

# A Preliminary Study on the Child Production of the Phonation Contrasts in Kunshan Wu



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## INTRODUCTION

- Tonal systems in modern Wu dialects consist of two registers that are associated with both pitch and voice quality [1, 2]
  - upper register tones – modal phonation
  - lower register tones – **usually breathier** phonation [3]
- Our pilot study on adult speech in Kunshan Wu (a Northern Wu dialect) confirmed that the phonation type in the lower register tones is generally breathier [4].
- Research on the child production of such phonation contrasts has become urgently needed because
  - the number of fluent Wu speakers is drastically decreasing in younger generations
  - the phonation contrasts tend to be lost among younger speakers in neighboring dialects such as Shanghaiese and Suzhou Wu [5].

## METHOD

- Participants
  - Four native children (aged 7;2-8;6; 2M, 2F)
  - Mandarin-Wu bilinguals
- Materials
  - 64 monosyllabic words in isolation
  - Onset types: stops /p, b, t, d, k, g/, fricatives /f, v, s, z/
  - Vowel context: /a, ε, i, ɔ/
  - Five unchecked tones

Example	Upper/Yin (a)	Lower/Yang (b)
<b>Tonal Category:</b>	/ka/	/ga/
<b>Ping (1)</b>	加 ‘plus’	茄 ‘eggplant’
<b>Shang (2)</b>	假 ‘fake’	解 ‘loosen’
<b>Qu (3)</b>	嫁 ‘marry’	

