

PERCEPTION AND CONTRAST IN LARYNGEAL (DIS)HARMONY¹

0 Introduction

- I propose a unified analysis of laryngeal assimilation and dissimilation as contrast neutralization.
- Both types of restrictions neutralize the contrast between one and two ejectives (aspirates or implosives) in a root. They differ as to the outcome of neutralization.
 - Both types of languages retain a contrast between forms with some and no ejectives (the existence v absence of a laryngeal feature in the root).

(1) a. * *k'api* – *k'ap'i* b. ✓ *k'api* – *kapi* ✓ *k'ap'i* – *kapi*

- The results of a perception experiment support the hypothesis that the contrast between one and two ejectives in word is weaker than the contrast between no ejectives and some ejectives.
 - Subjects in a discrimination task more reliably distinguish pairs like *k'api* – *kapi* and *k'ap'i* – *kapi* than pairs like *k'ap'i* – *k'api*.

1 Laryngeal harmony and disharmony

- Across languages, the laryngeal features (ejection, aspiration, and implosion) on stops in a root are subject to two types of restrictions.

Assimilatory restrictions: Stops in a root must *agree* in laryngeal features, e.g. Chaha (Rose and Walker 2004), Zulu (Hansson 2001). ✓ *k'ap'i* **k'api*

Dissimilatory restrictions: Stops in a root must *disagree* in laryngeal features, e.g. Quechua, Shuswap (MacEachern 1999). **k'ap'i* ✓ *k'api*

(2) Zulu (Doke, Malcolm, Sikakana and Vilakazi 1990)

k'ap' 'to spit' **k'ap* *k^hap^h* 'push violently' **k^hap*

(3) Quechua (2007)

k'apa 'cartilage' **k'ap'a* *k^hapa* 'step' **k^hap^ha*

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- In identity effect languages, pairs of distinct ejectives or aspirates are disallowed, but identical ejectives or aspirates may cooccur.
- Languages with the identity effect always disallow pairs of stops that only differ in a laryngeal feature. Similarly, languages without the identity effect always allow pairs of stops that only differ in a laryngeal feature.

- (7) a. *k'-k' ↔ ✓ k'-k
 b. ✓ k'-k' ↔ *k'-k

- The trading relation in (7) shows that the (un)grammaticality of consonants sharing the same laryngeal feature is inversely correlated with the (un)grammaticality of consonants differing only in that feature.
- The correlation in (7) holds for all of the languages in MacEachern's survey of laryngeal cooccurrence restrictions.

(8) identity effect languages

	distinct	identical	laryngeal contrast
Peruvian Aymara	*k'-p' *k ^h -p ^h	✓ k'-k' ✓ k ^h -k ^h	*k'-k *k ^h -k
Bolivian Aymara	*k'-p'	✓ k'-k'	*k'-k
Hausa	*ɓ-d̥	✓ ɓ-ɓ	*ɓ-b
Gojri	*t ^h -k ^h	✓ t ^h -t ^h	*t ^h -t
Tzutujil	*k'-p'	✓ k'-k'	*k'-k

(9) non-identity effect languages

	distinct	identical	laryngeal contrast
Cuzco Quechua	*k'-p' *k ^h -p ^h	*k'-k' *k ^h -k ^h	✓ k'-k ✓ k ^h -k
Souletin Basque	*t ^h -k ^h	*t ^h -t ^h	✓ t ^h -t
Sanskrit	*t ^h -k ^h	*t ^h -t ^h	✓ t ^h -t
Ofo	*t ^h -k ^h	*t ^h -t ^h	✓ t ^h -t
Shuswap	*k'-p'	*k'-k'	✓ k'-k

2 The hypothesis – contrast neutralization

- The active constraints in laryngeal cooccurrence restrictions are systemic markedness constraints (as in the Dispersion Theory of Markedness (Flemming 1995, 2006)) which penalize certain **contrasts** in laryngeal features among words in a language.
 - Standard markedness constraints demanding assimilation (e.g. the correspondence analysis of Rose and Walker (2004)) or dissimilation (e.g. the OCP analysis of MacEachern (1999)) are not responsible for laryngeal harmony and disharmony.
- Two types of laryngeal contrasts:

