

Effect of laryngeal and epilaryngeal adjustments on oral vibratory sensations at different semi-occluded vocal tract configurations

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PEVOC

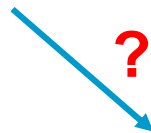
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Introduction

- Voice therapy aims to improve vocal efficiency and reduce risks of vocal fold injury
 - resonant voice therapy, semi-occluded vocal tract exercises, vocal function exercises, etc.
- Often emphasizes vibratory sensations in the front part of the vocal tract during phonation.

emphasis on vibratory sensations



laryngeal and vocal tract adjustments

**improved vocal efficiency
reduced risks of injury**



Research questions

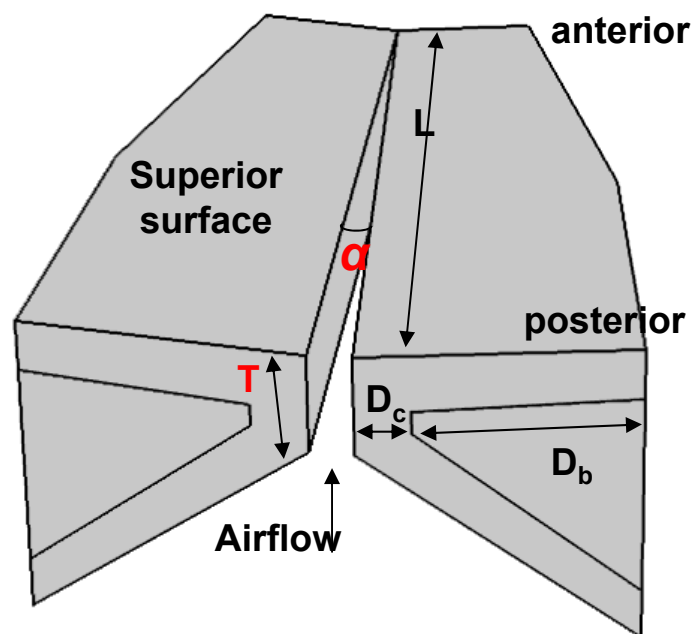
1. What laryngeal and epilaryngeal configurations can be elicited by an emphasis on maximizing oral vibratory sensations in an open or semi-occluded vocal tract?
2. Are these configurations associated with reduced vocal fold contact pressure when producing a target output SPL?
3. Does semi-occlusion at the lips make it easier for speakers to identify these favorable configurations compared to vocal tracts without semi-occlusion?



Approach: computational simulations

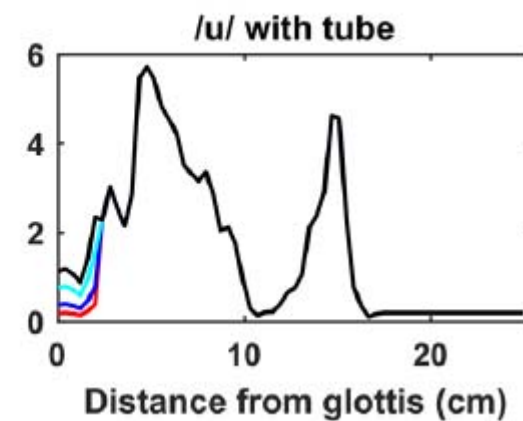
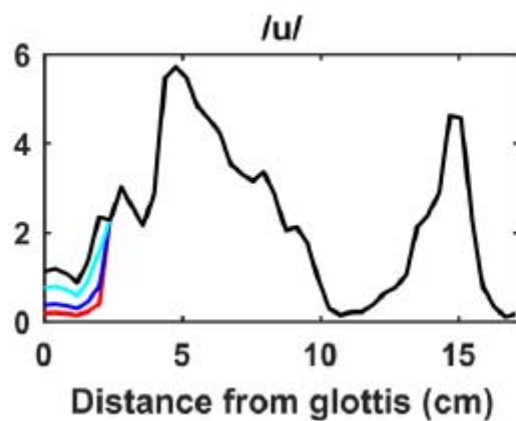
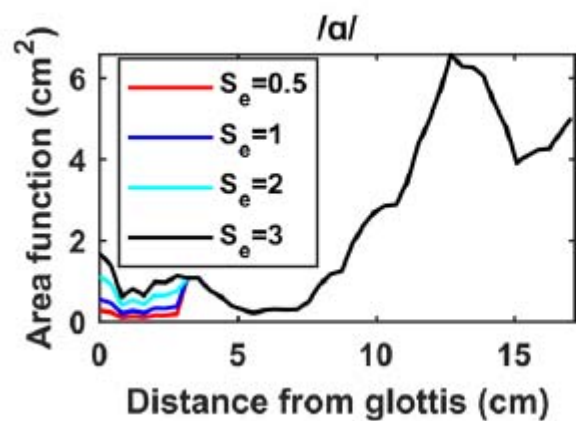
Voice simulations with parametric variations in the larynx:

