The relationship between laryngeal mechanism and vocal tract resonance in the music theatre voice: A pilot study.

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Introduction

Music theatre: a new area of vocal pedagogy and research.
- Singers, teachers and researchers not agreed on definitions of vocal qualities: especially 'belt', 'legit' and 'mix'.
- Previous research indicates that there is some agreement amongst elite music theatre teachers on registration for belt and legit in women, confusion about the male voice, and that there is more than one type of belt. (Bourne & Kenny, 2008)
- This study aims to clarify definitions by measuring differences at the larynx, and the vocal tract in chesty belt, twangy belt, legit and mix vocal qualities.

What are the differences between belt, legit & mix vocal qualities?
What laryngeal mechanisms/adjustments and resonance strategies characterise these vocal qualities?

Method

- 1 female music theatre singer
- 4 vocal qualities: 'chesty' belt, mix, legit, 'twangy' belt
- 3 vowels: [i], [u], [o]
- 4 pitches: A4, B4, C5, D5
- 5 samples for each vowel, pitch & quality

Measurements taken:
- Audio (at lips)
- Sound Pressure Level (SPL)
- Pitch Coefficient (c) of R1 & R2
- Impedance of vocal tract (Epps et al, 1997)
- 1st and 2nd Resonances (R1 & R2)
- Electroglottographic (EGG) signals
- Amplitude of EGG signal (Amp) & Open Quotient (OQ)

Results

Larynx

Background
- Registration mechanisms in laryngeal mechanism glottal gap [Houde et al, 2000] corresponding to different muscle activity and altered patterns of vocal fold closure.
- 'Chesty' = laryngeal mechanism M1
- 'Legit' = laryngeal mechanism M2
- 'Twangy' = laryngeal mechanism M2

According to Henrich et al. (2009), EGG parameters can be indicators of vocal tract resonance:
- M1: OQ from 0.5-0.95, low EGG signal, high ratio of closed to open glottal area
- M2: OQ from 0.3-0.8, high EGG signal, high ratio of closed to open glottal area

Western lyrical singing is produced in one mechanism but with adjustments in the vocal tract so that the perceived sound is more like the other mechanism; (M1 more like M2 and vice versa). Yet, OQ higher and EGG amplitude lower for twang. This supports the hypothesis that twangy belt may be a more efficient/safer type of belt than chesty belt.

Vocal Tract

Acoustic resonances of the vocal tract measured to determine R1 & R2 frequency values in relation to harmony frequencies and to determine tuning of vocal tract to harmonics.

Radiated Sound

How do SPL and δ relate?

- High R1 related to more open lips and jaw position and higher larynx position. R1 relates to more forward placement of the larynx.
- Perceptual descriptions of forward vs. backward placement of the voice match the acoustic measurements of R1 and R2 in some singers, and to the measurements of the tongue, jaw and lips. (Garnier et al. 2007)

Conclusions

What are the EGG parameters?

For this singer, the values of EGG parameters, forward belt:
- Chesty belt appears to be produced in M1
- Twangy belt appears to be produced in M2
- Legit and mix appear to be produced in M2

Electroglottographic (EGG) signals:
- For chesty belt, the EGG signal is low, the ratio of closed to open area is high
- For twangy belt, the EGG signal is high, the ratio of closed to open area is low

When is the EGG signal the highest?

Twangy belt = chesty belt > mix = legit

What are the resonance tunings?

Twangy belt produces both Resonance 1 (R1) and Resonance 2 (R2) up to C5, legit, and mix produce R1 and R2 up to C5 except for the [e] vowel.

REFERENCES: