
On the Rising-Falling boundary tone in Cantonese

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Background: intonation on SFPs (1)

- Pitch on Cantonese **Sentence-Final Particles (SFPs)** is traditionally transcribed as *lexical tones*
 - 咩 **me1** in high level/high falling T1 [55/51]
 - 嘅 **ge2** and 嘢 **ho2** in high rising T2 [35]
 - 呀 **aa4** in low falling T4 [21]
- However, a rising view is that a lot of these instances (if not all) should be analyzed as **intonational boundary tones**
 - **Meaning**-based: the same “tone” often carries similar pragmatic functions (Cheung 1972, Law 1990, Leung 1992/2005, Sybesma & Li 2007, Ding 2013, *i.a.*)

Background: intonation on SFPs (2)

- Supported by recent **acoustic** studies, where the realization of the **pitch level/contour** on SFPs is *different* from that of lexical tones
 - E.g. Wu (2009): **ge2**
 - E.g. Zhang & Tang (2016): T2 and T5 SFPs, like **ge2** & **ho2**
 - E.g. Ki & Lau (2019): **me1** (cf. Choi 2023 on meaning)
 - E.g. Lee (2019, 2021): **aa4** and its variants
- As well as **duration** of SFPs with the same segments (Lau 2019 for **aa3**, Lee this session for **ge2**)

Interjections (1)

- But how about 嘆詞 **Interjections**?
- They are also traditionally transcribed with lexical tones, though some explicitly stated that the tone is **intonational**
 - T1 [55/51]: 喔 *o1*, 啱 *ce1*, 㗎 *coi1*, 呢 *ne1*, ...
 - T2 [35]: 哦 ***o2***, 咦 *ji2*, 啊 *a2*, 吓/嘎 *ha2*, ...
 - T3 [33]: 哦 ***o3***, 嘩 *waa3*, ...
 - T4 [21/11]: 哦 ***o4***, 喺 *na4*, 咦 *ji4* ...
 - T5 [13]: 咧 *le5*
 - T6 [22]: 㗎 *ok6*

(Cheung 1969/2007:420-422, Gao 1980:178-185, Matthews & Yip 1994:356-358, Li et al. 1995:548-551, Zhan 2002:89-90, Cheng 2003)

Interjections (2)

- To the best of our knowledge, there is **no** acoustic study that attempts to test whether the pitch on Cantonese interjections is **intonation (boundary tones)**,
- that **independently exist** in the language (i.e. may combine with lexical words and not parasitic to interjections only).

→ ***Research gap 1***

Boundary tones (1)

- The inventory of boundary tones in C-ToBi
(Wong, Chan, and Beckman 2005:287)

No.	Tone types	Descriptions
1	L%	fall from the final lexical tone
2	H%	rise from the final lexical tone
3	H:%	rise from the final lexical tone, with a short plateau at the end
4	HL%	final rise and then fall from the final lexical tone
5	%	phrase-end with no extra tone
6	-%	truncated rise of the final lexical tone
7	%fi	frame-initial boundary used to mark the initial particle <i>mat</i>

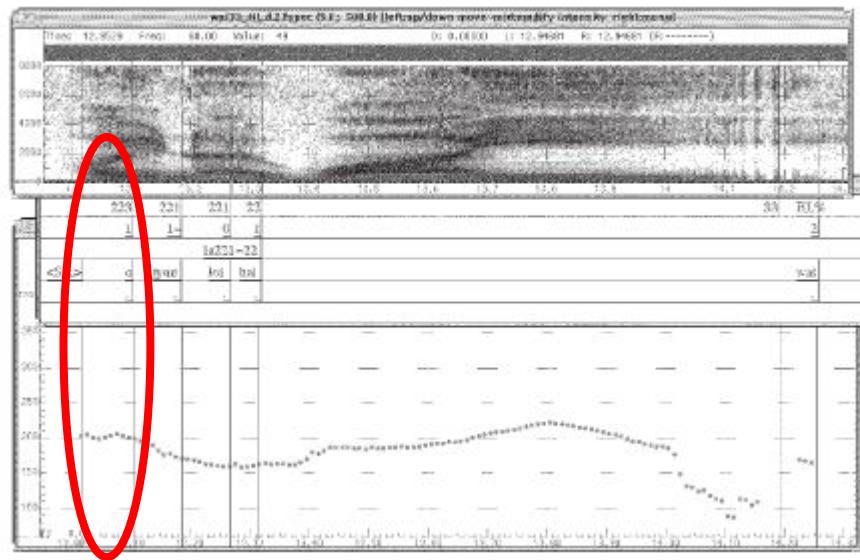
Boundary tones (2)

