

1. Introduction

Tones remain discernible in different phonations. Phonation changes impact on the larynx. EGG provides information on laryngeal activity. This study suggests that for Breathy and Theatrical Whisper, since vocal fold vibration remains periodic, tones may still be discerned through F0 profiles. Tone perception is predicted to be difficult for Whisper, though other cues such as duration may be helpful.

2. Methodology

Putonghua tones pitch contours:

T1: High flat; T2: Rising; T3: Dipping; T4: Falling

Phonation types:

Normal, Breathy, Theatric Whisper, Whisper

Frame:

Zhe ge ci nian ____ "This word is pronounced ____"

Stimuli: [ta, ti, tu]

all four tones for all phonation types

Informant: Female, 28yr, Baotou city

3. Average Duration (seconds)

Length of tone determined by length of rime

	N	B	T	W
T1	0.5369	0.6063	0.5176	0.4796
T2	0.5817	0.6676	0.5306	0.5892
T3	0.6596	0.7306	0.6401	0.6113
T4	0.5194	0.6219	0.5716	0.4387

Std Dev < 0.13 for all cells, but measurements for W highly unreliable because difficult to identify F0 activity

N: T3 > T2 > T1 > T4

B: T3 > T2 > T4 > T1

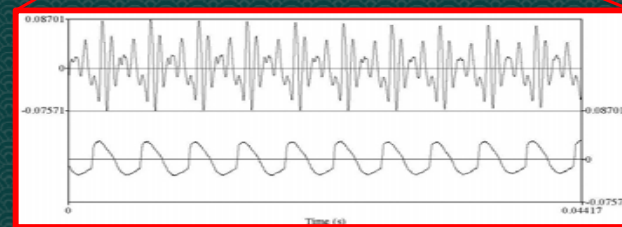
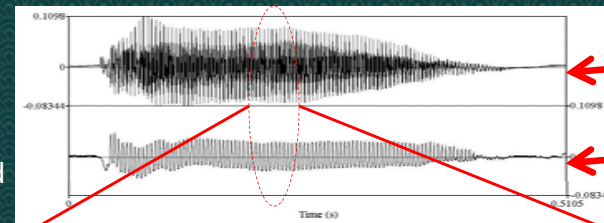
T: T3 > T4 > T2 > T1

W: T3 > T2 > T1 > T4

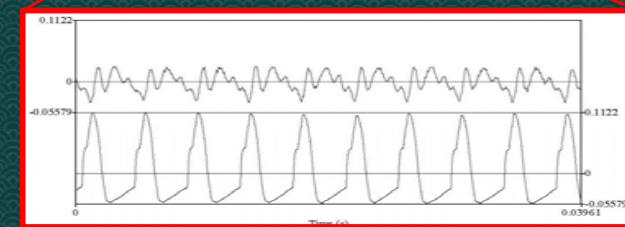
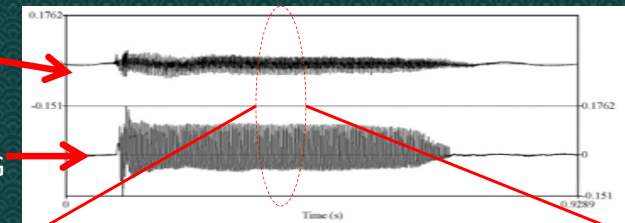
⇒ T3 discernible by length when other cues missing; duration inadequate for others

4. Waveforms (Illustrated with Tone 1 [ta])

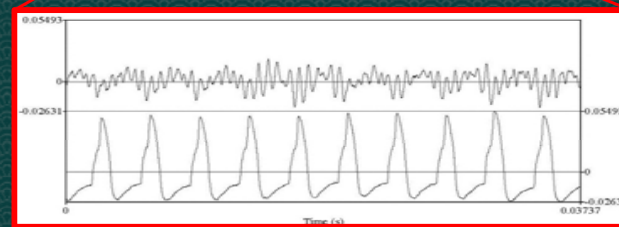
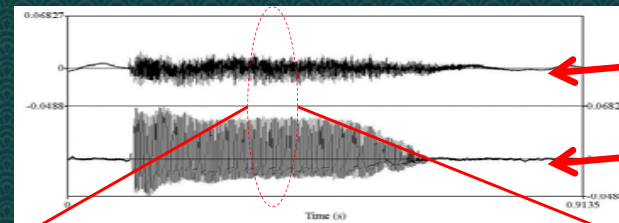
Normal Phonation



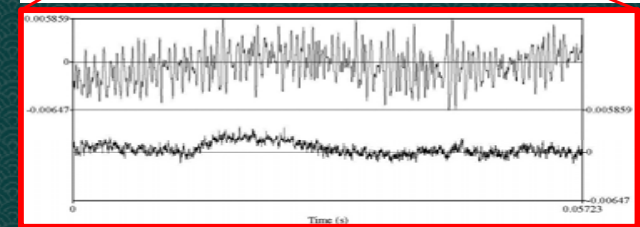
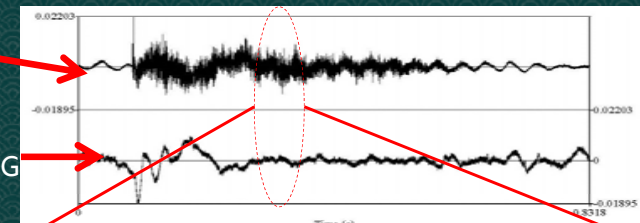
Breathy



Theatrical Whisper



Whisper



5. Analysis/Observation

- Periodic vocal fold vibrations seen in B and T,
- B and T wave shapes are similar in having sharp peaks.
- W appears to have no periodic vibration of vocal folds, thus F0 profile no longer useful for determining tone contour
- For W, T3 (0.6113s) & T2 (0.5892s) have nearly the same duration; similarly with T1 (0.4796) & T4 (0.4387s). However, these measurements are not entirely reliable since endpoints of tone are hard to identify.

6. Conclusion/Implications

1. Tones may still be discerned through F0 profiles for B and T
2. T2&T3 likely to be confused for W because similar duration with no F0 profile information to help discernment
3. T1&T4 likely to be confused for W, same reasons as (2) above
4. Perception tests for W would be necessary.