

Background

Hearing loss has been associated with

- atypical patterns of nasality [1–4]
- differences in coarticulation [5]

but extensive individual differences often observed.

Differences may remain after receiving a cochlear implant.

In past work [6,7] obtained different results patterns for word- and segment-level measures of nasalance; thus the analysis time frame is an important variable.

Current Goals:

- Compare nasalance patterns over subsegmental time windows in children with CIs and normally-hearing [NH] peers
- Assess variability in nasal coarticulation across speakers

Participants

Partic ID	Age	H-Aids	Age of implant.	Partic ID	Age
CIF1_5	5;10	no	24 mo	NHF11_6	6;0
CIM3_4	5;1	no	24 mo	NHM7_4	5;4
CIM5_6	6;5	no	24 mo	NHM8_6	6;4

Stimuli and Elicitation

- Picture-naming task
- 5 repetitions per word
- Target words with target medial consonants

Orthography	IPA	English Gloss
τόπος	'topos	'place'
τόμος	'tomos	'volume' (of book)
τόνος	'tonos	'tuna'
τούμπα	'tu ^m ba	'somersault'

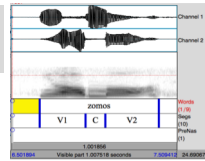
- /b/ can be prenasalized

Data & Processing

Data collected using Kay Elemetrics [now Pentax] nasometer
Oral and nasal microphones yield two signals
Nasometer software

- Imposes low-pass filtering
- Yields nasalance ratio (nasal/oral + nasal energy)

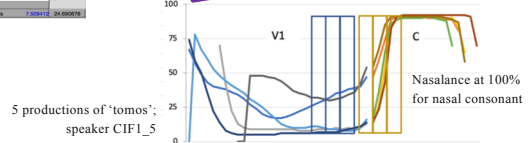
Low-frequency information used to demarcate segments in Praat



Time-varying nasalance extracted: V1, C, V2
To assess coarticulation:
Measure 24-ms windows at segment margins.

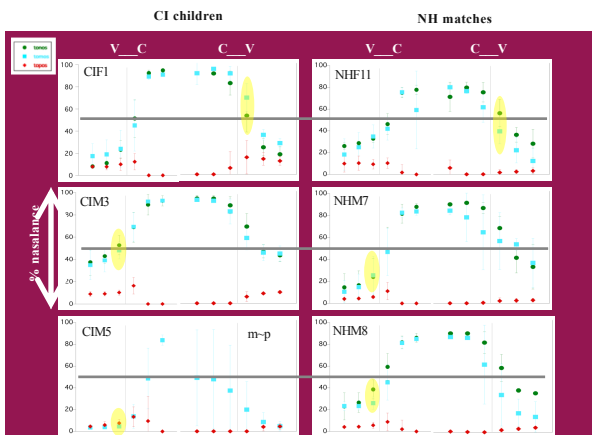
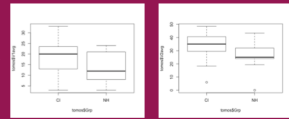
Example:

end of V1 beginning of C



Results: Oral vs. Nasal Cs

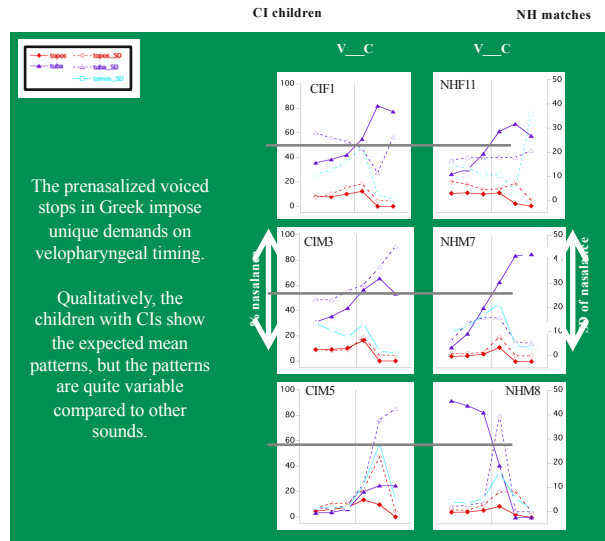
Averaging over segment and group, the children with CIs seem to show more extreme nasal coarticulation...
but that's not the case.



Comparing CI to NH:
More nasality or less? It depends.
Anticipatory and carryover coarticulation may show different patterns.

Results: /p/ vs. /m^b/

three 24-ms time windows per segment; showing means patterns and standard deviations



The prenasalized voiced stops in Greek impose unique demands on velopharyngeal timing.

Qualitatively, the children with CIs show the expected mean patterns, but the patterns are quite variable compared to other sounds.

- Speaker-specific patterns: Group statistics don't characterize individual children
- Carryover nasality tends to be higher than anticipatory for all speakers
- Some CI children show slight nasality in V2 following /p/
- Variability may differentiate groups as much as average patterns

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[2] Fletcher S, Mahfuzh F, Hendarmin H. (1999). Nasalance in the speech of children with normal hearing and children with hearing loss. *American Journal of Speech-Language Pathology*, 8, 241–248.
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[4] Nguyen, L. H. (2008). Effect of cochlear implantation on nasality in children. *Ear, Nose & Throat Journal*, 87, 138–143.
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[6] Okalidou, A., Koenig, L. L., & Pallas, G. (2017). *Nasality patterns in word productions of children with cochlear implants: Evidence from Greek*. Paper presented at the Poster presented at the 173rd Meeting of the Acoustical Society of America and the 8th Forum Acusticum, Boston, MA, May.
[7] Koenig, L. L., Okalidou, A., & Pallas, G. (2019). Velopharyngeal control for speech in children with cochlear implants: Nasalance data in Greek VCV disyllables. *Proceedings of Meetings on Acoustics*, 35(1), 060004.

Stay tuned!

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