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Phonetic, phonological, and social forces as  
filters: Another look at the Georgia Toscana

Christina Villafaña Dalcher\*

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# Phonetic, phonological, and social forces as filters: Another look at the Georgia Toscana

Christina Villafaña Dalcher

## Abstract

This study brings quantitative analysis to data from Florentine Italian to describe the lenition process *Gorgia Toscana*, assessing the roles of physiological, perceptual, phonological, and social factors. Data from six native speakers of Florentine Italian were analyzed acoustically for consonant duration, intensity, periodicity, and burst absence. Results indicate that *Gorgia Toscana* produces gradient and variable output, with certain patterns occurring in the variation. The observations that emerge from the data cannot all be accounted for if *Gorgia Toscana* is characterized as a purely phonetic, phonological, or socially driven process of sound change. Rather, different aspects of the process can and should be attributed to different motivators: gradience and velar preference to articulator movements; resistance of non-velar lenition to perceptual constraints; targeting of a complete natural class and categorical weakening to abstract featural representations; and intersubject variation in velar lenition to external social factors. *Gorgia Toscana* seems best understood by referring to various forces that act to encourage or inhibit weakening. Applying Hume and Johnson's (2001) filter model to lenition data, we can generalize over the observed patterns in *Gorgia Toscana* in a way that is descriptively and explanatorily more adequate than previous accounts of the process.

# Phonetic, Phonological, and Social Forces as Filters: Another Look at the *Gorgia Toscana*

Christina Villafañá Dalcher\*

## 1 Introduction

This study brings quantitative analysis to data from Florentine Italian to describe the lenition process *Gorgia Toscana* (GT), assessing the roles of physiological, perceptual, phonological, and social factors.

In the present study, data from six native speakers of Florentine Italian were analyzed acoustically for consonant duration, intensity, periodicity, and burst absence. Results indicate GT produces gradient and variable output, with certain patterns occurring in the variation. The observations that emerge from the data cannot all be accounted for if GT is characterized as a purely phonetic, phonological, or socially driven process of sound change. Rather, different aspects of the process can and should be attributed to different motivators: gradience and velar preference to articulator movements; resistance of non-velar lenition to perceptual constraints; targeting of a complete natural class and categorical weakening to abstract featural representations; and intersubject variation in velar lenition to external social factors.

GT seems best understood by referring to various forces that act to encourage or inhibit weakening. Applying Hume and Johnson's (2001) filter model to lenition data, we can generalize over the observed patterns in GT in a way that is descriptively and explanatorily more adequate than previous accounts of the process.

## 2 Background

The data are from a dialect of Italian spoken in the region of Tuscany that regularly exhibits GT, a weakening process occurring in several Tuscan dialects of Italian. Vogel (1997) describes GT as the variable phenomenon responsible for the pronunciation of /p/, /t/, and /k/ as [ɸ], [θ] and [h/x] between sonorants, resulting in surface realizations not occurring in the Italian phoneme inventory (1-3).

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- (1) la casa /la kaza/ → [la xaza / la haza / la aza] ‘the house’  
 (2) la torta /la tɔrta/ → [la θɔrta] ‘the cake’  
 (3) la palla /la pal:a/ → [la φal:a] ‘the ball’

GT effects extend beyond voiceless stops. Giannelli and Savoia (1978), Marotta (2001), Soriano (2001) and Villafaña Dalcher (2006) all observe that the voiced stops /b/, /d/, and /g/ are also involved in the process of weakening, surfacing as [β], [ð], and [ɣ] or [ɦ]. Examples (4-6) from Giannelli and Savoia (1978:44–47) illustrate this.

- (4) la gamba /la gamba/ → [ la ɣ/ɦamba ] ‘the leg’  
 (5) e dorme /e dɔrme/ → [ e ðɔrme ] ‘and (he/she/it) sleeps’  
 (6) e beve /e beve/ → [ e βeve ] ‘and (he/she/it) drinks’

Kirchner (1998:253) has claimed that spirantization of intervocalic stops is obligatory. This may be the case for some speakers: Giannelli and Savoia (1978:43) observe the difficulty with which speakers pronounce these stops, but acoustic studies performed by Marotta (2001), Soriano (2001) and Villafaña Dalcher (2006) show that stops do, in fact, surface among the allophonic variants. The present study supports the findings that GT is far from an obligatory rule, but instead a widely distributed pattern of variation occurring optionally for a variety of speakers.

Asymmetry in synchronic spirantization has been observed by a number of authors. Giannelli and Savoia (1978:43) report that Florentine speakers experience the most difficulty in producing non-fricated velars, followed by non-fricated dentals and then non-fricated labials. Cravens (2000:9), Bafile (1997:28) and Antelmi (1989:60–61) all corroborate these synchronic observations; Izzo (1972) provides evidence of velars leniting several generations before non-velars.

