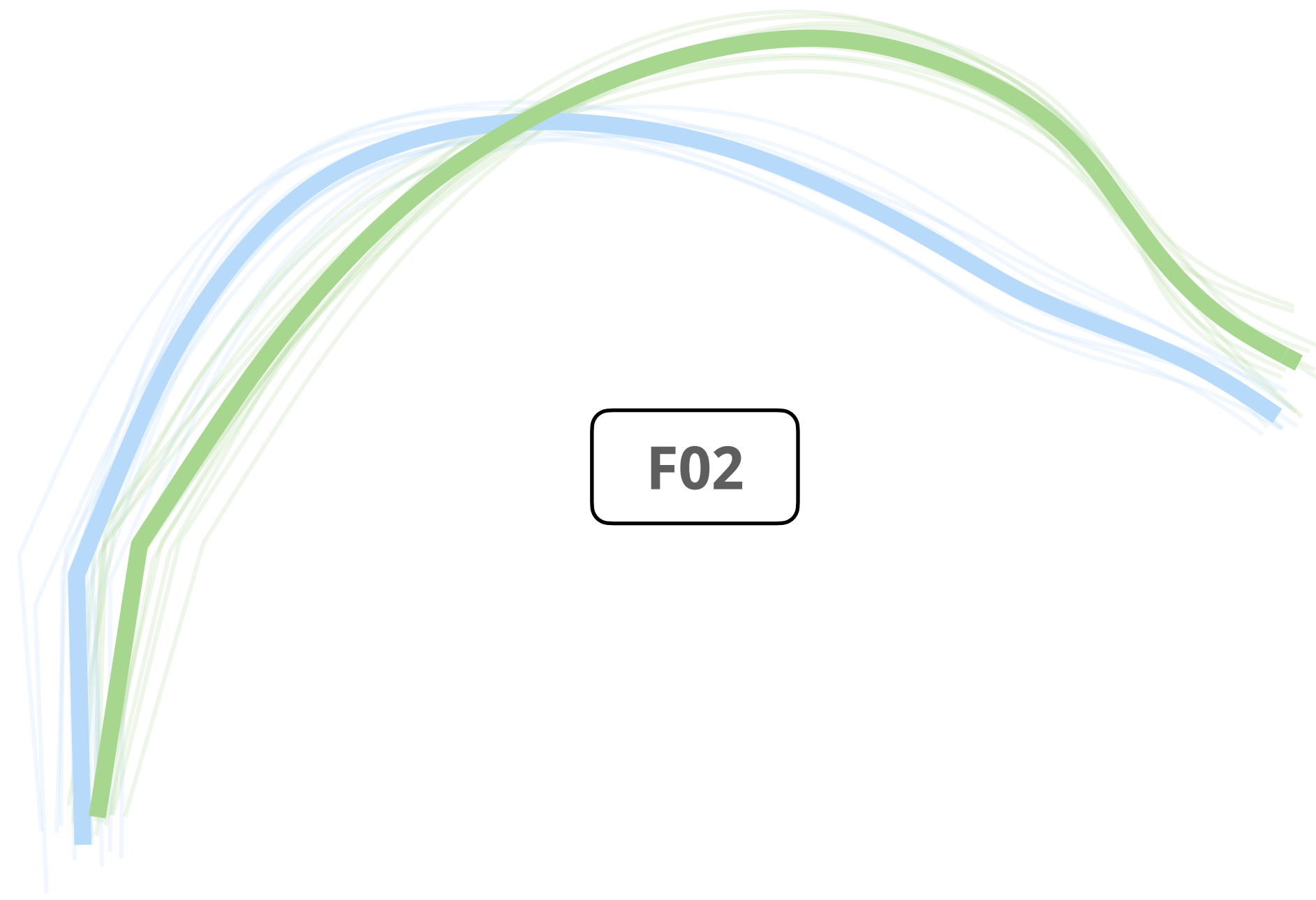
Tongue

post-lexical retraction



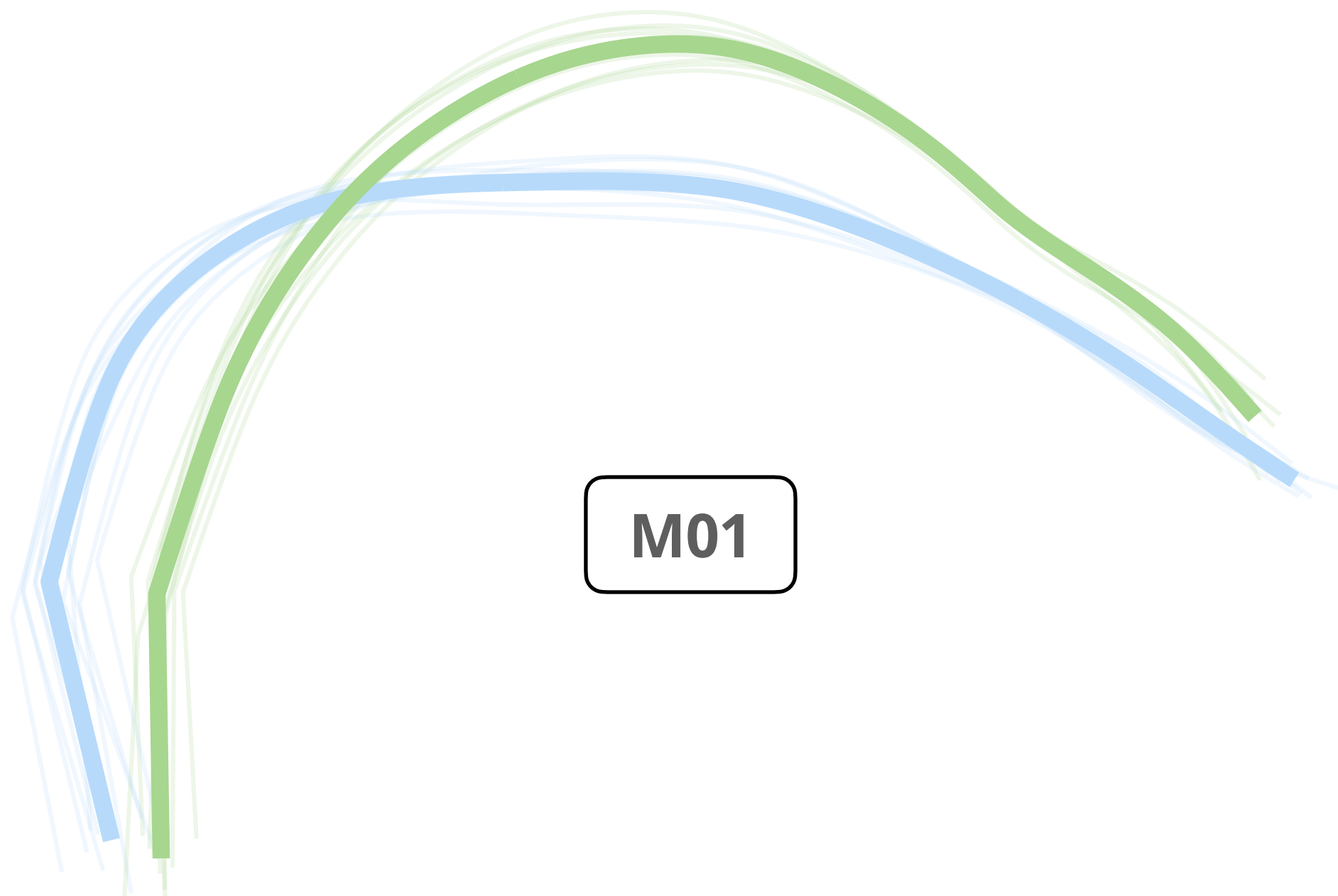


F01

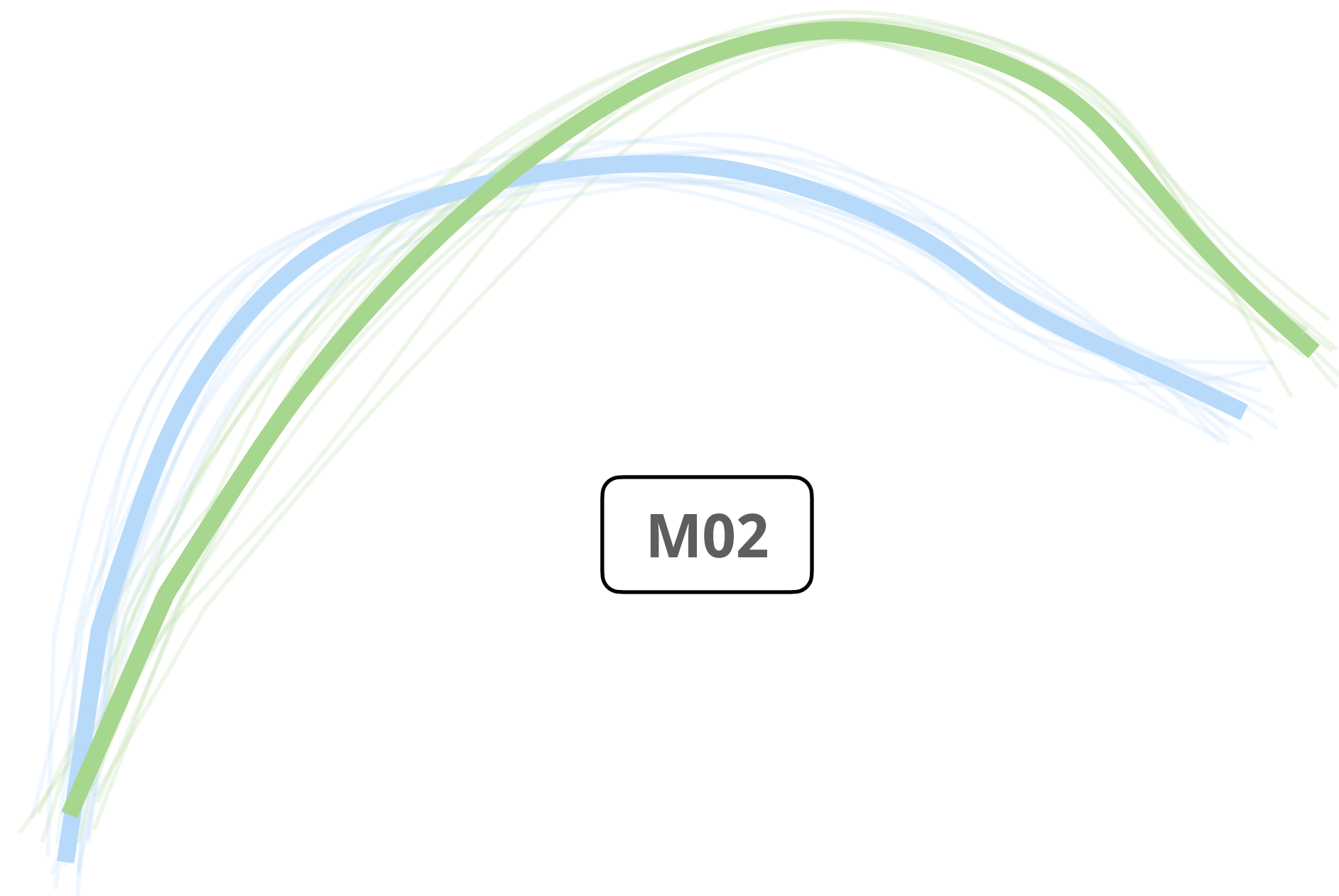


F02

V#s
*e.g. the **seat***

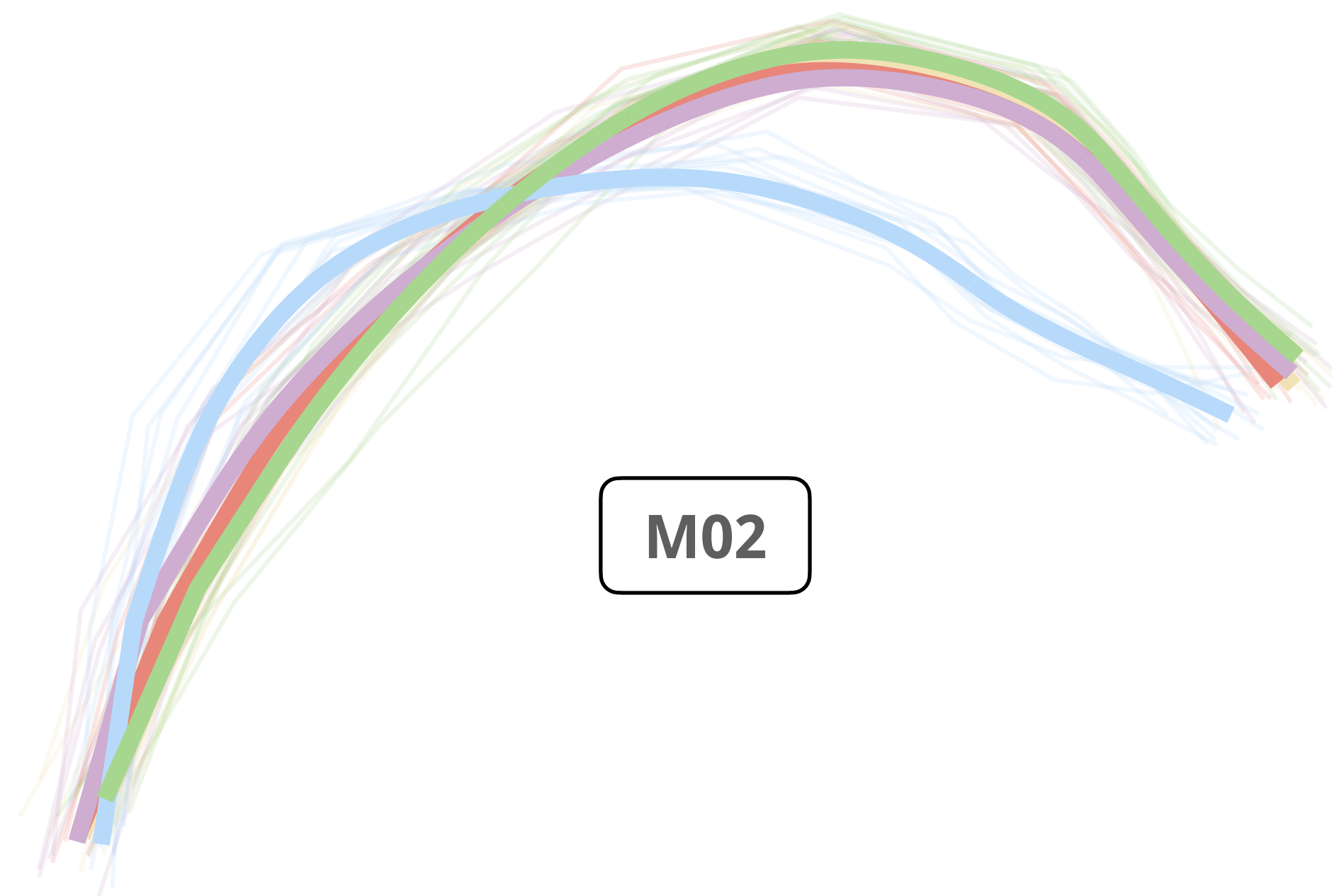
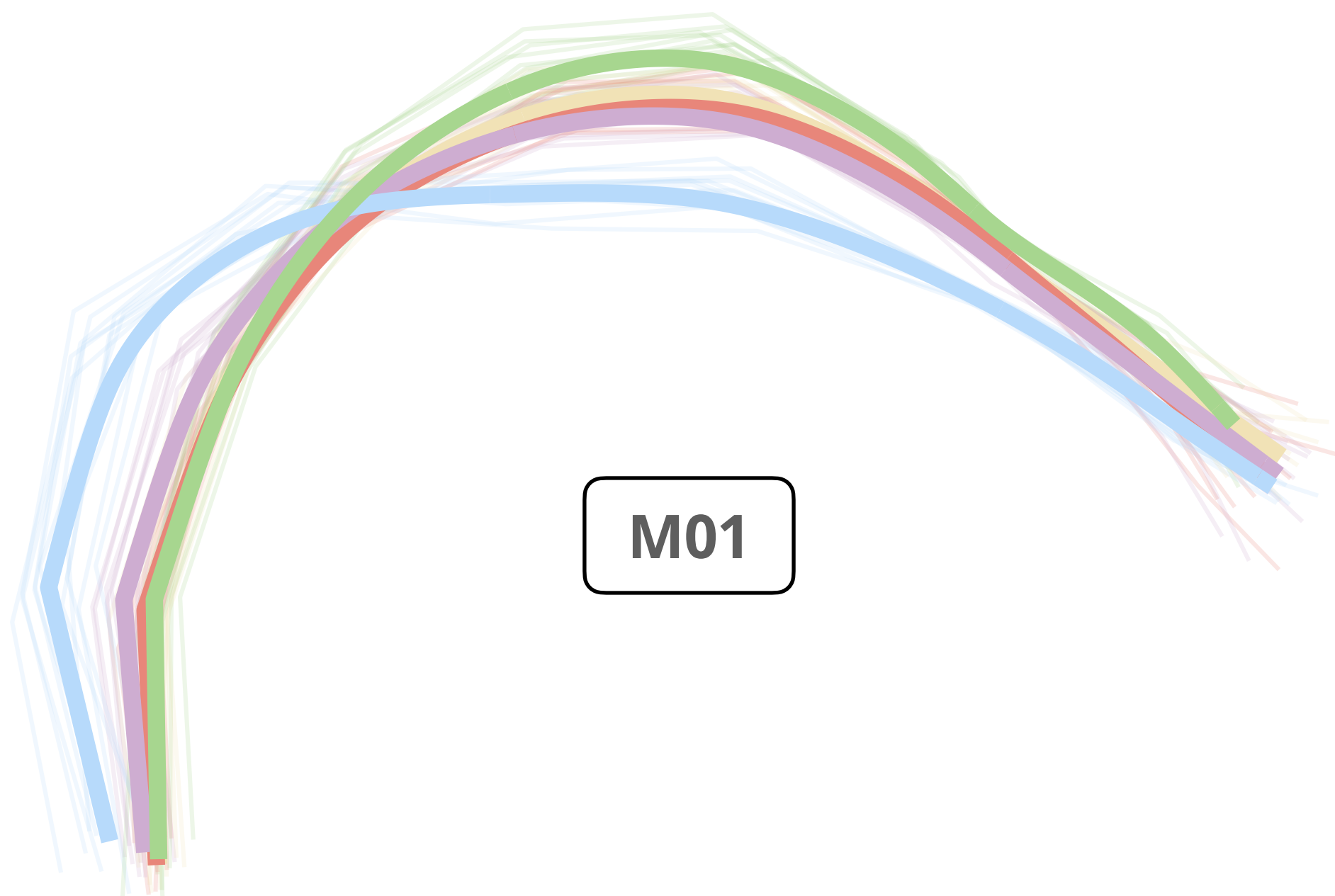
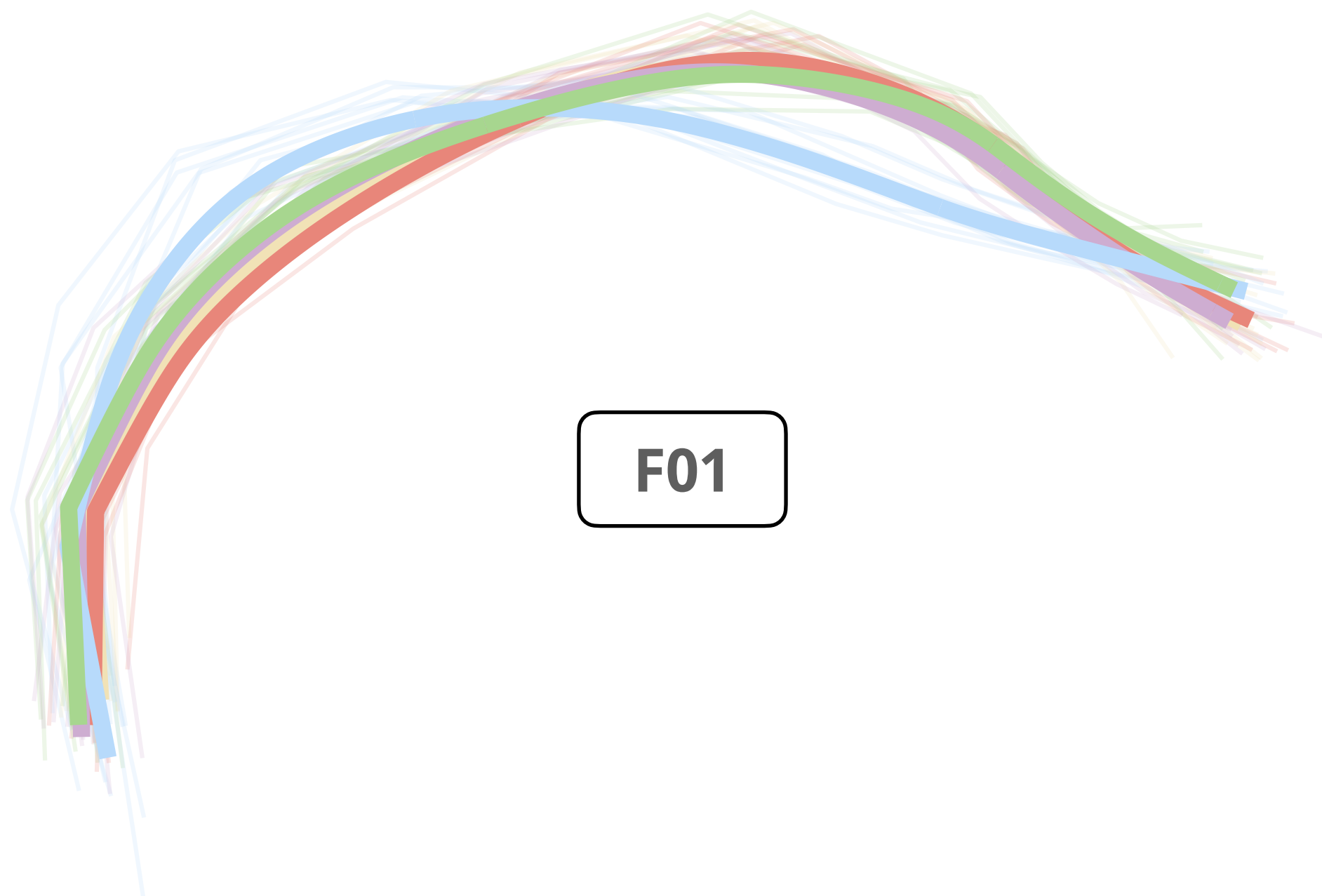


