THE EFFECT OF AUDITORY-BOMBARDMENT-INSPIRED LISTENING ACTIVITIES ON THE VOCAL PRODUCTION OF UNDERGRADUTE SINGERS

PAVA
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PURPOSE: To isolate and analyze the effect of auditory-bombardment-inspired listening activities on sung vocal production.

RESEARCH QUESTIONS

1. Can focused listening prior to sung practice affect initial sung production of a musical phrase such that it more closely matches the standard set by an aural model?
2. Which specific, measurable acoustic aspects of this sung musical phrase were affected by listening activity?
3. Is auditory bombardment, or focused auditory stimulation (Hodson & Paden 1991, Fey 1986) an effective model for designing listening activities in the Western Classical voice studio?

STUDY DESIGN

Participants *N*=38, Ages 17-26 (avg. 20.5)
Undergraduates enrolled in voice lessons and/or choir at a private liberal arts institution

Control Group
N=20
6 Novice, 14 Advanced

Listening Group
N=18
4 Novice, 14 Advanced

Focused Listening Activity: Ten minutes per day of repeated listening to recorded melody sung by professional opera singer of similar voice type (mezzo or baritone). No sung practice. Baritone performed one octave below pitches shown.

- Participants performed melody after a single hearing of the model singer's recorded performance.
- Printed text, but no musical score, was provided during recording session.

N. B.: Listening method (headphones vs. speakers) was not controlled.

METHOD & ANALYSIS

PARAMETERS MEASURED

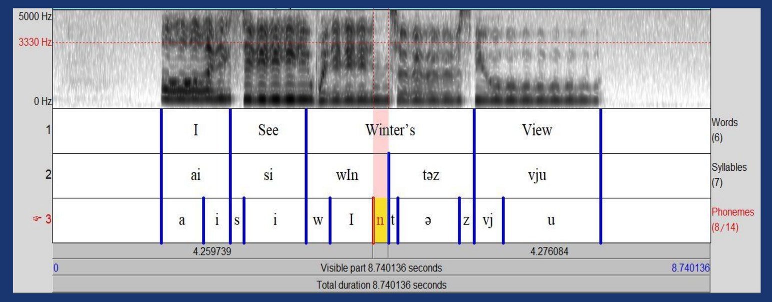
Musical Accuracy
- Interval accuracy & rhythmic accuracy

Duration: Vowel vs. consonant phonemes
Vibrato: Average of all vowel phonemes
- Rate, Regularity of rate (jitter)
- Extent, Regularity of extent

Intensity: Average of entire sung phrase
- 0-20 kHz, 0-2 kHz, 0-4 kHz, 4-10 kHz
- Singing Power Ratio (Omori et al, 1996): Ratio of Average Intensity 2-4 vs. 0-2 kHz

N.B.: Intensity data analysis compared treble and tenor/baritone voices separately.

Spectrogram and Text Grid in Praat Software



- Manual duration measurements in Praat software, sample order randomized, repeated five times, margin of error 8.5 ms.
- Vibrato and Singing Power Ratio data analyzed with Matlab software.
- Statistical analysis in SPSS software.

Data collected in soundproof space with Earthworks SR77 cardioid pattern condenser microphone. Singers positioned 6 feet from microphone.

$$ACC_X = |X_M - X_P|$$

$$NACC_X = \frac{ACC_X}{\sigma_X}$$

$$R_{VC} = \frac{T_v}{T_c}$$

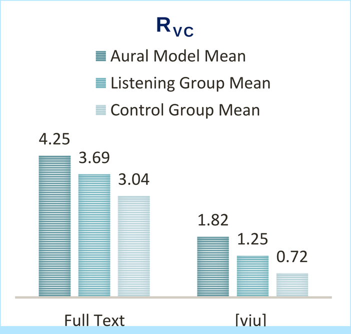
- ACCX = Accuracy of measured acoustic parameter X
- NACCX = Normalized accuracy metric for acoustic parameter X
- X = Any acoustic parameter measured (e.g. duration)
- | … | = Absolute value
- XM = Acoustic parameter measurement for model
- XP = Acoustic parameter measurement for participant
- σ = Standard deviation
- Rvc = Ratio of vowel duration to consonant duration
- Tv = Total time spent articulating vowels
- Tc = Total time spent articulating consonants

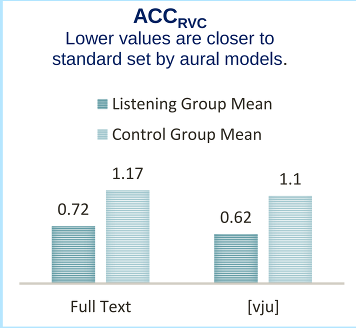
N.B.: This analysis treated [j] as a consonant.

RESULTS & DISCUSSSION

Differences between listening and non-listening groups were most apparent with regard to interval accuracy and relative duration of vowel and consonant phonemes. No significant between-group differences were observed for the vibrato or intensity parameters measured. These results suggest singers adjusted musical and articulatory aspects of the sung phrase to match the models' aural template after completing this focused listening activity.

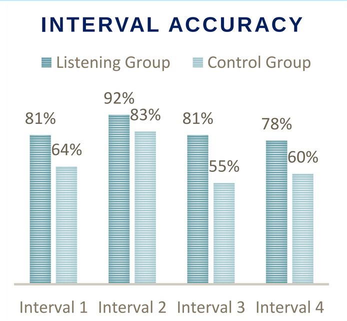
Listening group R_{vc} was higher than control group R_{vc}, indicating that listening group singers spent more time singing vowels vs. consonants relative to the control group.

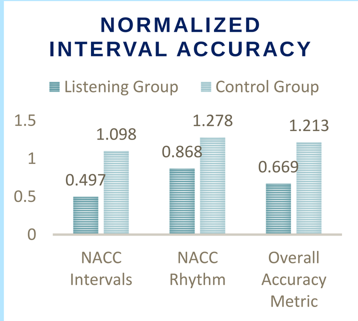




Listening group ACC_{RVC} was also closer to the to the aural models' R_{vc}. T-test of normalized accuracy (NACC) R_{vc} showed statistical significance (sig. .026).

Both rhythm and interval accuracy results favored the listening group, though larger differences were found in interval accuracy.





T-test of Overall NACC metric revealed difference between listening and control groups was statistically significant (sig.007).

CONCLUSIONS

These results demonstrate that listening via auditory bombardment (focused auditory stimulation) effectively influenced singers' initial production of a sung phrase.

Effects were most pronounced in interval and rhythm accuracy and articulatory aspects of tone production; less strong/negligible in acoustic parameters related to timbre and vibrato.

Voice teachers may wish to experiment with students using focused auditory stimulation activities prior to sung practice.

FUTURE DIRECTIONS

- Durational measurements to gather normative data on legato singing in the Western Classical style
- Expert listener perceptual corroboration of legato with higher Rvc values
- Analysis of the impact of focused listening activities on other acoustic parameters, i.e. vibrato onset
- Similar study with population including only voice majors.
- Experiments with structure of targeted listening activities

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