- vocal fold adduction (glottal angle α)
- medial surface thickness T
- subglottal pressure



Vocal tract configurations

- 3 vocal tract configurations:
 - /a/, /u/, /u/ with tube (8-cm long, 5mm diameter)
- Epilaryngeal tube area



Data analysis

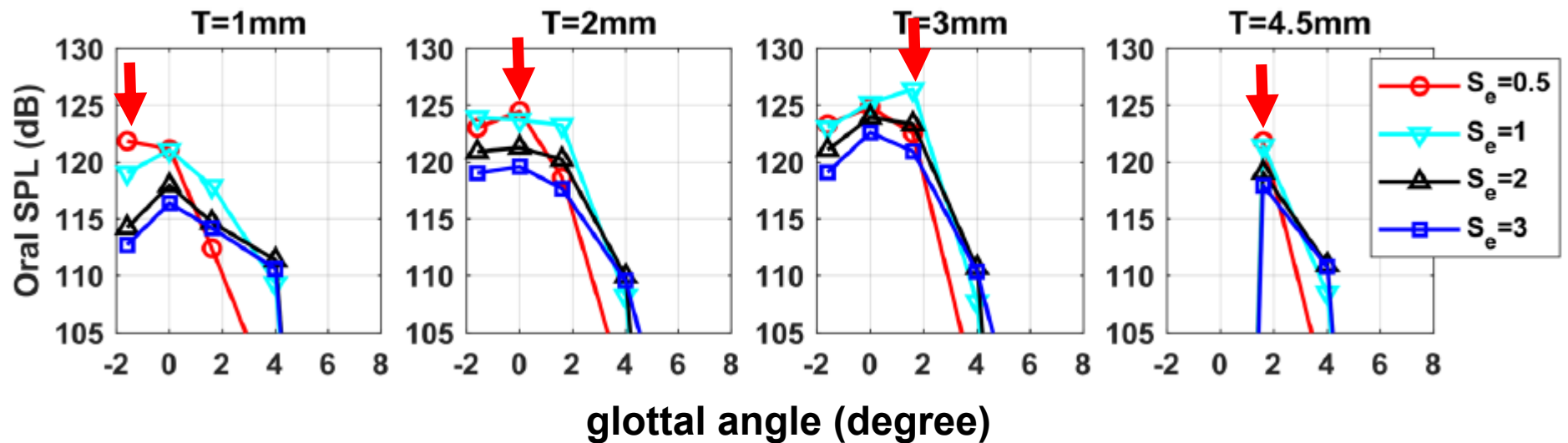
- For each laryngeal-vocal tract configuration, 0.5-second phonation was simulated.
- Oral vibratory sensations were quantified by the oral SPL at a location 8mm behind the lips.
- Peak vocal fold contact pressure when producing a target output SPL:
 - 70 db for /a/
 - 50 dB for /u/
 - 40 dB for /u/ with tube



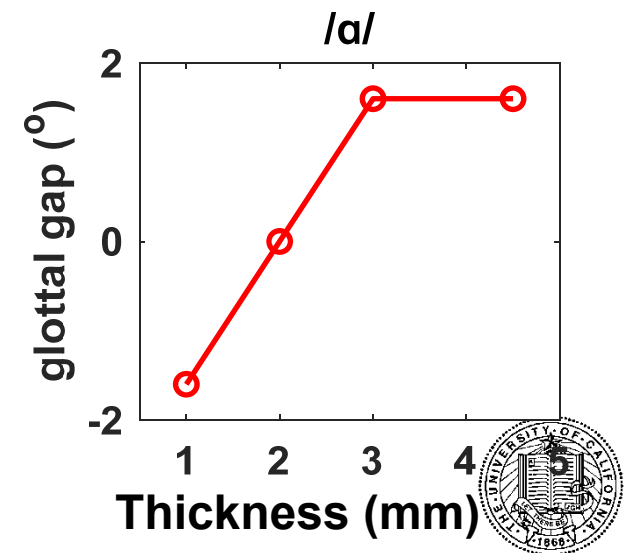
What laryngeal and vocal tract configurations are likely elicited by an emphasis on vibratory sensations?



