Stop lenition in Canary Islands Spanish – a motion capture study

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1. DATA COLLECTION

- field experiment conducted on Gran Canaria in 2021
- 16 native speakers aged 25-55
- video recordings made with an internet camera for lip movement exploration
- we tested labials /p b/ and their surface realisations ([p b̥ b β β̥])
- 376 sentences with 560 target words
- conditions: **deletion** (VsCV), **no deletion** (VCV), **stressed** (S), **unstressed** (US), **stressed in focus** (SF)
- flanking vowels were always /a/

2. METHOD

- temporal markings and acoustic measurements (Praat)
- lip measurements (custom Python script splitting each participant's video into segments containing VCV / V(s)CV sequences, processed with OpenFace 2.0 face-tracking utility, Baltrušaitis et al. 2018).

3. ASSUMPTIONS

- more lenition in VCV than VsCV contexts
- more lenition in focus, then stressed, then unstressed position
- native speakers either retain /s/ in the form of [h] or delete it in VsCV

4. MEASUREMENTS

- *intensity difference* (V1 maximum intensity – C minimum intensity)
- *vertical lip aperture* calculated as the Euclidean distance between the upper and the lower lip
- *total lip area*
- *vertical lip aperture trajectory* (normalized to 11 time steps via linear interpolation)

INTRODUCTION

Stop lenition in Canary Islands Spanish:

/b d g/ approximantis or delete **(only?)** postvocalically
/p t k/ voice or approximantise **only** postvocalically

→ **What happens after consonants** other that nasals or /l/? /b d g/ are reported to lenite in other dialects of Spanish.

→ obscured by **widespread consonant elisions**

→ **blocking effect** in derived postvocalic positions (after the deletion of a preceding consonant). The percentage of lenited forms in post-deletion contexts is much smaller

→ more lenition in unstressed syllables (Broś et al. 2021)

EXAMPLES

UR	Example	Majority realization	Other realizations
/p/	*la paciencia* 'the patience'	[la.b̥a.ˈsjen.sja]	[la.pa.ˈsjen.sja], [la.ba.ˈsjen.sja], [la.βa.ˈsjen.sja]
/p/	*Las Palmas*	[la.ˈpalmah]	[la.ˈb̥almah], [la.ˈbalmah]
/b/	*la barrera* 'the wall'	[la.βa.ˈre.ra]	[la.βa.ˈre.ra], [la:.ˈre.ra]
/b/	*las vacas* 'the cows'	[la.ˈba.kah]	[la.ˈβa.kah]

