

Stress and phrasal prosody in Udmurt: initial results

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Aims and claims

Object of study: **prosodic realization of stress** in Udmurt (Uralic, Permic), in the contexts of minimal pairs consisting of:

- (i) indicative verbs (PRS.3SG) and
- (ii) imperative verbs (IMP.2SG/PL).

- According to the literature:
 - **indicative** verbs are stressed on the **final** syllable,
 - **imperative** verbs are stressed on the **initial** syllable
- Based on novel experimental evidence, we show that the realization of stress in Udmurt is cued by **vowel duration** and alignment **with f_0 (pitch) targets**.

- We also show that these results align with our earlier results for (iii) negated indicative verbs (PRS.PST.2/3PL), also stressed on the initial syllable.
- Additional support for the current analysis comes from the interaction of stress and the spread of **high tone H**, associated with the interrogative particle *a*.

Roadmap

- **Background**
- **Previous research on Udmurt**
- **Current study**
- **Outlook**

Background: stress placement in Uralic

The Uralic languages vary widely with respect to their default stress assignment. Stress in Uralic may be:

- fixed on the **initial** syllable (Balto-Finnic, Saami, Hungarian, Mansi (other than Tavdin Mansi));
- fixed on the **penult** (Hill Mari);
- fixed on the **ultima** (Udmurt, Eastern Mari dialects, Tavdin Mansi);
- may form various types of stress systems governed by **phonological and/or morphological factors** (Moksha Mordvin, Meadow Mari, Komi Permyak, Komi Yazva, Southern Khanty dialects);
- may be ‘**absolutely free**’ – “the same word may be pronounced as if it may carry stress on different syllables” (Erzya Mordvin, Komi Zyrian, Konda Khanty) (Lytkin 1964: 234; 1970).

Background: stress placement in Uralic

No consensus on the stress properties of Proto-Uralic:

- fixed initial stress (Itkonen 1955; Collinder 1960);
- mobile stress linked to vowel harmony processes (Setälä 1896; Szinnyei 1922);
- ‘absolutely free’ stress (Steinitz 1964; Lytkin 1970).

Background: stress in Udmurt

Stress targets the **final syllable** of a word (Yemelyanov 1927: 14; Lytkin & Tepliashina 1962: 47; Csúcs 1990: 29):

- (1) *turná*
mow.PRS.3SG
's/he mows' (Csúcs 1990: 29)

- This might be the result of contact with Tatar (Tarakanov 1975), which, like most Turkic languages, has fixed final stress (Zakiev 1993: 98).

Exceptions to stress-finality

Initial stress with:

- Imperatives: *túrna* ‘mow!’ (Yemelyanov 1927: 14; Lytkin & Tepliashina 1962: 47; Csúcs 1990: 29).
- Negative verbs: *em čášete* ‘we didn’t make noise’ (Lytkin & Tepliashina 1962: 47; Csúcs 1990: 29; Winkler 2011: 22; Edygarova 2015).
 - NB: Variation with 2SG/PL prohibitives, e.g., *én vera ~ en véra* ‘don’t say!’ (Lytkin & Tepliashina 1962: 47; Vakhrushev & Denisov 1992: 66; Winkler 2001: 10; 2011: 22).
- Reduplicated adjectives: *górd-gord* ‘very red’ (lit. ‘red-red’) (Lytkin & Tepliashina 1962: 47; Csúcs 1990: 29; Winkler 2011: 22).

Exceptions to stress-finality

Variable stress placement:

- Some derived words, e.g. indefinite pronouns, *váńmy* ~ *vańmý* ‘we all’; “depending on utterance type” (Lytkin & Tepliashina 1962: 48; Csúcs 1990: 29; Winkler 2001: 11; Winkler 2011: 22)
 - Possible relevant factors: “emotional context of an utterance and/or logical emphasis” (Alatyrev 1983)
- Dialectal variation (Lytkin & Tepliashina 1962: 49; Winkler 2011: 23). Cf. Middle Cheptsá (Northern) and Beserman Udmurt (Yemelyanov 1927: 14; Tepliashina 1970; Karpova 2005: 48–51)

Acoustic correlates of stress

- **Duration:** stressed syllables/vowels may be greater in duration than unstressed ones
- **Intensity:** stressed vowels typically have greater intensity than unstressed ones
- **Pitch/ f_0 :** stressed vowels may have particular f_0 properties (high or low)
- **Vowel quality:** there may be language-specific requirements for quality of stressed (or unstressed) vowels.

Most languages rely on more than one of these to cue stress.

- The **interplay between cues** can be complex: in Spanish, stress is perceived if cued by **f_0 and duration** *or* **f_0 and intensity**, but not any one cue alone (Llisterri et al. 2003)

Languages with fixed stress: research challenges

- Languages with fixed stress have a **weaker acoustic expression of stress** (Rigault 1970; Cutler 2005); cf. also Fónagy (1966) on Hungarian, Janota (1967) on Czech, Jassem (1962) and Dogil (1999) on Polish.
- Speakers of languages with fixed stress have weaker intuitions about stress placement and have a hard time learning languages with variable stress placement – so called ‘**stress-deafness**’ (Dupoux & Peperkamp 2002; Dupoux, Peperkamp & Sebastián-Gallés 2001; Dupoux et al. 1997; Peperkamp & Dupoux 2002; Peperkamp, Vendelin & Dupoux 2010).
- Part of a more general pattern: **predictable** prosodic phenomena receive a **weaker** acoustic implementation (Aylett & Turk 2004; Gahl 2008; Watson, Arnold & Tanenhaus 2008; Turk 2010; Athanasopoulou, Vogel & Dolatian 2017; Turnbull 2017).

The phonetics of stress in Udmurt: earlier results

Impressionistic observations:

- a stressed [final] syllable is somewhat (ca. 1.5 times) longer than an unstressed one (Alatyrev 1983; Winkler 2001: 10; 2011: 22).

Preliminary experimental results:

- **Lytkin & Tepliashina** (1962): (1 speaker, 5 observations): stressed [final] syllables are marked by greater duration (ca. 1.5 times longer than the unstressed). Greater intensity and f_0 may also be used.
- **Baitchura** (1973): (4 speakers, no. of observations unknown): initial syllables are marked by greater intensity and f_0 ; final ones are 1.5-2 longer than the initial ones \Rightarrow interprets these findings as evidence for initial stress.

The phonetics of stress in Udmurt: earlier results

Instrumental study by Vakhrushev & Denisov (1992):

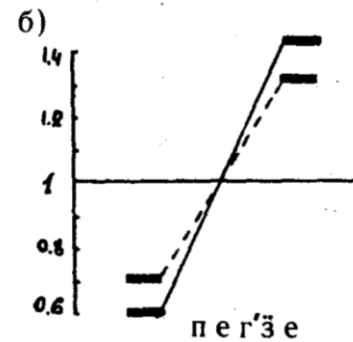
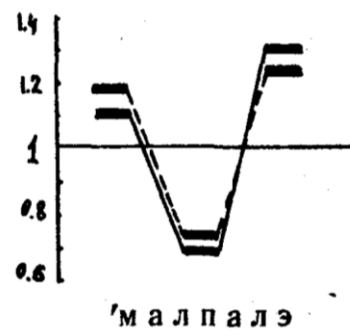
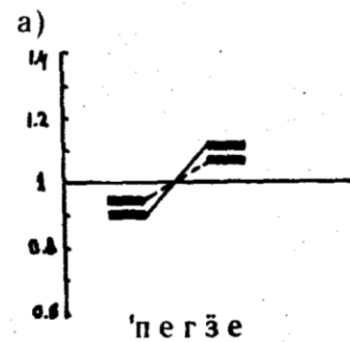
Set-up:

- di- and trisyllabic words
- minimal pairs:
 - 3SG indicative
 - 2SG/PL imperative verbs
- 2 speakers