### 3 Synchronic Patterns in *Gorgia Toscana*

#### 3.1 Time for a Broader Approach

Previous studies have described GT’s historic evolution (Izzo 1972), sociolinguistic variation (Giannelli and Savoia 1978; Cravens 2000), articulatory motivations (Kirchner 1998) and acoustic properties (Marotta 2001; Soriano 2001). None of these, however, offers an integrative explanation of certain observations: the gradient nature of Florentine lenition, the greater

susceptibility of velars to the process, the historic spread of GT from velars to non-velars, and the variation among speakers.

Based on the historical and synchronic patterns discussed in the following sections, we will see that perhaps it is time for a more integrated approach to the process of GT.

### 3.2 Methodology

Data were collected from six native speakers of Florentine Italian and recorded in quiet rooms familiar to the subjects using a unidirectional microphone, a USB-Pre hard-disk recorder and Praat (Boersma & Weenink 2006).

Tokens consisted of voiceless and voiced stops /p, t, k, b, d, g/ embedded between vowels in both high and low frequency lexical items, occurring either word-medially or word-initially within the prosodic domain of the intonational phrase. Lexical stress was controlled. Subjects read 33 sentences in random order, repeating each sentence three times in sequence.

This study measured the four acoustic features of duration, intensity, periodicity, and burst absence for each token, basing the choices of acoustic features primarily on those adopted by Lewis (2001) and Lavoie (2001). Using SPSS software, Principal Components Analysis (PCA) was run on the subset of voiceless stops {/p/ /t/ /k/} and on the subset {/b/ /d/ /g/} using input variables that exhibited a clear relationship to weakening in these groups. All assumptions passed the suitability tests required by PCA. For each set, only one principal component was extracted, defined as a new (standardized) variable, and renamed  $L_{ptk}$  or  $L_{bdg}$ . Higher latent variable scores indicate more weakening for both groups. The range of  $L_{ptk}$  scores is -2.79 to 2.55; the range of  $L_{bdg}$  scores is -2.99 to 1.87.<sup>1</sup>

To simplify further statistical testing, the L scores for voiceless and voiced segments were aggregated into one common L score. Because statistical computation of latent variables results in standardized scores (which measure distance from the mean), combining the scores is possible.

### 3.3 Results

#### 3.3.1 Observation 1: Everything Lenites, but Velars Lenite More

Figure 1 illustrates lenition scores of individual phonemes. Note that /b/ and

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<sup>1</sup>Of 637 voiceless and 358 voiced tokens, 28 and 18, respectively, were unmeasurable in terms of duration, intensity, and RPP. SPSS could not calculate latent variable scores for them. They were assigned a lenition coefficient equal to the maximum score for the set of either voiceless or voiced stops.

/t/ are least likely to lenite, and that most lenition occurs with the velars /g/ and /k/. Mean L scores for labials are -.223, for dentals -.113, and .638 for velars. Testing for place of articulation effects on both voiceless and voiced stops, a significant difference in L is found among the places of articulation (labial, dental, velar),  $F(2, 992)=69.365, p \leq .001$ .

The boxplot also indicates that L scores are variable. While L scores are generally higher for some phonemes than for others, it is not the case that a given phoneme always surfaces with a consistent score—within phoneme categories there are many different surface realizations.

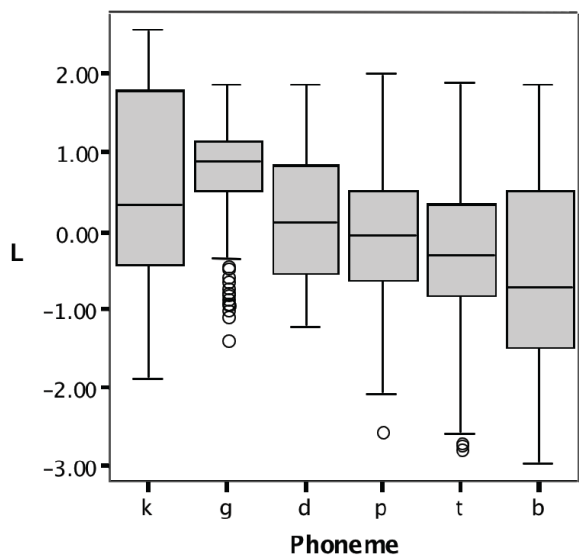


Figure 1: Lenition scores by phoneme

### 3.3.2 Observation 2: Lenition is a Gradient Process

Examining the range of L scores graphically, we see that the distribution is approximately normal (with the exception of some spikes at the extreme right, which are discussed below) and that L scores fall at all points along a continuum. That is, they do not cluster into discrete categories, as shown in Figure 2.