EXPERIMENT – SAMPLE SENTENCES

La barrera estaba mal colocada y el portero no veía. **(US)**
'The wall was incorrectly placed and the goalkeeper could not see'
La paciencia de esa mujer me tenía impresionado. **(US)**
'The patience of this woman had me impressed'
La banda de música empezó el concierto con *la bamba*. **(S, SF)**
'The music band started the concert with la bamba'
La paga mensual es *más baja* de lo que pensaba *Paco*. **(S, DEL, SF)**
'The monthly pay is less than what Paco thought'
La vaca de Juan cuesta mucha *pasta*. **(S, SF)**
'Juan's cow costs a lot of money'
Las Vacas Locas es una banda de música de Tenerife. **(DEL)**
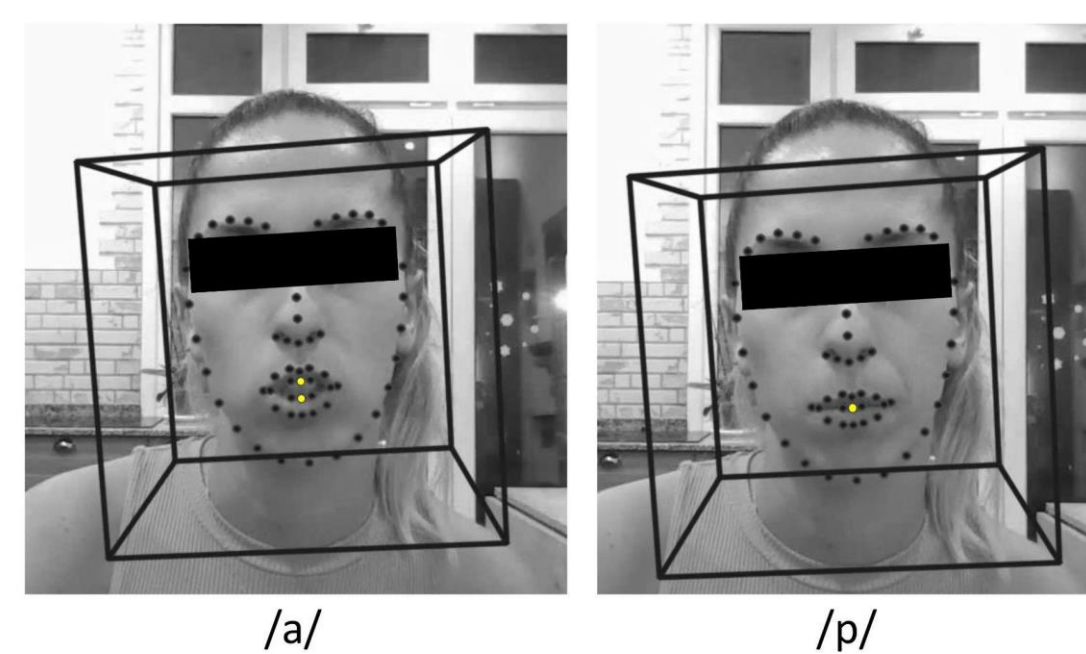'The Mad Cows is a music band from Tenerife'

RESULTS

Figure 1. Two motion-tracked frames depicting the OpenFace key points. These frames were extracted from a real production of the phrase "mucha pasta" in which the obstruent was fully realized. Left: the oral configuration during the /a/ of mucha, Right: the oral configuration during the /p/ of pasta. Parameters 62 and 66 were used to measure lip aperture (highlighted in yellow).