The phonetics of stress in Udmurt: earlier results

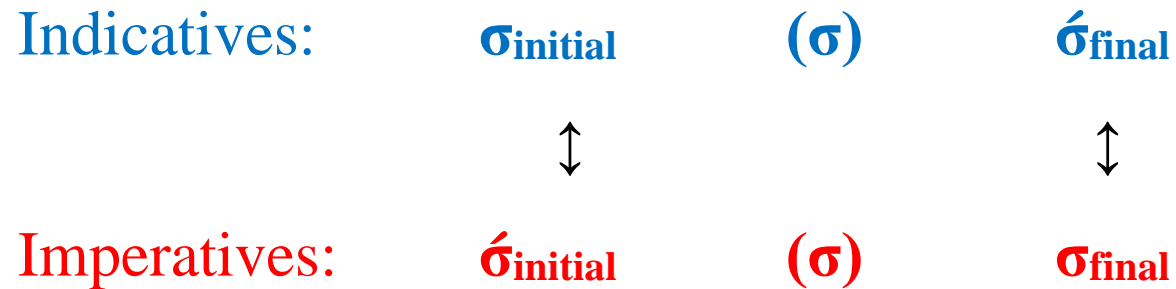
Duration in minimal pairs:

- stressed syllables, whether non-final or final, have greater duration than their unstressed counterparts
 - BUT interfering factor: final lengthening



The phonetics of stress in Udmurt: earlier results

Solution to the problem of final lengthening: between-word as opposed to within-word comparison of syllable duration

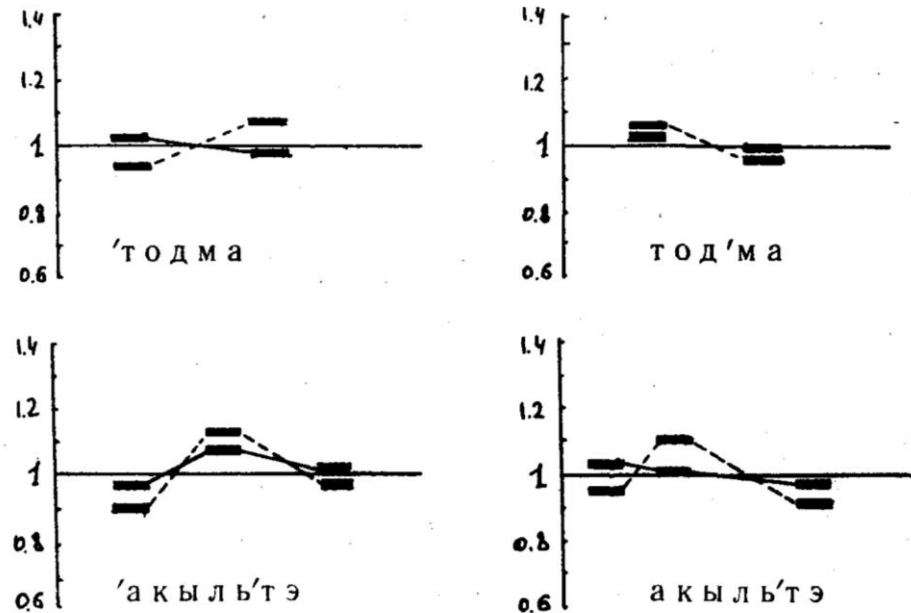


➤ Also used in our study

The phonetics of stress in Udmurt: earlier results

f₀ (pitch):

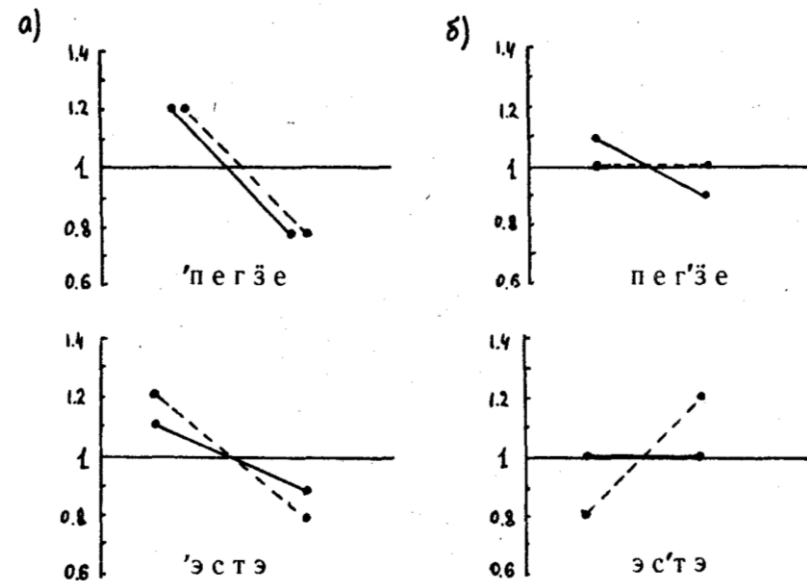
- disyllables: mean f₀ on the second syllable lower than on the first syllable
- BUT: declarative intonation also typically has falling f₀



The phonetics of stress in Udmurt: earlier results

Intensity:

- No results reported for di- and trisyllables.
- In minimal pairs, the fall in intensity is steeper when the initial syllable is stressed, flattens out when the final one is stressed:
- Intensity decreases from left to right within prosodic word (independent of stress).



The phonetics of stress in Udmurt: earlier results

Overall:

- Duration is a cue for stress in minimal pairs
- Final stressed syllables are associated with low f_0 values; picture unclear for initial stress
- A flattened (as opposed to falling) intensity curve throughout the word, in minimal pairs, is indicative of final stress in minimal pairs

Instrumental study

Research questions:

1. What acoustic means does the realization of Udmurt stress rely on?
2. What are the prosodic properties of cliticization in Udmurt?

Tasks:

Task 1: nouns, adjectives, postpositions → Q1

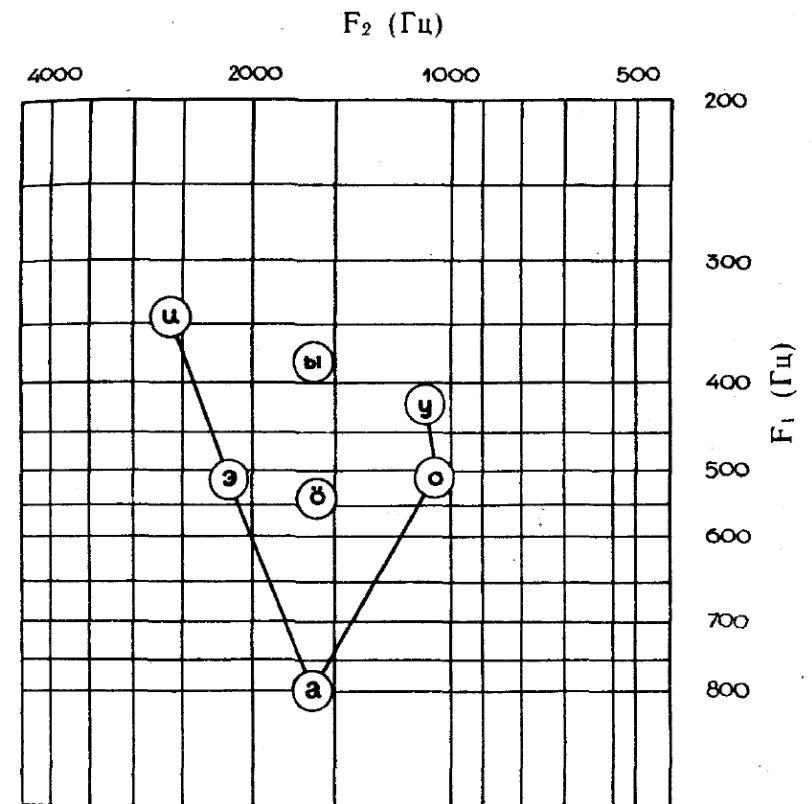
Task 2: minimal pairs of indicative and imperative verbs → Q1

Task 3: negative and affirmative verbs, different clitics, questions → Q2

Instrumental study

Stimuli:

- minimal pairs of verbs:
 - **indicative** (PRS.3SG): final stress
 - **imperative** (IMP.2SG/PL) initial stress
- di- and trisyllabic
- CV syllable shape
- low ([+low]) vs. mid/high ([-low]) vowels
 - NB: verbs with high vowels contained a mid vowel in the second syllable, for morphological reasons, e.g. *bude* 'grow'
- Total: n=172, randomized



(Vakhrushev & Denisov 1992:27)

Instrumental study

- All items were collected from Kirillova's (2008) dictionary and checked with a native speaker who did not participate in the experiment
- All items were embedded in **carrier phrases**
- Information structure: backgrounded vs. focused

Carrier phrases

- (1a) I ‘**x!**’ word said, but ‘**y!**’ word – not. focused; **imperative**
- (1b) I ‘**x**’ word said, but ‘**y**’ word – not. focused; **indicative**
- (2a) I ‘**x!**’ word quietly/slowly said, but loudly/quickly – not. backgrounded
imperative
- (2b) I ‘**x**’ word quietly/slowly said, but loudly/quickly – not. backgrounded
indicative

Examples

vala ‘understand’, dysyllabic, [+low]

1a focused; imperative

Mon “vala!” *kilez* *veraj*, *a* *“gaža!”* *kilez* *ej*.

