A Phonetic Study of Voicing Contrast of Obstruents in Wuxi Wu Chinese

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Overview

1. Introduction to Wu Chinese and Wuxi dialect
2. Literature Review and Research Gap
3. Research Questions
4. Methodology and Measurements
5. Contributions

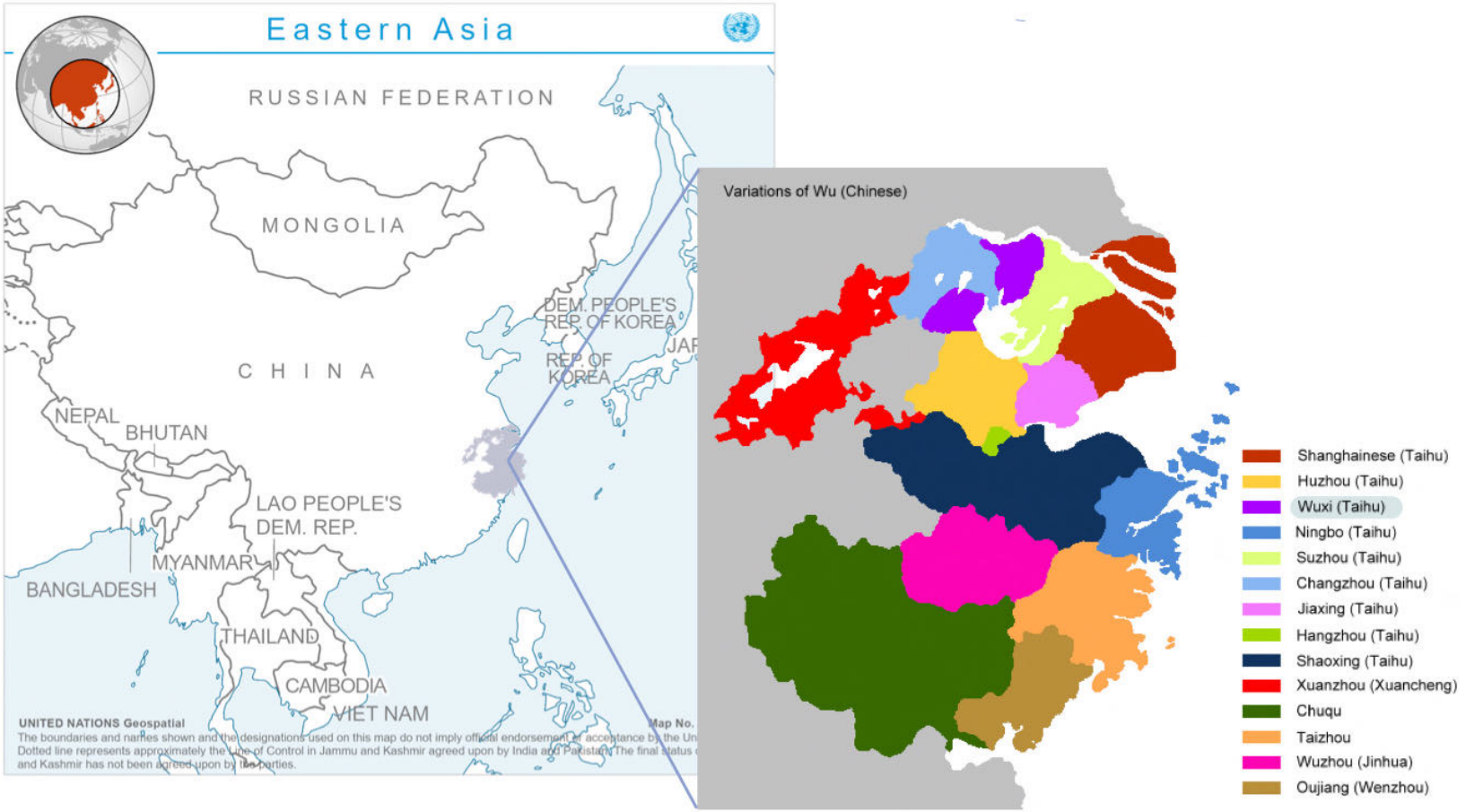
Language vs. Dialect

- Criterion: Mutual intelligibility
- Wu Chinese: Language, mutually unintelligible with other varieties of Chinese such as Mandarin

  Wuxi Wu: Dialect, partially mutually intelligible with other dialects of Wu Chinese such as Shanghainese

- Language family branching:
  Sino-Tibetan
    Sinitic
      Chinese
        Wu Chinese
          Wuxi Wu

Geographical location



Demographics

- Number of speakers: 2 million (Yan, 2010), bilinguals
- Current situation: Used in limited scenarios; children have less exposure and shift to a more dominant language
- Expanded Graded Intergenerational Disruption Scale (EGIDS):

6b	Threatened	Acquisition: The language is used orally by all generations, but it is losing users.
		Motivation: Members of the child-bearing generation perceive the benefit of using their language orally for some purposes, but for others find more benefit in shifting to a more dominant language.