M01



M02

V#j
*e.g. the **sheet***



V#s
*e.g. the **s**eat*

s#tj
*e.g. this **tune***

s#tɹ
*e.g. this **tree***

s#tʃ
*e.g. this **cheese***

V#ʃ
*e.g. the **sheet***



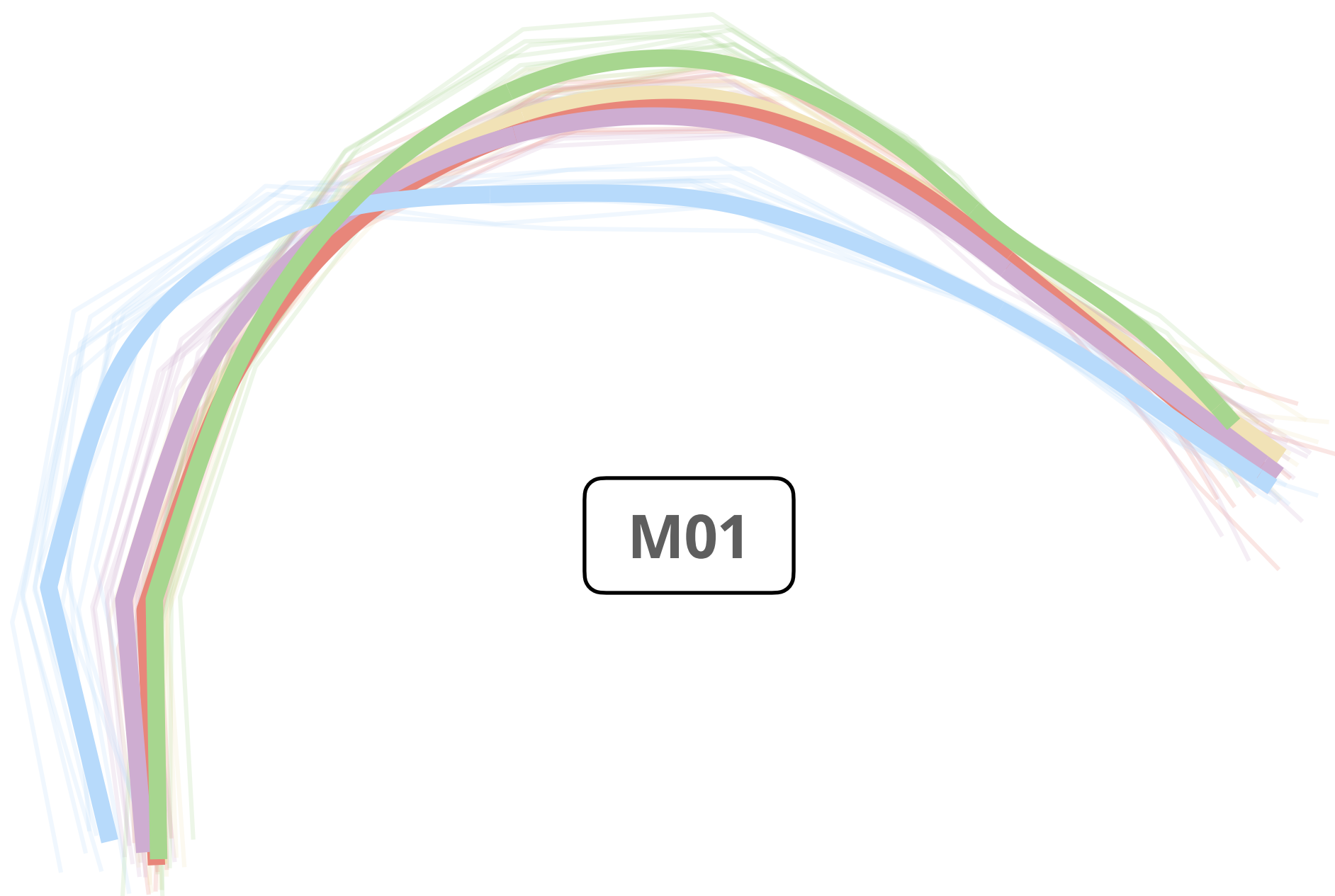
V#s
*e.g. the **s**eat*

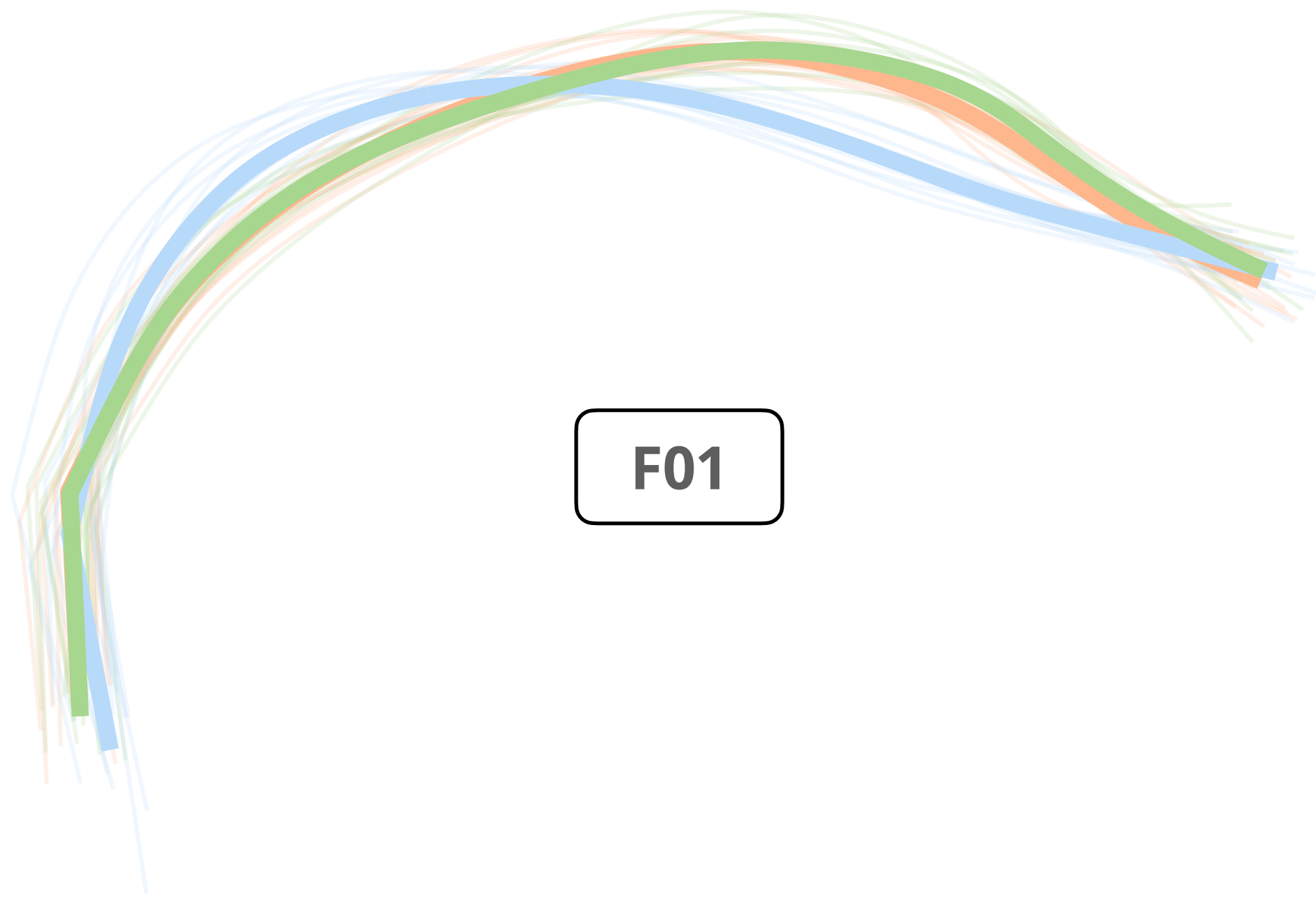
s#tj
*e.g. this **t**une*

s#tɹ
*e.g. this **t**ree*

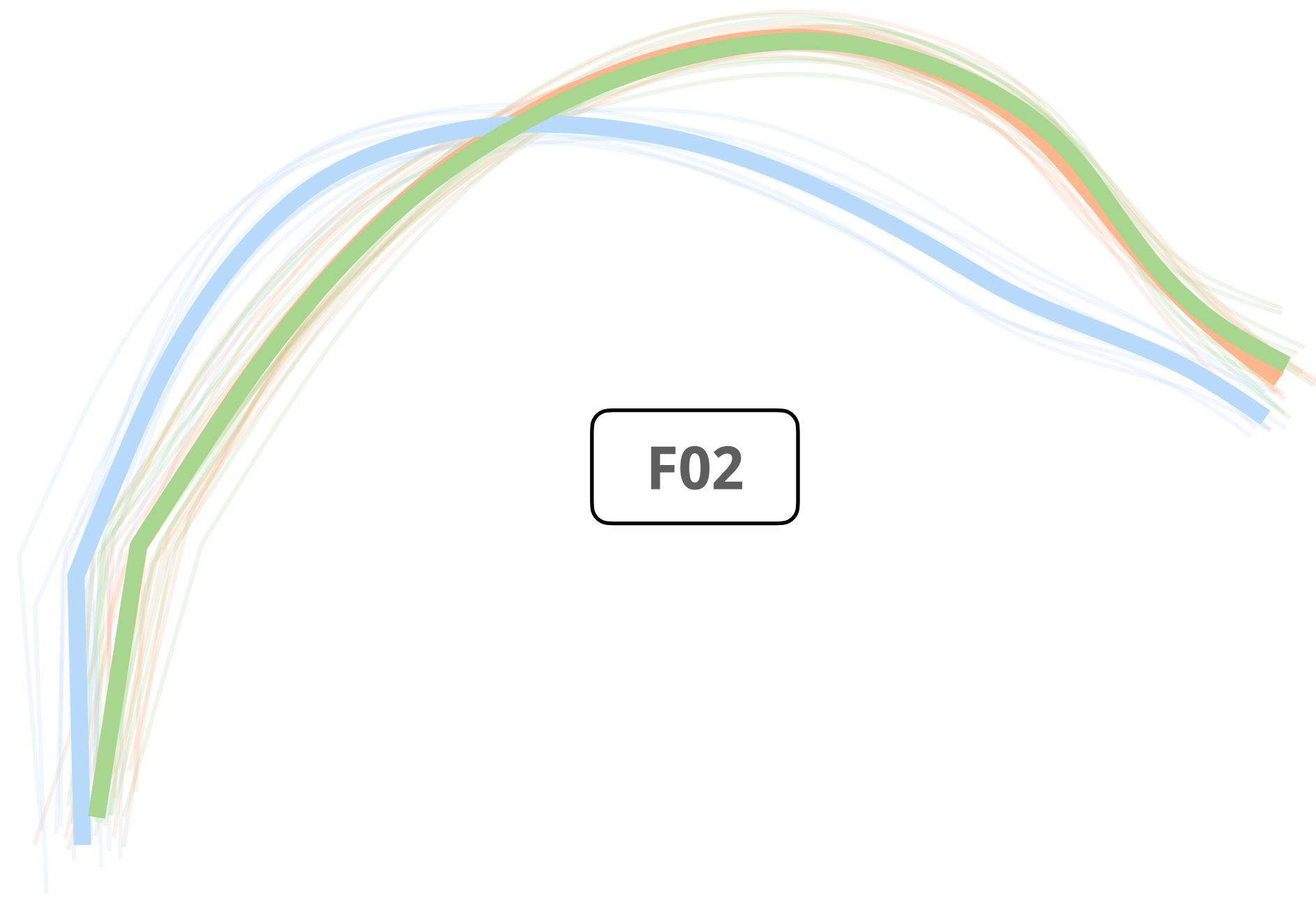
s#tʃ
*e.g. this **ch**ease*

V#ʃ
*e.g. the **sh**ee**t***





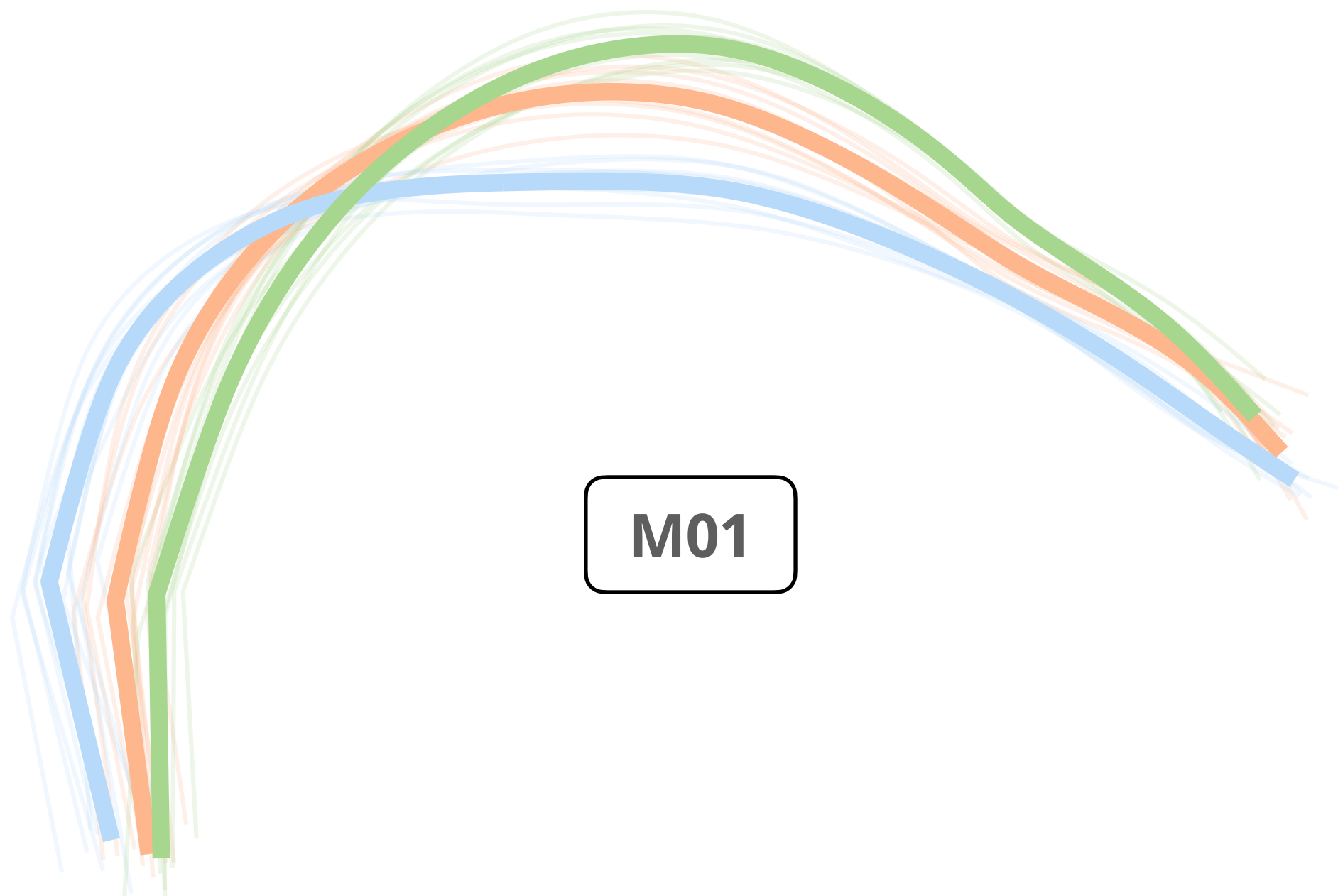