I understand.IMP.2SG word.ACC said but respect.IMP.2SG word.ACC didn’t

‘I said the word ‘vala!’, and not the word ‘gaža!’.’

1b focused; indicative

Mon “vala” *kilez* *veraj*, *a* *“gaža”* *kilez* *ej*.

I understand.PRS.3SG word.ACC said but respect.PRS.3SG word.ACC didn’t

‘I said the word ‘vala’, and not the word ‘gaža!’.’

Examples

2a backgrounded; imperative

Mon “vala!” kilez šip veraj, zol ej.

I understand.IMP.2SG word.ACC quietly said loudly didn't

‘I said the word ‘vala!’ quietly, not loudly.’

2b backgrounded; indicative

Mon “vala” kilez šip veraj, zol ej.

I understand.IMP.2SG word.ACC quietly said loudly didn't

‘I said the word ‘vala’ quietly, not loudly.’

Method

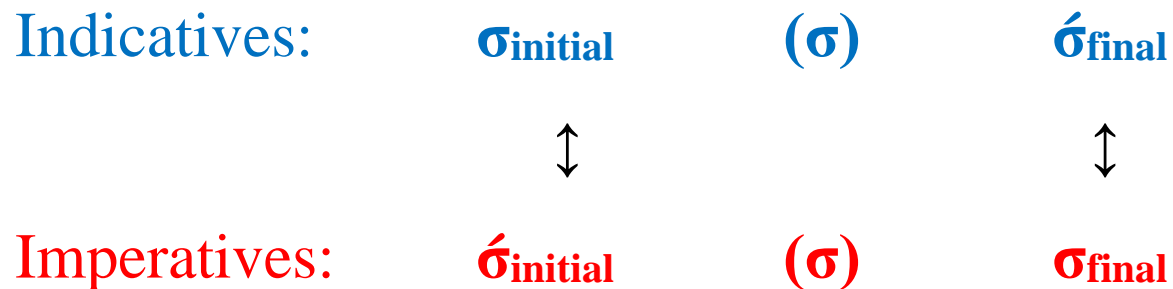
- 6 native speakers (5 f, 1 m; age range 20–40; Central and Northern dialects)
- Target sentences were displayed on the screen one at a time
- Experiments took place in June and October 2020 at RIL
- Recordings were made in a quiet room with a head-worn microphone

Processing

- The sound files were manually annotated in Praat
- Duration and intensity (not reported here) were measured for each vowel
- f_0 measurements were made at 10 fixed points per vowel
- Statistical analysis was performed in R

Results

- In **indicative** and **imperative** verbs, both di- and trisyllabic, the stressed syllable has greater **duration** than its counterpart in the verb of the other type



- **Imperative** verbs are marked by **high f_0 values** on the stressed syllable (or the juncture between the stressed and post-tonic syllables)
- **Indicative** verbs may carry a **high or a low f_0 target** on the stressed syllable
- Speakers may preferentially rely on **f_0 or duration** to mark stress

Averaged results

Duration, [-low] vowels

		Focused		Backgrounded	
		Indicatives	Imperatives	Indicatives	Imperatives
Disyllabic	initial	68.08952 (16.85068)	116.7755 *** (27.9411)	61.87278 (17.31549)	112.6036 *** (29.11423)
	final	86.09696 (16.93234)	74.94284 *** (15.70377)	79.87921 (10.07818)	77.71154 (12.11575)
Trisyllabic	initial	57.97592 (14.76401)	94.98495 *** (17.38961)	56.46343 (15.92255)	87.45692 *** (26.50306)
	final	70.81858 (11.48189)	72.0464 * (10.89306)	68.51495 (8.460949)	64.020114 (10.04928)

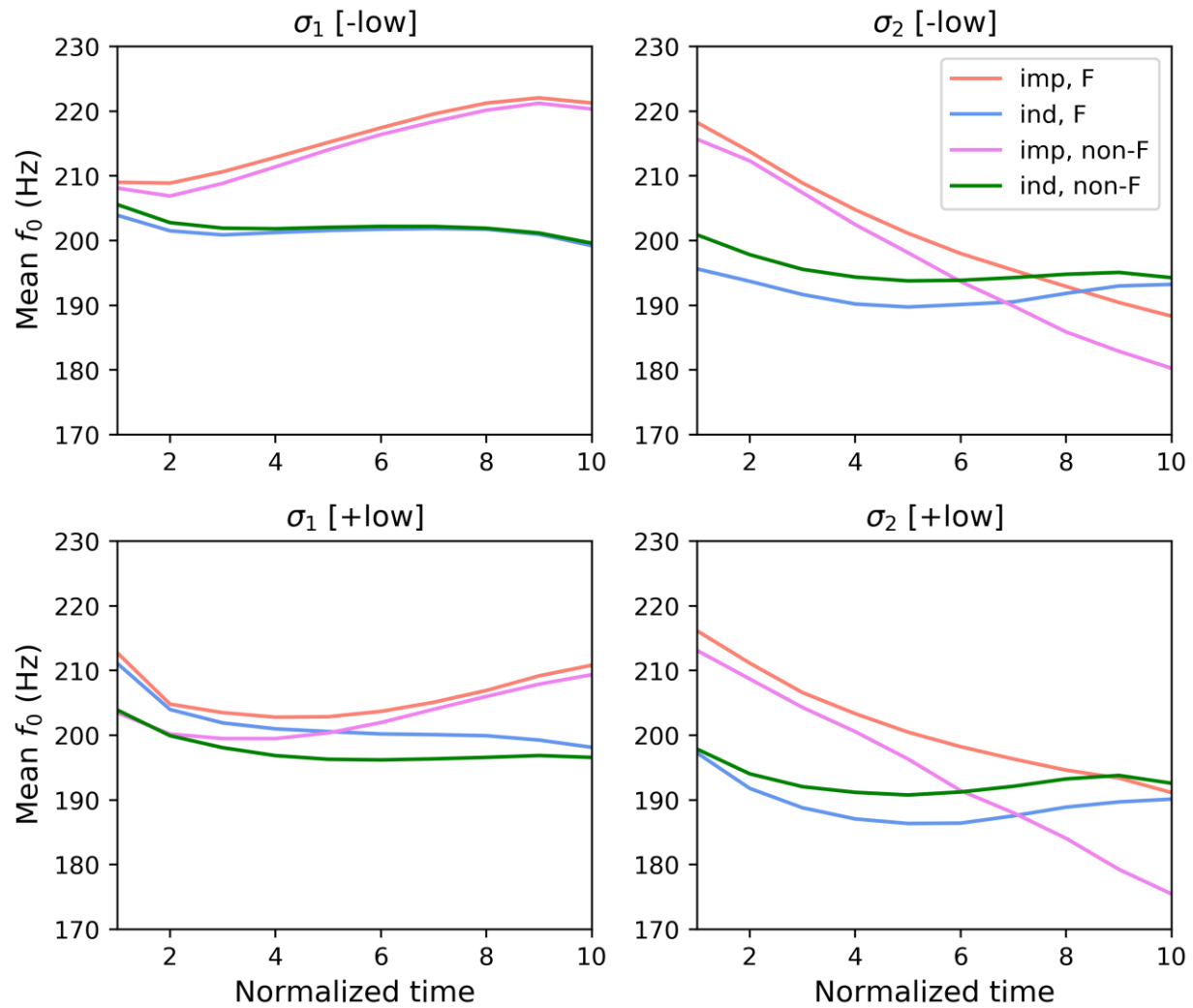
- duration measurements are made in ms
- in brackets: standard deviation
- significance values: LME model (Duration ~ Verb type + (1|Speaker) + (1|Item))