Table 1: Example words from the recording materials

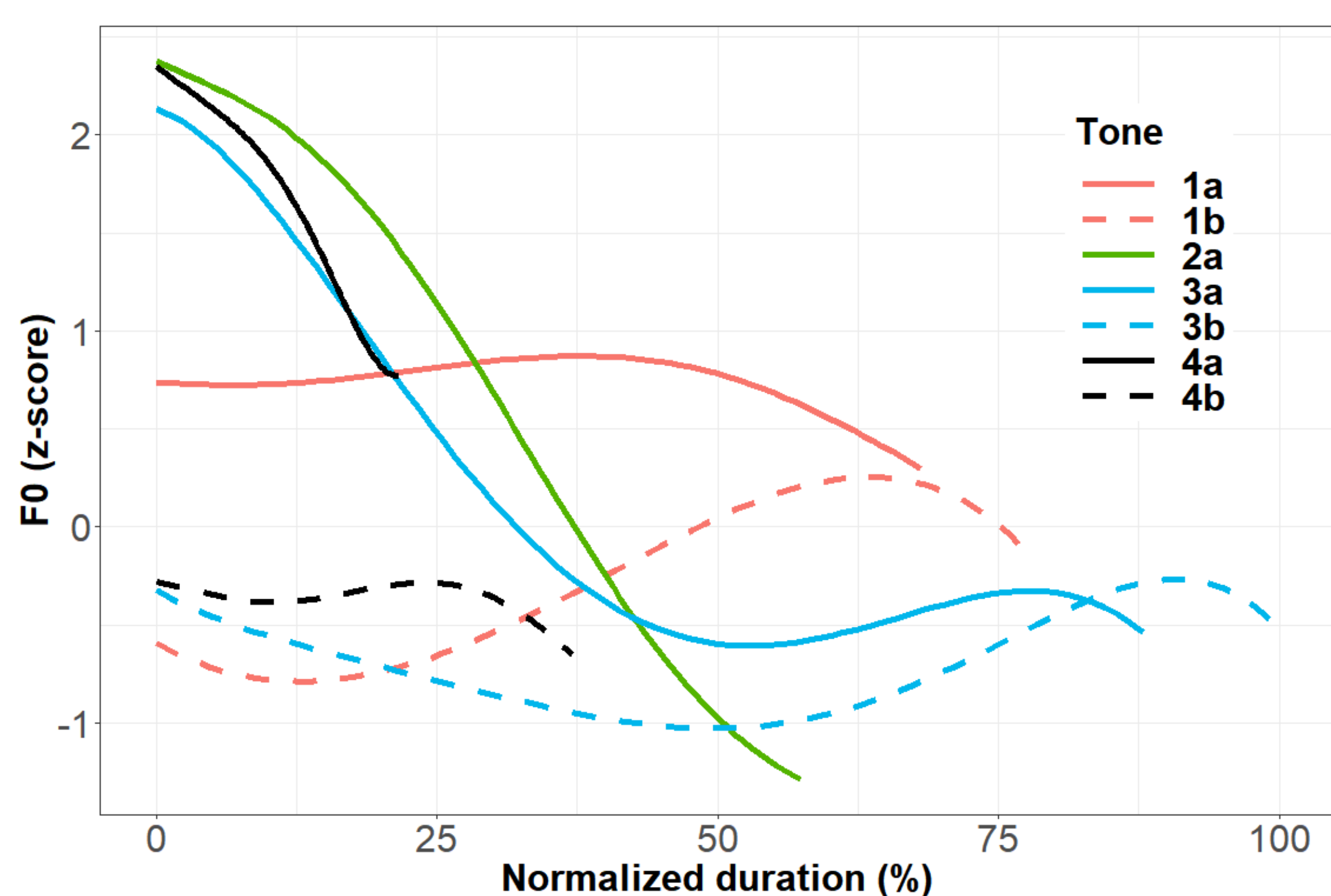


Figure 1: F0 contours of the citation tones in Kunshan Wu [4]

- Acoustic measures are extracted from VoiceSauce [6], averaged on normalized-time intervals (ninths of the vowel duration) and Z-normalized within each speaker
  - spectral tilts: H1-H2, H2-H4, H4-H2K, H2K-H5K, H1-A1, H1-A2, H1-A3, H1-H4, H1-H2K, H1-H5K (all corrected for formant influence)
  - noise/aperiodicity: Cepstral peak prominence (CPP), the harmonics-to-noise ratios (HNR) in 0-500Hz, 0-1500Hz, 0-2500Hz and 0-3500Hz