(10) a. some v. no laryngeal features **k'-p'** or **k'-p** v **k-p**
 b. one v. two laryngeal features **k'-p'** v **k'-p**
- Both assimilatory and dissimilatory restrictions neutralize the contrast in (10b), while preserving the contrast in (10a).
 - For words with two pairs of stops, all languages contrast the existence and absence of a laryngeal feature. No language completely neutralizes laryngeal contrasts just in words containing two stops.
- The unifying factor between cooccurrence restrictions is neutralization of the contrast between words with one and two ejectives or aspirates, and preservation of the contrast between words with some and no ejectives or aspirates.
 - Why do languages treat these two types of contrasts differently?

Hypothesis: The contrast between an ejective or aspirate and a plain stop is stronger in words with other plain stops than in words with another ejective or aspirate.

k'api – kapi is more distinct than k'ap'i – k'api

- If the hypothesis is correct, subjects should perform better on a discrimination task when the target stimulus (an ejective or aspirate) is presented in a word without another ejective or aspirate than in a word with another ejective or aspirate.
 - The pair *k'api – kapi* should be more easily and accurately distinguished than the pair *k'ap'i – k'api*.

3 A perception experiment

- To test the hypothesis, a discrimination task was designed to evaluate the relative perceptual distinctness of pairs of words differing in the presence or absence of ejection.

3.1 Design

3.1.1 Structure of a trial

- Subjects are presented with pairs of nonsense CVCV words and asked to decide whether the two words are the same or different from one another.
- Subjects listen to the two stimuli, with a 300 ms interstimulus interval, while looking at a black computer screen.
- After the end of the second stimulus, a line of green asterisks appears on the screen. Subjects are told to press the key indicating their choice of ‘same’ or ‘different’ as quickly as possible after the appearance of this line.
- Responses are collected using a regular USB keyboard.

3.1.2 Stimulus types

- Each trial consists of a pair of CVCV stimuli. The two stimuli in a trial are either the same or different from one another. There are three types of ‘same’ trials and three types of ‘different’ trials.

(10)	a. ‘Same’ pairs	0 0	<i>kapi – kapi</i>	no ejectives in either stimulus
		1 1	<i>k’api – k’api</i>	one ejective in each stimulus
		2 2	<i>k’ap’i – k’ap’i</i>	two ejectives in each stimulus
	b. ‘Different’ pairs	0 1	<i>kapi – k’api</i>	one ejective and no ejectives
		0 2	<i>kapi – k’ap’i</i>	two ejectives and no ejectives
		1 2	<i>k’api – k’ap’i</i>	one ejective and two ejectives

- Stimuli in a trial only differ from one another in the number of ejectives. There are six consonant pairs (drawn from p, t, k), and two vowel patterns (a-i; i-u). These twelve combinations vary from trial to trial.
- Stimuli in ‘different’ trials are presented in both orders (e.g. 0 1 trials include both pairs like *kapi – k’api* and *k’api – kapi*).
- In stimuli with only one ejective, the ejective may be on either the first or the second consonant (e.g. *k’api* and *kap’i*). Position never differs within a trial (e.g. there are no trials like *k’api – kap’i*).