Averaged results

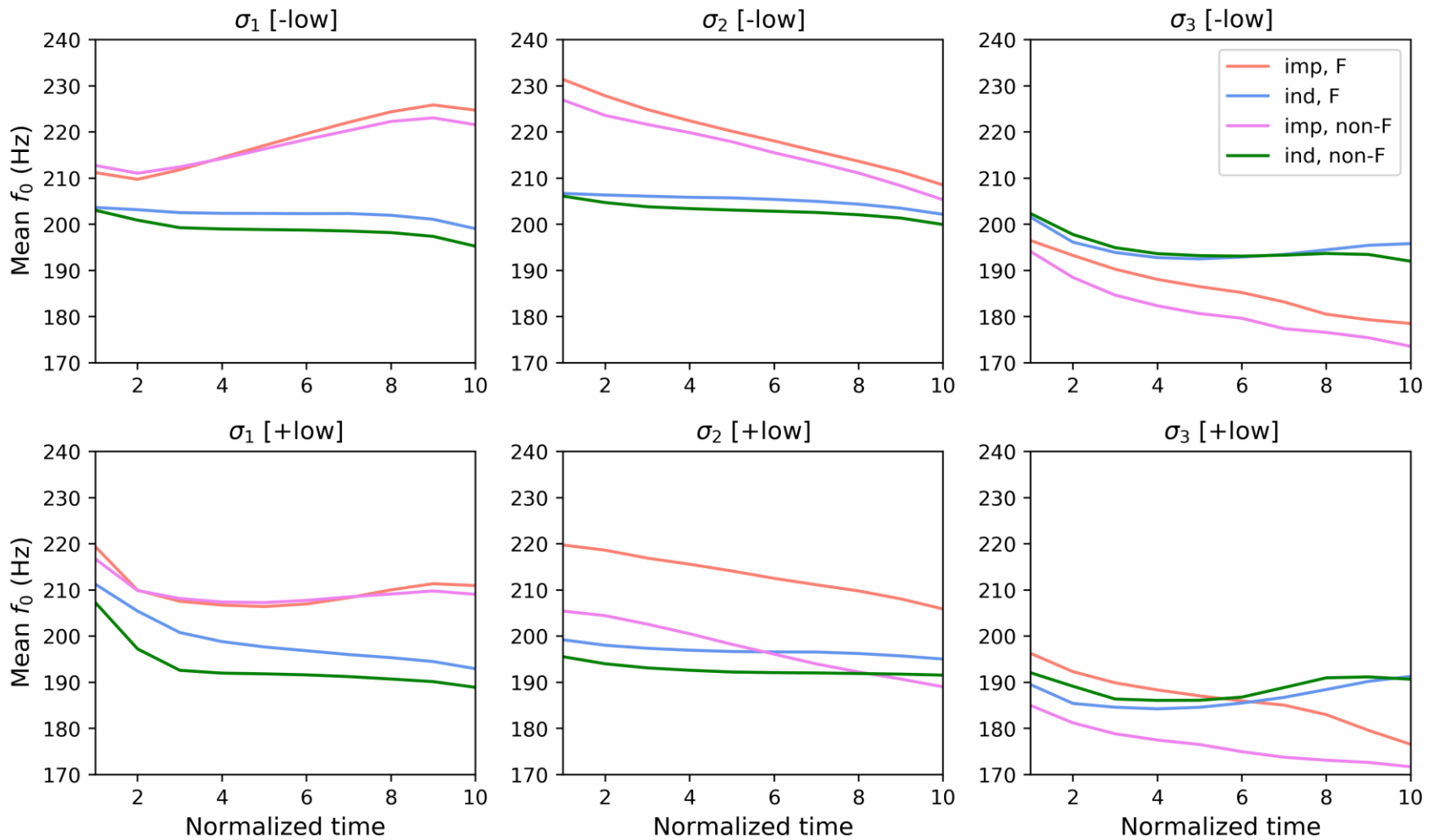
Duration, [+low] vowels

		Focused		Backgrounded	
		Indicatives	Imperatives	Indicatives	Imperatives
Disyllabic	initial	90.39888 (18.61061)	121.8908 *** (32.42607)	87.09756 (22.31177)	121.77 *** (39.06998)
	final	113.159 (47.97227)	92.79653 *** (37.07969)	107.3795 (46.88834)	94.47824 ** (30.51985)
Trisyllabic	initial	74.88686 (16.53813)	106.0115 *** (30.80553)	76.24305 (15.8824)	112.3703 *** (25.91348)
	final	94.83139 (39.03924)	87.17771 (29.88872)	101.3746 (41.51658)	82.85396 ** (28.78845)