DELETION VS NO DELETION CONTEXTS

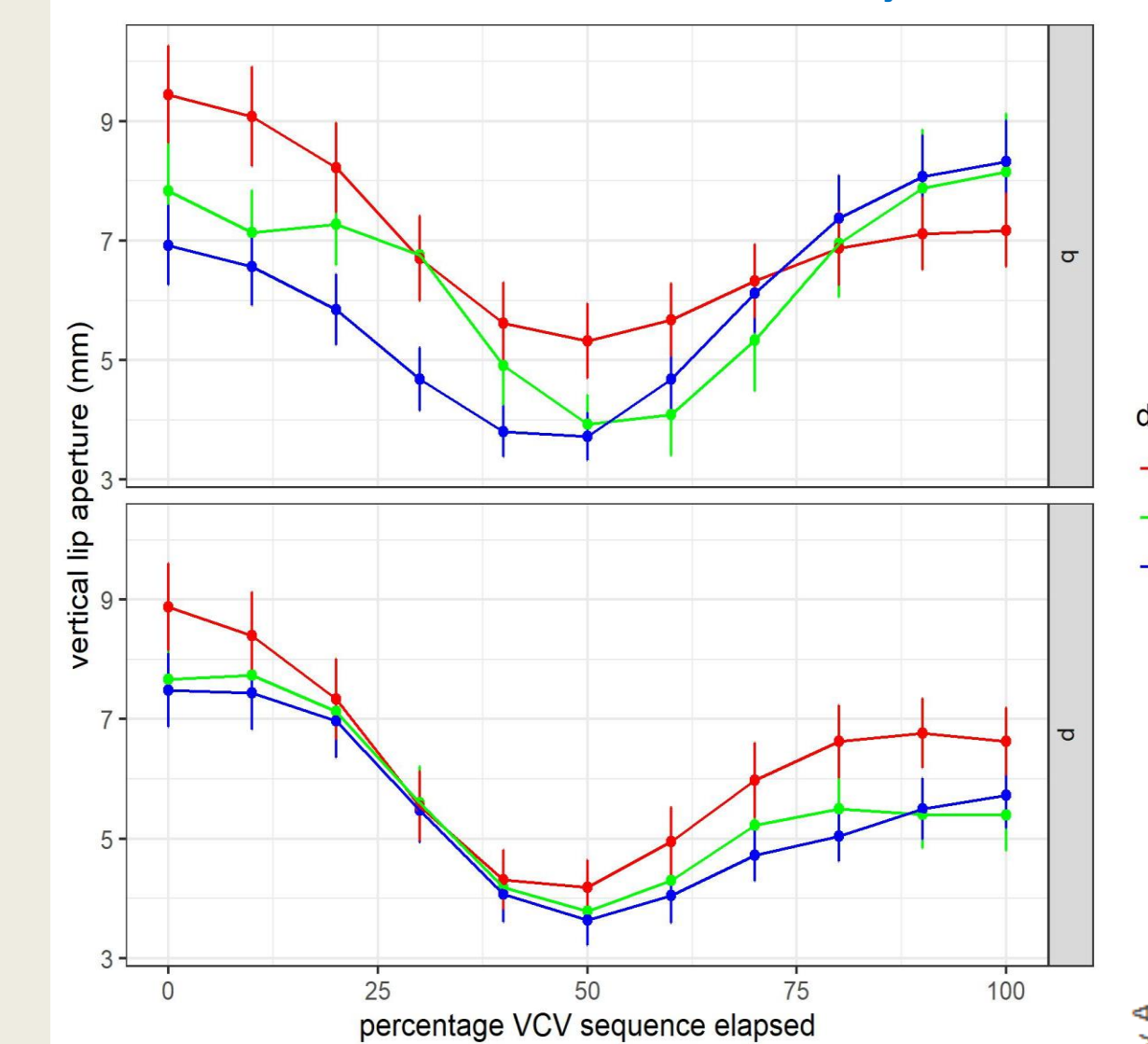#### UNDERLYING VCV, UNDERLYING VsCV AND DERIVED VCV

Figure 2. Graph of vertical lip aperture trajectories as a function of deletion context. Raw means time-normalized to 11 time steps.
Minimum lip aperture does not differ between retained and deleted /s/, although the starting point and timing of the drop do differ.

