

## Introduction

- What are the perceptual cues to coda voicing?

In addition to voicing during the constriction, influences on perceived voicing include preceding vowel duration (Raphael 1972), F1 and transition duration (Summers 1988), and F0 (Gruenenfelder & Pisoni 1980), among others

- Are cues to voicing language-specific?

There are some language-specific differences in the realization of these correlates (e.g. Chen 1970)  
Native language also influences what cues listeners use for voicing (e.g. Crowther & Mann 1992)

### This study:

- Three experiments on coda stop identification, with the major cues to voicing removed or obscured
- Native English listeners are significantly better than chance at identifying coda place and voicing based only on the vowel
- Higher accuracy with English stimuli than Hindi or Telugu stimuli, suggesting language-specific differences in the realization of voicing as well as listeners' expectations of those realizations

## Methodology

- Participants (24 native English listeners) heard VC nonce words and decided which of two written items matched the auditory stimulus

- Characteristics of the stimuli:

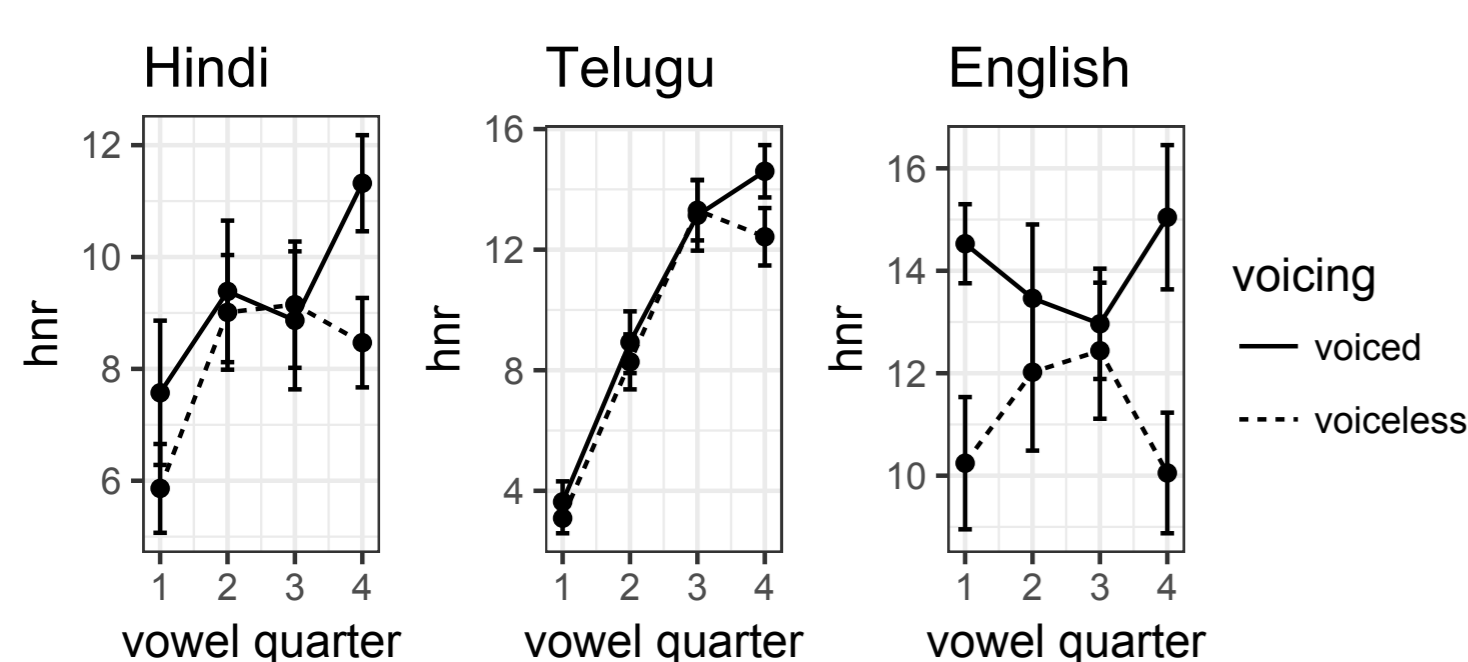
Produced with final stops; the closure, release, and most of the transition was removed (piloted to target 75% accuracy for place)  
Vowels were manipulated to have 2 durations (230 ms, 160 ms)

