1pSCb3:Building a Multilingual Ultrasound Corpus

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Background

Vision, Principles, Current Languages

Vision: Create a "Languages of the World" ultrasound corpus.

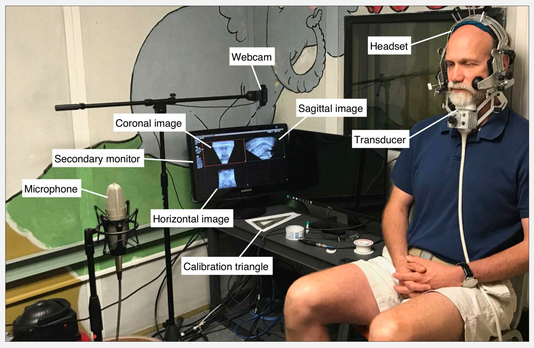
Principles: Coverage, Access, Service

- **Coverage:** ALAP (as many languages as possible); more data is best, some better than none.
- **Access:** whenever possible and appropriate: Open Access, publicly-available, help teach people how to work with their own data
- **Service:** Actively pursue making data useable by speaker communities.

Current Languages				
Arabic[1]	Gengbe[4]	Kannada	Russian	Western Yugur[11]
Basque	Gua[5]	Korean[6]	Taiwanese Mandarin8	Wolof[12]
Brazilian Portuguese[2]	Hakha Chin	Marathi	Tamil	upcoming: Japanese
Bengali	Hindi	Mauritian[7]	Telugu	upcoming: Lautu
Chatino[3]	Hungarian	Polish	Turkish[9]	upcoming: Yoruba
English	Igbo	Rukiga	Uyghur[10]	upcoming: Zophei

Collaborators: [1]Noor Abo Mokh, Abdullah Alfaifi, Sarah Robinson; [2]Sherman Charles: [3]Hilaria Cruz, Colette Feehan; [4]Samson Lotven; [5]Samantha Myers, Michael Obiri Yeboah; [6]Young Hwang; [7]Fabiola Henri, Samantha Myers; [8]Kuan Yi Chao, Young Hwang; [9]Sherman Charles, Öner Özçelik; [10]Mustafa Aksu; [11]Xueqing Zhong; [12]Khadija Tamba.

Technology and Methods



Palate Impressions made using dental alginate & digitized with a NextEngine 3D laser scanner; data were saved in binary STL format.

Ultrasound Recordings

- Philips EPIQ 7G system, xMatrix x6-1 digital 3D/4D transducer secured under chin w/ Articulate Instruments ultrasound stabilization headset.
- Recording rates: btwn ~12 & 22 volumes per second (higher rates possible for smaller volumes).

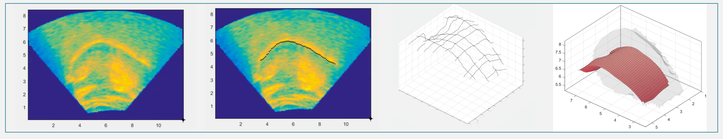
Joint Palate-Ultrasound Analysis

- Fully uncompressed DICOM ultrasound files transferred to a Windows 7 computer
- Ultrasound/palate files analyzed w/ a custom MATLAB toolbox.
- Palate manually rotated/translated to align w/ tongue data.

Audio Recordings: a SHURE KSM microphone, 48kHz sampling rate.

Audio-Ultrasound Synchronization

- Audio and ultrasound recordings begun and ended by pressing a foot pedal connected to both the ultrasound system and the Windows computer.



Coronal Contrasts in San Juan Quiahije Chatino

H. Cruz, M. Cavar, M. Nelson, K. Berkson

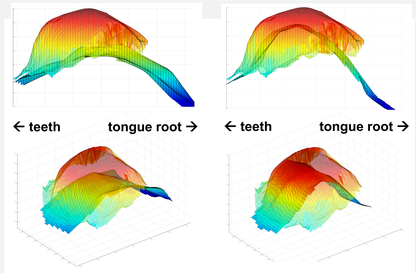
Focus: apico-dentals vs. **lamino-alveolars?**

- Chatino is a group of under-documented indigenous languages spoken in Oaxaca, Mexico[1 2 3 4 5]