- Wong et al. (2005) describes HL% as carrying a “discovery” function
- They claim that this HL% occurs in 哦 **o2** (transcribed as **o223**)

哦 原來係畏

O223 *jyun221 loi221 hai22 wai33.*

(Oh, I see, so it was (the word)
“fear”.)’,



Boundary tones (3)

- Again, there is **no** *systematic* acoustic study on this “discovery” HL%
- The only exception: Ki (2019): on HL% with a **different** pragmatic function of negating addressees’ belief
 - e.g. Q: 地球係圓定方? ‘Is the earth round or square?’
A: 圓~ (HL%)! ‘(Of course) round! (Why the hell would you think that the earth could be square?)’

→ we call it **NegHL%**, and will return to it later

→ **Research gap 2**

The study

- Today, we focus on two interjections with the same vowel <o> [ɔ]:
- **哦 o2 (prolonged): *discovery of new information*** (Wong et al. 2005)
 - Sometimes described as surprise (Cheung 2007) or curious (Cheng 2003)
- **哦 o3/4: *echoing in response***
 - “signifies that the speaker has got the message from his or her conversation partner” (Cheng 2003:57)
- An acoustic experiment

Research questions

1. What is the **phonetic realization** of the boundary tone HL%?
2. Does HL% have the same phonetic realization **across grammatical categories** (namely, interjections, SFPs, and words that bear lexical tones)?

Design: stimuli (1)

- 2 x 3 factorial design
- **Boundary tone:** Rising-Falling (**HL%**), Falling (**L%**)
- **Category:** Interjections (**IntJ**), **SFP**, Possessive marker (**Poss**)
 - The possessive marker *ge3* bears a genuine lexical tone mid-level T3

	HL%	L%
IntJ	你畀我試一試，哦～ ... Nei5 bei5 ngo5 si3 jat1 si3, o2~ ... 'Let me try, ahuh! ...'	既然你咁計較，哦， ... Gei3 jin4 keoi5 gam3 gai3 gaau3, o3, ... 'Now that he is being stingy, okay, ...'
SFP	原來四伯放假嘅～ ... Jyun4 loi4 Sei3 Baak3 fong3 gaa3 ge2~ '(I see!) It turns out Sei-baak takes vacation!'	聽講四伯放假嘅， ... Teng1 gong1 Sei3 Baak3 fong3 gaa3 ge3. '(I) heard that Sei-baak takes vacation! ...'
Poss	原來報告蔡俊嘅～ ... Jyun4 loi4 bou3 gou3 Coi3 Ging3 ge3~ '(I see!) It turns out the report is Coi-ging's!'	聽講報告蔡俊嘅， ... Teng1 gong1 bou3 gou3 Coi3 Ging3 ge3. '(I) heard that the report is Coi-ging's.'