Half of trials tested voicing contrasts, and half tested place contrasts

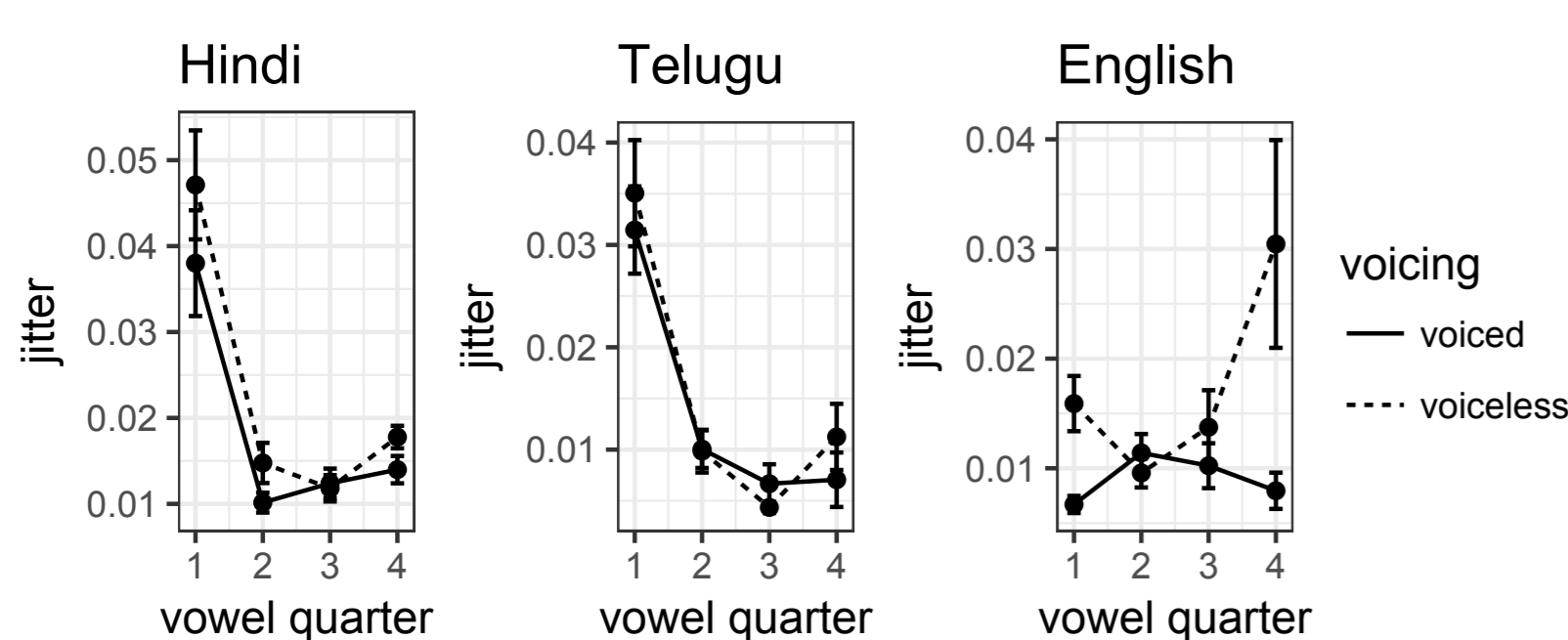
Three blocks (in randomized order), differing only in the speaker's L1: (a) English; (b) Hindi; (c) Telugu