F01



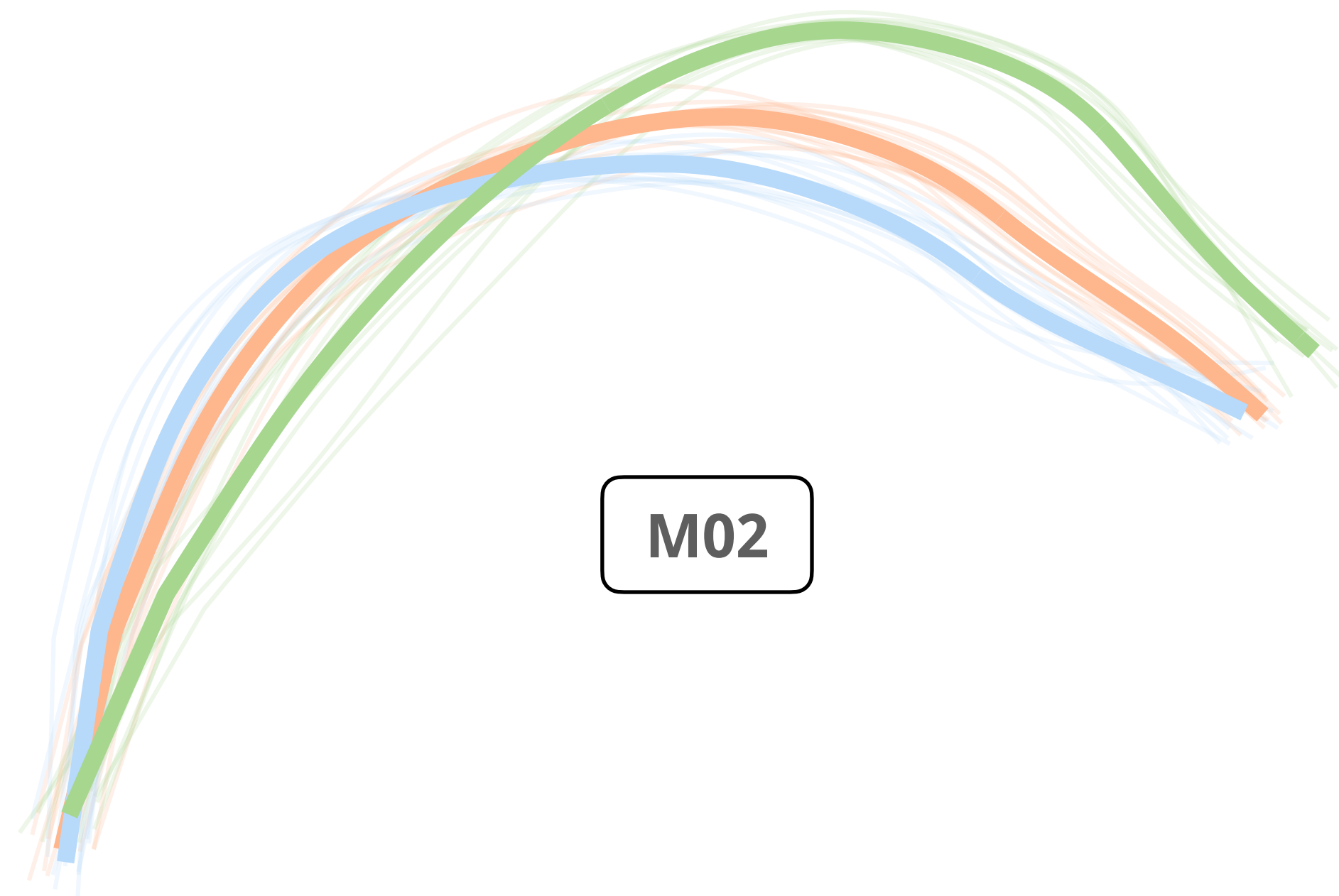
F02

V#s
e.g. the *seat*

s#ʌ
e.g. this *reed*

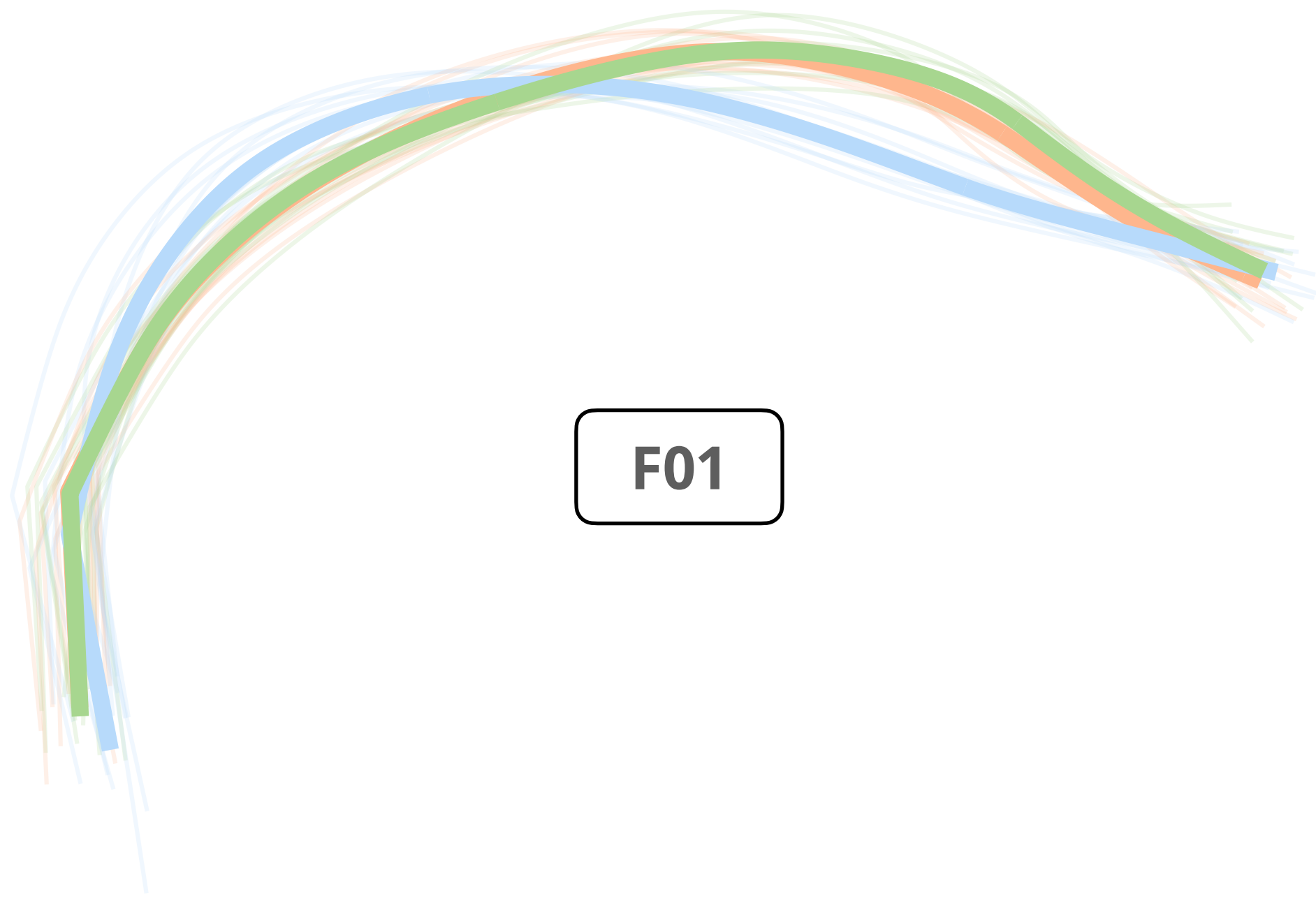


M01

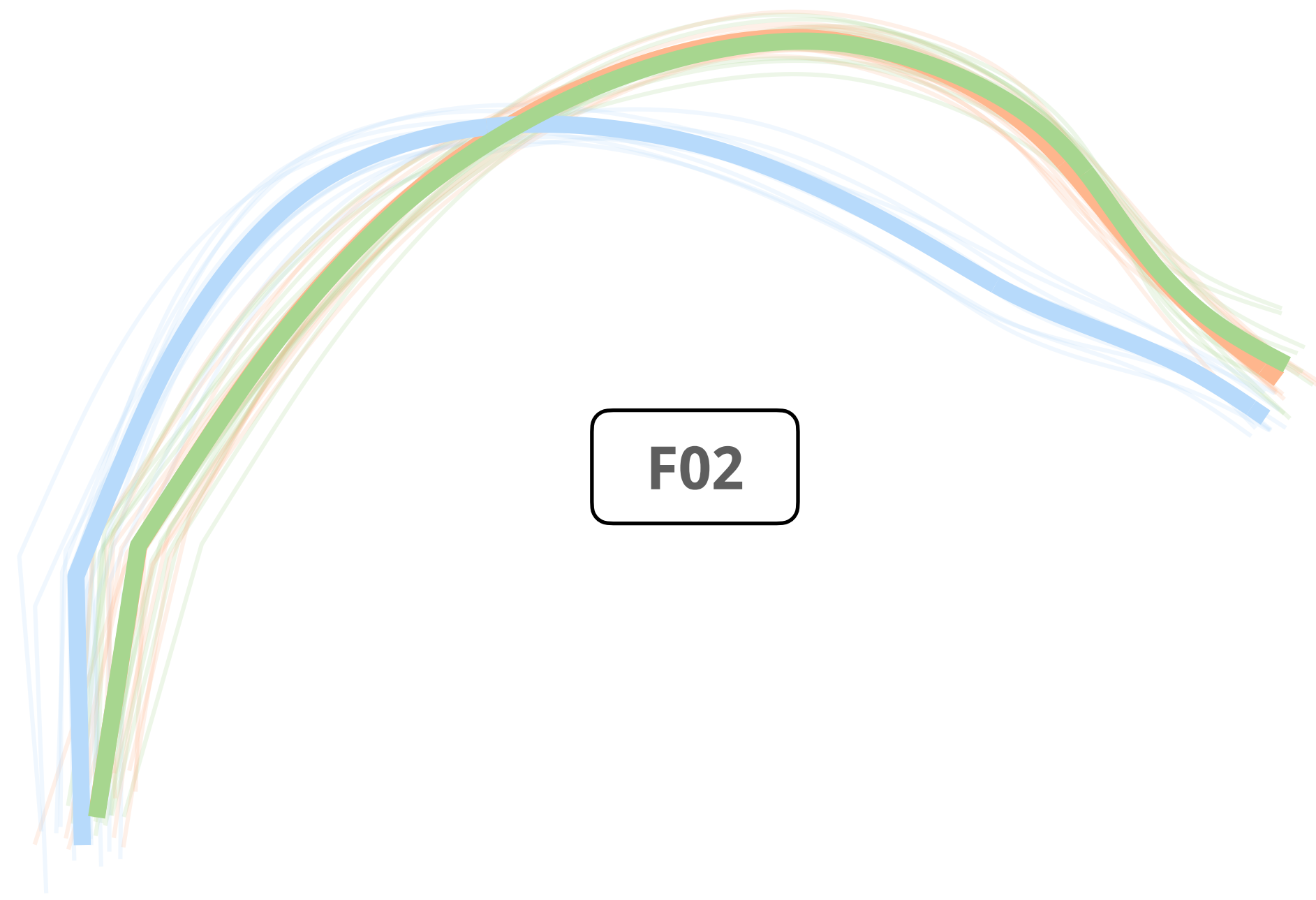


M02

V#ʃ
e.g. the *sheet*



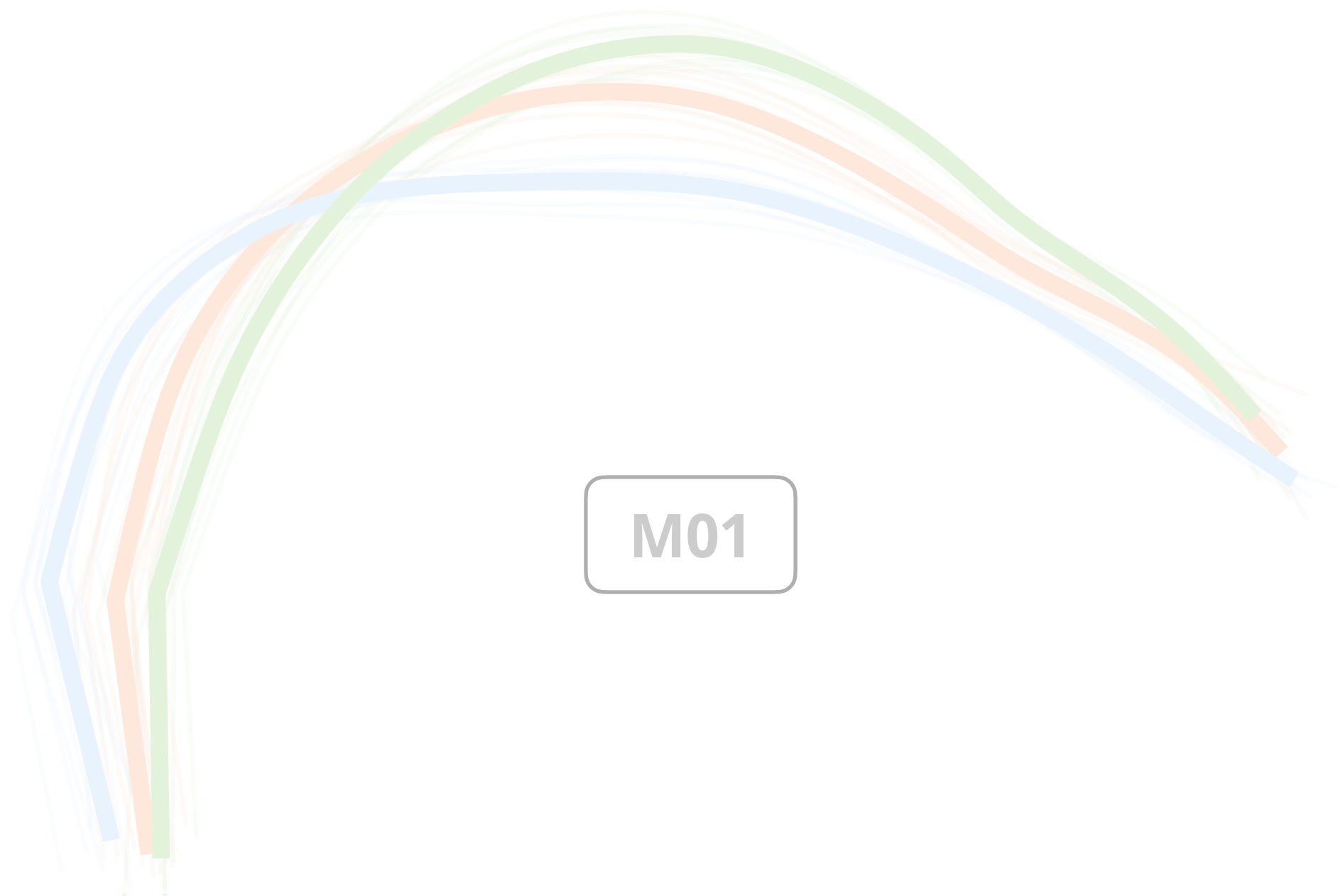
F01



F02

V#s
e.g. the *seat*

S#J
e.g. *this* reed



M01



M02

V#J
e.g. the *sheet*



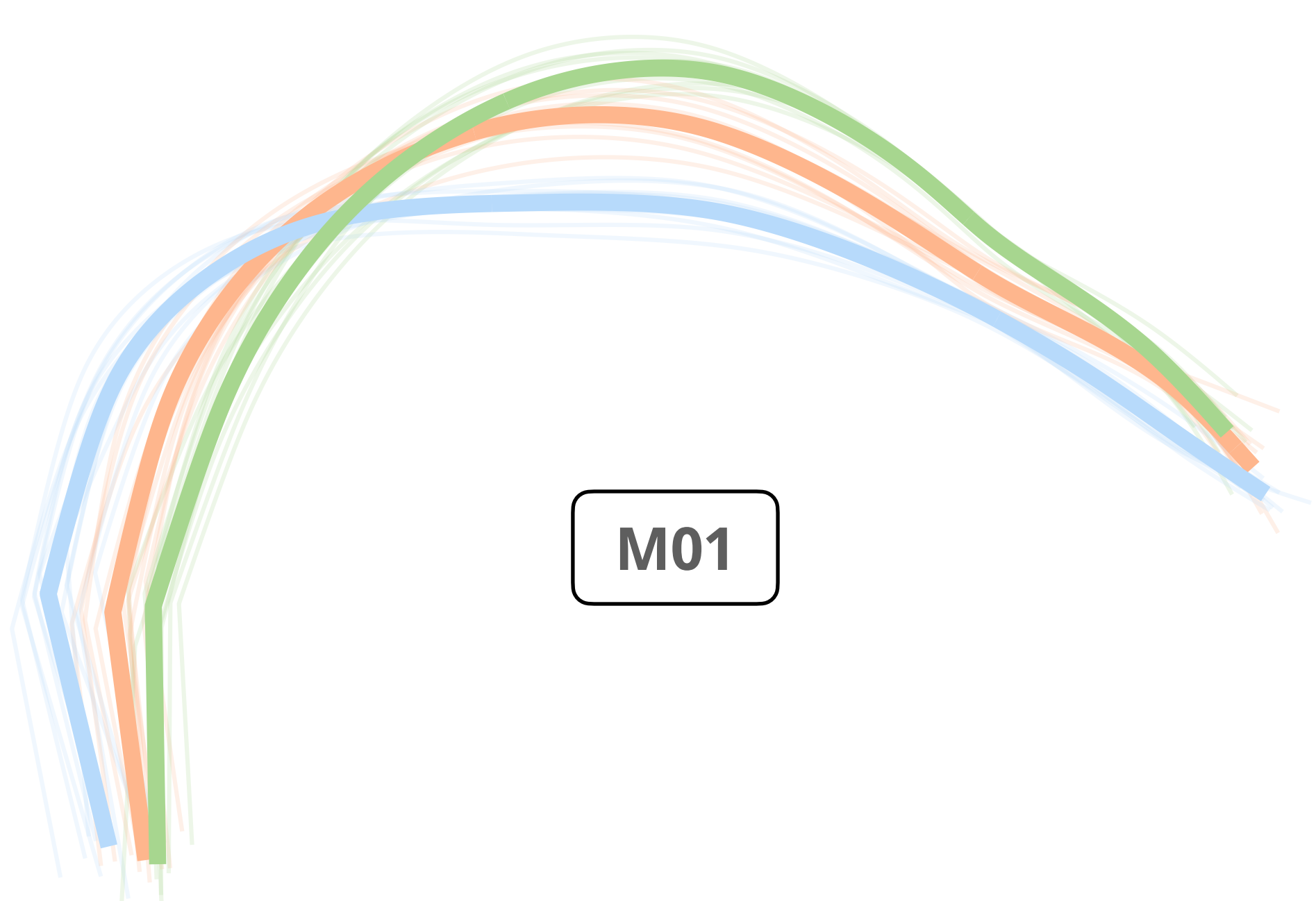
F01



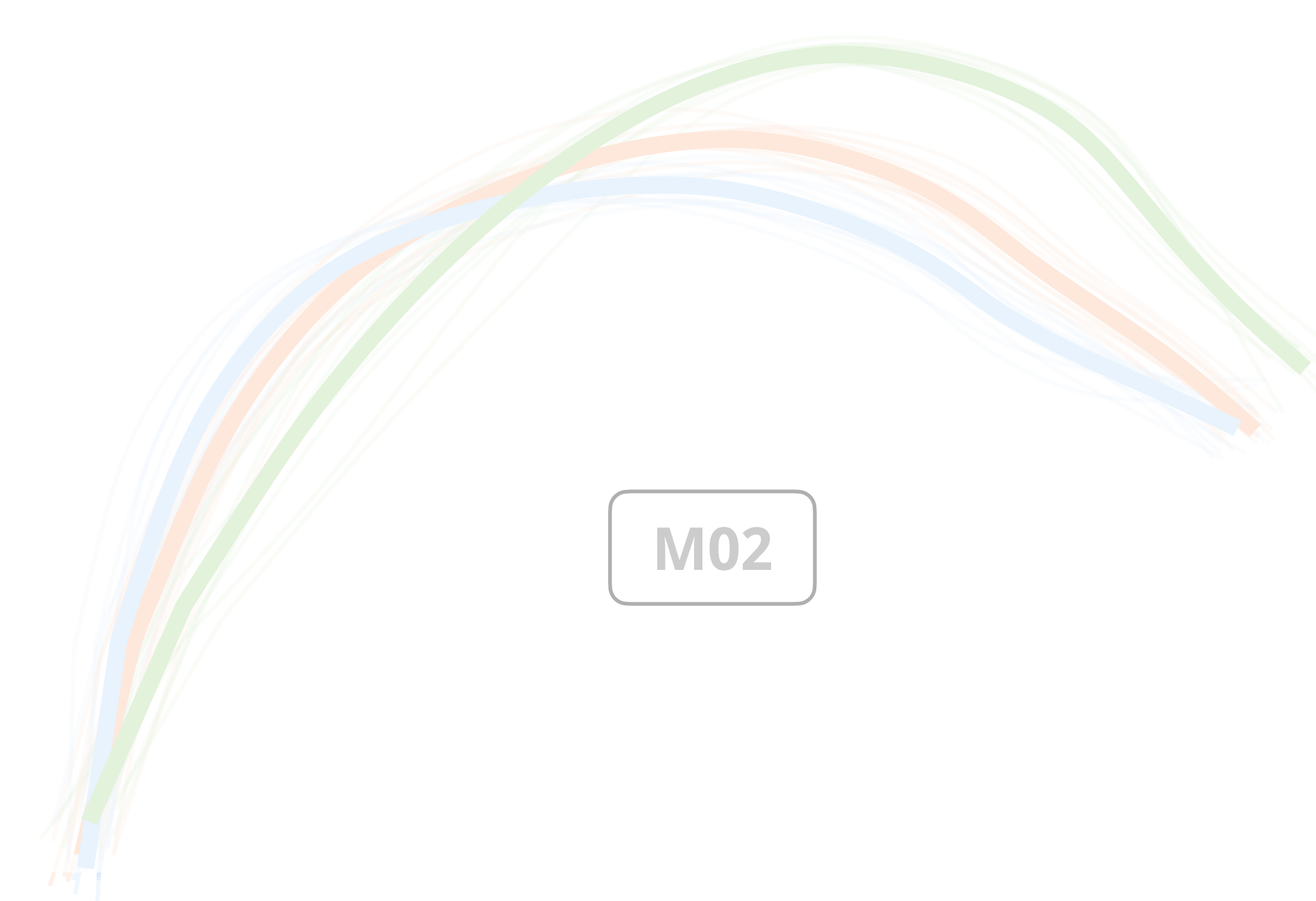
F02

V#s
*e.g. the **seat***