Design: stimuli (2)

- Each target item is placed on the **7th syllable** in the sentence.
- Each item is **preceded by a T3 syllable** across conditions.
- Each sentence is **followed by another sentence**, to avoid the item being utterance-final.
- Each sentence was presented with **an appropriate context** in terms of the pragmatic function of the item.
- 4 lexical sets

四伯整極都整唔掂部電視，搵你求救，你話：

你畀我試一試……哦～

電路板原來冇咗粒螺絲

。

Design: participants and procedures

- 13 native speakers of Cantonese (Age: 22-49, F: 7) were recruited in New Haven, US in February 2023
- Recorded in a sound-proof booth at Yale University
- Compensation: USD \$15 for an one-hour session
- Target-filler ratio = 1:2 (filler items from an independent experiment)

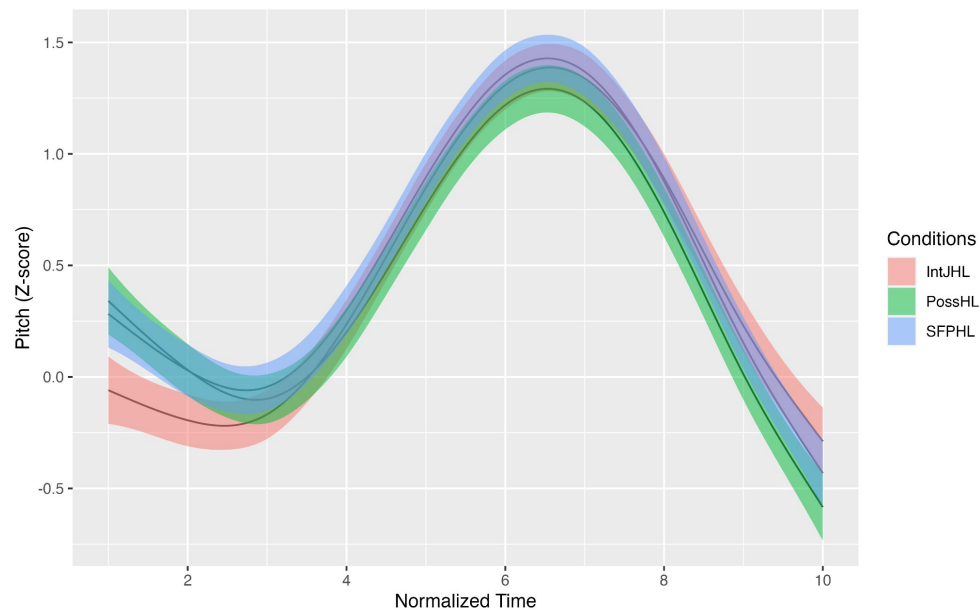
- 13 subjects x 6 conditions x 4 lexical sets x 3 repetitions = 936 tokens were obtained (only presenting 2 lexical sets = 468 tokens today)

Measurement

- Pitch
 - Each syllable is divided into 10 time-equivalent intervals using ProsodyPro (Xu 2005) for acoustic analysis
 - Extracted by Praat, then z-score (by Participant)
 - SSANOVA
- Duration
 - The duration of the target syllable, extracted by Praat
 - Linear mixed effects regression model in R