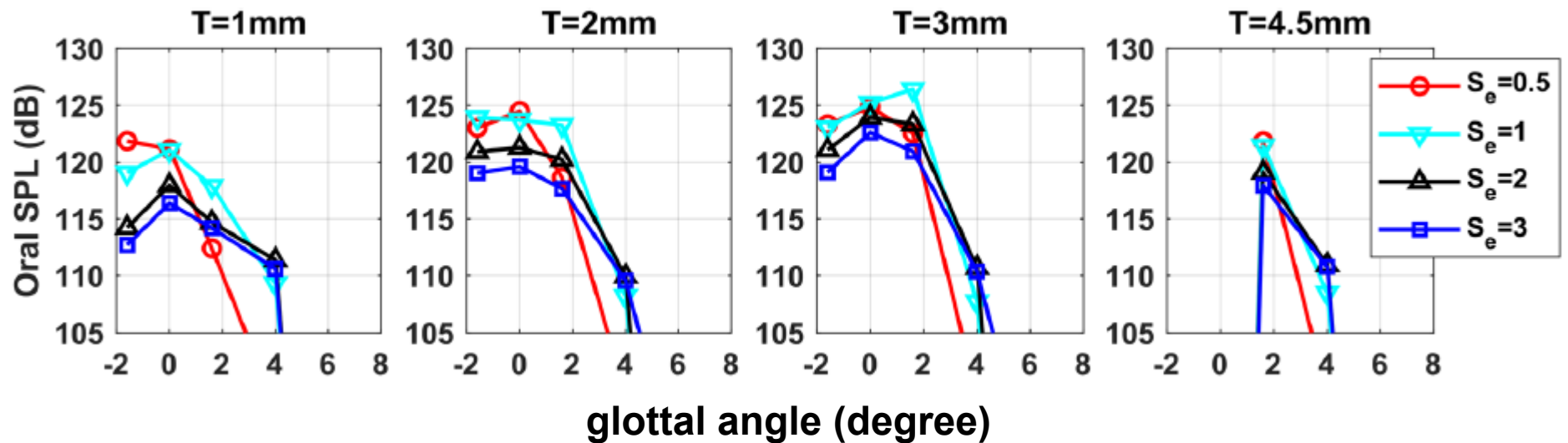
/a/ vocal tract



- Maximal oral SPL occurs at intermediate adduction conditions.
- Trade-off between thickness and glottal gap
 - Tight approximation, thin folds
 - Weak approximation, thick folds
 - Trade off between TA and LCA/IA