S#J
*e.g. this **reed***



M01



M02

V#J
*e.g. the **sheet***



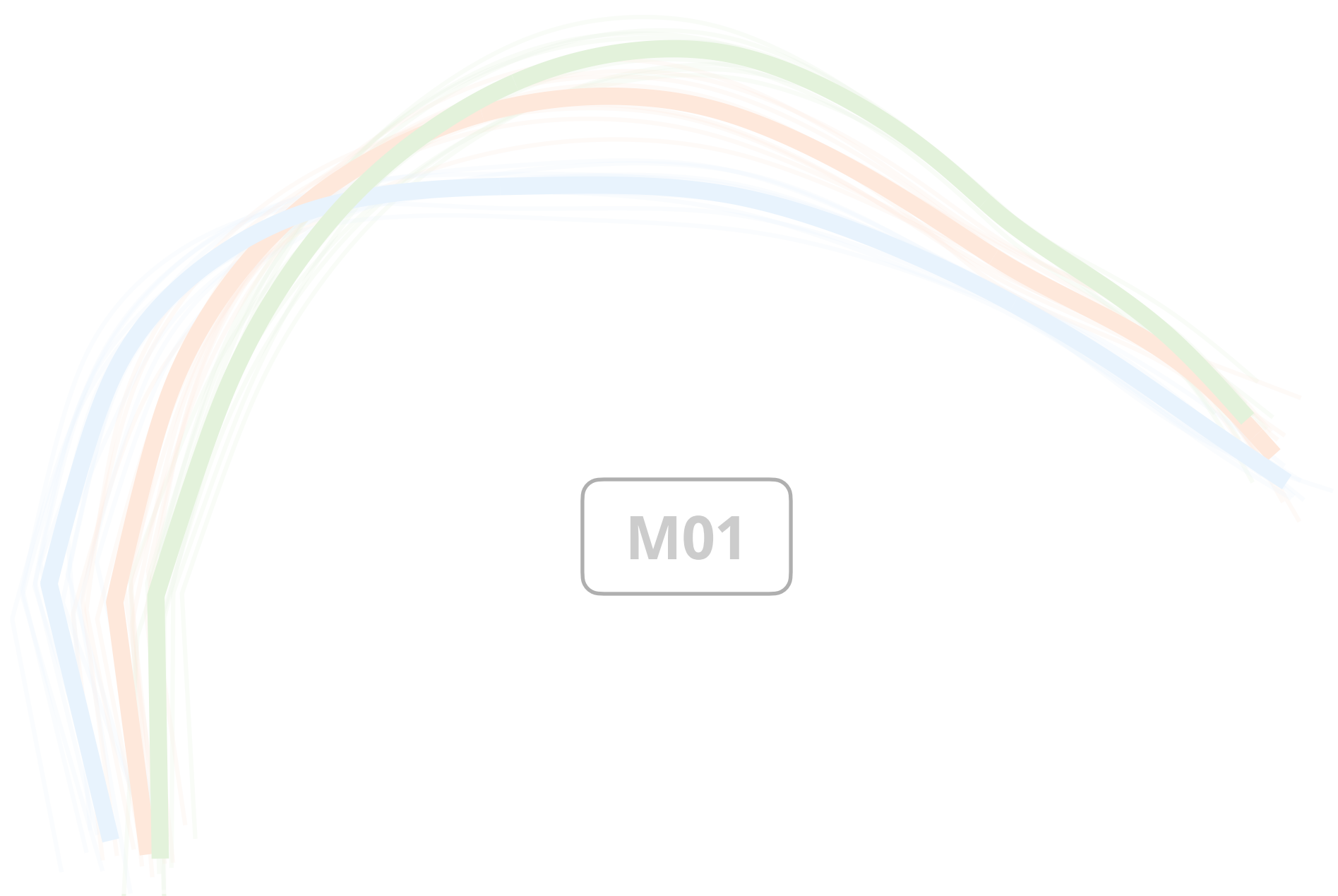
F01



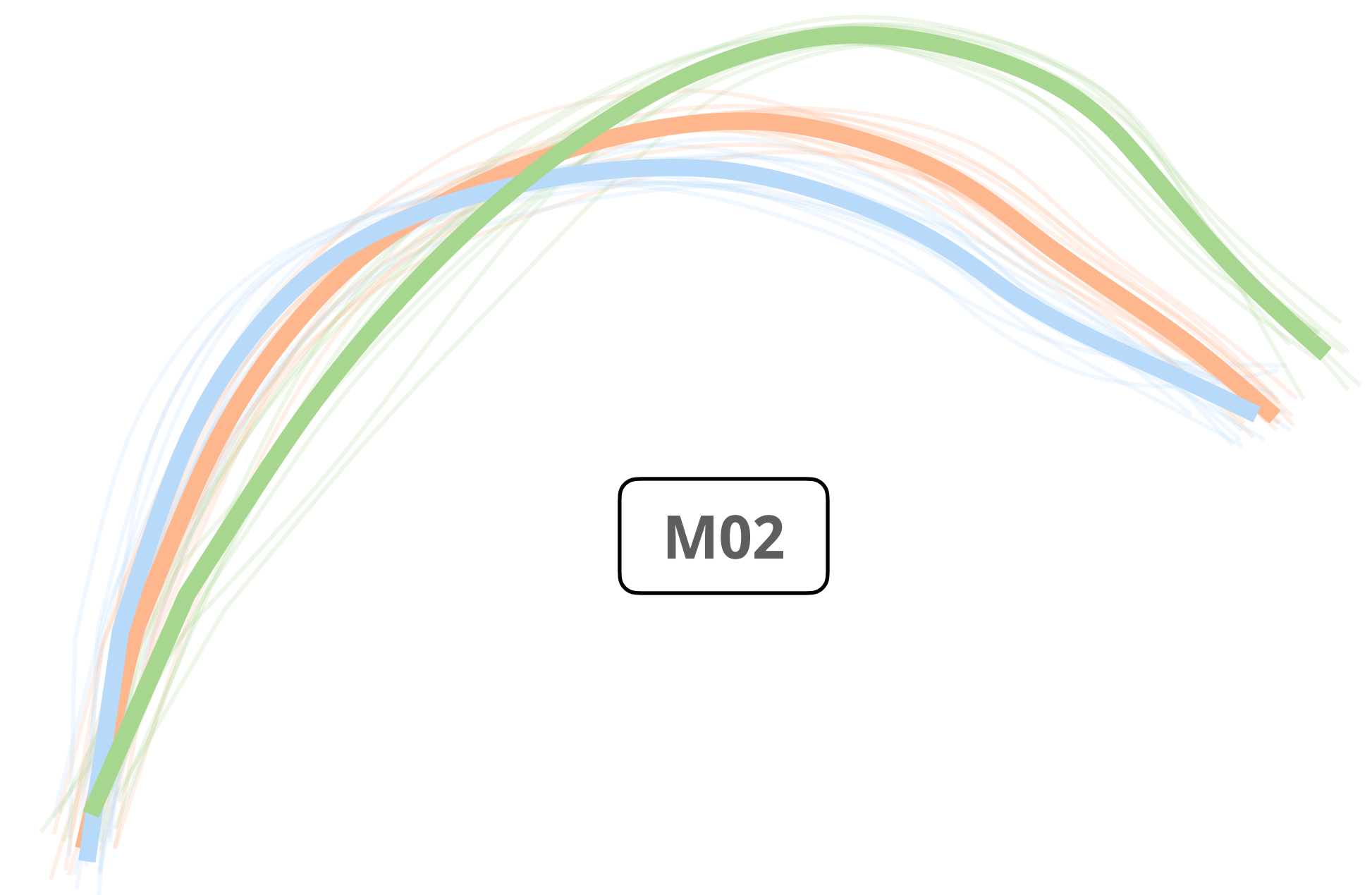
F02

V#s
*e.g. the **seat***

S#ɹ
*e.g. **this** reed*

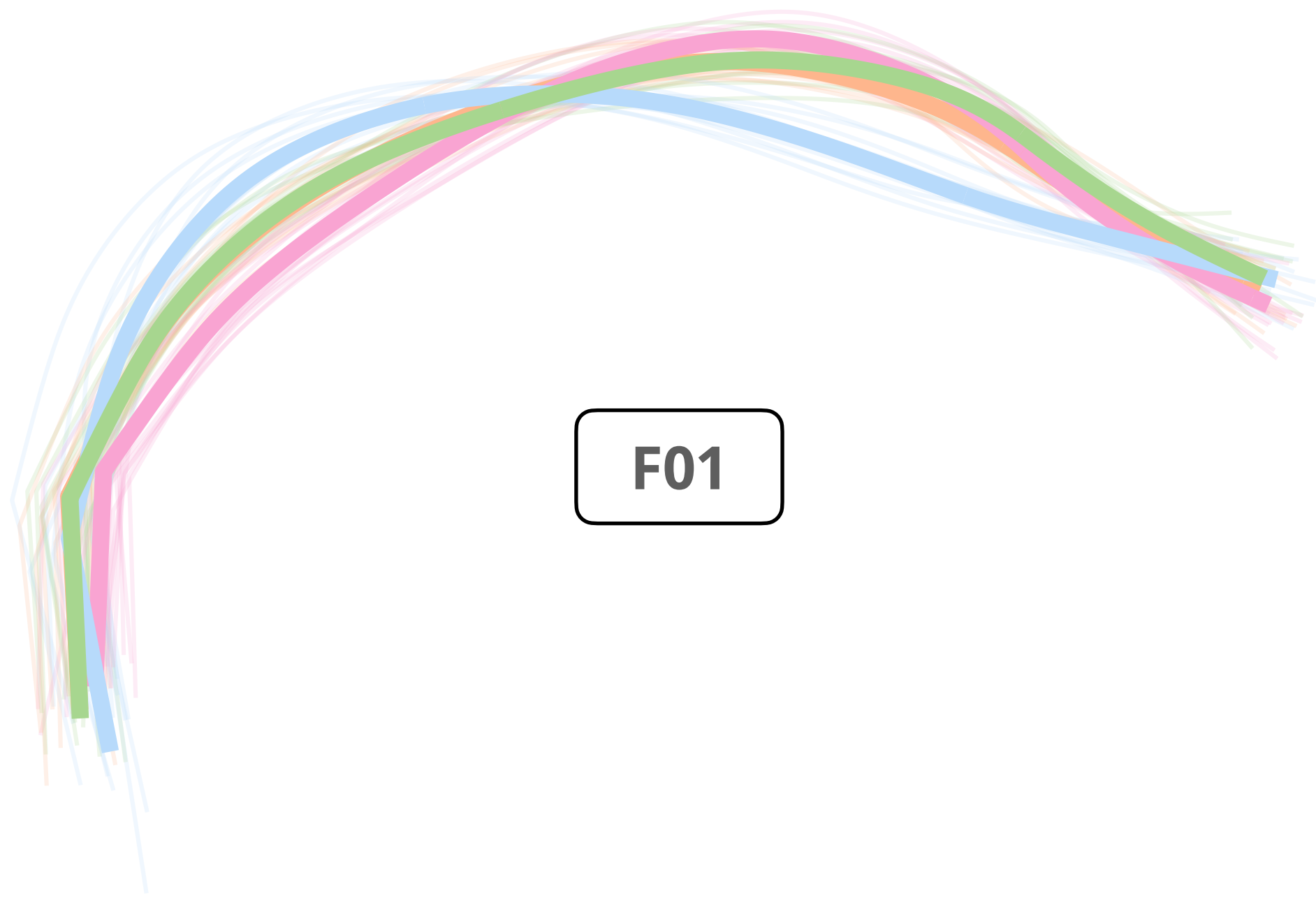


M01

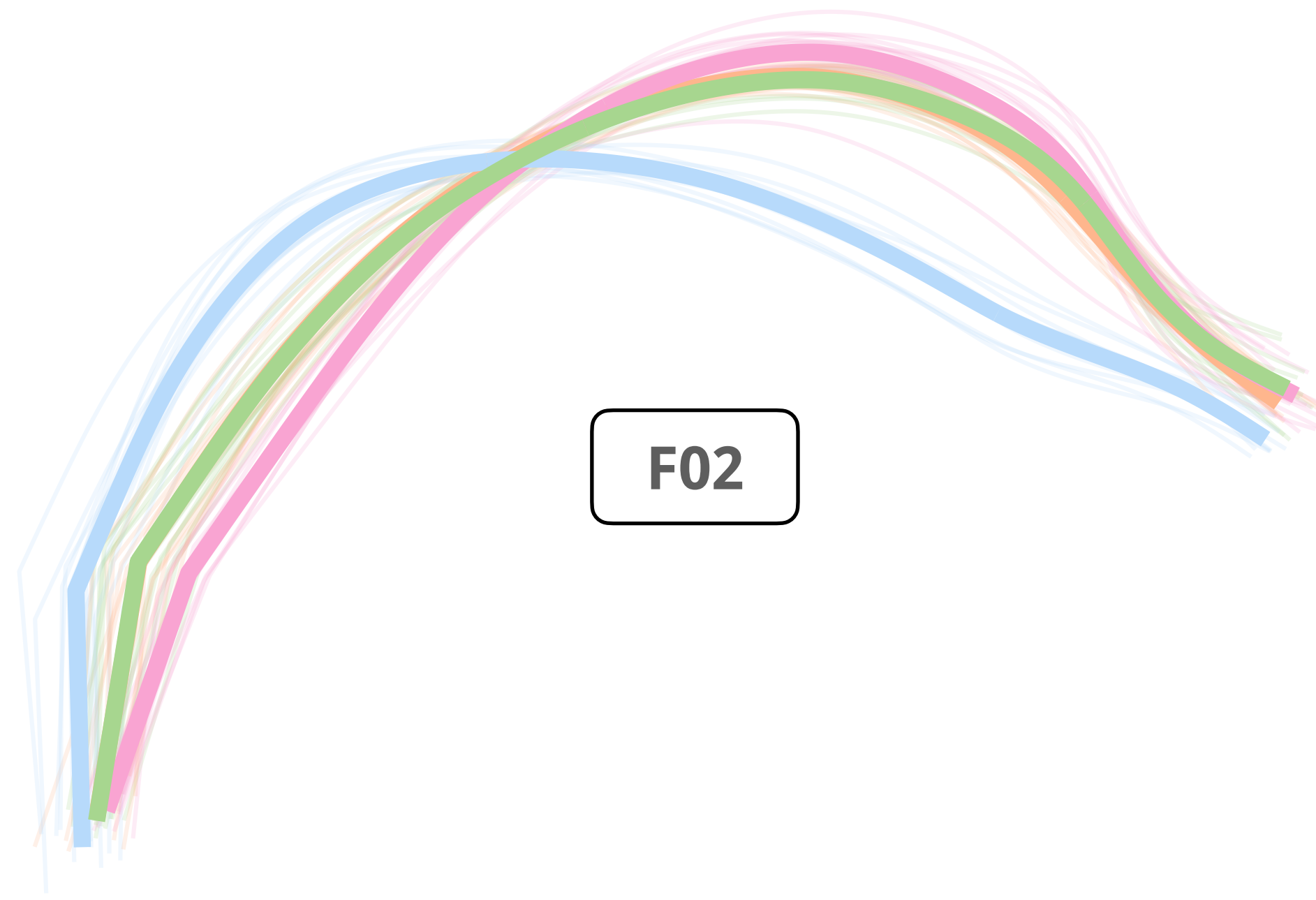


M02

V#ʃ
*e.g. the **sheet***



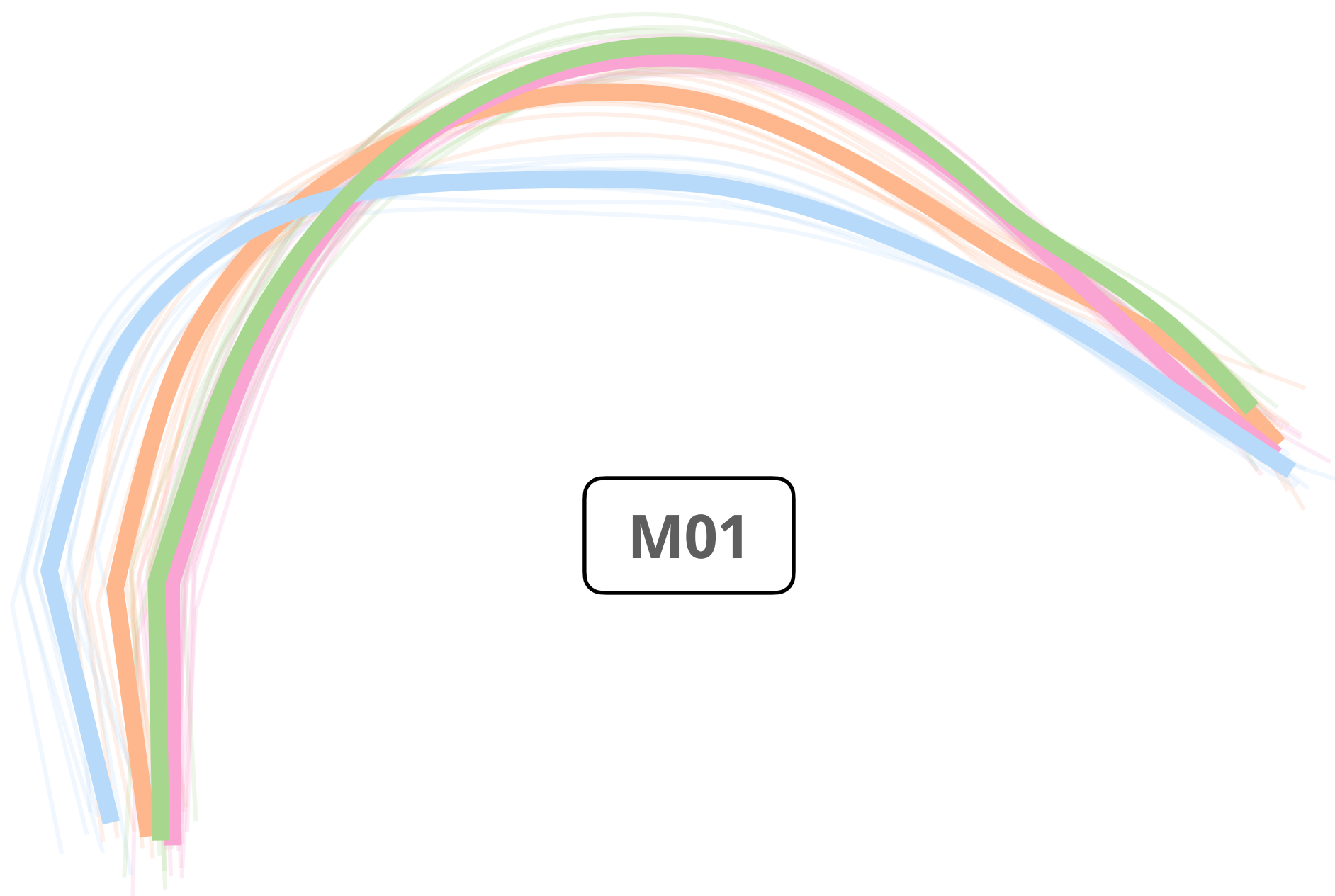
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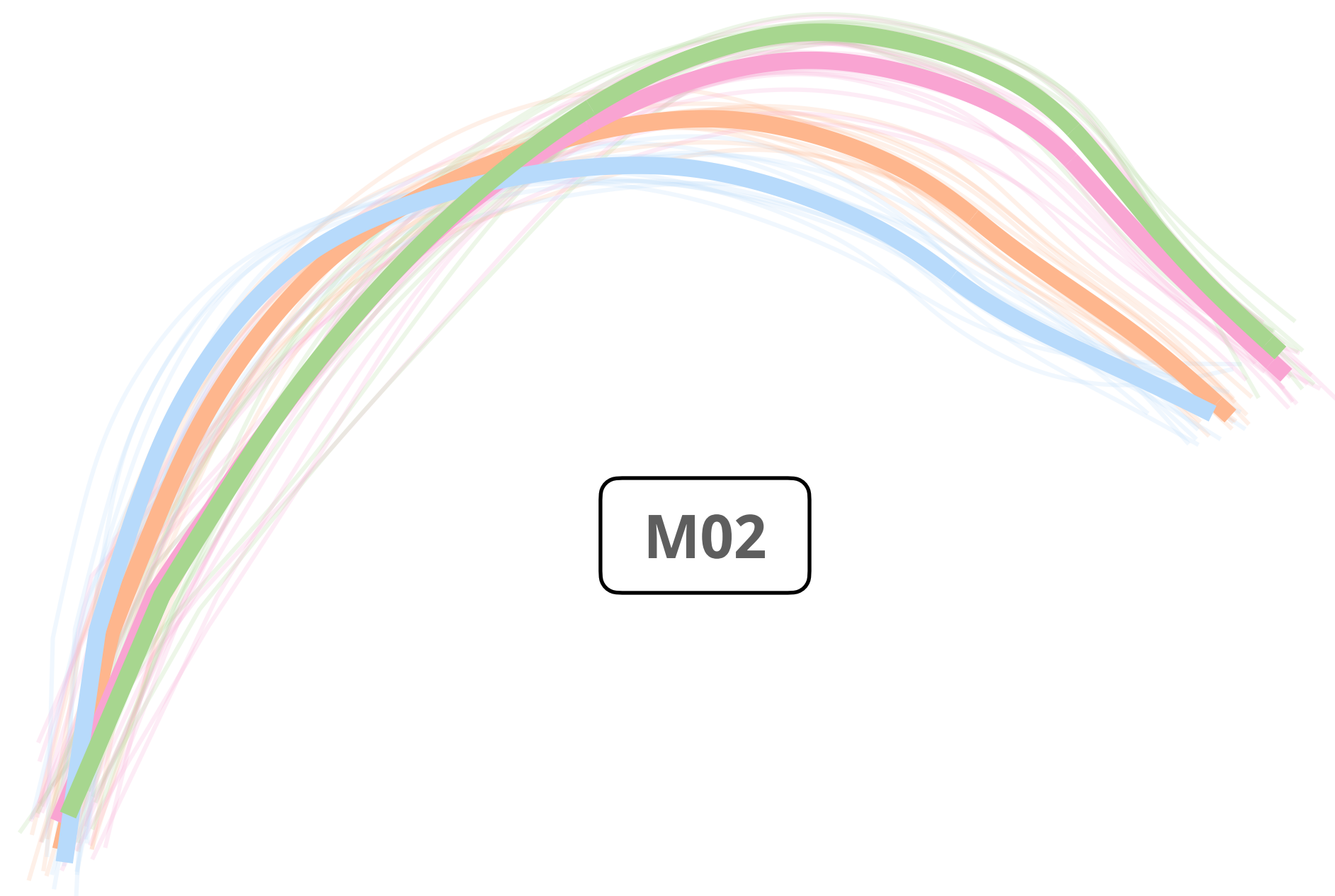
F02