UNESCO: Vulnerable

- Tendency: Decline

Literature Review

Overview of research on Wuxi dialect: Inadequate and unbalanced

- Predominantly impressionistic descriptions which are merely based on researchers' hearing and judgement
- No acoustic studies on segments
- Rely on research of other varieties of Wu Chinese, such as the most prestigious one –– Shanghainese
- Research gap: An overall phonetic study based on experiments

Consonant Inventory

	Bilabial	Labio–dental	Alveolar	Alveolar–palatal	Velar	Glottal
Plosive	p^h p b		t^h t d		k^h k g	ʔ
Affricate			ts^h ts	$tɕ^h$ tɕ dʑ		
Nasal	m		n	ɲ	ŋ	
Fricative		f v	s z	ɕ		h ɦ
Lateral approximant			l			

Obstruent Inventory

	Bilabial	Labio-dental	Alveolar	Alveolar-palatal	Velar
Plosive	p^h p b		t^h t d		k^h k g
Affricate			ts^h ts	$tɕ^h$ tɕ dʑ	
Fricative		f v	s z	ɕ	

- Plosives and affricates: Preserving a three-way laryngeal contrast derived from Middle Chinese (voiced vs. voiceless unaspirated and voiceless aspirated), which has been lost in other Chinese varieties
- Fricatives: A two-way laryngeal contrast

Literature Review

- Chao (1928) first noticed that the phonologically voiced obstruents actually sound voiceless in the initial position.

- In 1964, Voice Onset Time (VOT) was proposed by Lisker and Abramson as a cue distinguishing the voicing categories of stops across languages.

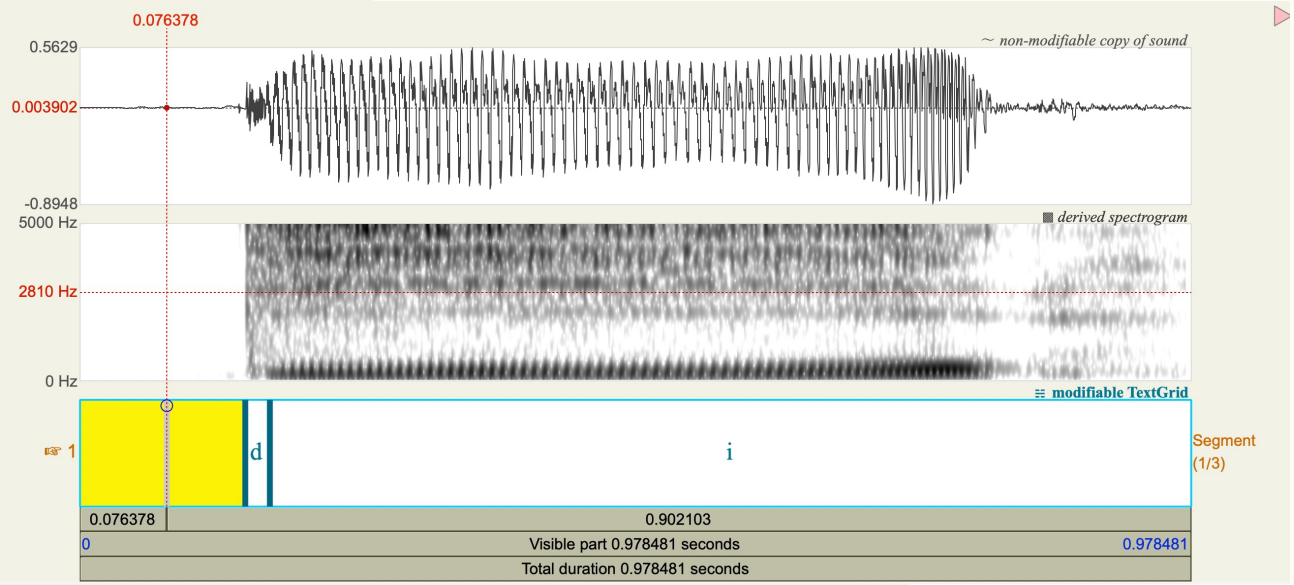
  VOT serves as an effective cue in non-initial position, but fails to distinguish between voiced and voiceless unaspirated in the initial position.

