Cross-language mapping for small-vocabulary ASR in under-resourced languages: Investigating the impact of source language choice

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Outline

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Small-vocabulary recognition: Why & how

Cross-language pronunciation mapping

- The Salaam method (Qiao et al. 2010)

Our contribution: Impact of source language choice

- Data & method
- Experimental results
- Conclusions

Ongoing & future work

Small-vocabulary recognition: Why & how

Goal: Enable non-experts to quickly develop basic speech-driven applications in any Under-Resourced Language (URL)

- Training/adapting recognizer takes data, expertise
- Many applications use $\leq$100 terms (e.g. Bali et al. 2013)

Strategy: Use **existing** HRL recognizer for small-vocab recognition in URLs (Sherwani 2009; Qiao et al. 2010)

Key: Mapped pronunciation lexicon

Terms in target lg. (URL) → Pronunciations in source lg. (HRL)

Yoruba			English
igba	i͡gba	→	igbə | ibə | ...?

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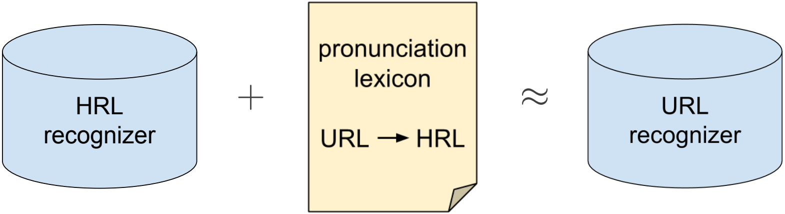

Cross-language pronunciation mapping

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The Salaam Method (Qiao et al. 2010)

- Requires $\geq$1 sample per term (a few minutes of audio)
- Mimics phone decoding
- "Super-wildcard" recognition grammar:

$$\textit{term} \rightarrow \{*| **| ***\}_0^{10}$$

(∗ = any source-language phoneme)

- Iterative training algorithm finds confidence-ranked matches

igba → ibæə, ibɹə, ibɛə, ...

- Accuracy: ≈80-98% for $\leq$50 terms

Impact of source language choice

Hypothesis

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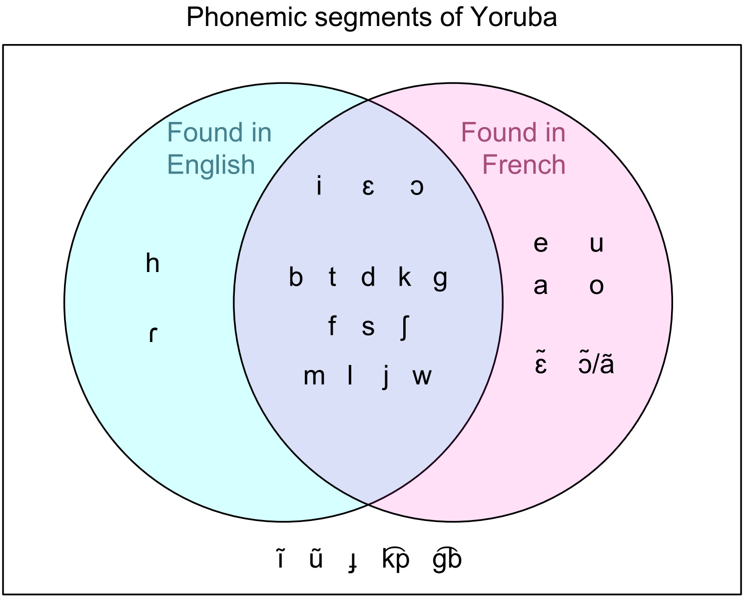
Experiment

- Target language: Yoruba
- Source languages: English (US), French (France)


Phonemic segments of Yoruba
Found in English
Found in French
h
ɾ
i ɛ ɔ
b t d k g
f s ʃ
m l j w
e u
a o
ɛ̃ ɔ̃/ã
ĩ ũ ɟ k͡p g͡b

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Data

- 25 Yoruba terms (subset of Qiao et al. 2010 dataset)
- 5 samples/term from 2 speakers (1 male, 1 female)
- Telephone quality (8 kHz)

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Method

- Generate Fr./En. lexicons with Salaam (Qiao et al. 2010)
  - Microsoft Speech Platform (msdn.microsoft.com/library/hh361572)
  - 1, 3, and 5 pronunciations per term