/a/ vocal tract



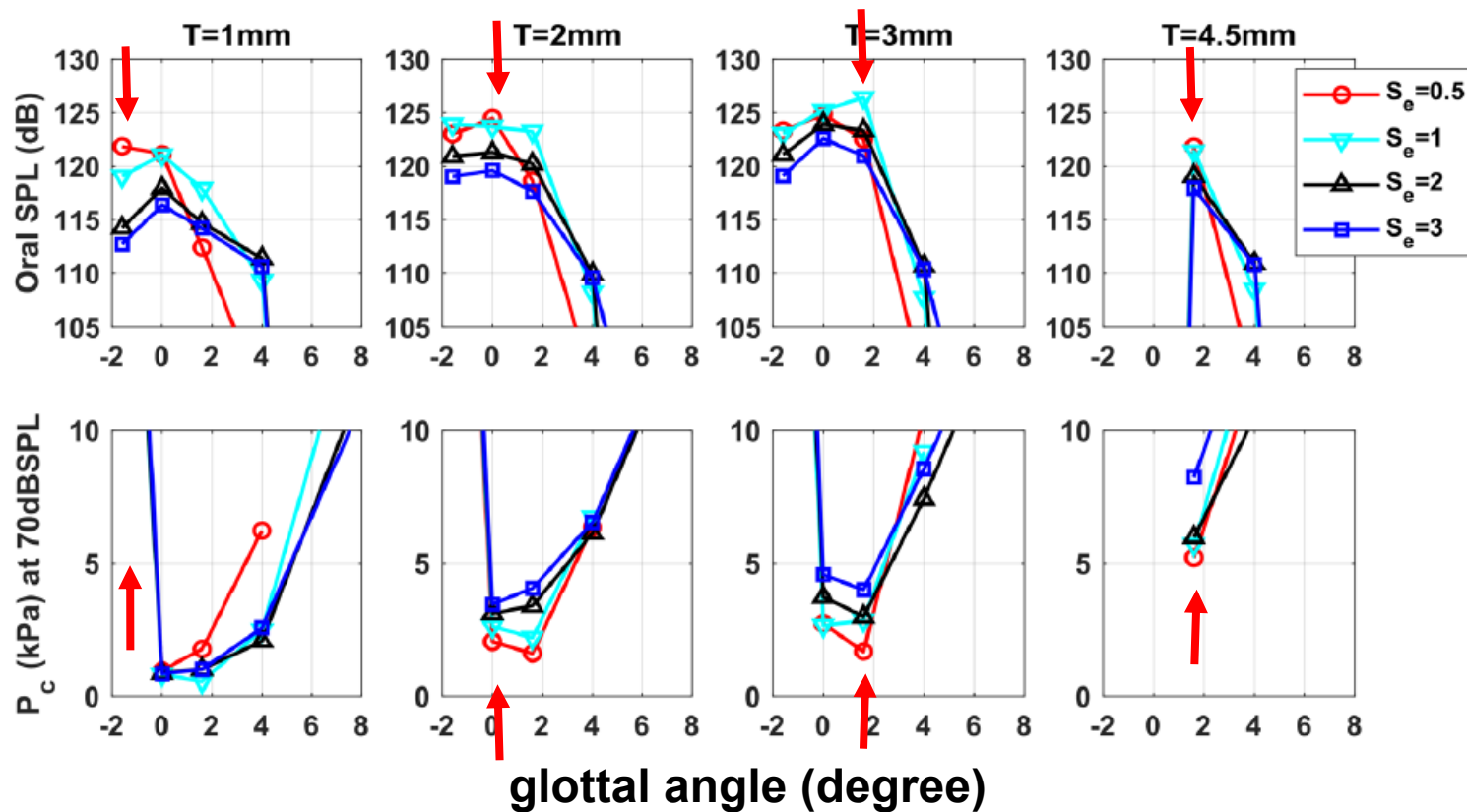
- Maximal oral SPL occurs at **intermediate adduction conditions**.
- **Epilaryngeal tube narrowing increases oral SPL.**