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## RESULTS

### 1. Across speakers

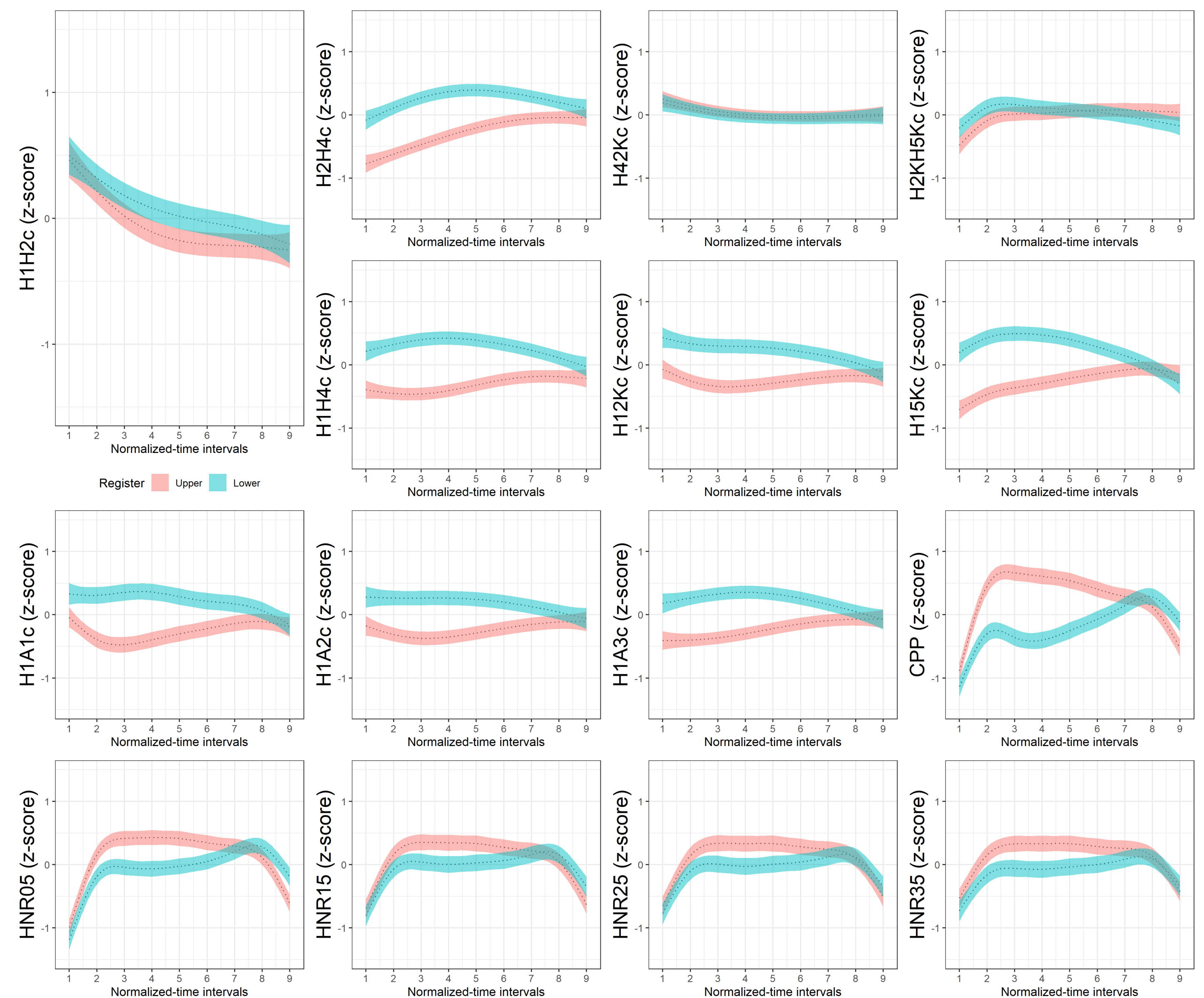


Figure 2: Results of SSANOVA on each measures across speakers

### 2. Within speakers

Measures	F1 (7;2)	F2 (8;4)	M1 (7;7)	M2 (8;6)
H1*-H2*			*	
H2*-H4*	*	*	*	*
H4*-H2K*				
H2K*-H5K				
H1*-H4*	*	*		*
H1*-H2K*	*	*	*	*
H1*-H5K		*	*	*
H1*-A1*	*	*		*
H1*-A2*		*	*	*
H1*-A3*		*	*	*
CPP	*	*	*	*
HNR05				*
HNR15				*
HNR25				*
HNR35		*		*

Table 2: Results of SSANOVA of each measure within speakers (\*significant differences show for at least 1/3 of the vowel duration)

## DISCUSSION

- For at least one-third of the vowel duration, the lower register tones generally exhibit
  - higher spectral tilts
  - lower noise measures (i.e. noisier)
- Most measures show diverse patterns among the children
- Since the acoustic measures are believed to be related to various physiological aspects of producing breathiness, it is concluded that children aged at 7;2 or above can produce some type of breathier phonation as a phonetic feature of the lower register tones, while between-speaker variation may be explained by idiosyncratic factors or the characteristics of their primary caretaker’s speech.

References: [1] Yip, M. J. (1980). *The tonal phonology of Chinese*. (Doctoral dissertation). MIT. [2] Duanmu, S. (1990). *A formal study of syllable, tone, stress and domain in Chinese languages*. (Doctoral dissertation). MIT. [3] Cao, J., & Maddieson, I. (1992). An exploration of phonation types in Wu dialects of Chinese. *Journal of Phonetics*, 20, 77–92. [4] Xu, W. & Mok, P. (2021). The acoustic correlates and time span of the non-modal phonation in Kunshan Wu Chinese. In *Proceedings of ISCSLP2021*, Hong Kong, 71–75. [5] Gao, J. (2016). Sociolinguistics motivations in sound change: On-going loss of low tone breathy voice in Shanghai Chinese. *Papers in Historical Phonology*, 1, 166–186. [6] Shue, Y., Keating, P., Vicenik, C., & Yu, K. (2011). VoiceSauce: A program for voice analysis. In *Proceedings of the 17th ICPHS*, Hong Kong, 1846–1849.