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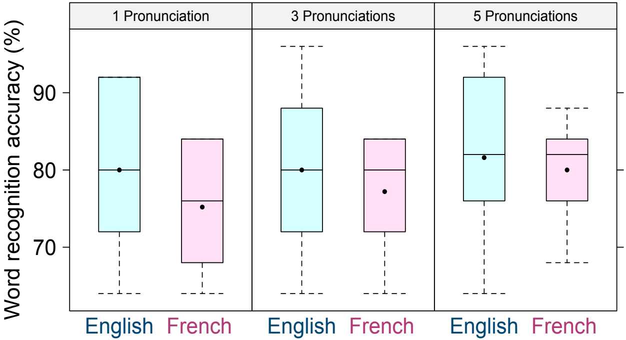
Method

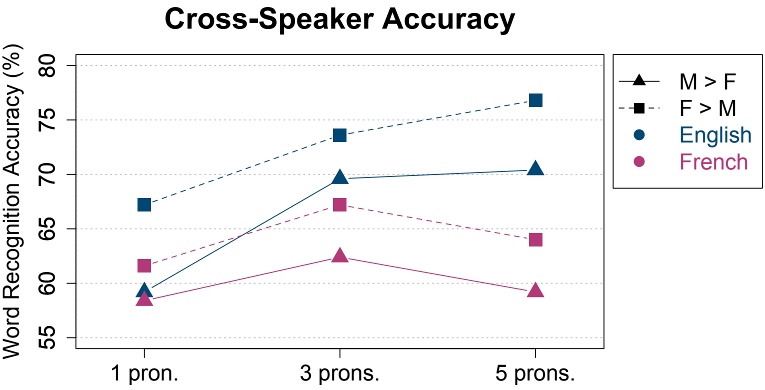
- Generate Fr./En. lexicons with Salaam (Qiao et al. 2010)
  - Microsoft Speech Platform (msdn.microsoft.com/library/hh361572)
  - 1, 3, and 5 pronunciations per term
- Compare mean word recognition accuracy
  - Same-speaker: Leave-one-out
  - Cross-speaker: Train M > Test F; F>M
  - *t*-tests for significance ($\alpha = 0.05$)

Same-speaker accuracy



1 Pronunciation		3 Pronunciations		5 Pronunciations	
80.0	75.2	80.0	77.2	81.6	80.0
$p = 0.20$		$p = 0.34$		$p = 0.59$	

Results



En. mean	63.2	71.6	73.6
Fr. mean	60.0	64.8	61.6
p (* $\leq$ .05)	0.41	0.04*	0.04*

Results

Accuracy by word type (**nasal**)

	English	French
Best	duro	ogba
	ogba	iba
	shii	mejo
	ogoji	ogoji
	mesan	**lehin**
	beeni	**tunse**
	⋮	⋮
	iba	**mesan**
	igba	**ookan**
	ogorun	**sun**
	meta	meji
	sun	bere
Worst	meji	igba

Conclusions

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Predicted: French accuracy $>$ English accuracy
Observed: French accuracy $\leq$ English accuracy

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- Better metric needed for evaluating source-target match

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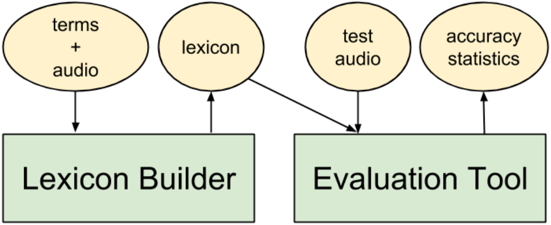
Possible explanations:

- Source languages may be too similar w.r.t. target language
- Better metric needed for evaluating source-target match
- Baseline recognizer accuracy may play a role

Ongoing & future work

lex4all: Pronunciation **Lex**icons **for A**ny **L**ow-resource **L**anguage (Vakil et al. 2014)



`http://lex4all.github.io/lex4all`

Planned experiments:

- More source-target language pairs
- Discriminative training (Chan and Rosenfeld 2012)
- Algorithm modifications

References

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- A. Vakil, M. Paulus, A. Palmer, and M. Regneri. "lex4all: A language-independent tool for building and evaluating pronunciation lexicons for small-vocabulary speech recognition". In: *ACL 2014: System Demonstrations*. 2014.

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