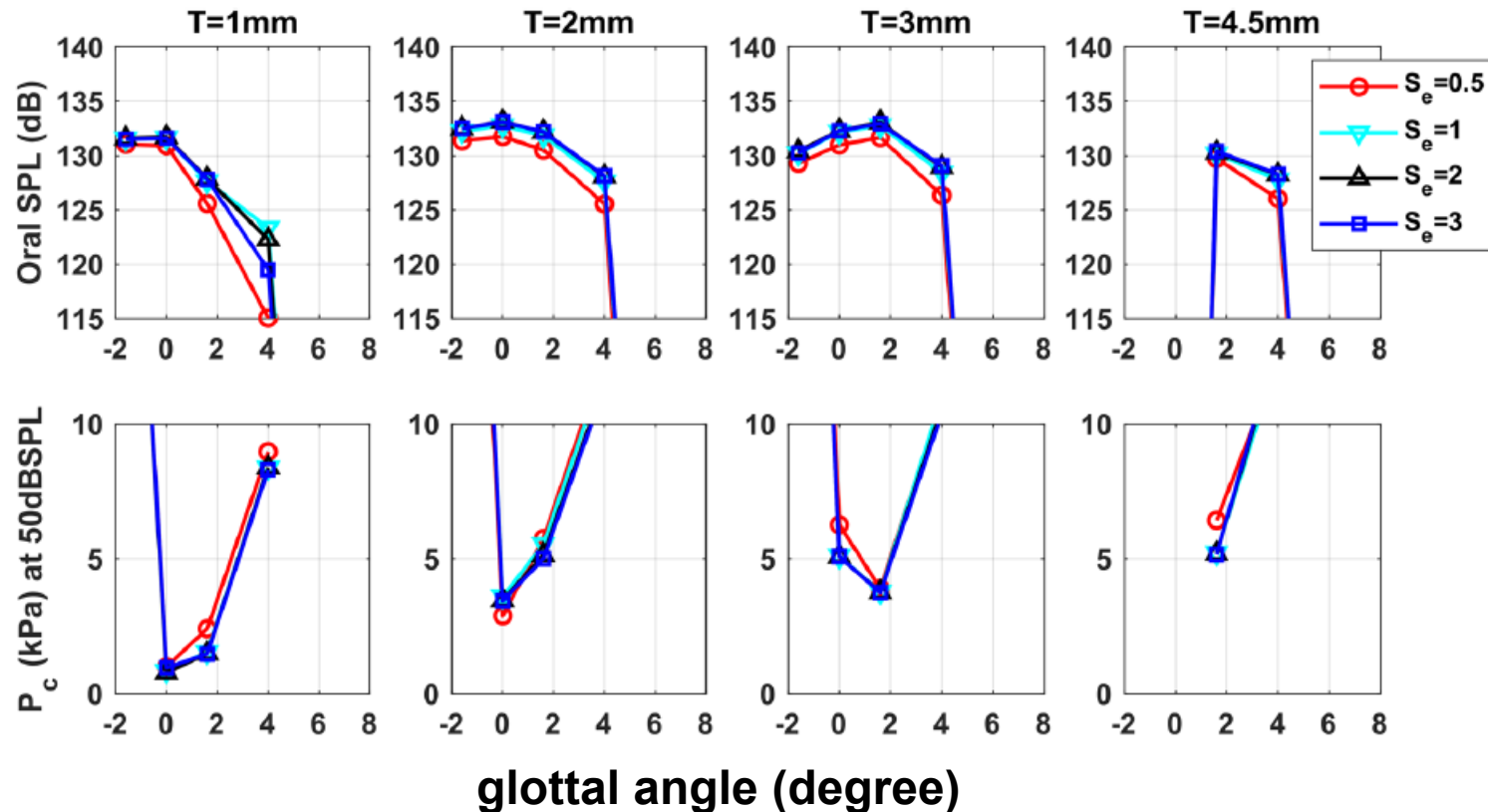
Are these configurations associated with reduced vocal fold contact pressure when producing a target output SPL?