Figure 3. Effects plot showing the interaction between consonant and deletion context in predicting relative intensity A. The difference between retained and deleted /s/ is significant in /b/ but not /p/.
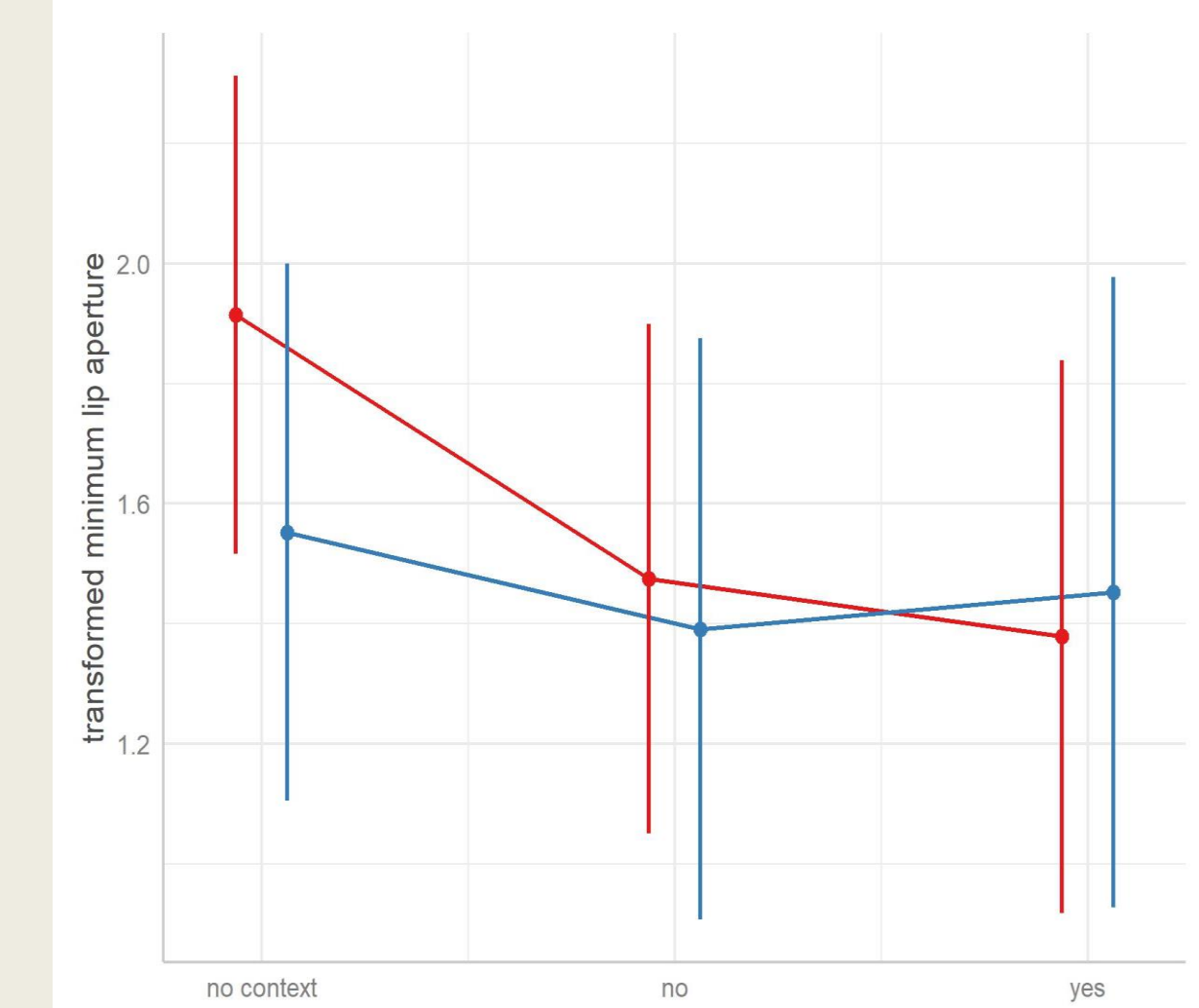

Figure 4. Effects plot, based on the estimated marginal means of the mixed-effects model, of the interaction between consonant and deletion context in predicting minimum lip aperture.
There is no significant difference between retained and deleted /s/.