## Acoustic Characteristics

**Figure 1:** HNR by coda voicing and language of the stimuli



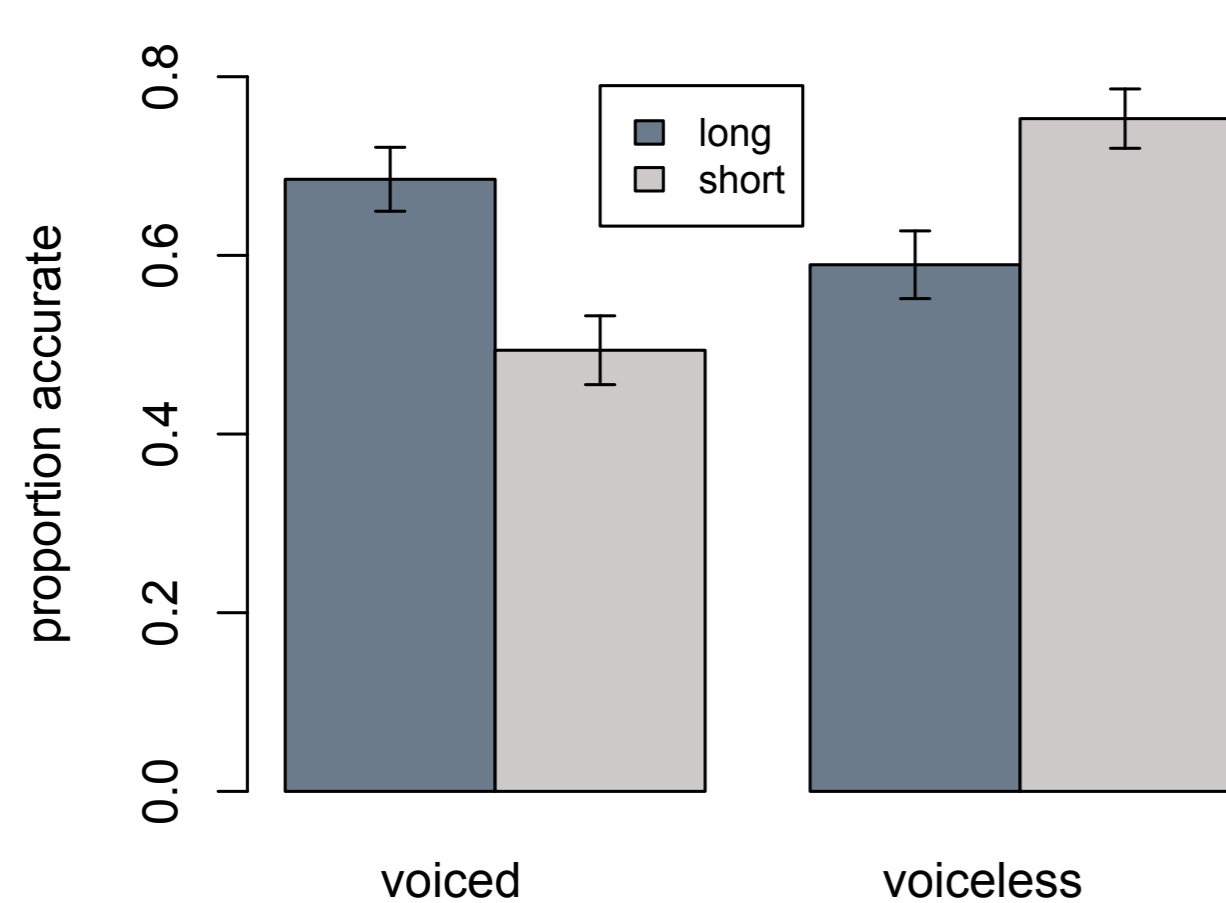
**Figure 2:** Jitter by coda voicing and language of the stimuli



There are large differences between voiced and voiceless environments in the English stimuli in HNR and jitter (Figs. 1 & 2)

Other correlates of voicing (F1, F0, spectral tilt) were weaker and exhibited less difference across the three languages