Averaged results: f_0 , disyllables



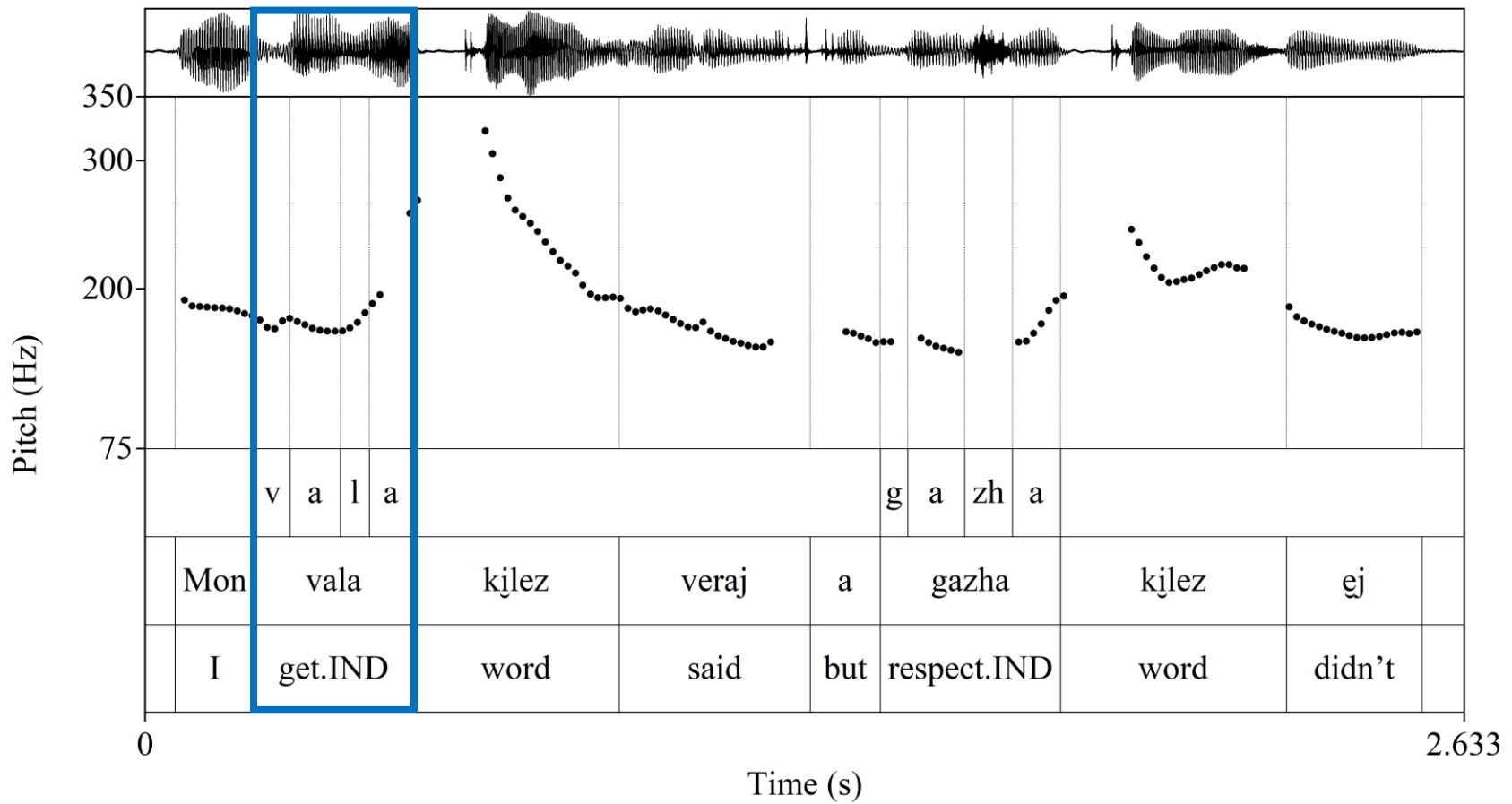
Averaged results: f_0 , trisyllables



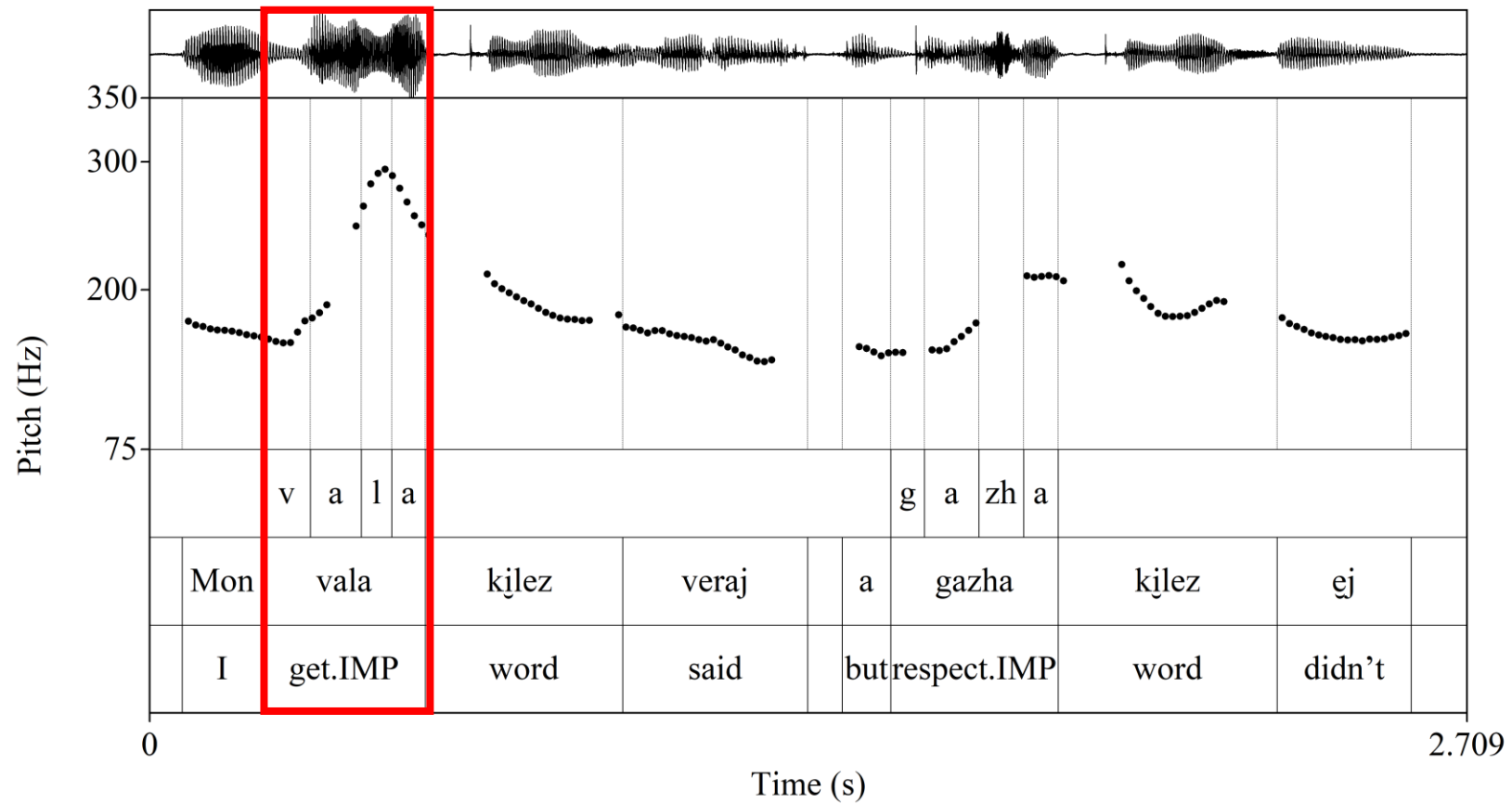
Interspeaker variation

- Speakers in our sample varied with respect to which acoustic cue (duration or f_0) they mainly used to cue stress.
 - three speakers relied mainly on **duration**
 - two speakers relied mainly on **f_0**
 - one speaker utilized **both**