INTERPRETATION

→ articulatory data are compatible with the acoustics: more lenition in underlying VCV compared to the deletion contexts
→ no difference in lip/consonant aperture depending on whether the preceding /s/ was retained in some form or completely elided
→ derived VCV sequences behave like VsCV (as if deletion never occurred)
→ no obstruent weakening after /s/ in this variety of Spanish
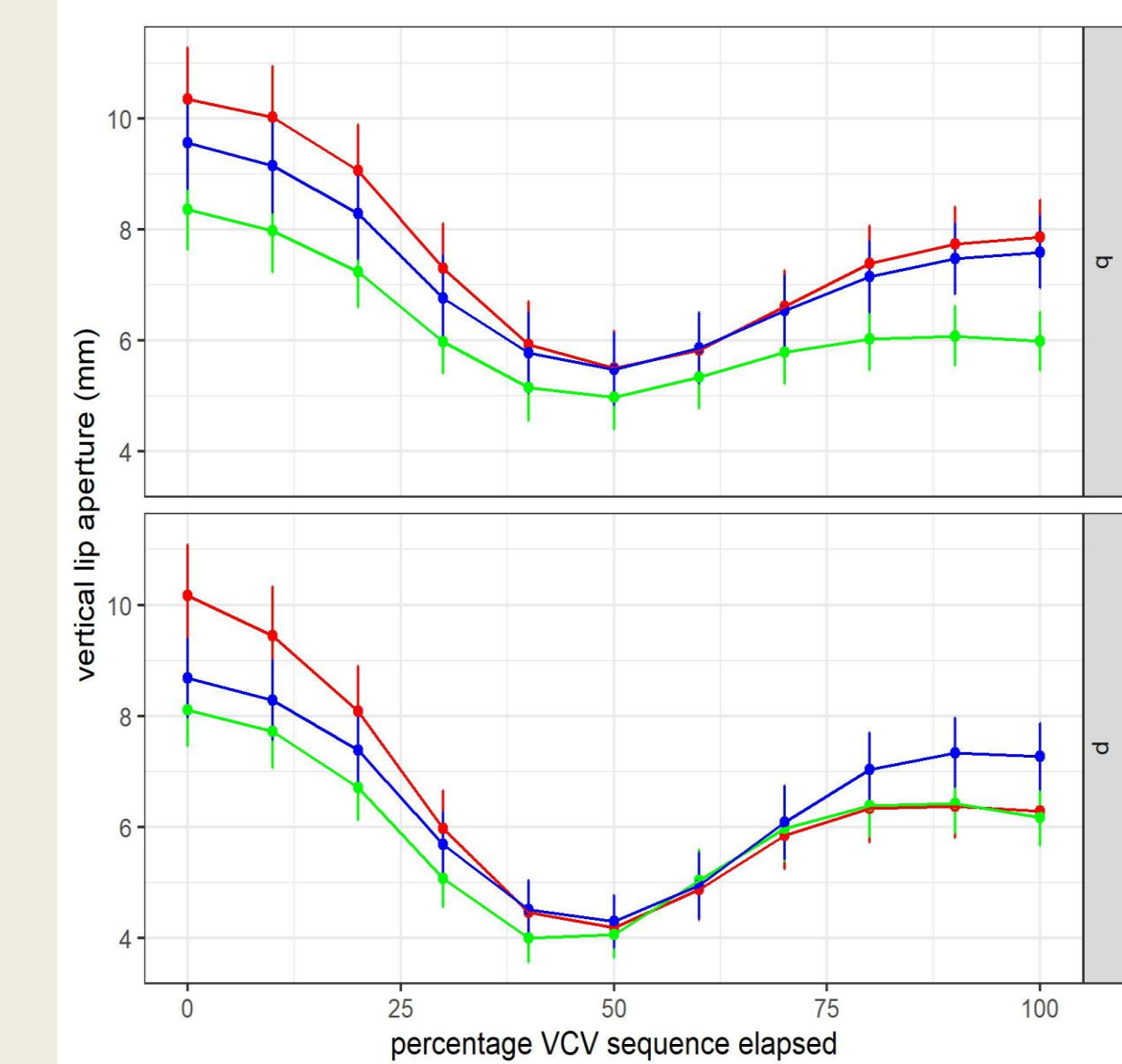
RESULTS