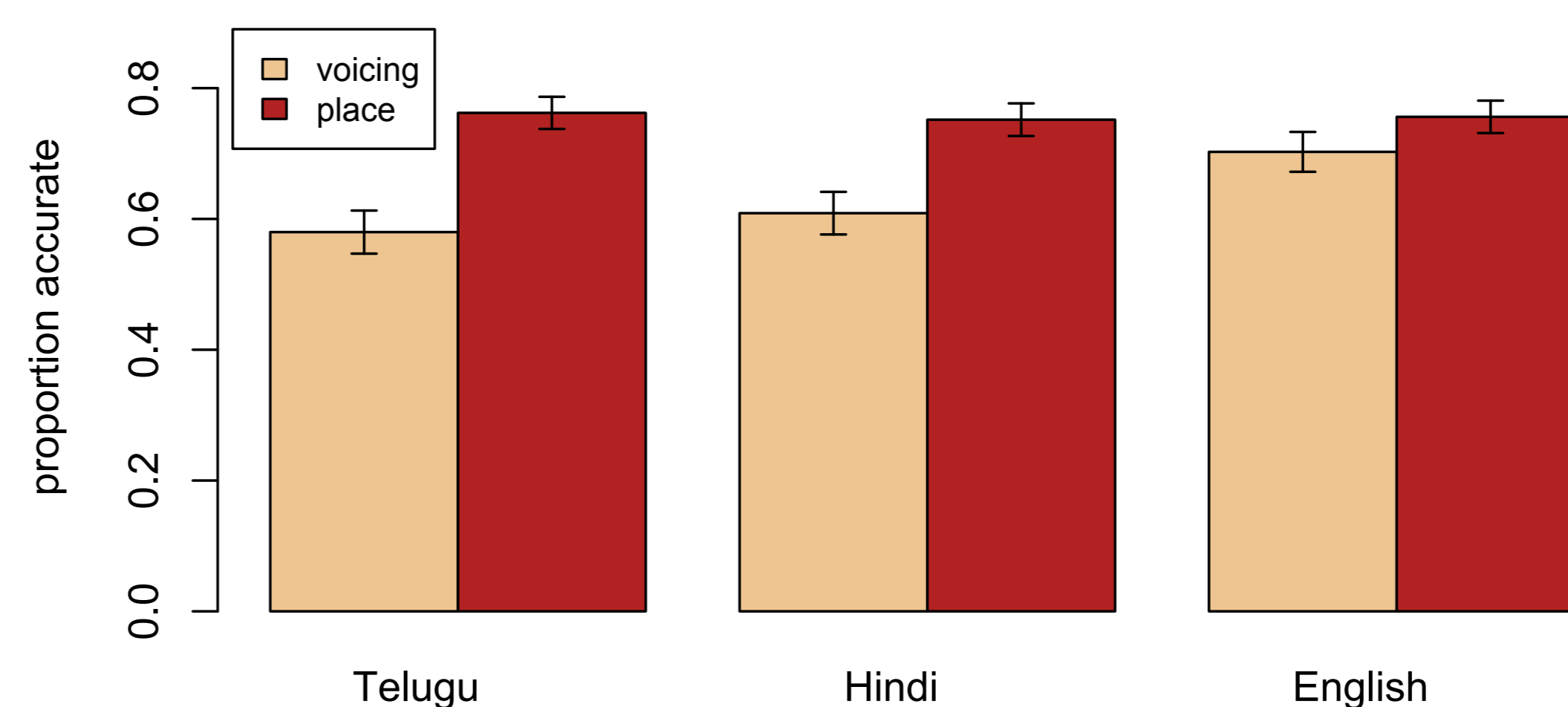
## Effects of Duration



**Figure 4:** Voicing decisions by vowel duration

Across language conditions, short vowels were more often identified as having voiceless codas  
The actual voicing of the original coda had a larger effect when the vowel was long

## Main Perception Results



**Figure 3:** Accuracy by language for decisions about voicing and place

Stimuli were designed to elicit similar accuracy for place across language conditions; there was no significant difference in accuracy for place of articulation based on the language of the stimuli  
However, accuracy for voicing contrasts was significantly higher for the English stimuli than for stimuli from Hindi or Telugu ( $p < 0.001$ )

## Accuracy by Voicing

Listeners more often identified codas as voiceless than as voiced

No consistent difference in place identification accuracy based on coda voicing

**Table 1:** Accuracy by coda voicing and decision type

	Voicing decisions		Place decisions	
	voiced coda	voiceless coda	voiced coda	voiceless coda
Telugu	54%	62%	76%	77%
Hindi	58%	63%	76%	74%
English	64%	76%	79%	73%

## Conclusions

- Realizations of coda voicing differ by language; in particular, jitter and HNR in the preceding vowel exhibit a larger effect of coda voicing in English than in Hindi and Telugu
- English listeners are most accurate with stimuli produced by an English speaker, suggesting that they are expecting the set of coda voicing cues typical of English
- Use of these additional characteristics as perceptual cues is consistent with listeners' relatively high accuracy for voicing decisions even when most of the major voicing cues were controlled or obscured
- Flexibility in use of perceptual cues to voicing can reinforce differences in production and may also facilitate shifts from voicing to other contrasts

## References

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