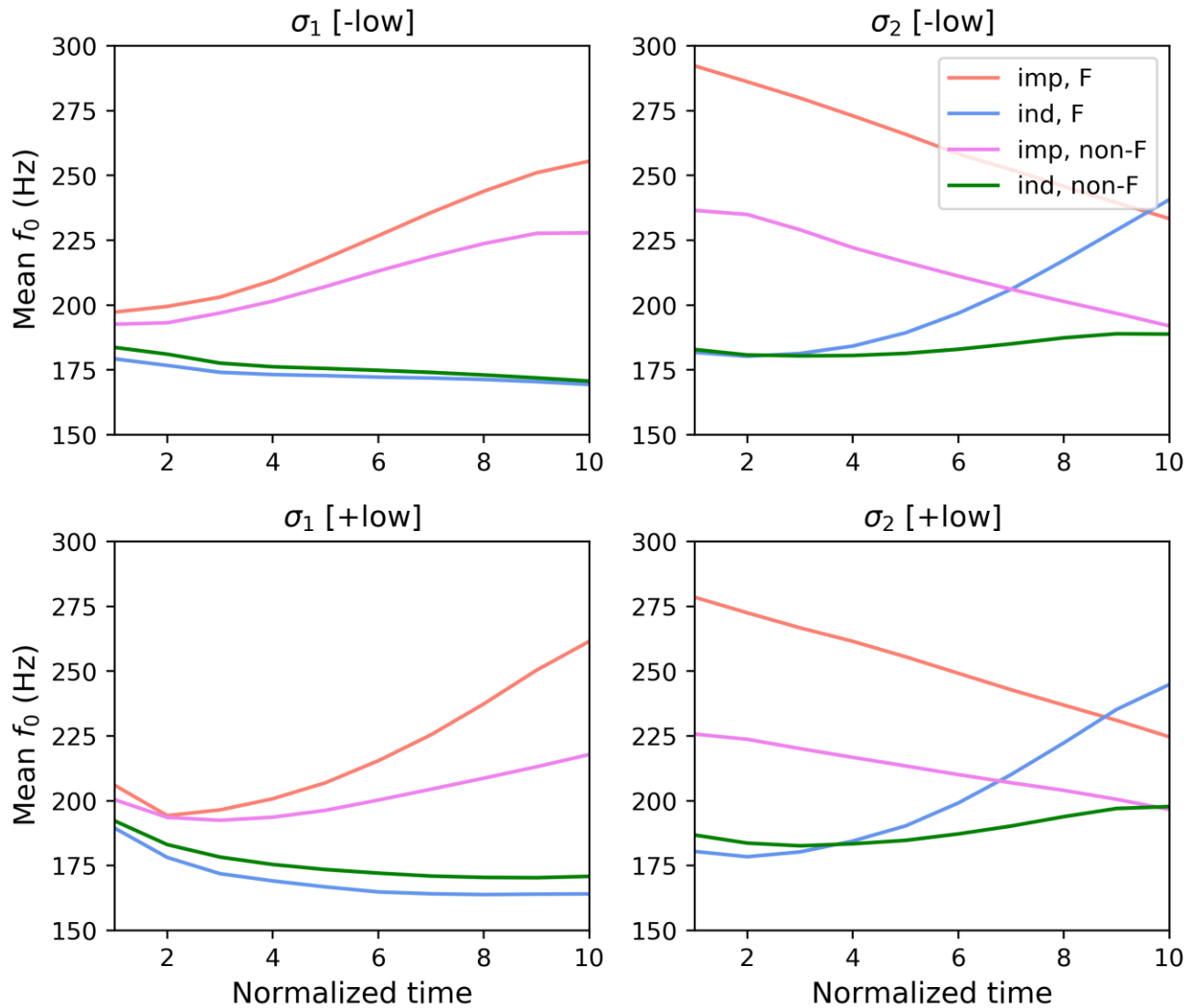
S6, illustration: indicative



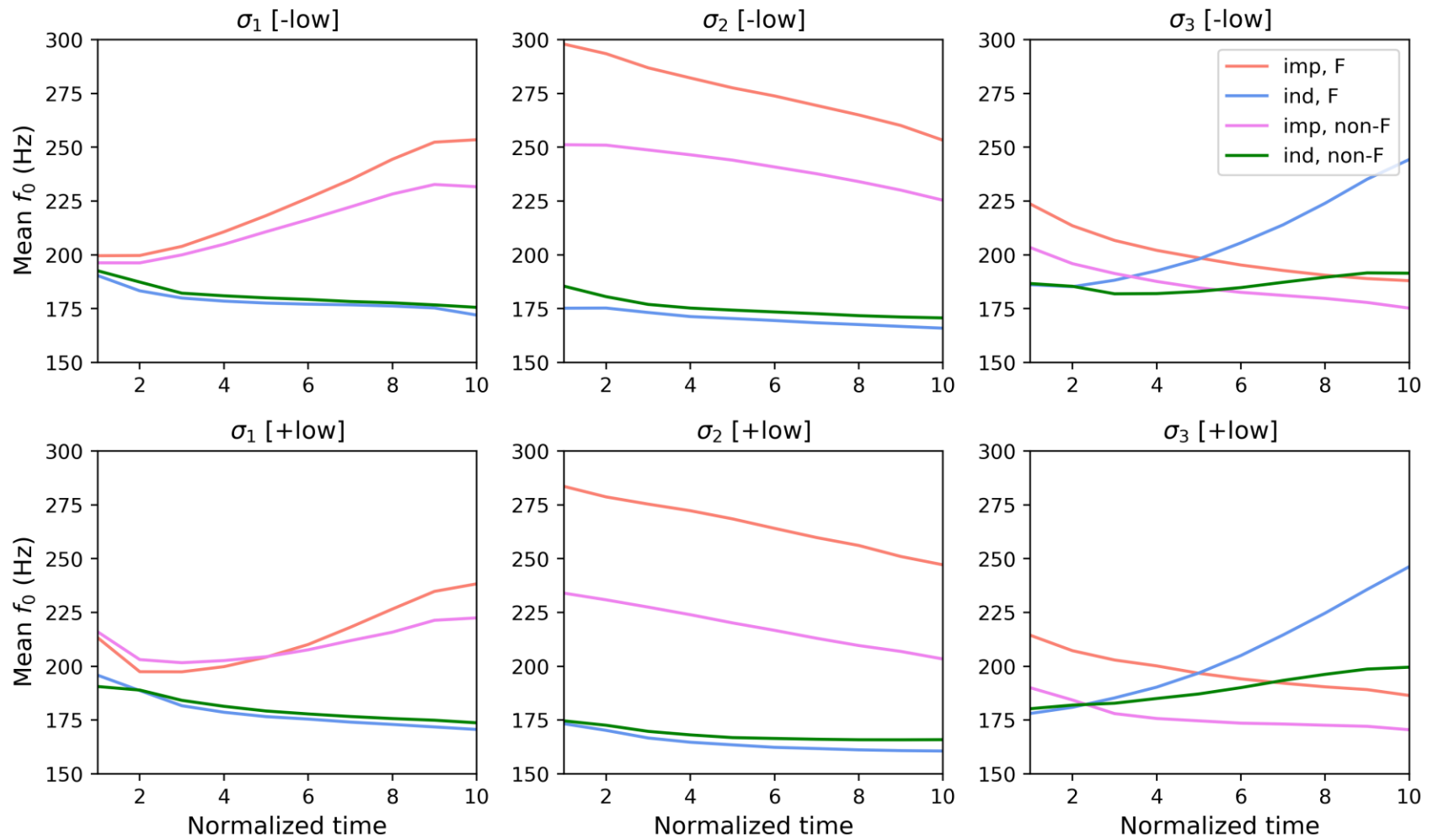
S6, illustration: imperative



S6, f_0 , disyllables



S6, f_0 , trisyllables



S6, Duration

[-low] vowels

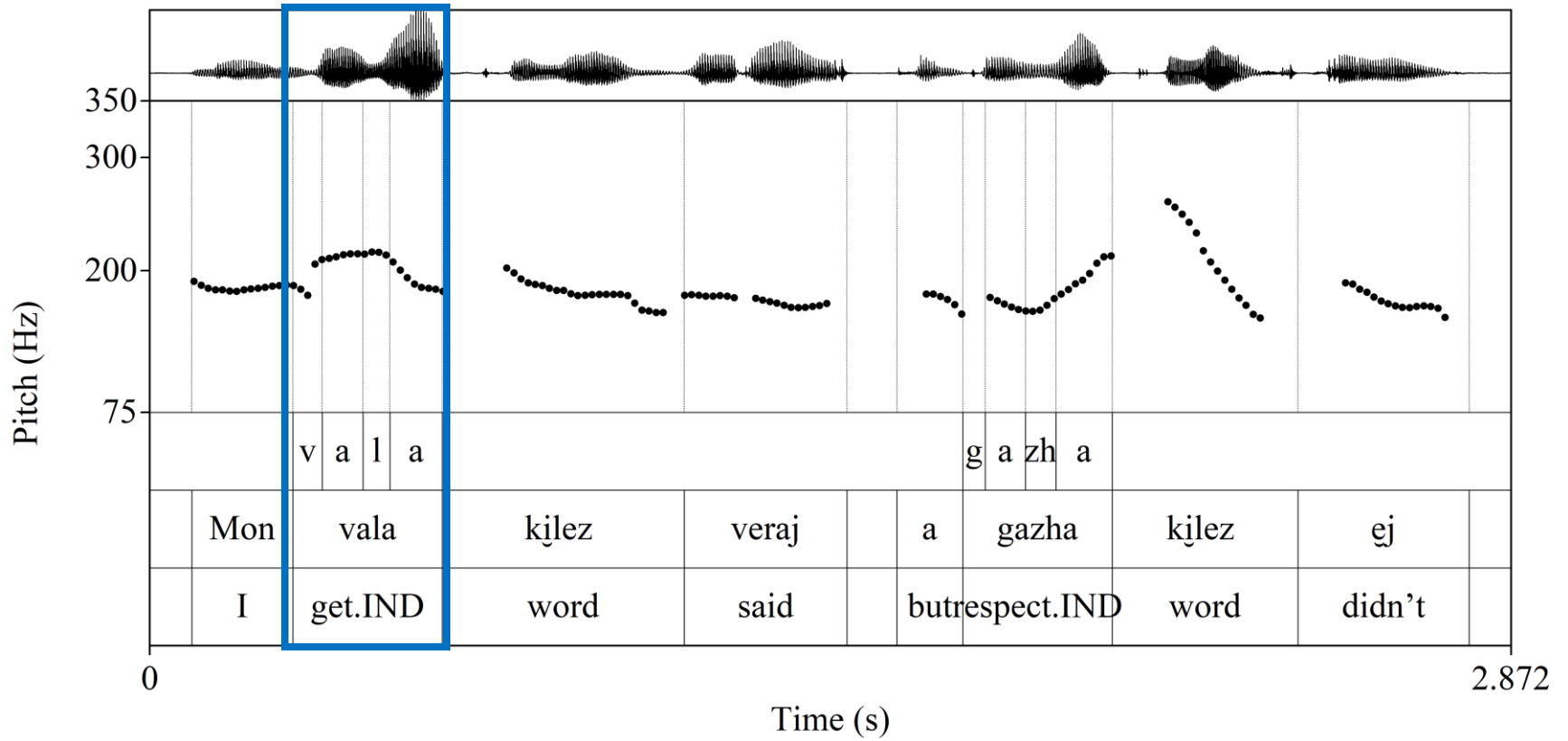
		Focused		Backgrounded	
		Indicatives	Imperatives	Indicatives	Imperatives
Disyllabic	initial	72.27881 (22.97583)	81.31244 (14.59496)	68.28303 (19.20435)	89.98299 *** (15.26356)
	final	81.90462 (20.30196)	77.21266 (17.47291)	82.84707 (16.69295)	80.32969 (19.00552)
Trisyllabic	initial	89.05209 (19.78594)	85.03692 (27.16686)	79.92946 (15.23259)	77.75648 (14.78279)
	final	74.27141 (21.24324)	76.86357 (16.53693)	84.57082 (16.73069)	77.34087 (17.67608)