Configurations producing maximal oral SPL often have reduced vocal fold contact pressure when producing a target output SPL.



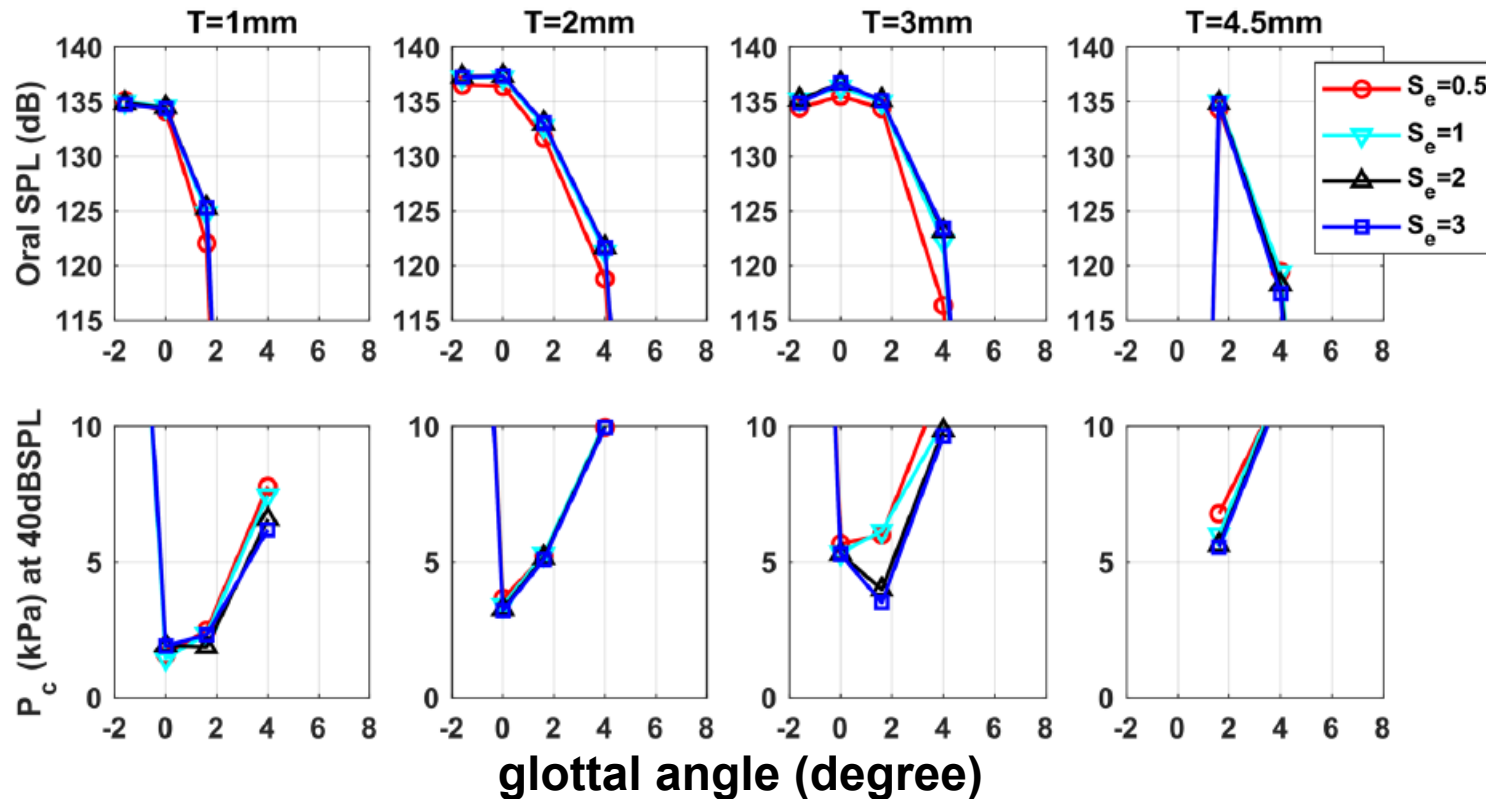
/u/ vocal tract



- Intermediate adduction conditions
- Epilaryngeal manipulation has much reduced or even reversed effect on oral SPL.