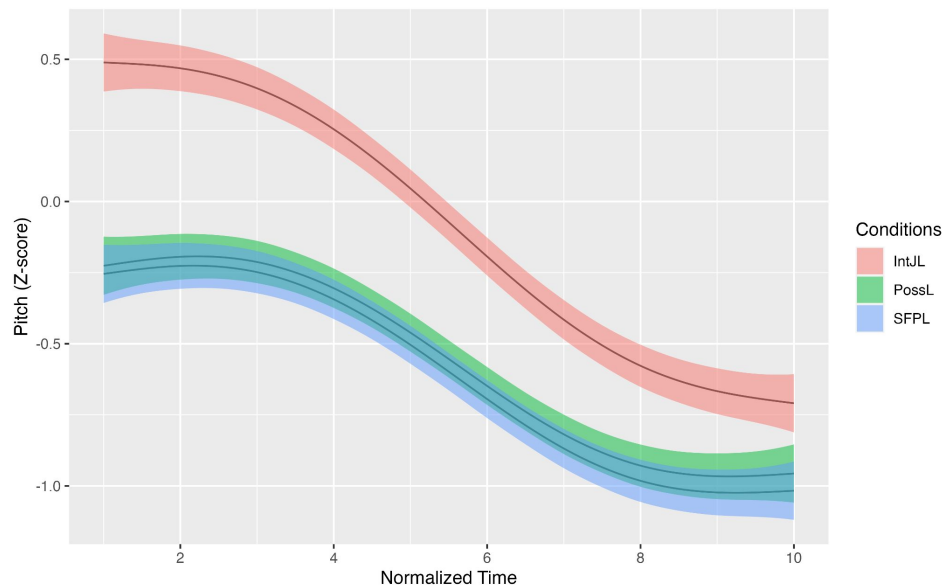
Results: pitch HL

- The pitch patterns are the same for all the three categories (**interjections**, **SFP**, **possessive marker**)



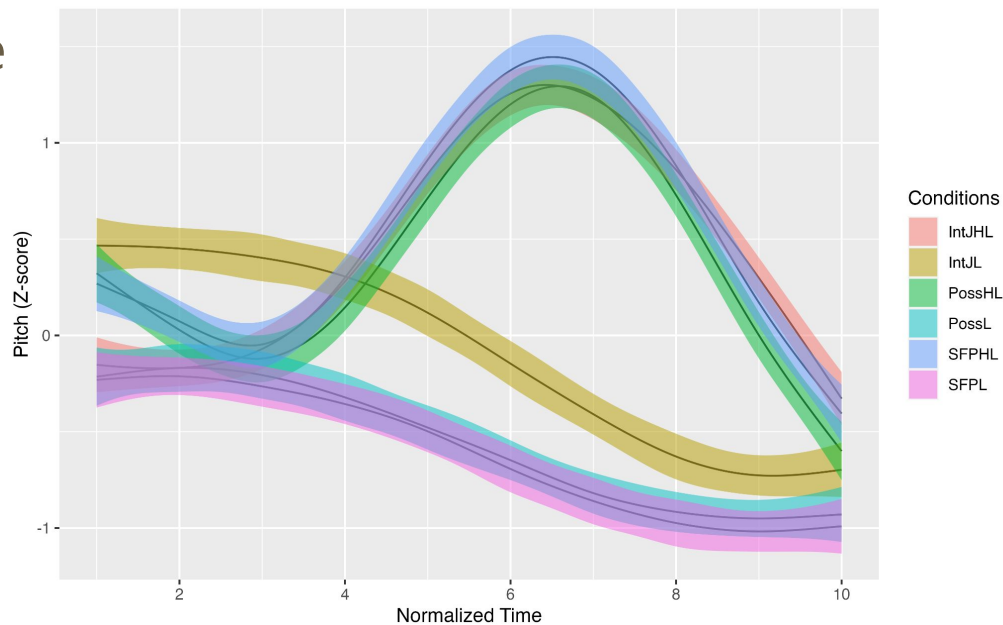
Results: pitch L

- The pitch patterns are the same for **SFP** and **possessive marker**
- The whole **interjection** pattern is higher, probably due to pitch reset (IntJ=new Intonational Phrase)
- Overall, the patterns are the same