V#s
*e.g. the **seat***

s#ɹ
*e.g. **this** reed*



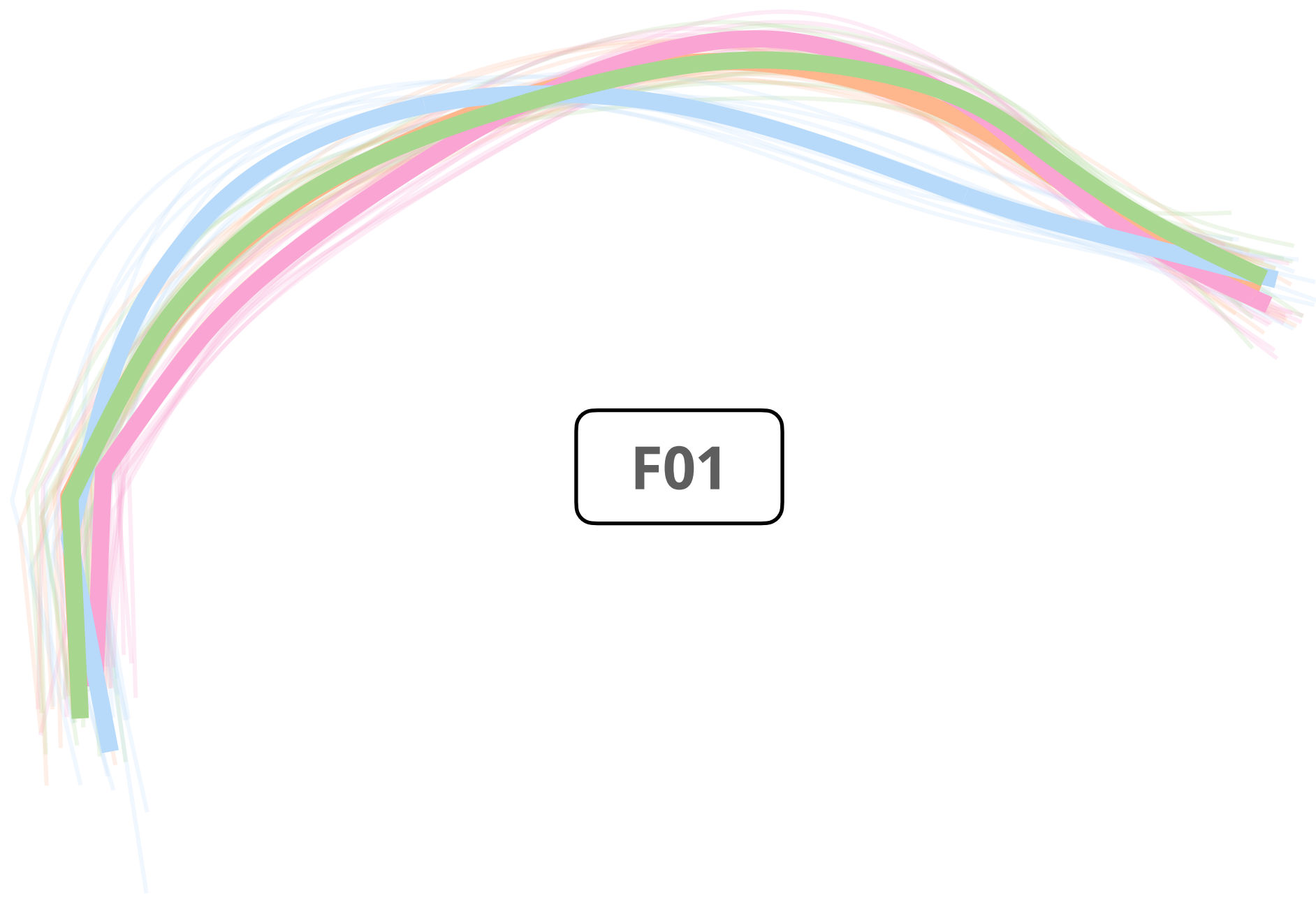
M01



M02

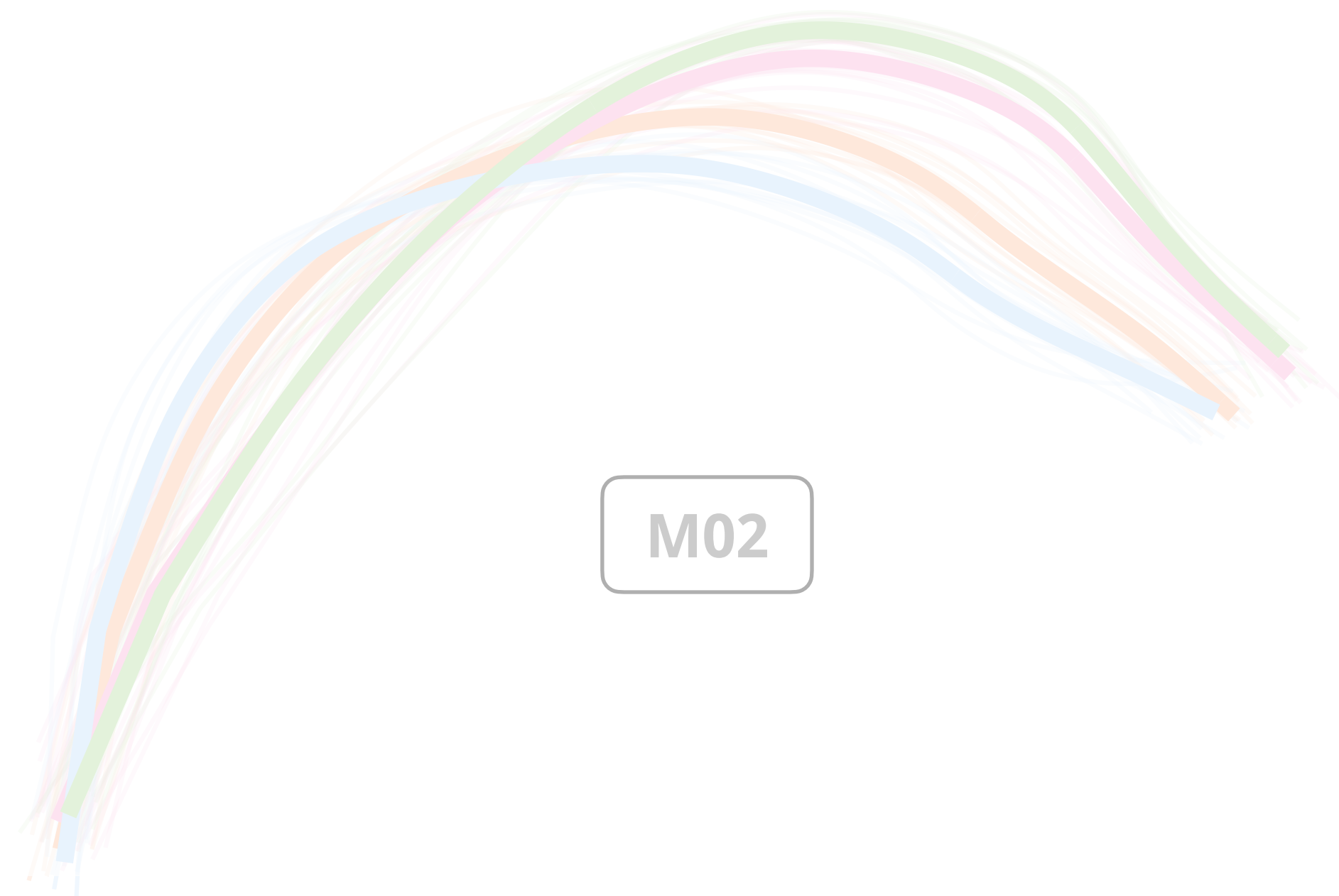
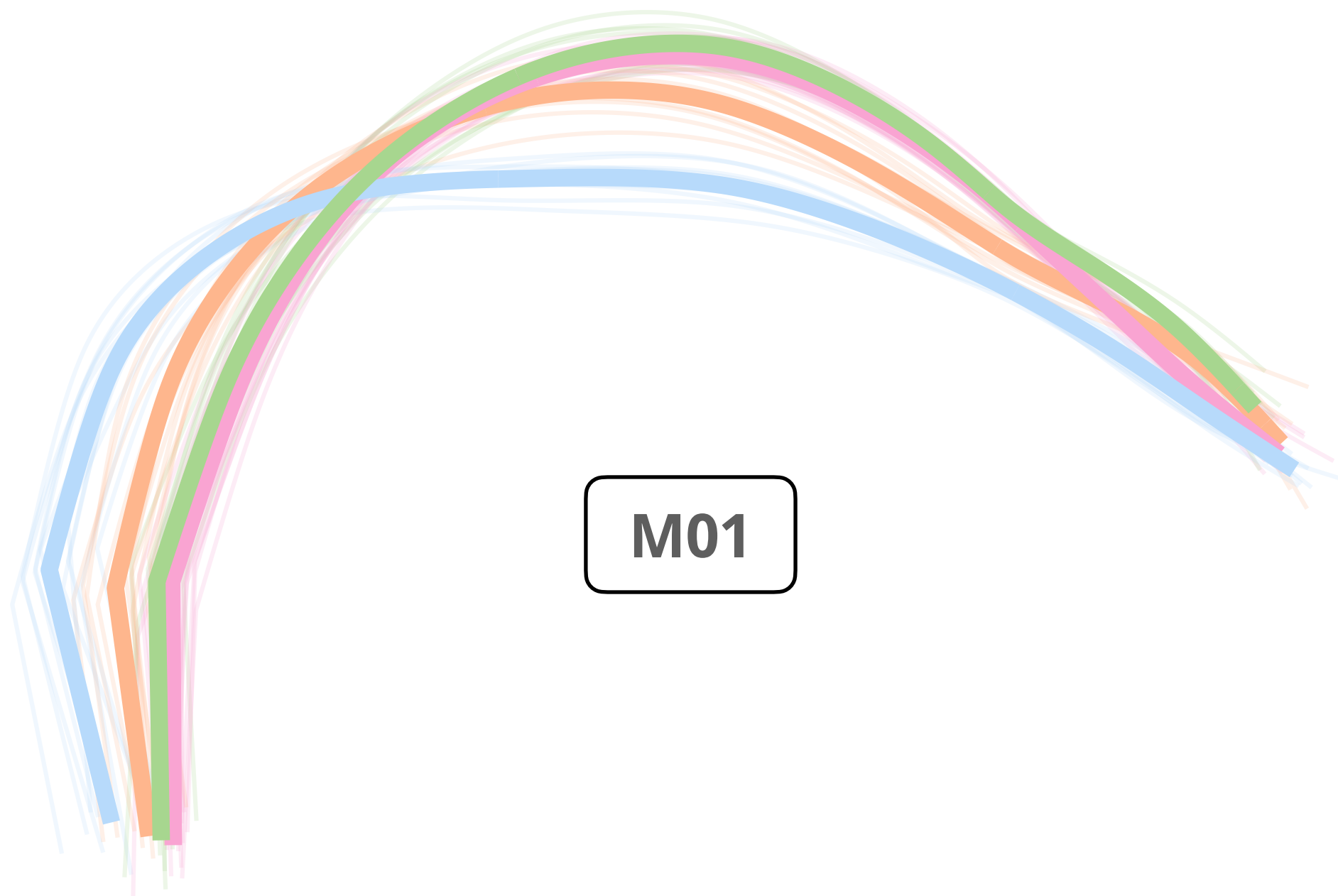
s#j
*e.g. **this** yeast*