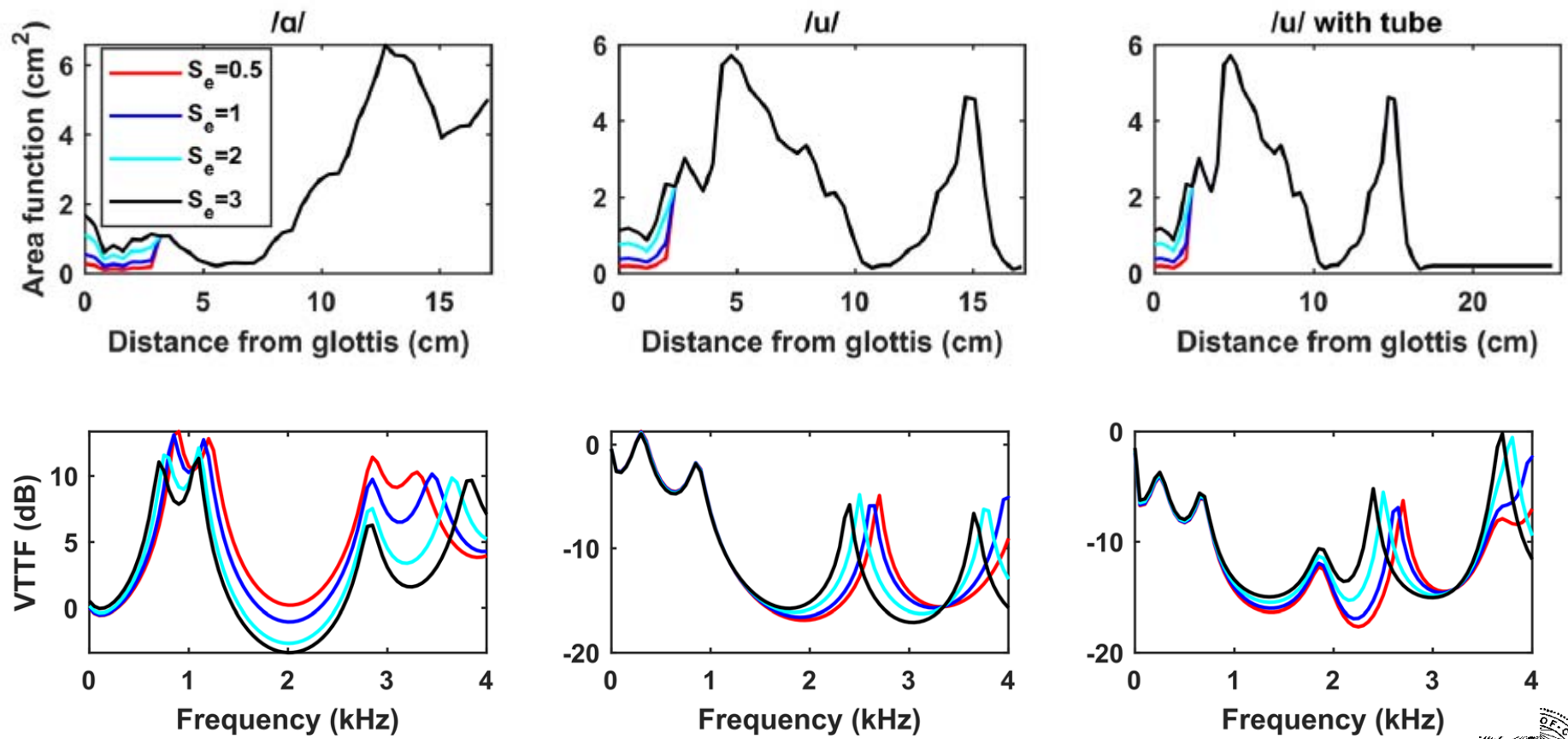
/u/ vocal tract with a tube



- Intermediate adduction conditions
- Epilaryngeal manipulation has much reduced or even reversed effect on oral SPL.

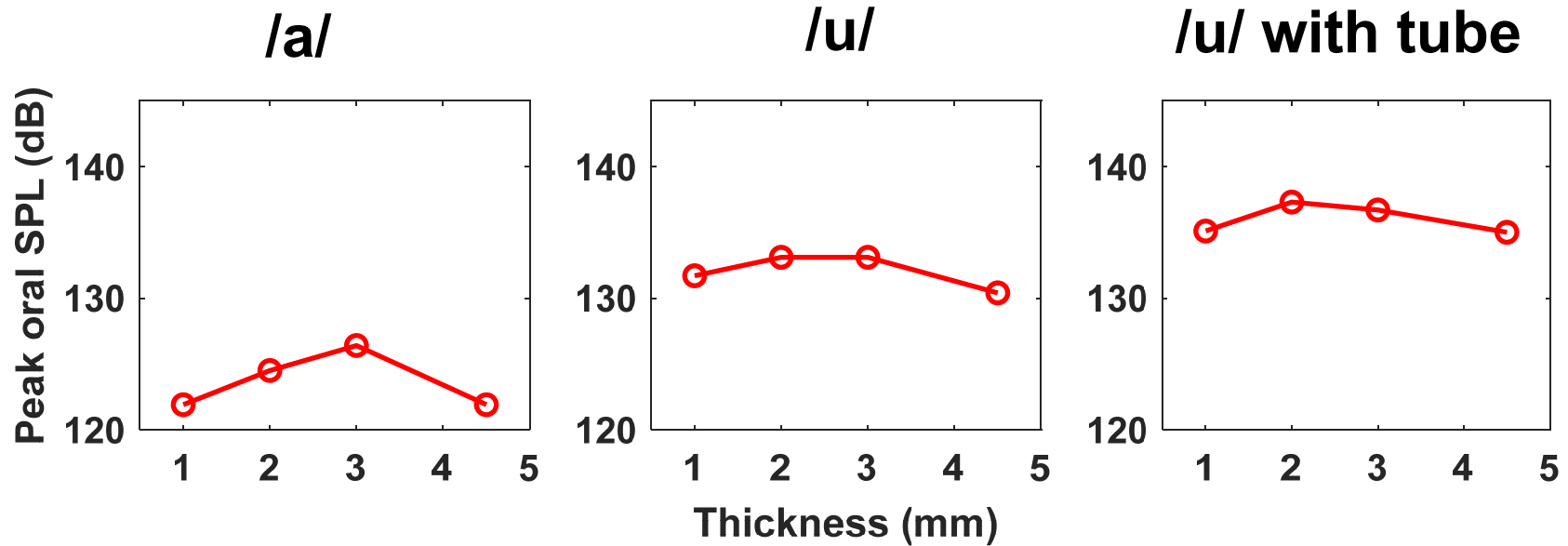


For semi-occluded vocal tracts: epilaryngeal manipulation has little effect on first formant



Does semi-occlusion at the lips make it easier for speakers to identify these favorable configurations compared to vocal tracts without semi-occlusion?