S6, Duration

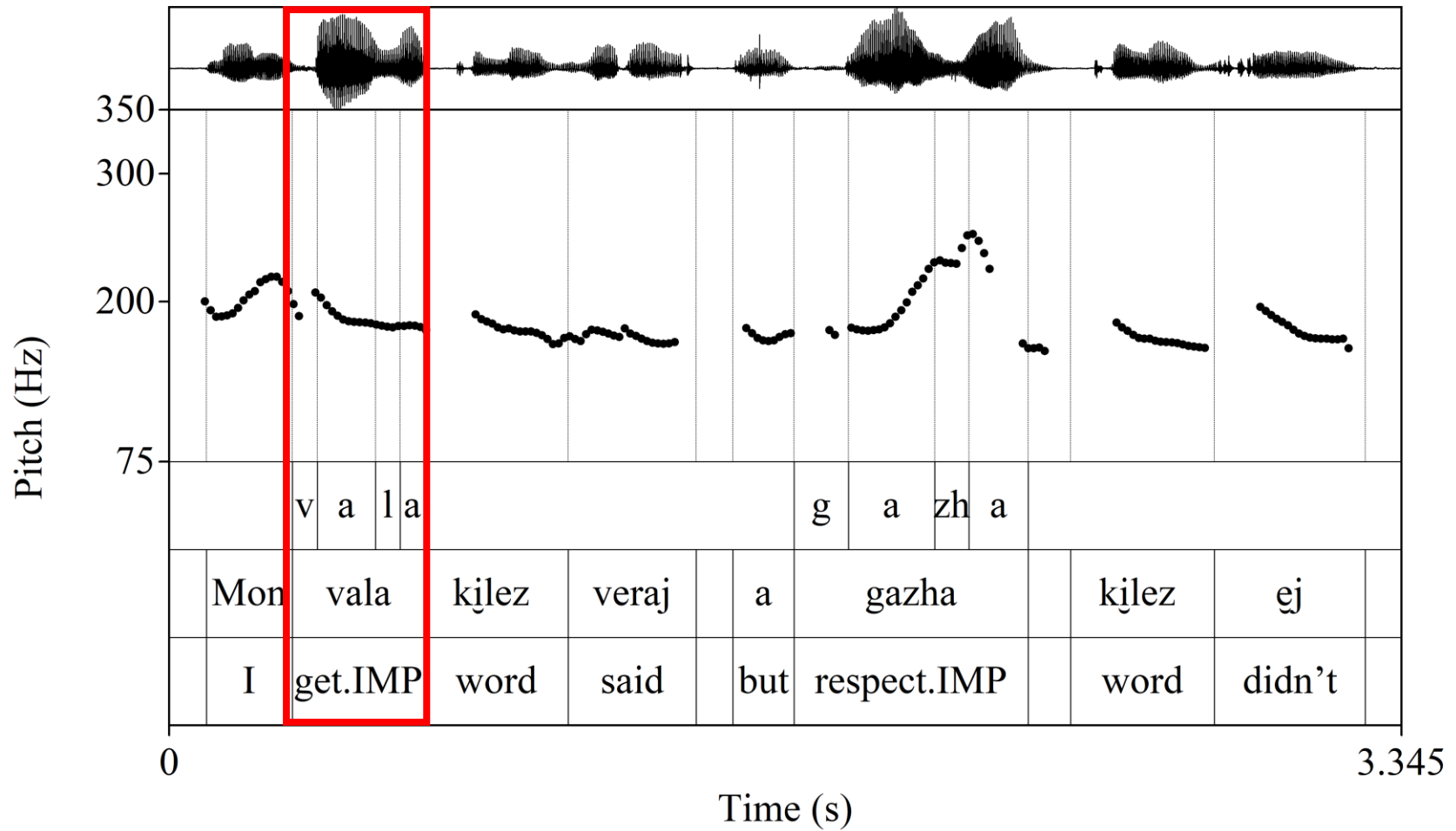
[+low] vowels

		Focused		Backgrounded	
		Indicatives	Imperatives	Indicatives	Imperatives
Disyllabic	initial	85.773335 (24.71298)	84.7936 (16.46009)	78.27464 (16.99829)	84.0384 (29.33852)
	final	74.24918 (18.02073)	69.14234 (17.52394)	76.40547 (14.29793)	88.64335 (19.60273)
Trisyllabic	initial	85.069 (12.76227)	79.10147 (12.91829)	76.99177 (13.13932)	85.11231 (18.44686)
	final	76.79666 (32.40021)	83.19697 (19.50729)	79.28523 (12.23287)	82.76227 (15.47289)