V#ʃ
*e.g. the **sheet***



V#s
*e.g. the **s**eat*

s#ɹ
*e.g. **this** reed*



s#j
*e.g. **this** yeast*

V#ʃ
*e.g. the **sheet***

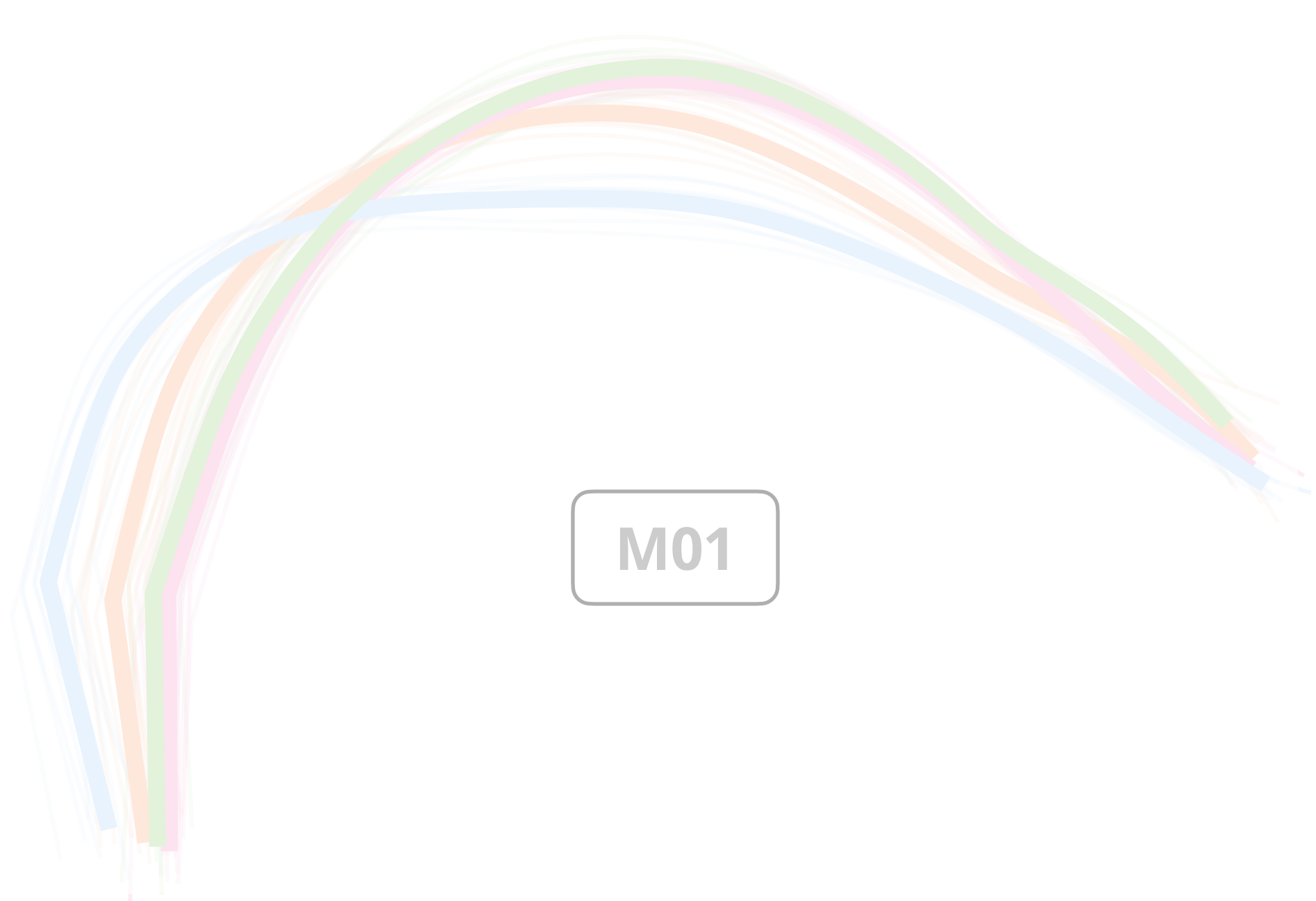


F01

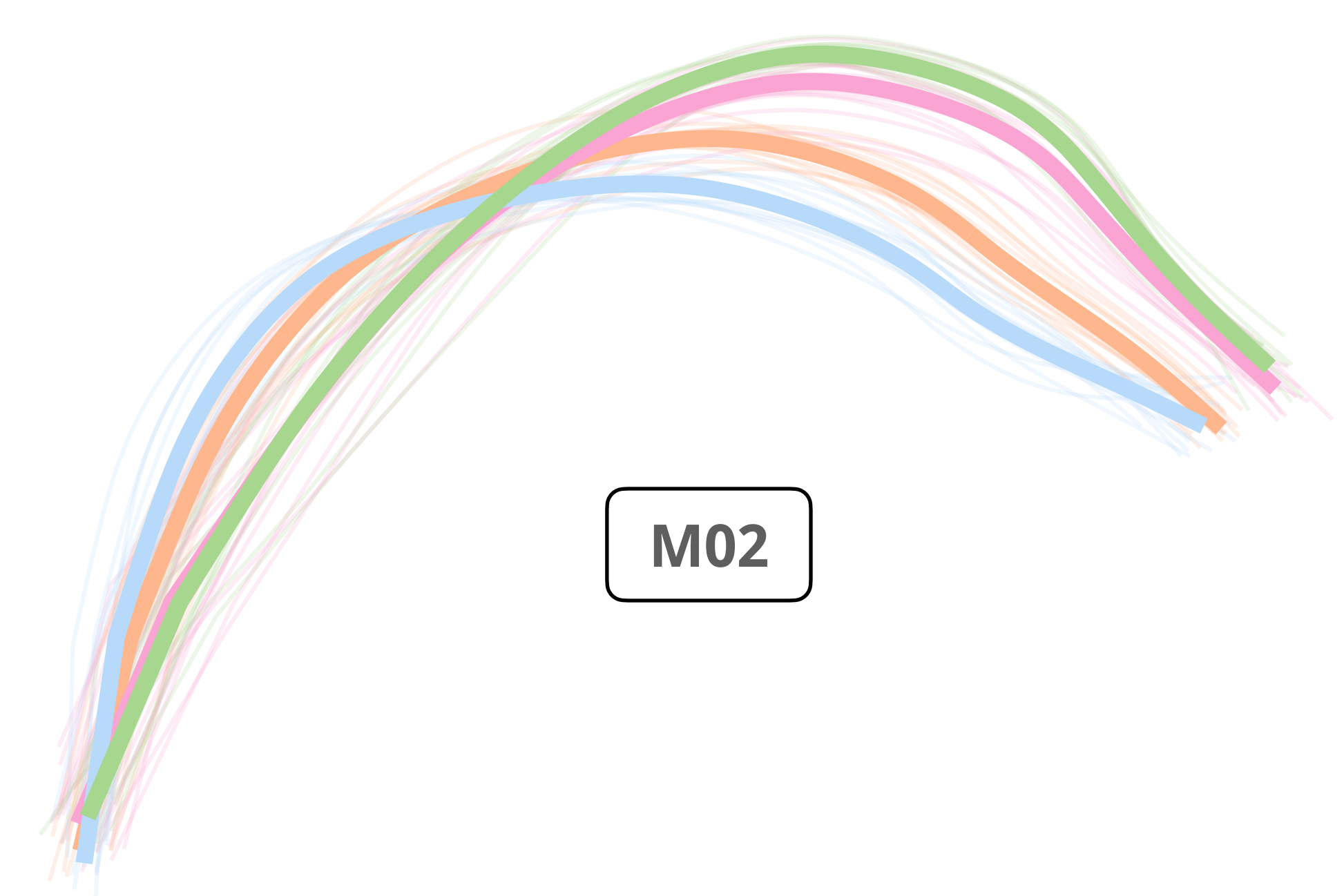


F02

V#s
*e.g. the **s**eat*



M01



M02

s#ɹ
*e.g. **this** reed*

s#j
*e.g. **this** yeast*

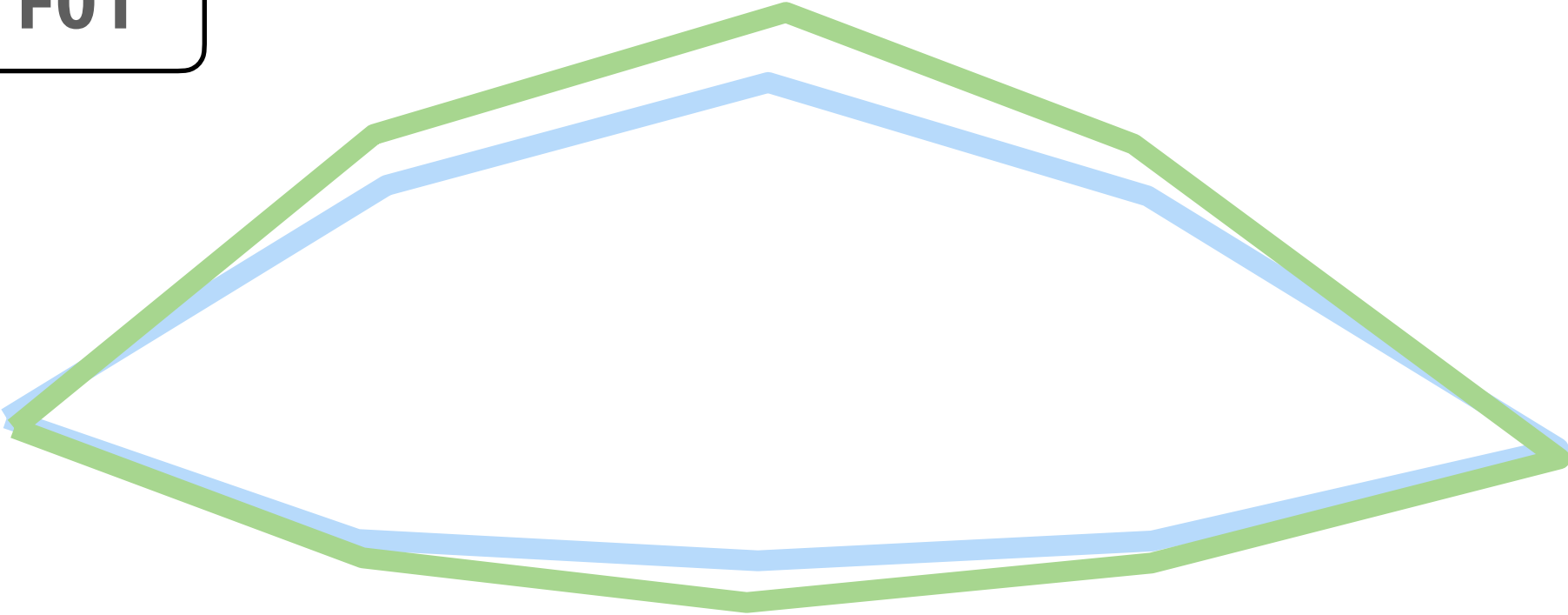
V#ʃ
*e.g. the **sheet***

Lips

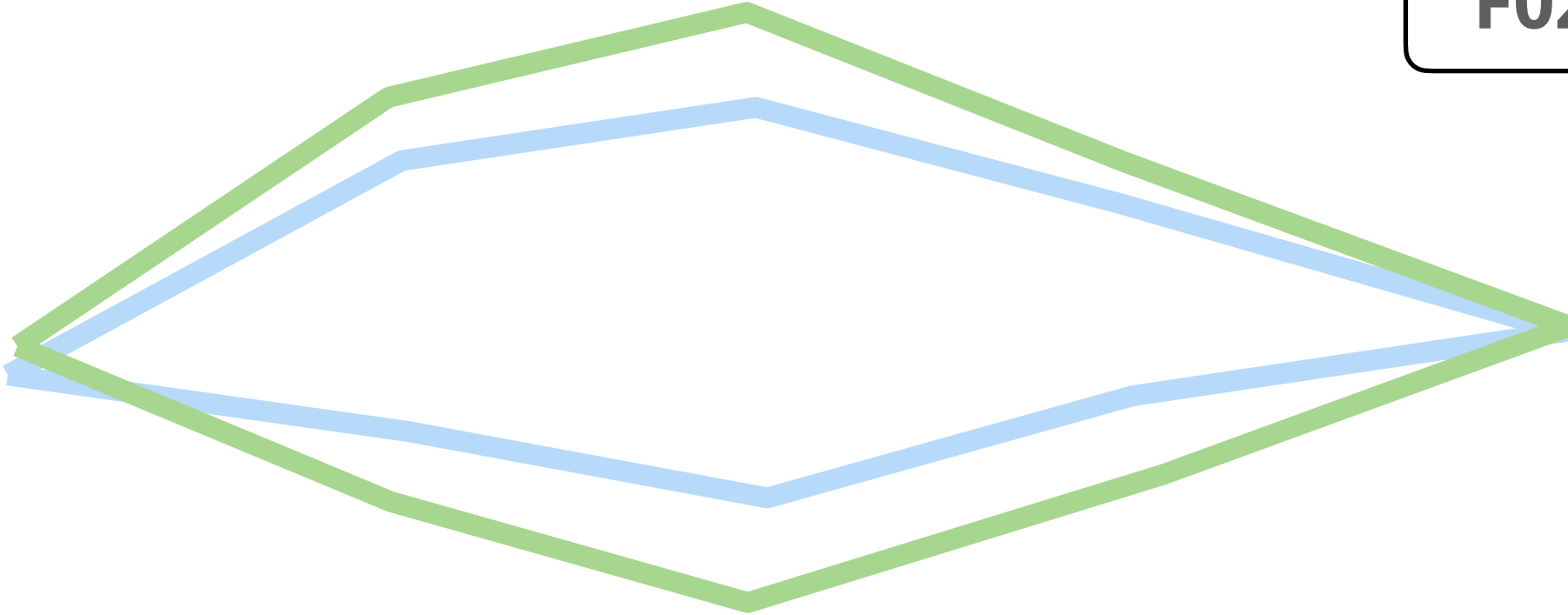
post-lexical retraction



F01

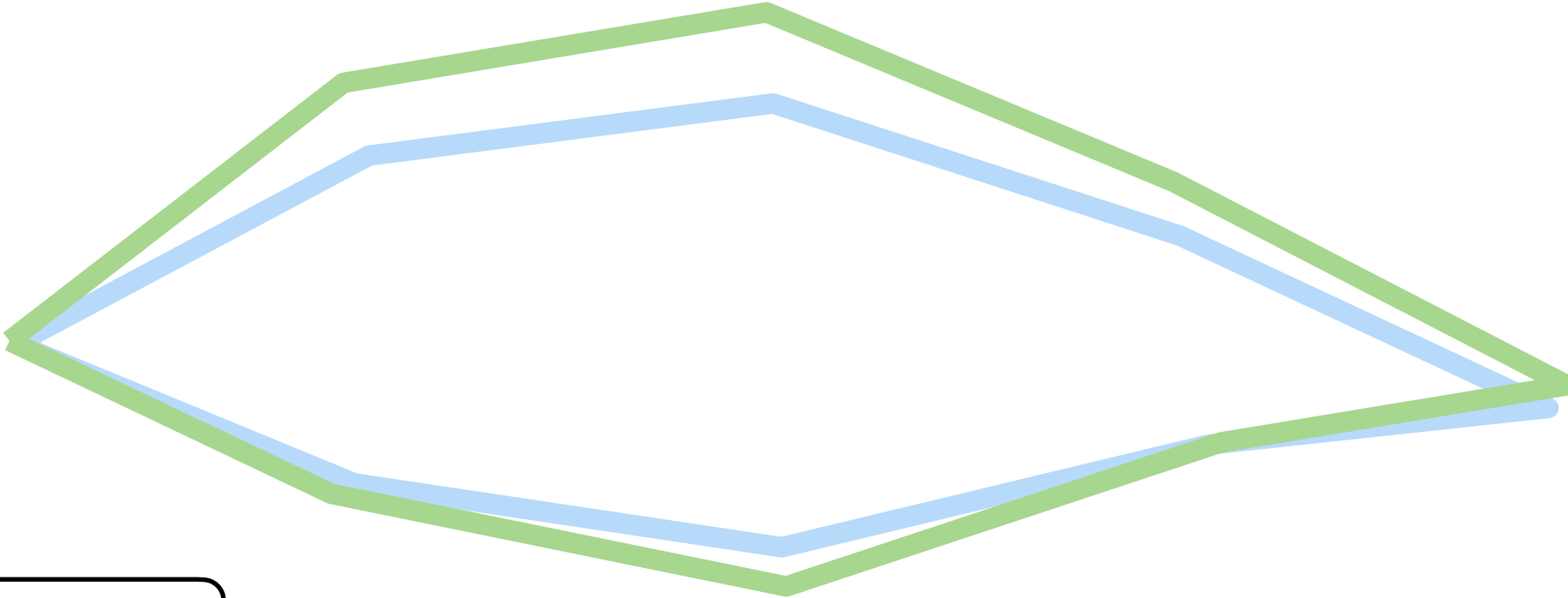


F02

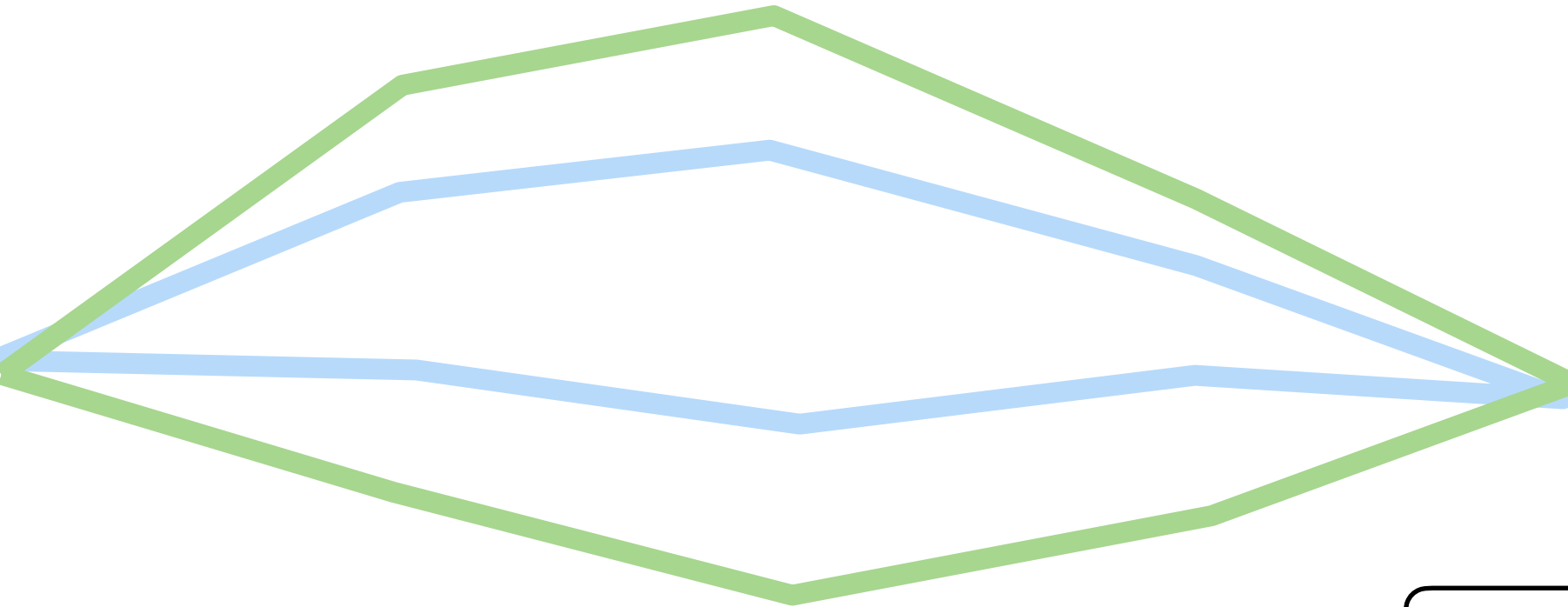


V#s
e.g. seat

M01

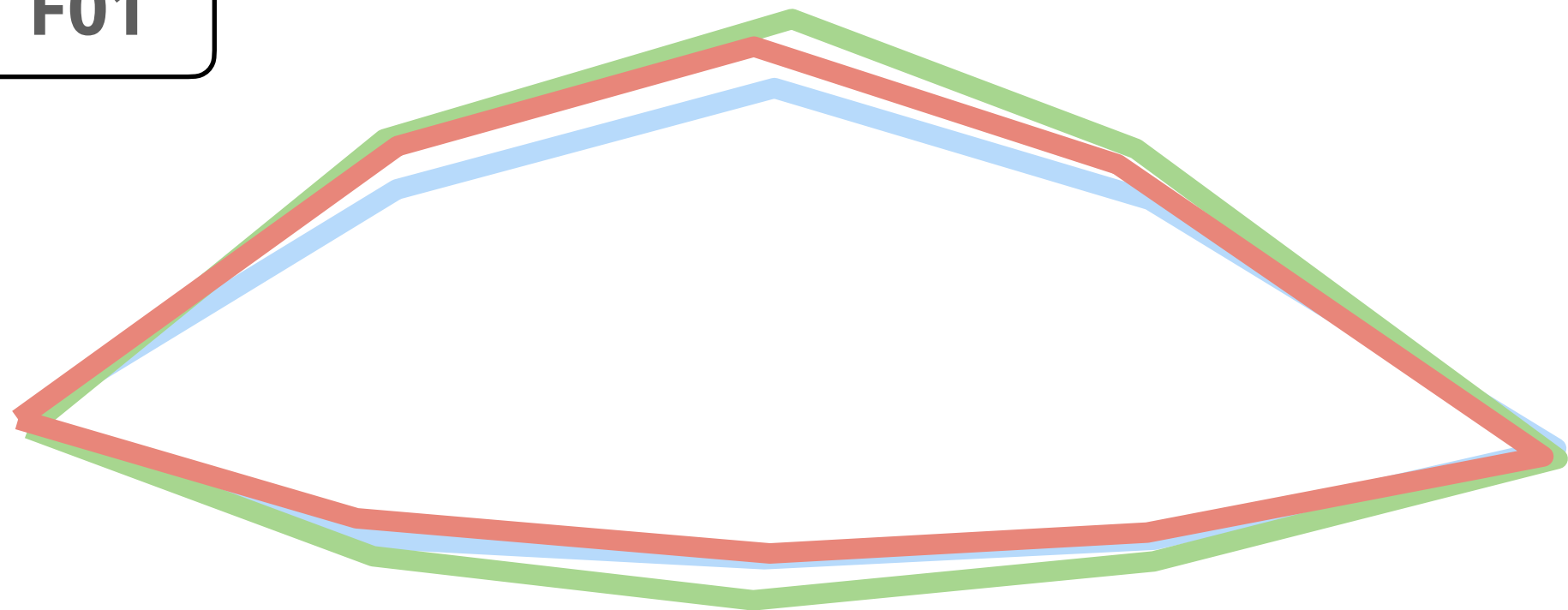


M02

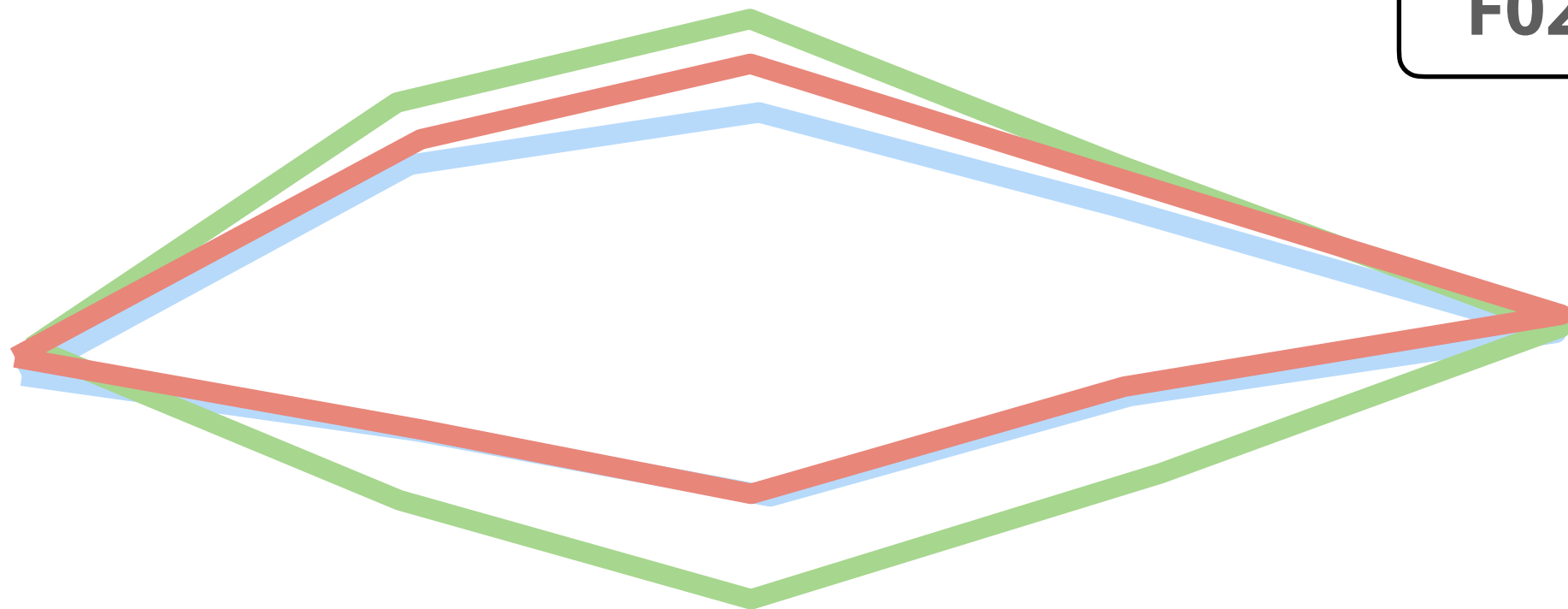


V#j
e.g. sheet

F01



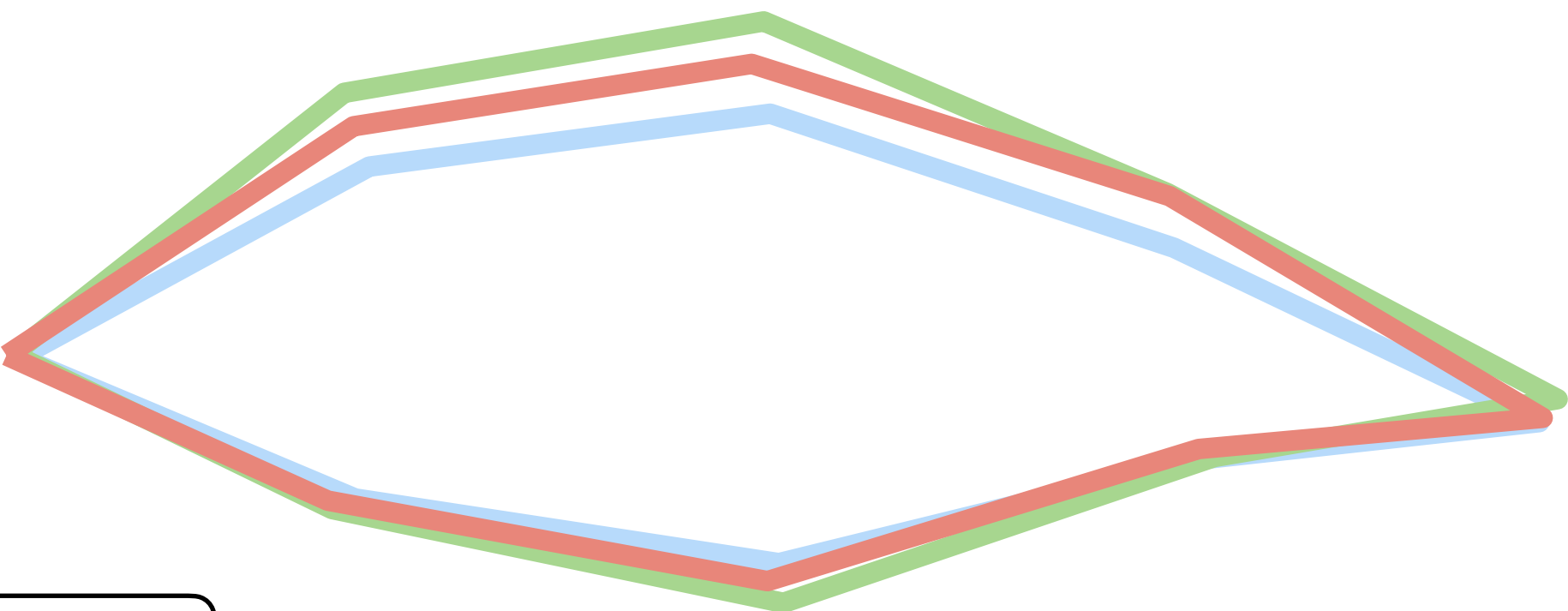
F02



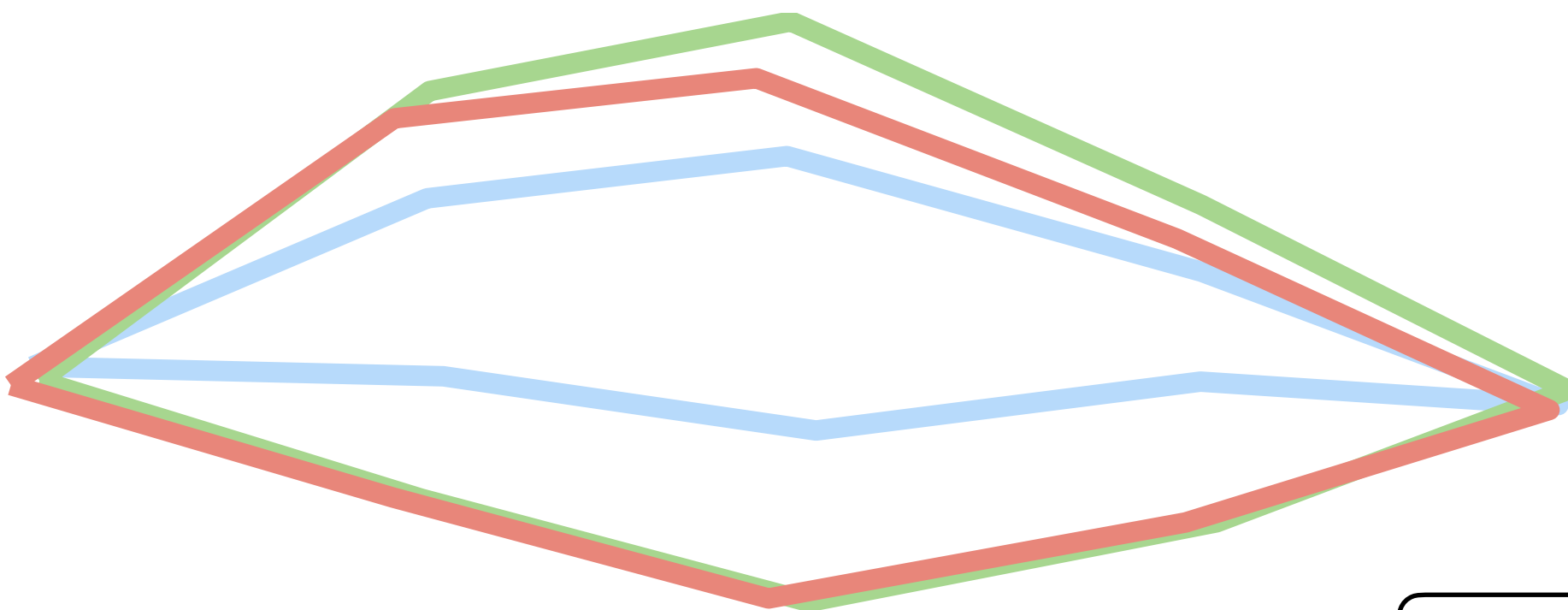
V#s
e.g. seat

s#tj
e.g. this tune

M01

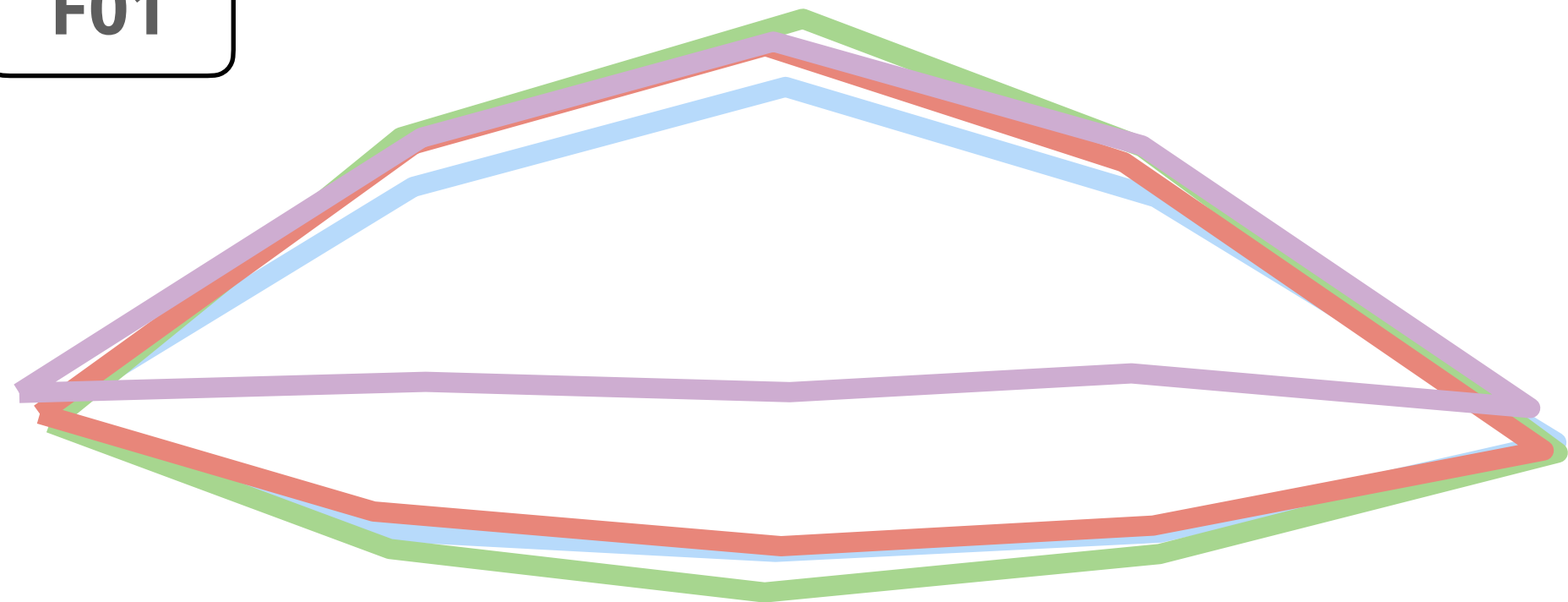


M02

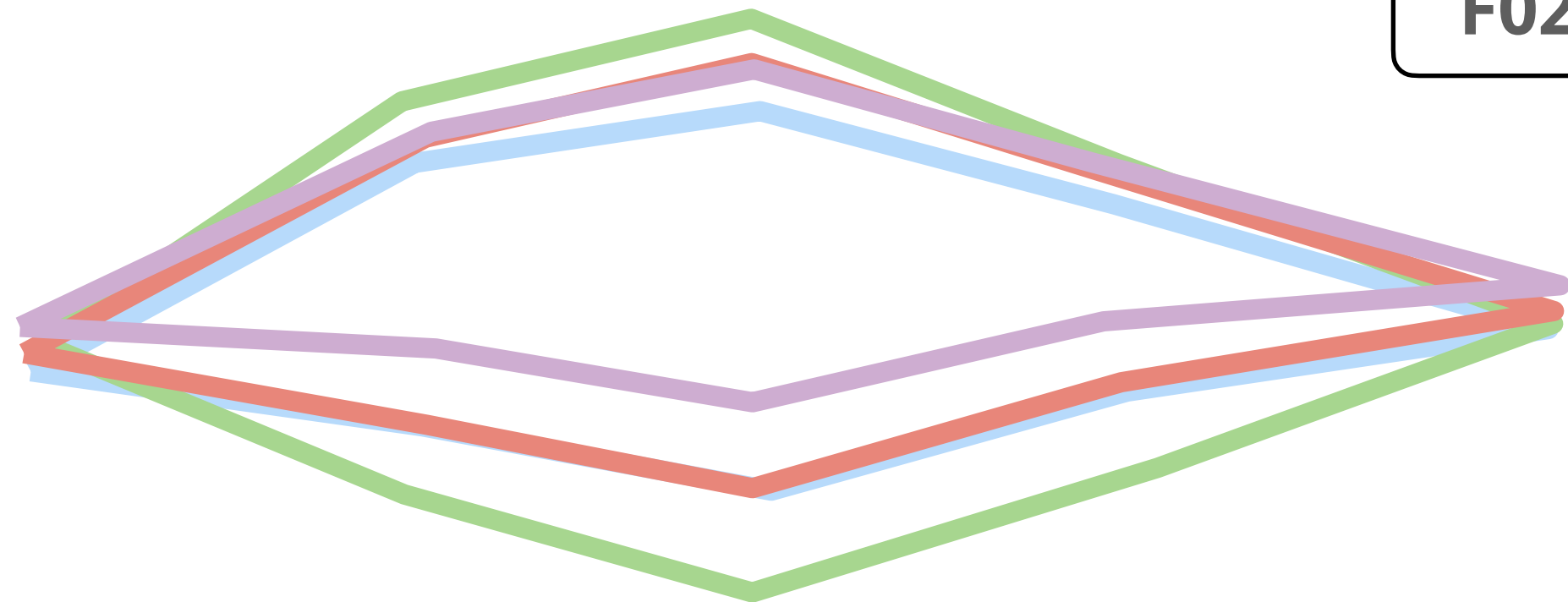


V#j
e.g. sheet

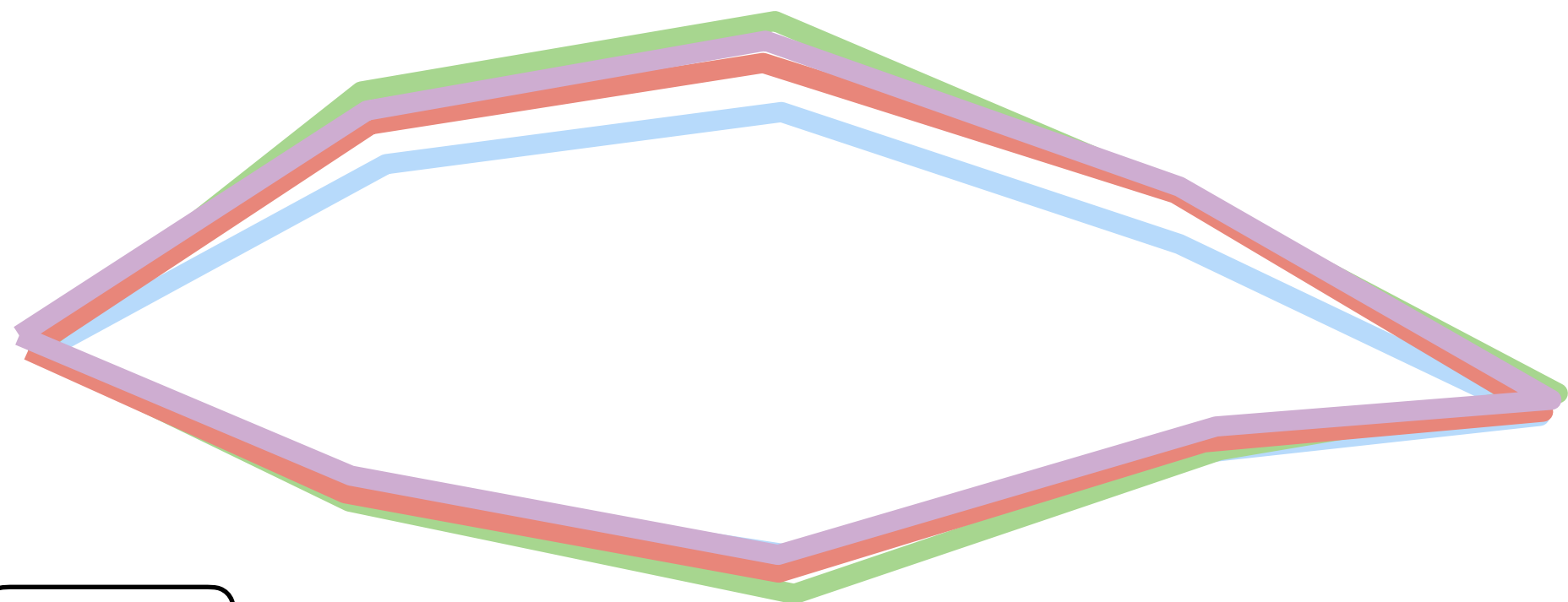
F01



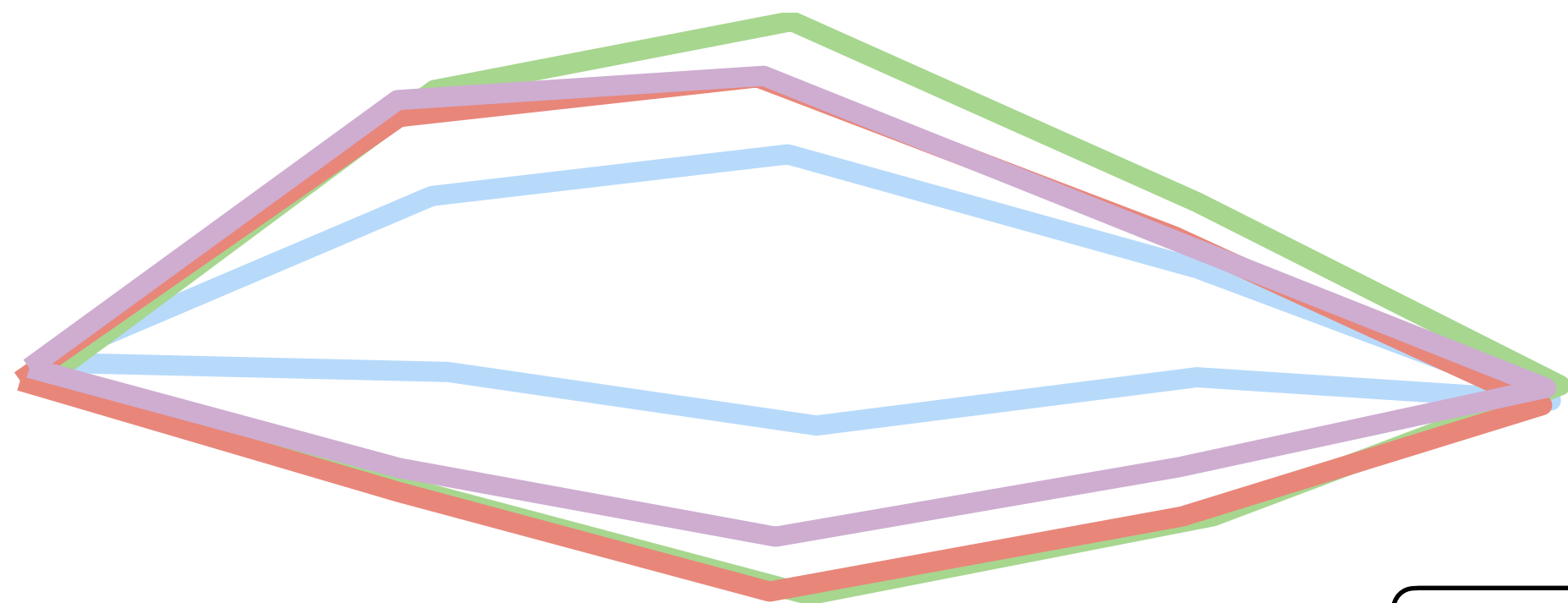
F02



M01



M02



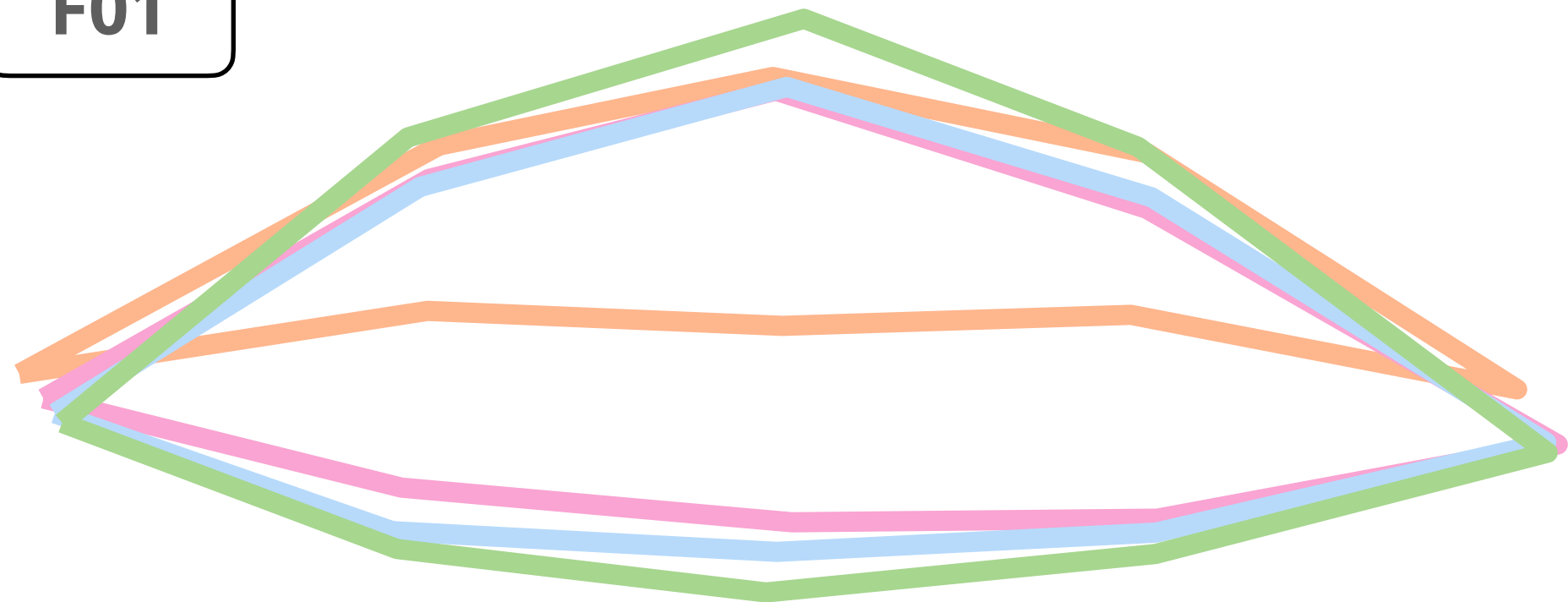
V#s
e.g. seat

s#tj