3.1.3 How the stimuli were made

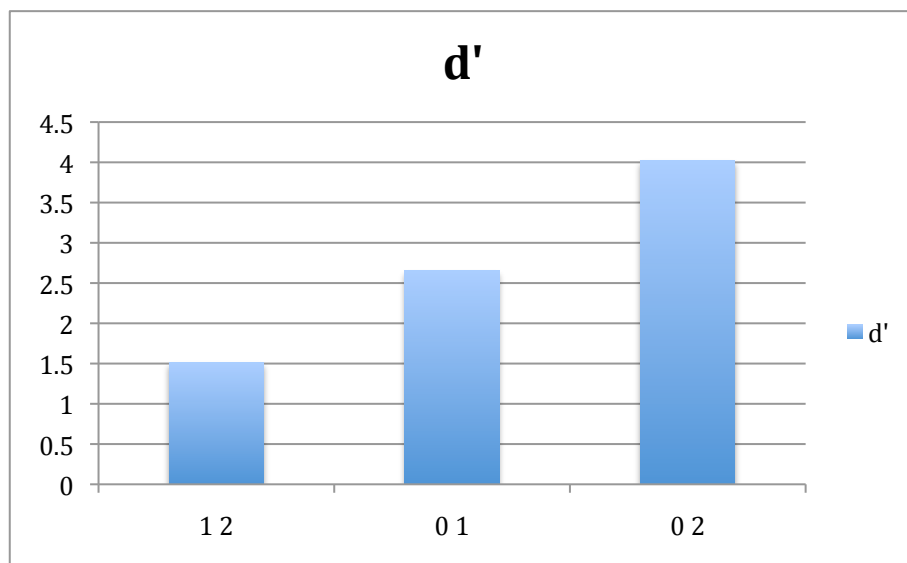
- Stimuli were made from recordings of a speaker of Cochabamba Quechua reading CVCV nonsense words. The recordings were done in the sound booth at Cornell University specifically for this experiment.
- All stimuli were spliced together. Cuts were made during the closure of the second C.
 - A stimulus like k'a π was made, for example, by splicing 'k'a' from k'api and 'pi' from kapi.

3.1.4 Subjects

- 18 native speakers of English participated in the experiment, and were reimbursed \$5 for the 15 minutes it took them to complete the experiment.
- English speakers are used instead of native speakers of Quechua to avoid a phonological bias in perception. The behavior of native Quechua speakers in the same type of task is a topic for future research.

3.2 Results

- Subjects perform as predicted. 0 1 and 0 2 pairs are more reliably distinguished than 1 2 pairs.
 - A Helmert coded repeated measures ANOVA shows a significant difference in performance on 1 2 pairs as compared with 0 1 and 0 2 pairs: $F(1, 34) = 33.437, p < .0001$.
 - There is also a significant effect of 0 1 v 0 2, with 0 2 pairs being easier to distinguish than 0 1: $F(1, 34) = 14.059, p < .001$.



4 Summary and future work

- The results presented here support the proposal that neutralization of the 1 v 2 contrast in languages with laryngeal cooccurrence restrictions is driven by the relative perceptual weakness of this contrast.
- The weaker 1 2 contrast is targeted for neutralization, but what determines the outcome of neutralization?

Hypothesis: Language specific differences in the phonetic realization of laryngeal features are correlated with whether a language is assimilatory or dissimilatory.

- Acoustic study of one assimilatory and one dissimilatory language is necessary to determine if laryngeal features are realized differently in the two types of languages.
- Further perception experiments must be carried out to confirm that the 1 2 contrast remains perceptually weakest regardless of phonetic differences in laryngeal features.
- A comparison of 0 1 and 0 2 trials for an assimilatory and dissimilatory language may show that the 0 1 contrast is stronger in dissimilatory languages. If this is the case, we can develop the following analysis:
 - Dissimilatory languages prefer forms with 1 ejective in order to minimize articulatory effort.
 - Assimilatory languages prefer forms with 2 ejectives in order to maximize the contrast between a form with ejectives and one without.

References

- Ajacopa, Teofila Laime, et al. 2007. *Diccionario Bilingüe, Iskay Simipi Yuyayk'anacha: Quechua – Castellano Castellano –Quechua*. La Paz, Bolivia.
- Doke, C. M., D.M. Malcolm, J. M. A. Sikakana and B.W. Vilakazi. 1990. *English-Zulu Zulu-English Dictionary*. Johannesburg: Witwatersrand University Press.
- Flemming, Edward. 1995. Auditory representations in phonology. Doctoral Dissertation, University of California, Los Angeles.
- Flemming, Edward. 2006. The role of distinctiveness constraints in phonology. Ms. MIT.
- Hansson, Gunnar Olafur. 2001. Theoretical and typological issues in consonant harmony. Doctoral Dissertation, University of California, Berkeley.
- MacEachern, Margaret. 1999. *Laryngeal co-occurrence restrictions*. New York: Garland.
- Rose, Sharon, and Rachel Walker. 2004. A typology of consonant agreement as correspondence. *Language* 80: 475-531.