-> Other acoustic correlates such as closure duration (Shen & Wang, 1995) and phonation type (Cao, 1988)

Literature Review

- Voiced obstruents come with a ‘muddy voice’

eg. /di/



‘Muddy Airflow’

- Chao (1976) proposed that the voiced obstruents are ‘clear sound followed by muddy airflow’ such that /b, d, g/ can be transcribed as [pɦ, tɦ, kɦ].
- Ren (1988) proposed that the ‘muddy airflow’ is caused by the breathy voice of the following vowel.
- It is not clear whether the ‘muddy airflow’ belongs to the obstruent, the following vowel or the entire syllable.

Research Questions

a. Regarding the voicing contrast of obstruents, what are the acoustic cues distinguishing voicing in the initial and non-initial position?

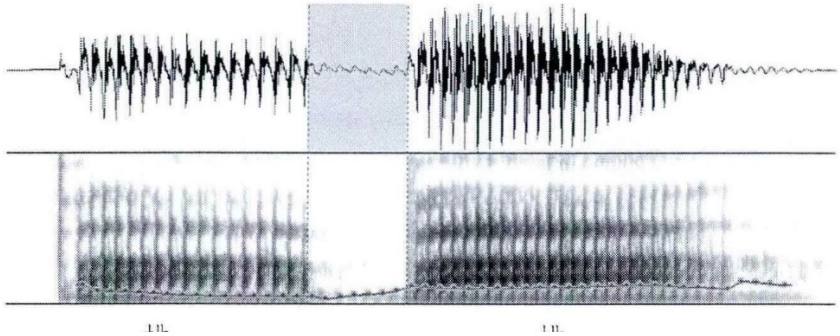
b. What is the nature and domain of the ‘muddy airflow’?

Methodology

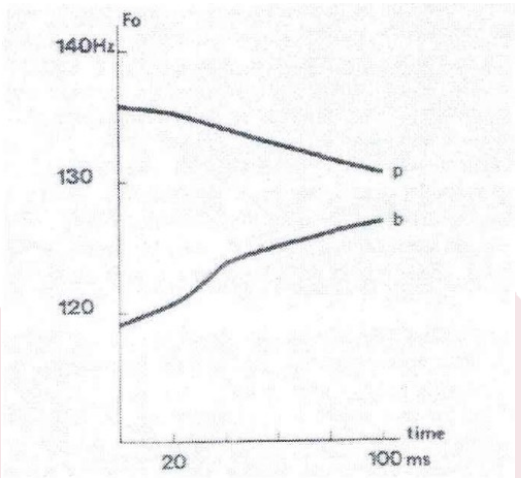
- A combination of both acoustic and articulatory studies –> effectiveness of measurements & correlation
- Participants: 20 native speakers (10 male, 10 female)
- Stimuli: Put into carrier sentences ‘Say X three times’ –> more natural; measure some parameters such as closure duration for initial obstruents

Acoustic Measurements

- VOT: Negative VOT values for voiced obstruents (Lisker & Abramson, 1964)
- Closure duration: Shorter closure duration for voiced obstruents (Lisker, 1957)



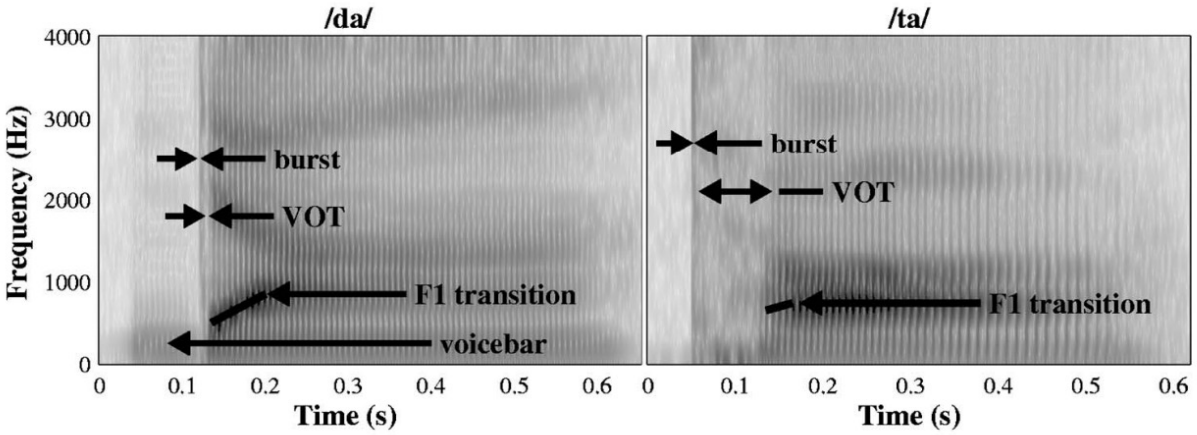
- Onset F0: Lower for voiced obstruents (Hombert et al., 1979)