e.g. this tune

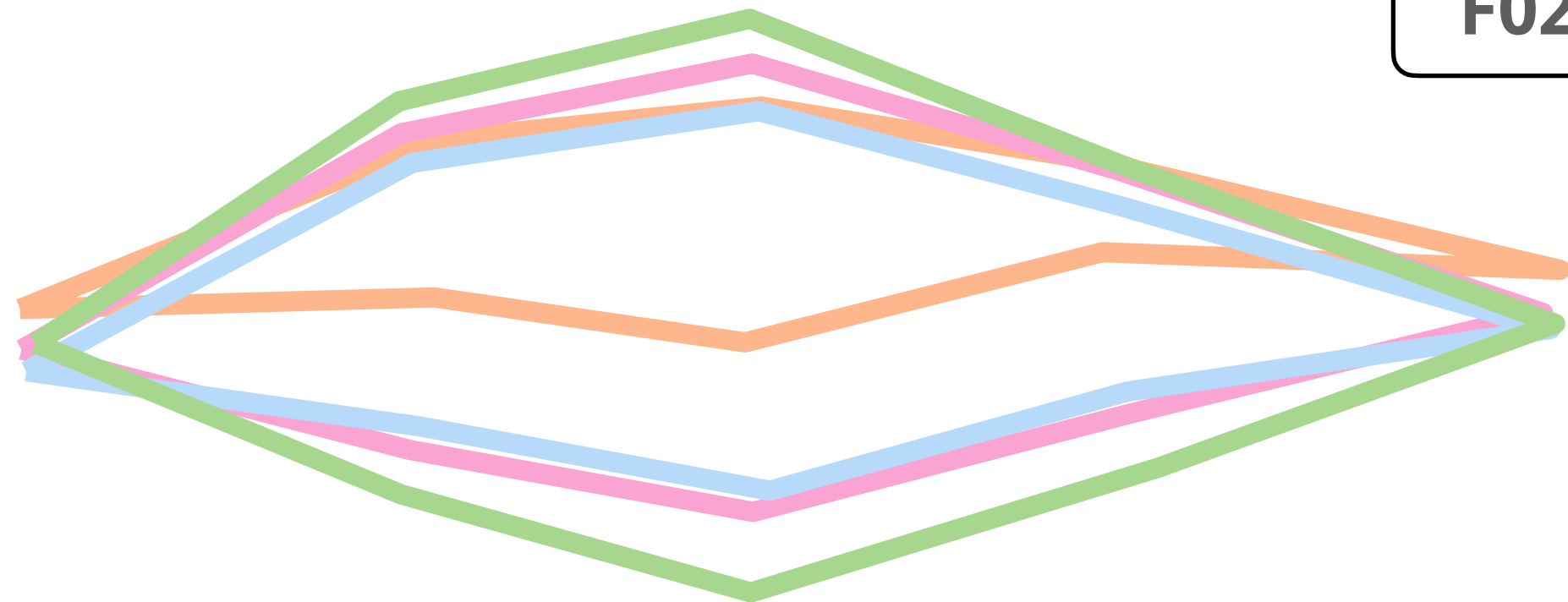
s#tɹ
e.g. this tree

V#ʃ
e.g. sheet

F01



F02



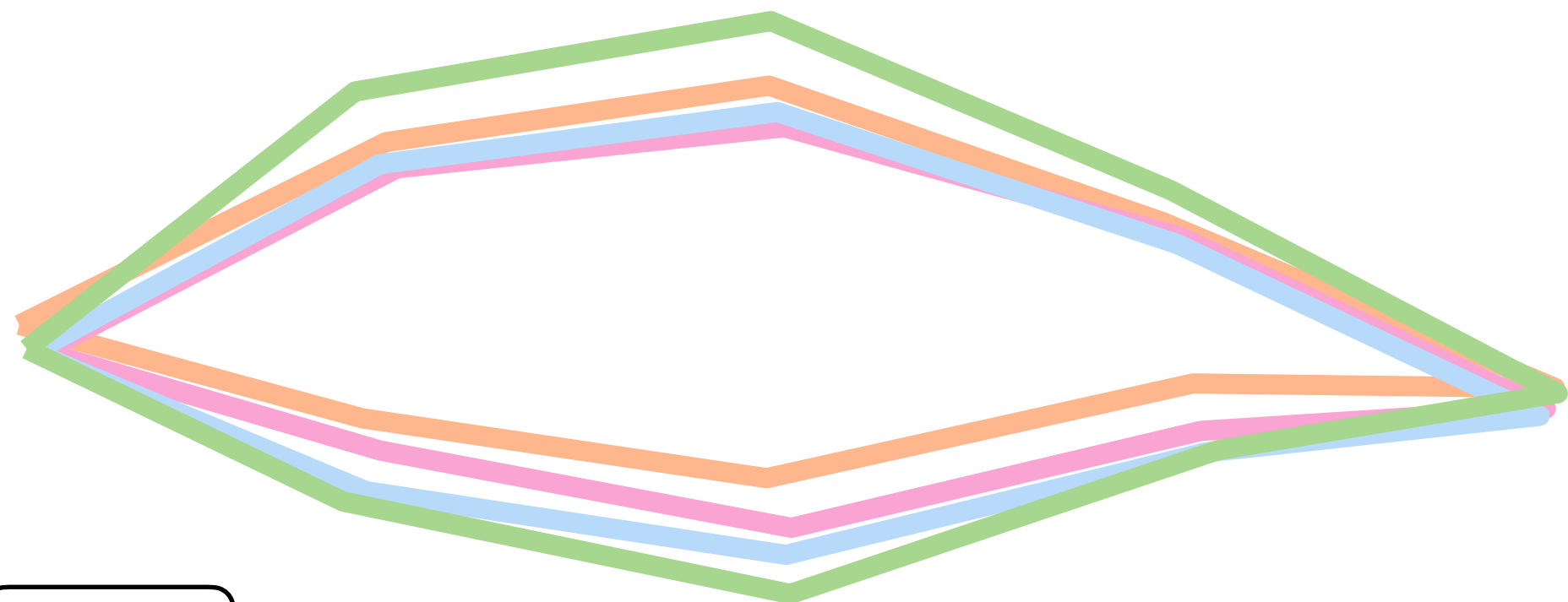
V#s
e.g. seat

s#ɹ
e.g. this reed

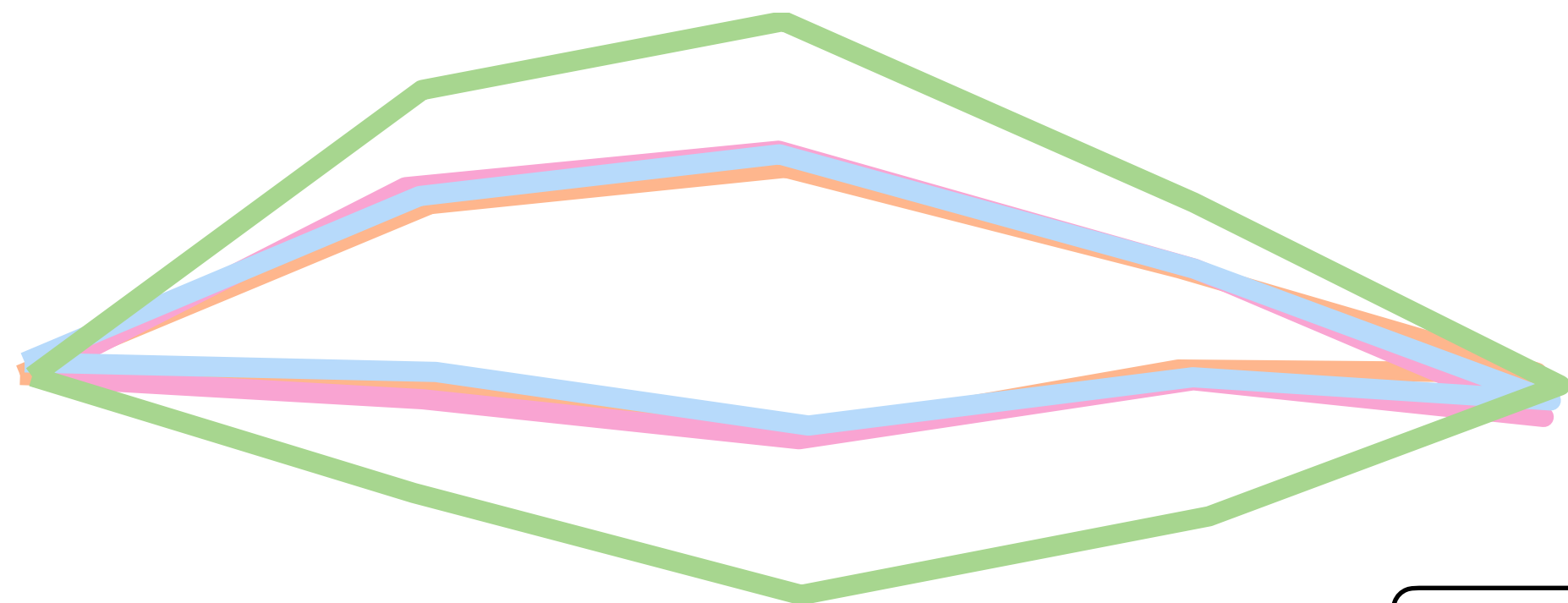
s#j
e.g. this yeast

V#ʃ
e.g. sheet

M01



M02



F01

V#s

V#ʃ

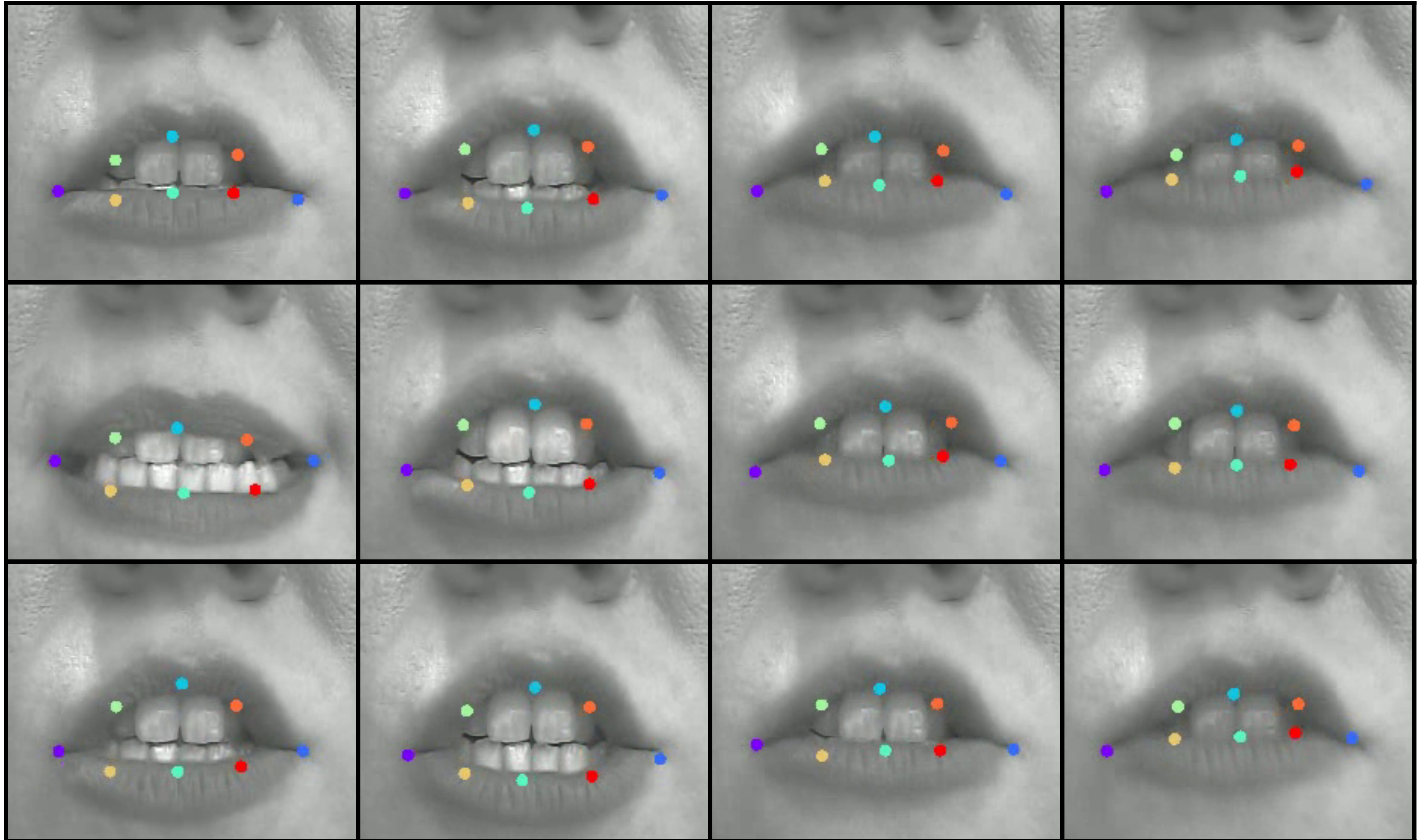
s#tʌ

s#ʌ

/ʊ/

/i/

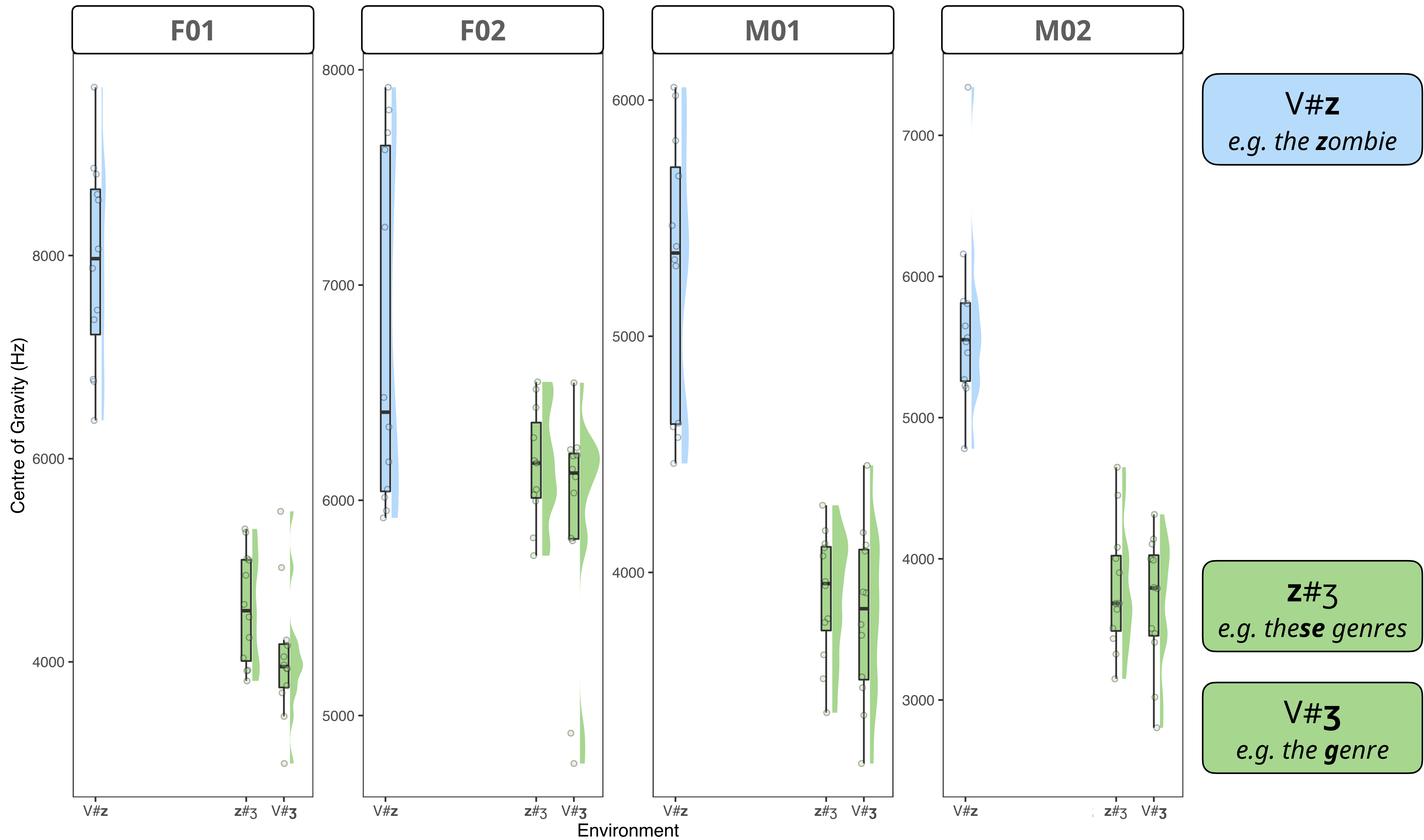
/u/

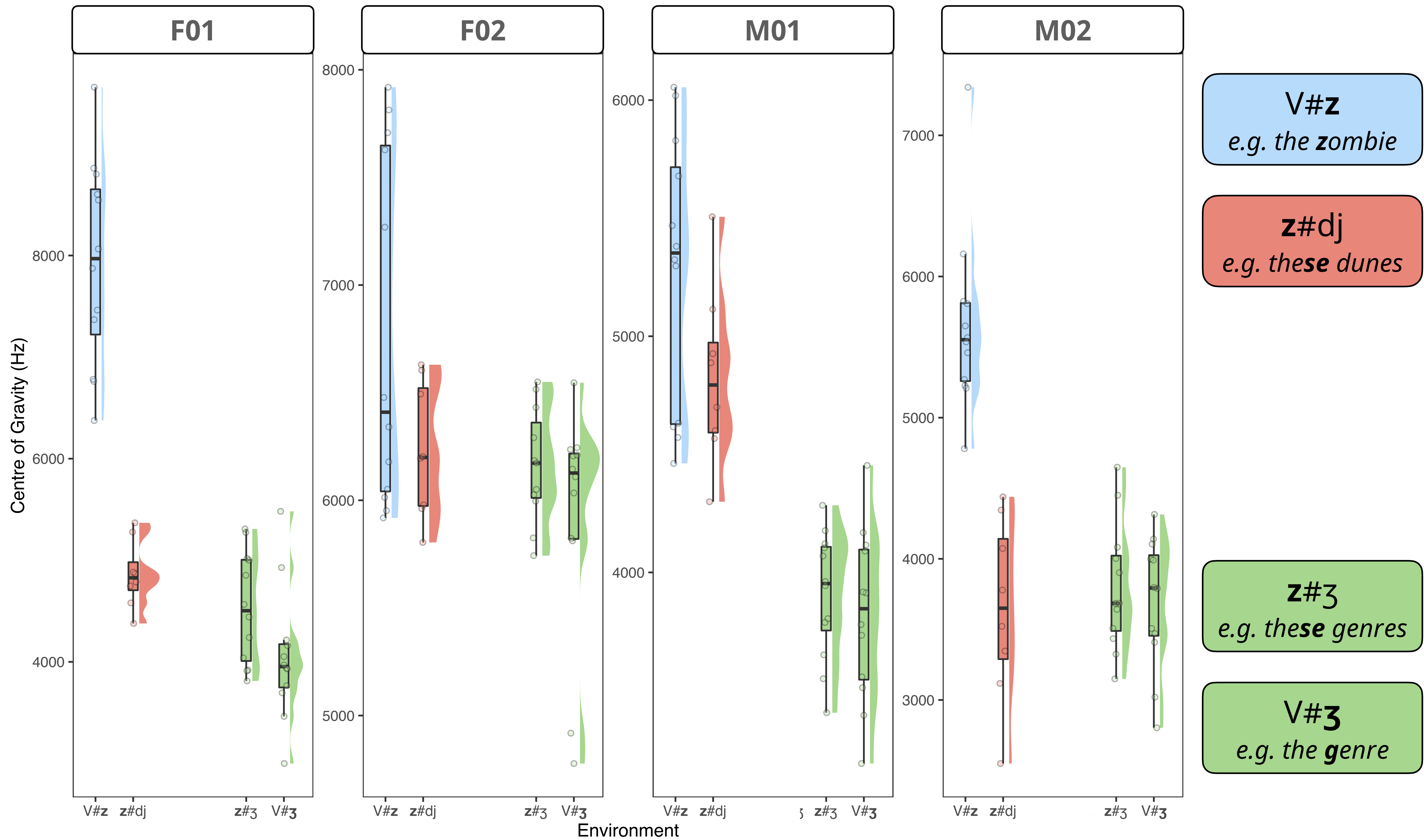


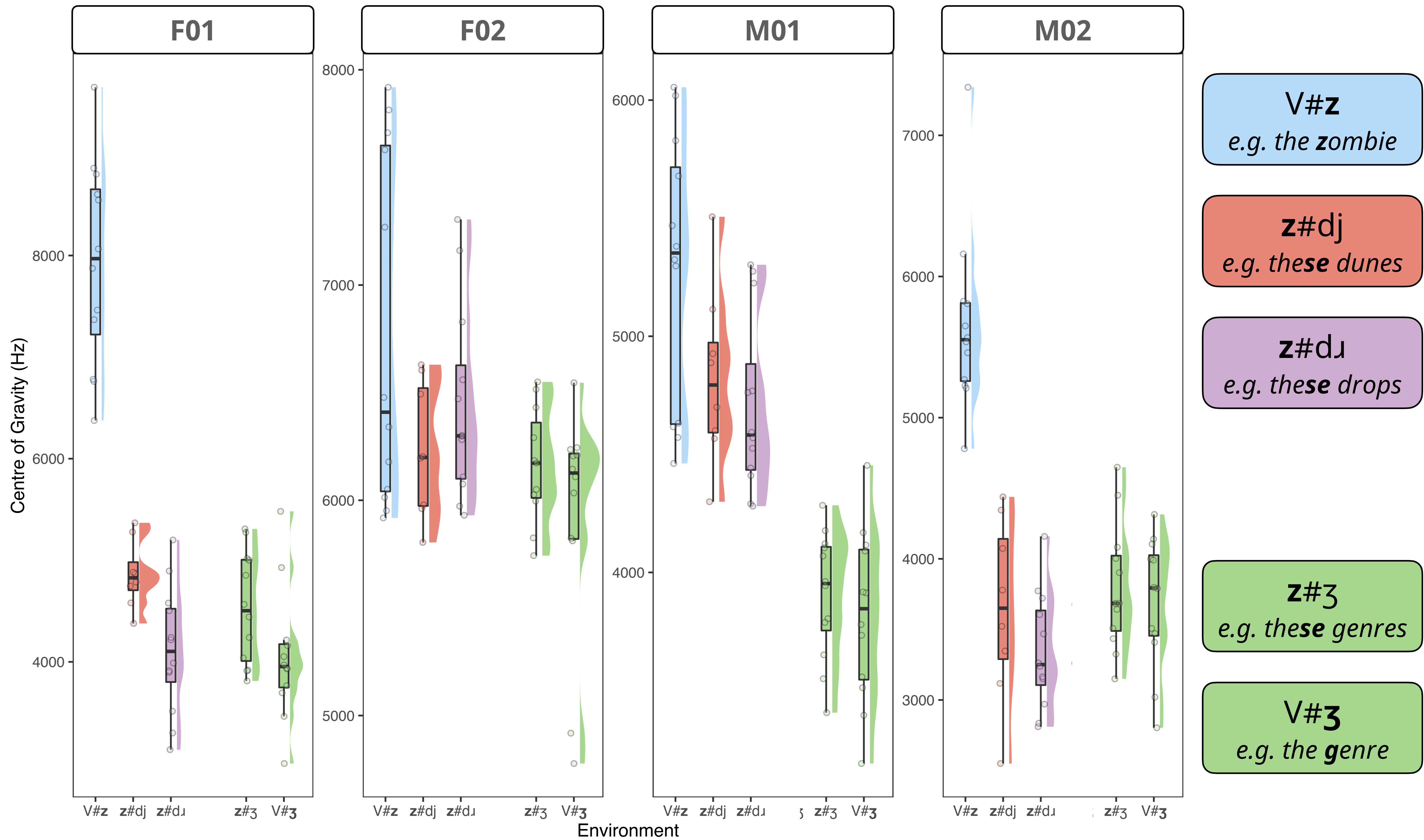
Acoustics

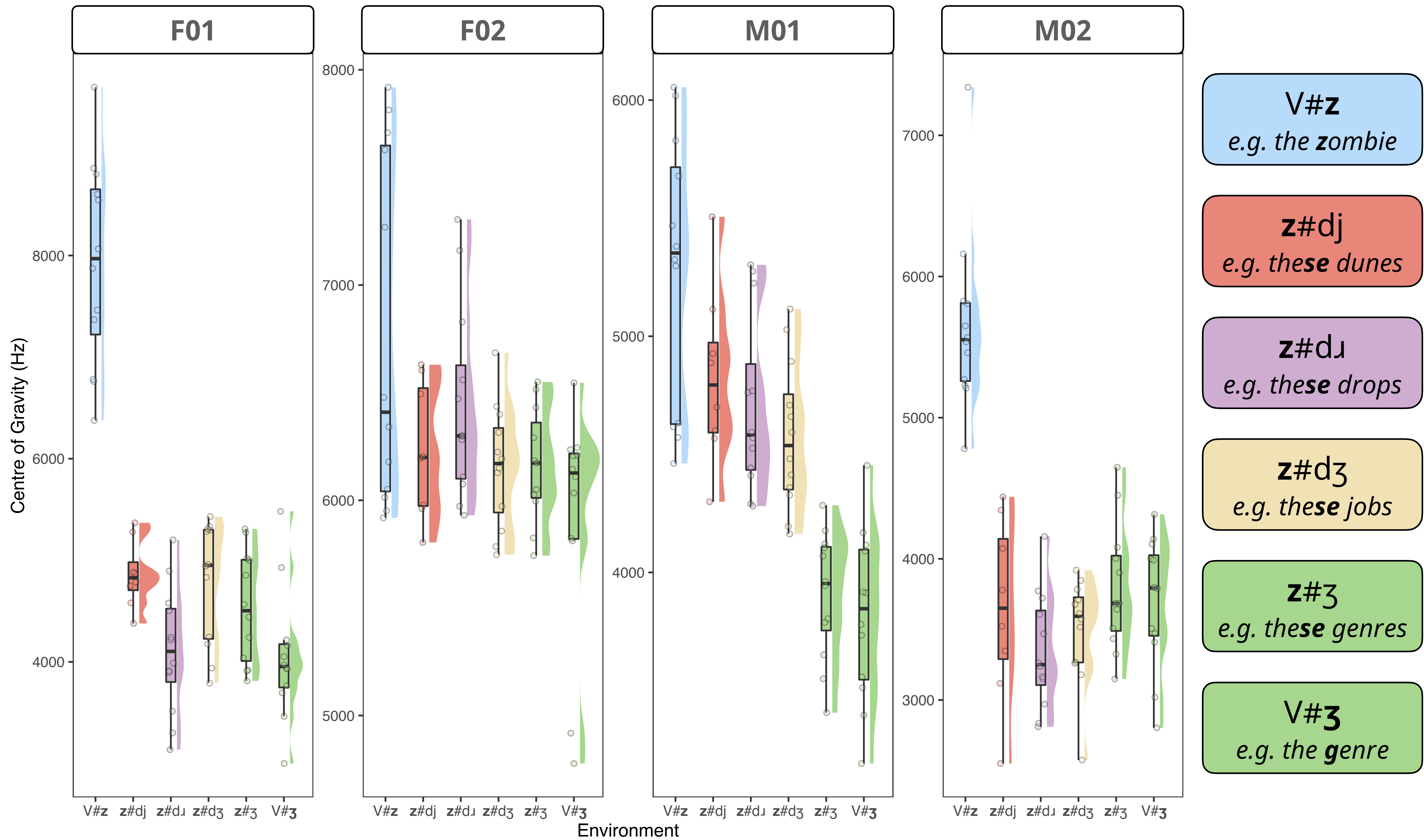
/z/-retraction











Making sense of it all

/s/-retraction is an extremely widespread process

- very advanced even across word boundaries, and in voiced /z/!
- phonetic uniformity of the pre-affricate(d) /tɹ, tʃ, tʃ/ contexts
- retraction *does* happen before /ɹ, j/ in the absence of affrication (cf. Baker et al. 2011; Bailey et al. 2022)
 - **but** the magnitude varies between speakers in a way that the other pre-affricate(d) contexts don't, suggesting multiple sources/processes of retraction

/s/-retraction is an extremely complex process

- phonetic uniformity on the surface masks a lot of individual-level variation in articulatory mechanisms:
 - ▶ some contexts show a direct correlation between lingual gesture and acoustic signal
 - ▶ but the labial gesture varies between contexts in speaker-specific ways (cf. Thielking 2022)
- /ʃ/ and /ɹ/ are ‘rounded’ but in different ways (see also Smith et al. 2019), and retracted /s/ can display both types depending on the trigger

What /r/ /r/ future plans?

- Recording more speakers who represent the full conservative–innovative continuum of the change
- With a focus on /ɹ/, this study feeds into bigger questions about:
 - covert variability in the lingual gesture of /ɹ/ (**bunched** vs **retroflex**) (Delattre & Freeman 1968; Baker et al. 2011)
 - variation in the labial gesture of /ɹ/ (**protrusion/out-rounding** vs **compression/in-rounding**) (Smith et al. 2019)
 - the link between those gestures (**bunched** favours **protrusion**; **retroflex** favours **compression**) (King & Ferragne 2020)
 - how those gestures influence the degree and manner of /s/-retraction

Thanks for listening!