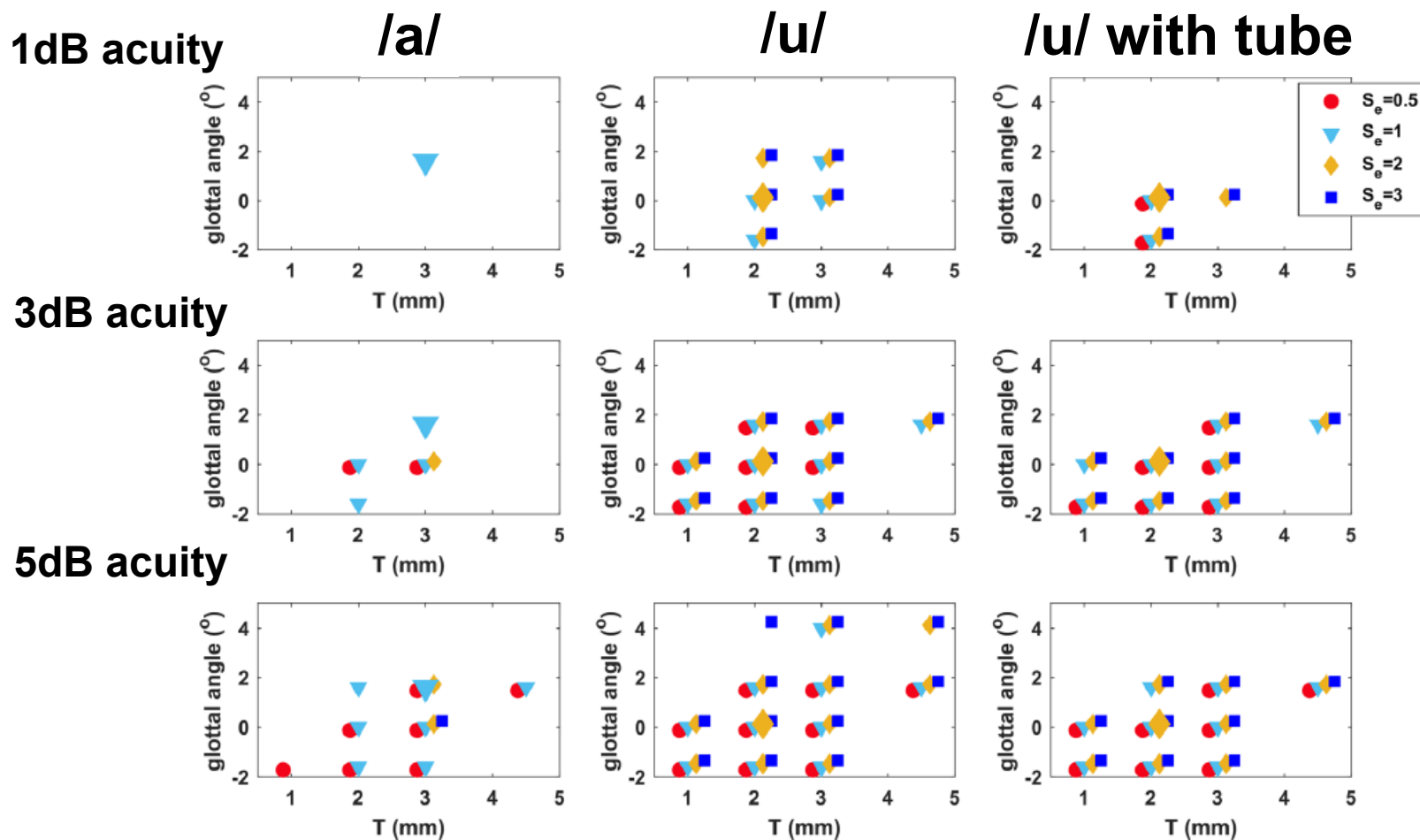




- Semi-occlusion significantly increases overall oral SPL, making it easier to perceive an increased vibratory sensations.
- Semi-occlusion leads to smaller variation in oral SPL across laryngeal conditions, making it difficult to identify favorable conditions.



Conditions producing an oral SPL within a given decibel range of the overall maximum oral SPL



The /a/ vocal tract has the fewest conditions identified, thus is the easiest for speakers to identify and adopt the most favorable configurations.



Summary

- Emphasis on maximizing oral SPL or vibratory sensations will lead to intermediate adduction conditions that are neither too tight nor too open, with a trade off between glottal gap and vertical thickness.
- Open vocal tract facilitates epilaryngeal narrowing, but semi-occlusion does not facilitate any consistent epilaryngeal changes.
- These configurations generally have a lower peak vocal fold contact pressure when producing a target output SPL.
- Semi-occlusion at the lips does not facilitate identification of favorable laryngeal conditions any more than open vocal tracts.
- Semi-occlusion does significantly increase both the mean oral pressure and oral SPL. This may familiarize speakers with oral vibratory sensations, increase their acuity to sensation, thus allowing them to better adopt favorable laryngeal configurations.

Zhang, Z. (2022). Oral vibratory sensations during voice production at different laryngeal and semi-occluded vocal tract configurations, *J. Acoust. Soc. Am.*, 152, 302-312.