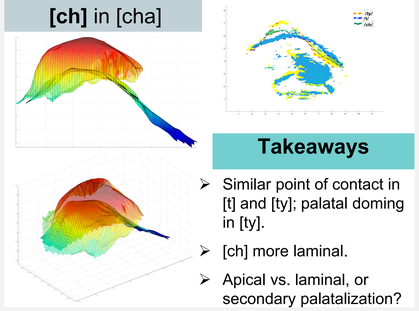
- Appr. 17 varieties (Otomanguean, Zapotecan), noted for contrasting two series of coronals.
- Historically: Alveolars palatalized after [i] in Proto-Chatino but became distinct phonemes in most varieties.[6]
- Current focus: San Juan Quiahije (SJQ) Chatino[1 2 3]
- Coronals described by Boas (1913) as dentals and palatalized dentals[5], but by others—and consistently, for SJQ—as apico-dentals and lamino-alveolars[1 2 3]

Our aim: generate 3D imaging of these sounds to better understand the articulations involved in these contrasts.

[t] in [ta] **[ty]** in [tya]



[ch] in [cha]



Takeaways

- Similar point of contact in [t] and [ty]; palatal doming in [ty].
- [ch] more laminal.
- Apical vs. laminal, or secondary palatalization?

[1] Cruz, E. 2011. Phonology, tone, and the functions of tone in San Juan Quiahije Chatino. PhD diss., UT Austin. **[2] Cruz, H.** (2015). Linguistic poetic and rhetoric of Eastern Chatino of San Juan Quiahije. PhD diss., UT Austin. **[3] Cruz, E., & Woodbury, A. C.** (2014). Finding a way into a family of tone languages: The story and methods of the Chatino Language Documentation Project. LDC 8: pps 490-524. **[4] McIntosh, J. D.** (2011). Grammatical sketch of Teotepec Chatino.https://repositories.lib.utexas.edu /handle/2152/ETD-UT-2011-05-3026 **[5] Boas, F.** (1913). Notes on the Chatino language of Mexico. American Anthropologist, 15(1), 78-86. **[6] Campbell, E.** (2013). The Internal Diversification and Subgrouping Of Chatino 1. IJAL, 79(3), 395-420.

Dorsal Consonants in Arabic

N. Abo Mokh, A. Alfaifi, S. Robinson, S. Charles, S. Lulich, K. De Jong

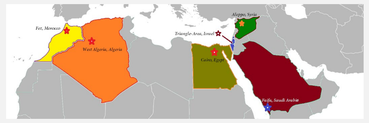
Focus: apico-dentals vs. **lamino-alveolars?**

- POA of the dorsal fricative contested: different reports for different dialects.

	Pal.	Velar	Uv.	Phar.
		k	q	
	ʃ	x ɣ	ħ	ʕ
	j	w		

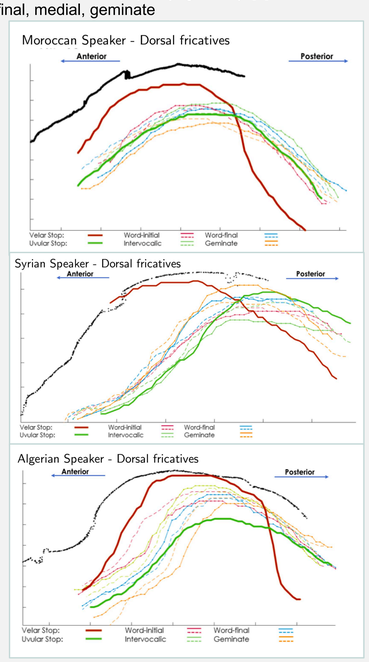
Dialect	Voiceless Dorsal Fricative PoA	Source
Algiers (Algeria)	Uvular	Grand'Henry (2006)
Anatolian (Turkey)	Velar	Jastrow (2006)
Baghdadi (Iraq)	Velar	Abu-Haidar (2006)
Bahraini (Bahrain)	Velar	Holes (2006)
Cairene (Egypt)	Velar	Woidich (2006)
Jordanian (Jordan)	Velar	Al-Wer (2008)
Lebanese (Lebanon)	Velar	Feghali (1999)
Meccan (Saudi Arabia)	Uvular	Abu-Mansour (2008)
Modern Standard Arabic	Velar Post-velar Uvular	McCarus (2008) Bearman, Donzel, & Lewis (1997) Saiegh–Haddad (2003)
Moroccan (Morocco)	Velar	Caubet (2008)
Najdi (Saudi Arabia)	Velar Uvular	Abboud (1978) Ingham (2008)
Palestinian (Palestine)	Uvular	Shahin (2008)
San'ani Arabic (Yemen)	Velar/post-velar	Watson (2002)

Six native speakers of Arabic:



2D Mid-sagittal imaging to compare:

- dorsal fricative **/x/** with reference points (palatal **/j/**, velar **/k/**, uvular **/q/**, pharyngeal **/ʕ/**). [a] context; initial, final, medial, geminate



Tongue Root Contrasts in Gua

S. Myers, M. Obiri Yeboah, K. De Jong, K. Berkson

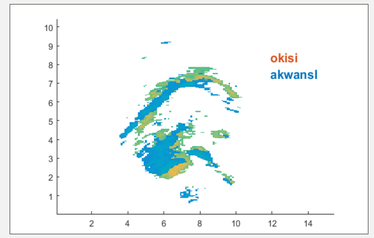
Focus: [±ATR] vowels in Gua

- Gua: Highly under-documented Kwa language (Niger Congo), spoken in coastal Ghana[1,2].
- 9 ~10 vowel system
- [+ATR]: /i e (ɜ) o u/
- [-ATR]: /ɪ ɛ a ɔ ʊ/
- What is the relationship between tongue body height and tongue root advancement?

http://www.freelargeimages.com/map-of-west-africa-695/

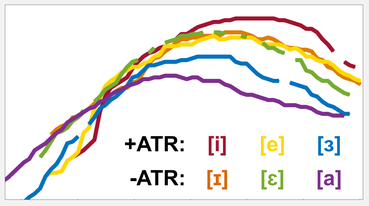
- **What does the coronal plane reveal that the sagittal plane does not?**

Raw Ultrasound Overlay



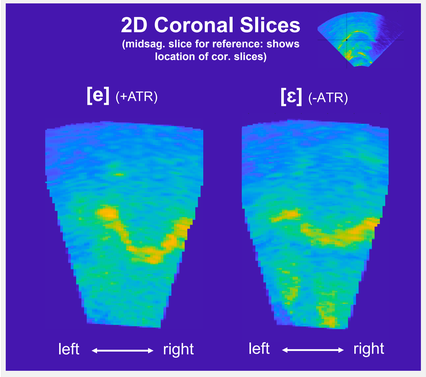
tongue root ⟷ tongue tip

Midsagittal Trace Overlays



2D Coronal Slices

(midsag. slice for reference: shows location of cor. slices)



[1] Simons, G. F., & Fennig, C. D. (2017). *Ethnologue: Languages of the world*. SIL International. **[2] Obiri-Yeboah, M.** (2013). Aspects of Gua (Gwa) Phonology. (Thesis, University of Ghana).

Rhotics in American English

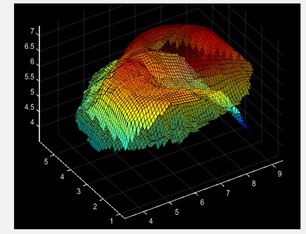
S. Lulich, B. Rhodes, M. Nelson, K. Berkson, K. De Jong,

Focus: /ɹ/ production in American English

- Rhotics in onset/coda before/after [i, ɑ, oʊ̃]
- 2 male & 2 female native speakers of American English
- Three patterns of articulation:

Posterior Groove Pattern (dominant pattern)

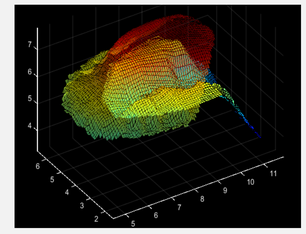
- A (typically) deep groove is produced in the posterior tongue from the dorsum down to the root.
- The anterior dorsum is high in the mouth and "bunched."
- The blade is angled downward toward the floor of the mouth.
- Produced exclusively by male speaker 3354 & female speaker 1921, sometimes by female speaker 1836.



Female speaker 1836: *I said a reap again.*

Full Groove Pattern

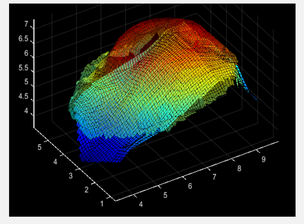
- A (typically) wide groove is produced along the entire length of the tongue (most often excluding the tip).
- Tongue blade and dorsum are relatively low in the mouth.
- Most often, tip is slightly raised (or "retroflexed").
- This pattern is produced exclusively by male speaker 0029.



Male speaker 0029: *I said a par again.*

Posterior Arch Pattern

- Rather than producing a groove, the tongue dorsum is arched and retracted.
- Tip/blade are low, resting on the floor of the mouth.
- This pattern is sometimes produced by female speaker 1836.



Female speaker 1836: *I said a reap again.*