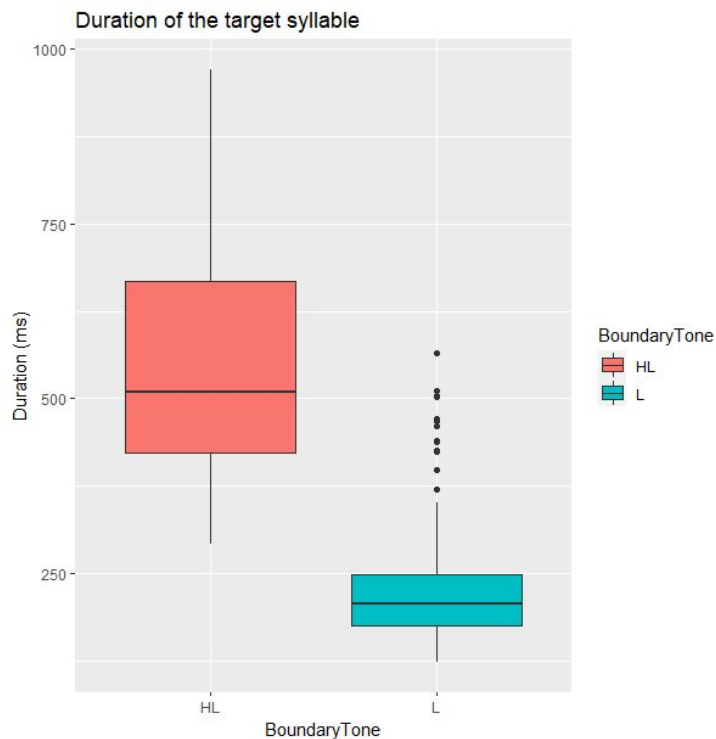
Results: pitch

- The same pattern within the same boundary tone category, despite the different grammatical categories