STRESS AND FOCUS

Figure 5. Graph of vertical lip aperture trajectories as a function of condition (after removing trials in the deletion context).
Lip movements show a difference in aperture when comparing SF with both S and US, and no difference between the latter two.
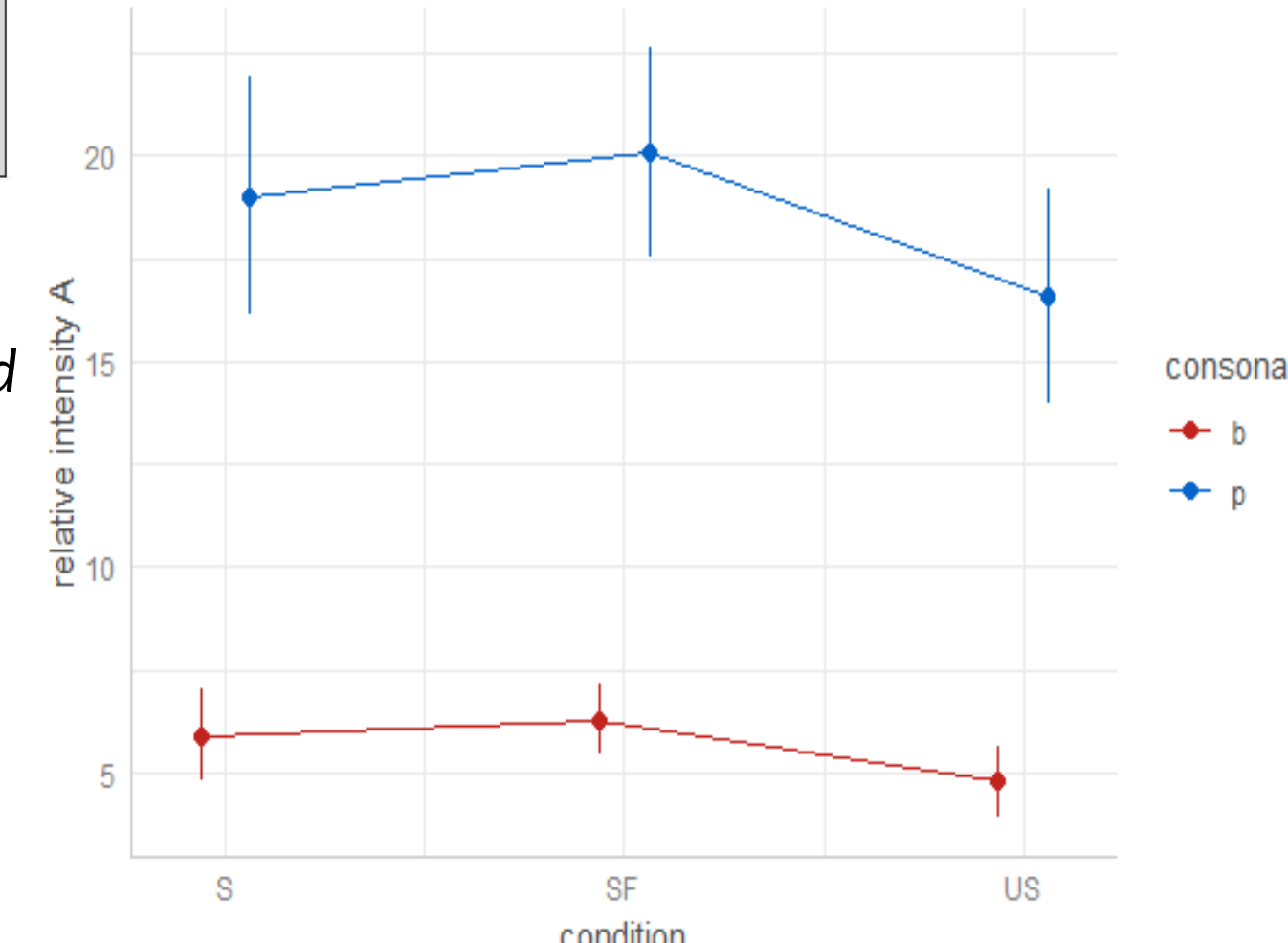
Figure 6. Effects plot, based on the estimated marginal means of the mixed-effects model, of the interaction between consonant and condition (S, SF, US) in predicting relative intensity A. Acoustics show a difference between US and both S and SF.

The results of the model for lip aperture show a significant difference between SF and both S and US, and no significant difference between the latter two

INTERPRETATION

→ lip aperture is more sensitive to phrase-level effects, such as focus
→ acoustics reflect word-level effects instead (word stress)

CONCLUSIONS

The data: **confirm the blocking effect of deletion**
show that there is **no obstruent weakening after /s/**
show **different lenition patterns for voiced vs. voiceless stops** (in line with differences in the advancement of lenition)
show an **opacity** effect: **consonant not deleted completely**
support containment-based approaches to phonological problems

The study: **provides a novel, cost-effective way of exploring** the phonetics and phonology of **consonant lenition**

Proposed representation of underlying vs surface structures:

	a)	b)	c)
Surface structure	V C V	V h C V	V [ ] C V
	⇅ ⇅ ⇅	⇅ ⇅ ⇅ ⇅	⇅ ↑ ⇅ ⇅
Underlying representation	V C V	V s C V	V s C V