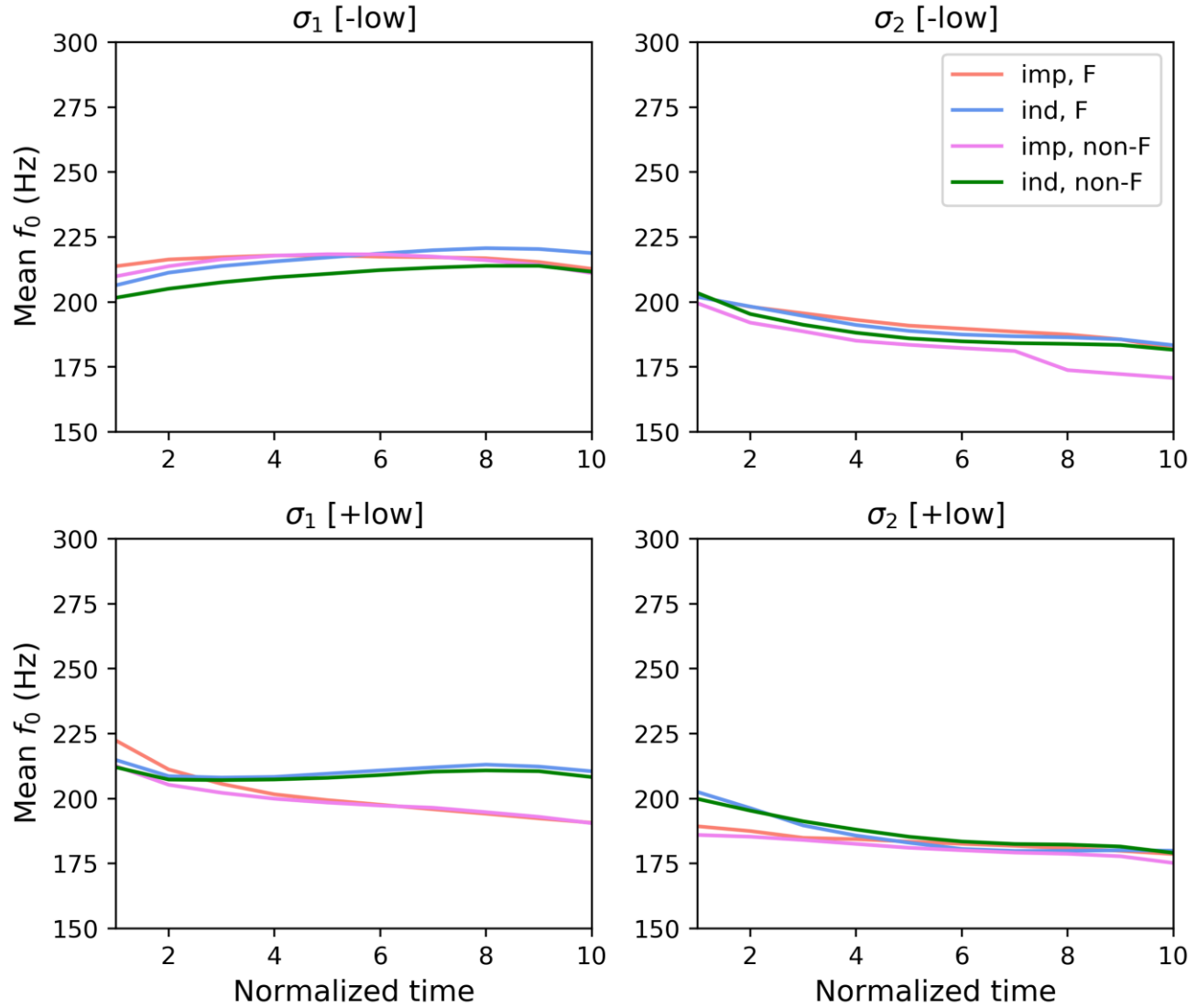
S5, illustration: **indicative**



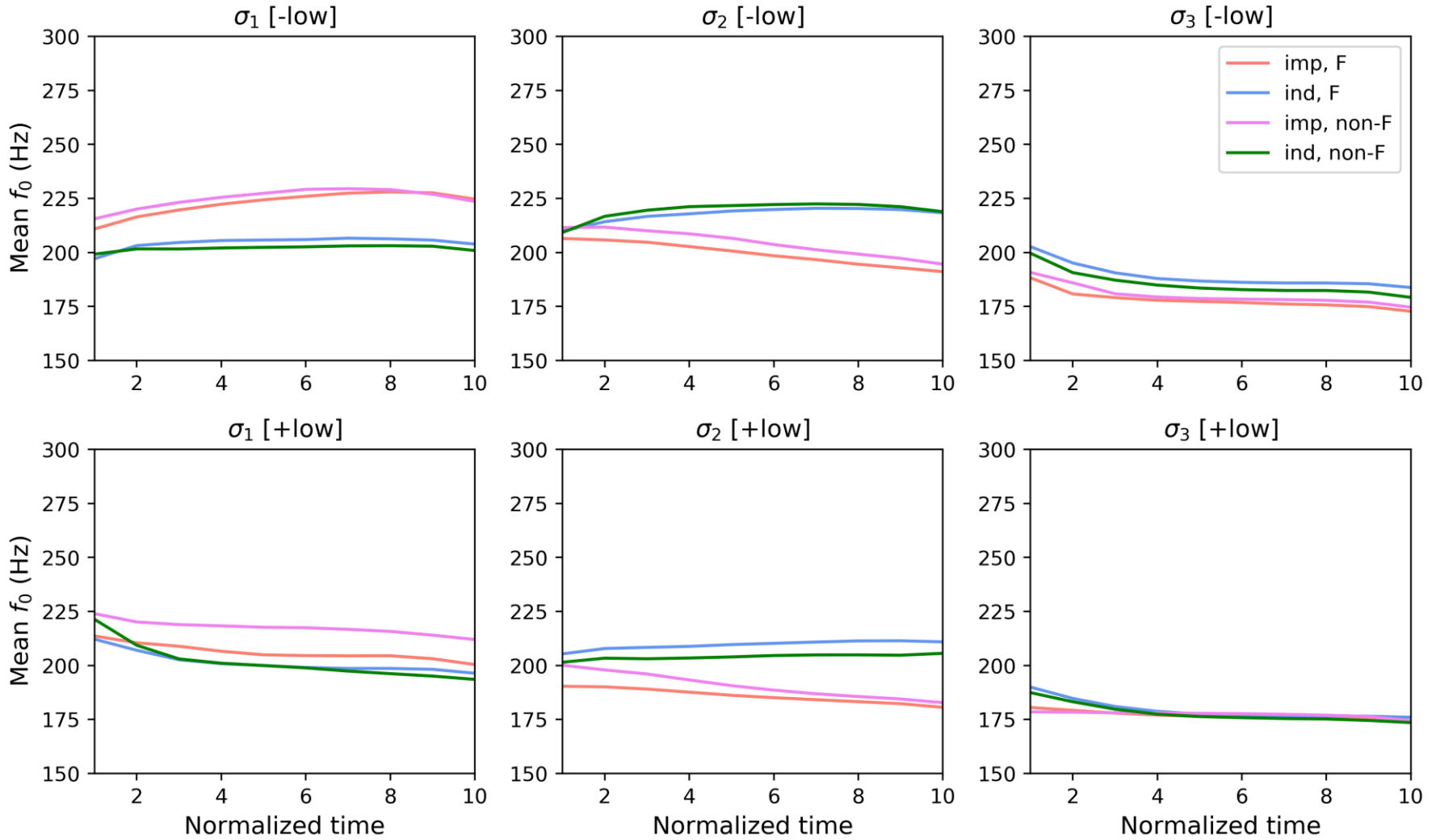
S5, illustration: imperative



S5, f_0 , disyllables



S5, f₀, trisyllables



S5, Duration

[-low] vowels

		Focused		Backgrounded	
		Indicatives	Imperatives	Indicatives	Imperatives
Disyllabic	initial	86.50864 (15.53248)	128.494 *** (27.54516)	88.89531 (30.36566)	143.6463 *** (26.7408)
	final	132.0594 (37.89683)	107.7936 (37.58826)	133.5819 (44.33091)	130.8547 (31.23878)
Trisyllabic	initial	84.67487 (20.44461)	109.1967 ** (28.17197)	78.36445 (11.52493)	116.7359 *** (20.88054)
	final	123.9002 (49.5809)	90.84126 (31.39045)	111.2852 (41.88558)	101.9282 (42.13521)

S5, Duration

[+low] vowels

		Focused		Backgrounded	
		Indicatives	Imperatives	Indicatives	Imperatives
Disyllabic	initial	100.9941 (16.62947)	158.6109 *** (14.43941)	100.5229 (16.68486)	160.1965 *** (24.58089)
	final	149.8482 (47.64543)	83.67448 *** (20.01257)	114.0783 (17.64767)	88.96737 * (24.71387)
Trisyllabic	initial	82.35457 (12.97789)	135.7533 * (49.85971)	89.21813 (16.60879)	126.8499 *** (22.88382)
	final	112.2145 (51.95583)	74.24305 * (22.28727)	119.2101 (50.53844)	63.8078 * (7.64331)

Conclusions

- In **indicative** and **imperative** verbs, the stressed syllable has greater **duration** than its counterpart in the verb of the other type
 - **Imperative** verbs are marked by **high f_0 values** on the stressed syllable (or the juncture between the stressed and post-tonic syllables)
 - **Indicative** verbs may carry a **high or a low f_0 target** on the stressed syllable
 - Speakers may preferentially rely on **f_0 or duration** to mark stress
- Implications for perception of stress: different acoustic cues can have the same phonological interpretation

Outlook

- Task 1: nouns, adjectives, postpositions → Q1
- Task 3: negative and affirmative verbs, different clitics, questions → Q2

Other acoustic cues to consider:

- intensity
- vowel quality/formant structure

Thank you for your attention!

Тау кылзйськемды понна!

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