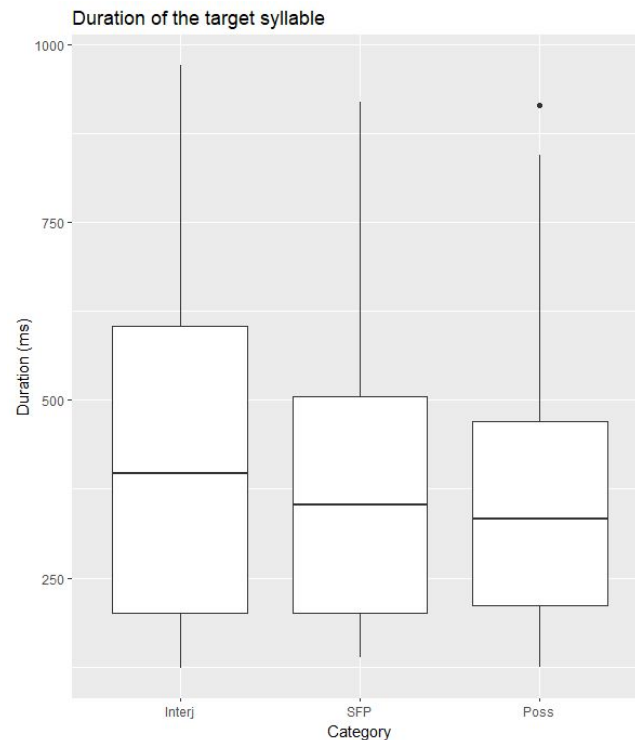


Results: duration

- **Boundary Tone:** HL > L

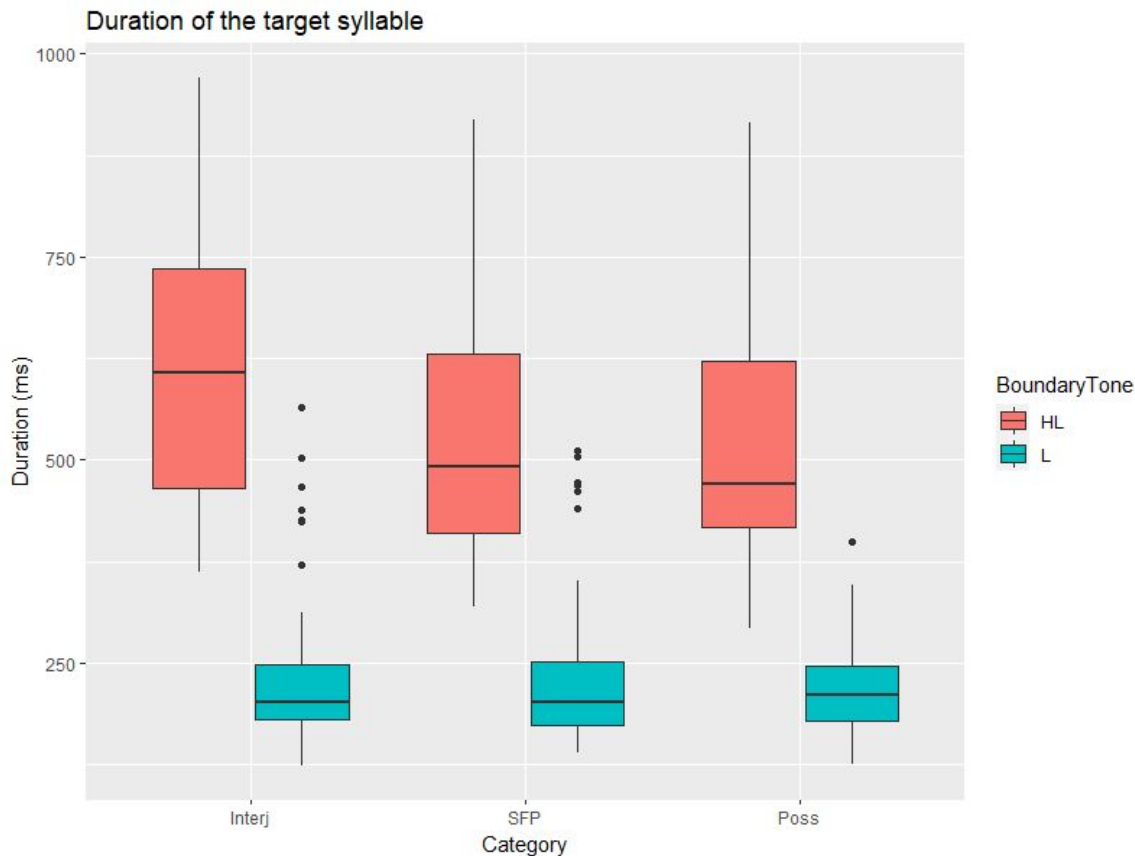


- **Category:** IntJ > {SFP, Poss}



Results: duration

- **Category x Boundary Tone**
- For Intj, the difference between HL & L is larger than for SFP and Poss
- Intj forms a whole IntP



Results: duration

- Linear mixed effects regression model; lmer in R

	Estimate	Std. Error	df	t value	Pr(> t)
(Intercept)	621.31	27.8	19.3	22.35	2.92E-15***
CategorySFP	-87.82	17.57	12.47	-5	0.000275***
CategoryPoss	-100.94	17.57	12.47	-5.746	7.93E-05***
BoundaryToneL	-392.05	14.85	436.87	-26.407	< 2e-16***
CategorySFP:BoundaryToneL	91.07	20.96	436.9	4.345	1.74E-05***
CategoryPoss:BoundaryToneL	95.83	20.99	436.92	4.565	6.52E-06***

- Fixed effects: **Category, BoundaryTone, Category * BoundaryTone**
 - all significant
- Random effects: Participants, Lexical Sets, Trials

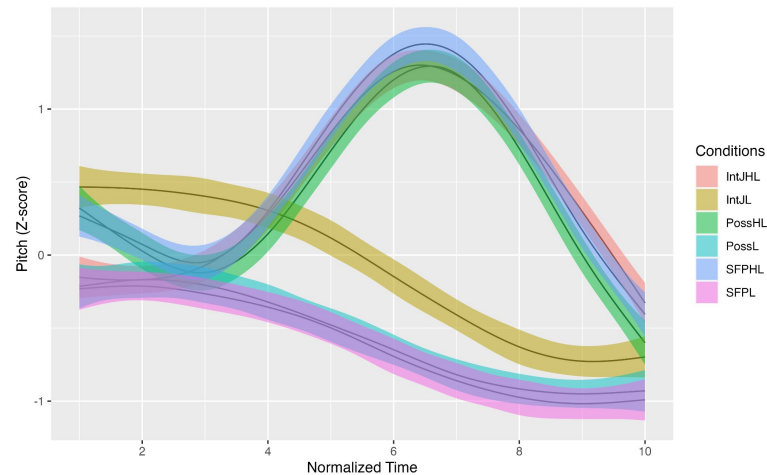
Discussion

1. Answering the research questions
2. Comparison with NegHL% (Ki 2019)
3. Separating suprasegmentals and segments on interjections