Acoustic Measurements

- Vowel duration: Vowels following word-initial voiced stop are longer in duration. (Allen et al., 2007)

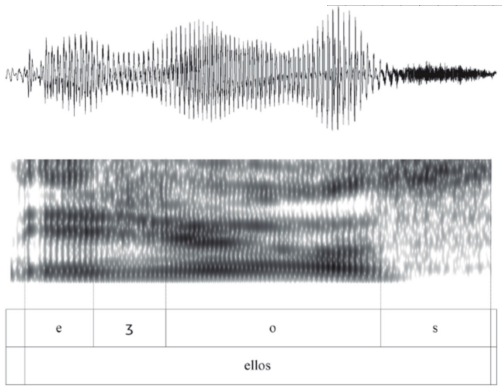
- Formant transitions (onset F1/F2/F3, T1/T2/T3): A significant formant transition after voiced plosives. (Stevens & Klatt, 1974)

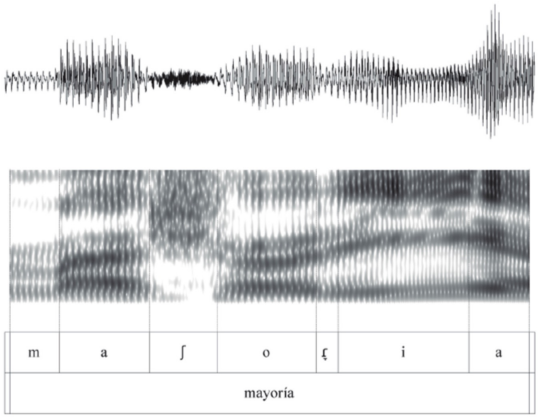


Acoustic Measurements

For fricatives,

- Segment duration: Shorter for voiced counterparts (Baum & Blumstein, 1987)
- Percentage of fricative duration: Higher for voiced counterparts (Schmidt and Willis, 2011)





Acoustic Measurements

For breathiness,

- Harmonics-to-noise ratios (HNR)
- Cepstral peak prominence (CPP)
- F0
- Spectral tilts (H1-H2, H1-F1, H1-A1, etc.)
- …

- These measurements are not always effective across languages (e.g., Larger H1-H2 generally serves as a cue for breathy voice, but not in Shanghainese)

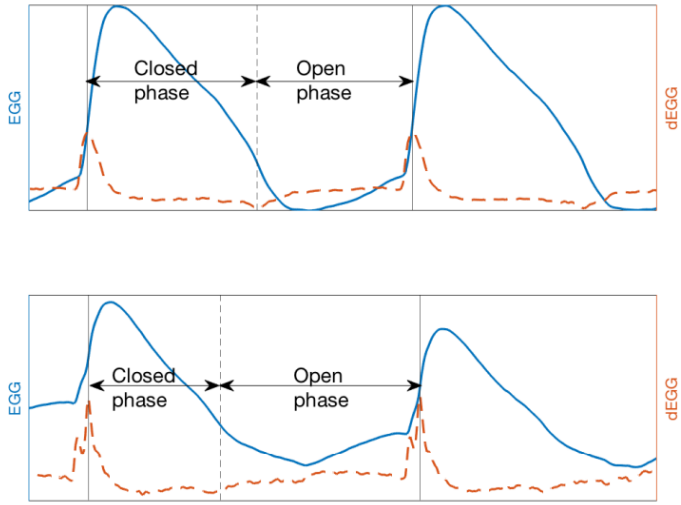
Articulatory Measurements

Simultaneous electroglottographic (EGG) and audio recordings

- EGG: Electrodes on neck to measure the current variations to study the degree of vocal fold contact, confirming the presence of voicing, breathy voice, etc.

- EGG signals: High–closed, low–open
- Peak of dEGG: Glottis opens

- Breathy voice: Vocal folds with lower tension, not fully closed



Articulatory Measurements

- Closed quotient (CQ): the ratio between the closed phase and the whole glottal cycle
  Breathy voice have lower CQ than modal voice (Khan, 2012).

- Peak Increase Contact (PIC): the amplitude of the positive peak of the dEGG signal
  Breathy voice have higher PIC (Keating et al., 2011)

-> Correlation between EGG data and acoustic data: More accurate phonetic properties

Contributions

- To Wuxi dialect: Being part of language documentation; helping preserve the dialect
- To Wu Chinese: Having a better understanding of the language
- To cross-linguistic comparisons: Providing a more objective and reliable acoustic description of the sound system
- To phonetic features: Investigating more into voicing contrast, phonation type and their relationship
- To methodology: Investigating the effectiveness of measurements and the relationship between acoustics and articulation

Thank you!