(Also individual differences - feel free to ask us in the Q&A)

Discussion: research questions

1. What is the **phonetic realization** of the boundary tone HL%?



lexical tone remains (points 1-2) → **Rising-Falling:**
rise at point 3 → peak at point 6 → fall til end (point 10)

- The portions of rising and falling are even (each 40% of the syllable)

Discussion: research questions

2. Does HL% have the same phonetic realization **across grammatical categories** (IntJ, SFP, Poss)?

Yes, the same boundary tone is used in different grammatical categories → *IntJ's pitch is intonation!*

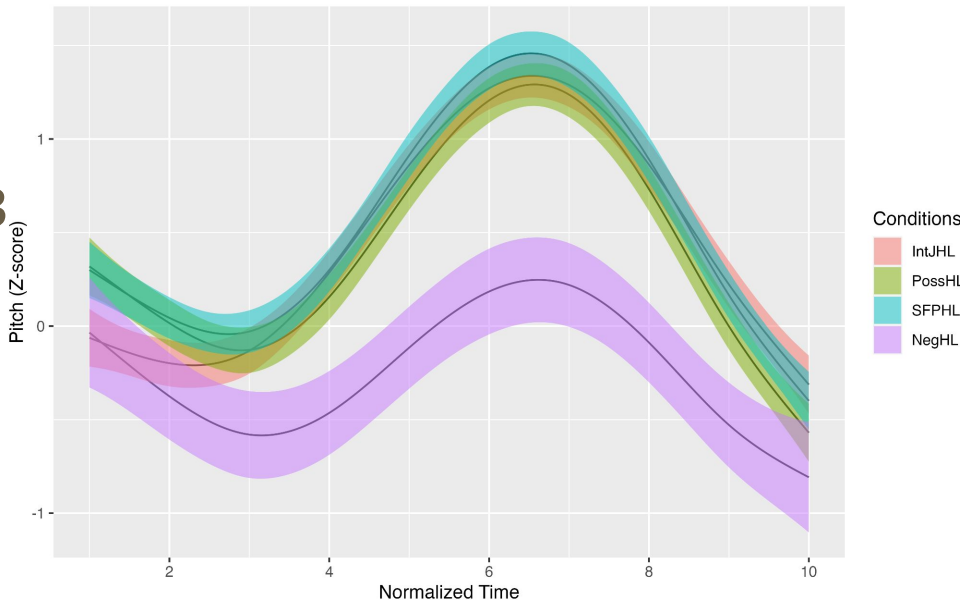
- Pitch: The same, no difference
- Duration: Interjections with HL% are longer than SFP/Poss
 - potentially because they form their own intonational phrases (vs. SFP/Poss = part of an IntP)

Discussion: Comparing with NegHL% in Ki (2019)

- **NegHL%**
- Ki (2019): an HL% intonation expressing a **negation**
 - Q: 你去唔去?(Will you go?) A: 我去HL%。(I go HL%.)
 - To negate the belief of the hearer (that “I am not coming”)
- Also Rising-Falling, yet different pragmatic functions
→ The same HL%?

Discussion: Comparing with NegHL% in Ki (2019)

- Extracted T3 data from Ki (2019)
 - Reduced 50 timepoints to 10 timepoints to make the data comparable
- *NegHL%*: **Lower pitch from pt. 3**
→ The “boundary tone” portion
- Potential issues:
 - Different participants
 - Different stimuli
- It is worth conducting experiments to further confirm if there is a difference



Discussion: other interjections

- Prolonged “T2” interjections (i.e., with HL%) seem to share a similar discourse function: (i) Responding to discourse information (ii) previously *not* in the Spkr’s belief state
- *But with different attitudes*

- 啊 aa2~: 啊~有雲啊 (discovering it’s cloudy) **positive**
- 噢 ji2~: 噢~有雲啊 (discovering it’s cloudy) **negative**
- 哦 o2~: 哦~有雲啊 (discovering it’s cloudy) **neutral**

Discussion: other interjections

- **Decomposition** of SFPs

(Law 1990, Sybesma & Li 2007, Ding 2013, Zhang & Tang 2016, Tang 2020, ...)

- ge3 (assertion) vs. ge2 (question) vs. ge2~ (discovery)
- = $g3+e_{\text{default}}+L\%$ $g3+e_{\text{default}}+H\%$ $g3+e_{\text{default}}+HL\%$
- “T3” might be the default tone (Tang 2015, Yuen 2015)

- Same for Interjections?

- aa2~ (+ve) vs. ji2~ (-ve) vs. o2~ (neutral)
- = $aa+HL\%$ $ji+HL\%$ $o+HL\%$
- Also o3 (echoing) vs. o2 (surprise) vs. o2~ (discovery)

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Selected references (1)

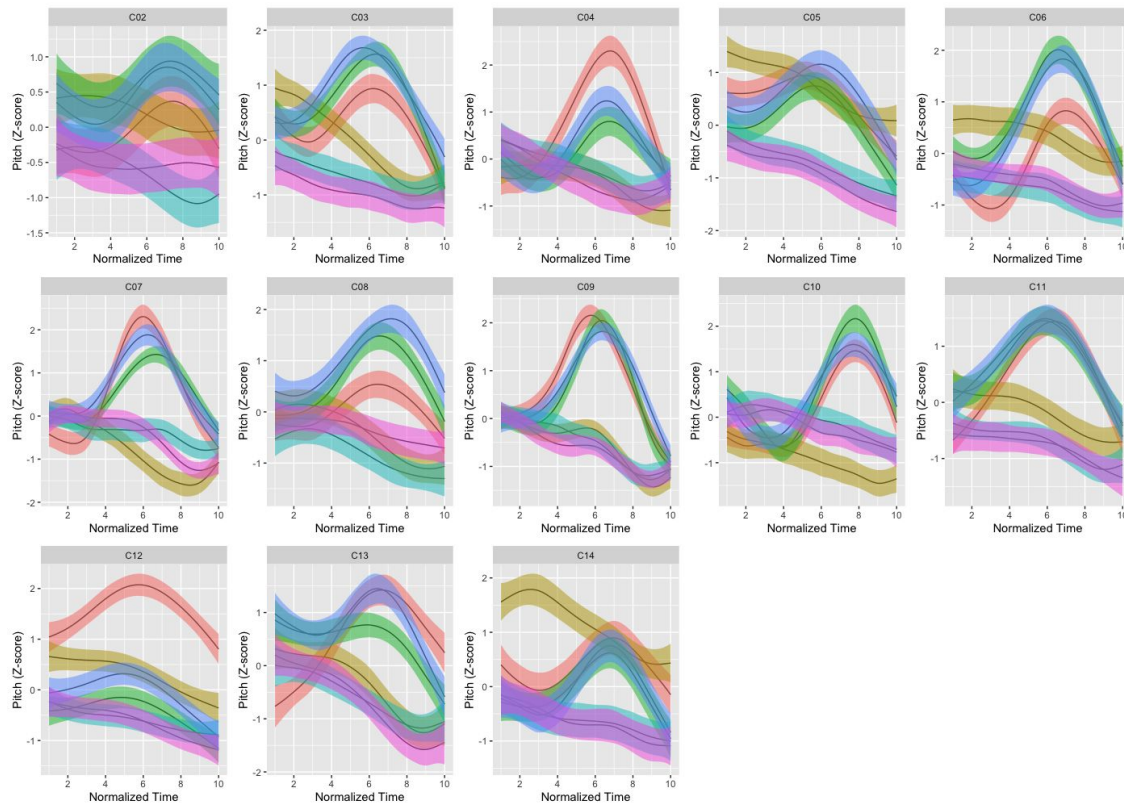
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Individual differences

- Huge individual differences were observed



Individual differences in Duration