### 3.3.3 Observation 3: Lenition of Velars Looks Categorical

Another histogram (Figure 3) indicates a bimodal distribution of L scores for /k/, evidenced by the jump in frequency of weak segments at the right edge.

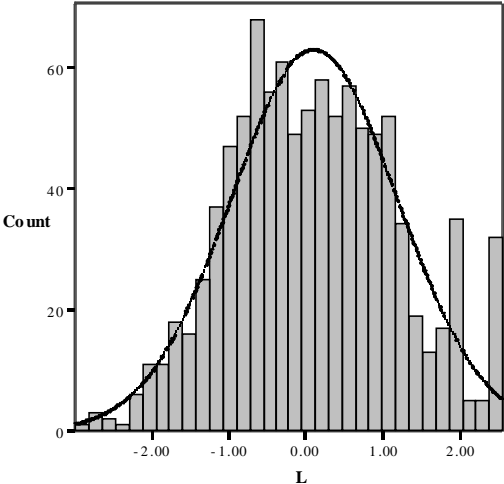


Figure 2: Histogram of lenition scores—all phonemes

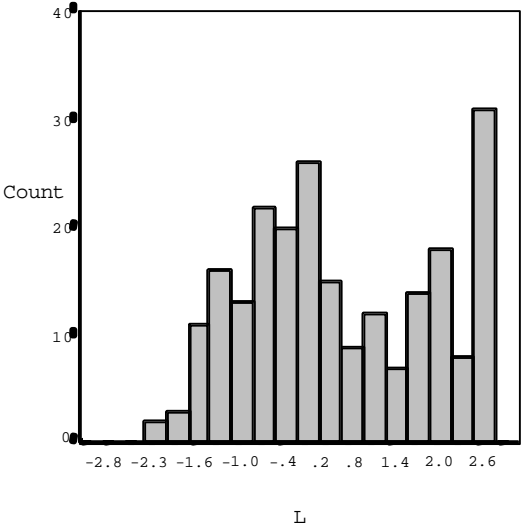


Figure 3: Histogram of lenition scores—/k/

### 3.3.4 Observation 4: Not All Subjects Lenite Identically

Despite a general tendency of velars to lenite more than non-velars, much variability is found among subjects with respect to place of articulation. Table 1 and Figure 4 illustrate that two of the subjects, F1 and M1, show more lenition of /k/ than of any other segment. The other four subjects show a preference for leniting /g/, and three rank /k/ no higher than third. An additional pattern emerges in which F1 and M1 appear both extremely similar to one another and markedly different from the other subjects in terms of their lenition hierarchies. This pattern is of interest when we consider the six subjects' non-linguistic characteristics, which indicate a different social profile for F1 and M1 than for the other subjects.

Subject	Ranking (most lenition to least lenition)
F1	k >> g >> d >> b >> p >> t
M1	k >> g >> b >> p >> d >> t
F2	g >> p >> d >> k >> t >> b
M2	g >> d >> k >> t >> p >> b
F3	g >> k >> p >> t >> d >> b
M3	g >> p >> k >> d >> t >> b

Table 1: Weakening hierarchies by subject

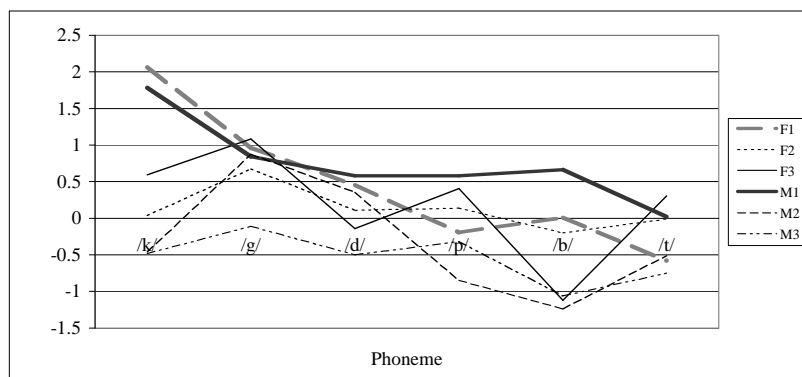


Figure 4: Weakening hierarchies by subject

## 4 An Integrated Account

The preceding analysis illustrates the regular occurrence of lenition throughout the entire class of stops in the Italian consonant inventory, the overall



gradient nature of lenition, the special status of velars (both historically and synchronically) in the lenition process, and the presence of intersubject variation in preference towards velar lenition. This section discusses GT in light of these observations.

To begin, we might ask whether GT is motivated physiologically, perceptually, phonologically, or socially—or, in fact, whether a combination of all such factors is at play. A recent model of sound change proposed by Hume and Johnson (2001) provides a mechanism for viewing GT through a set of multiple filters.

#### 4.1 A Filtering Model's Ingredients

As we have seen, GT data may best be addressed by reference to various forces acting to either encourage or inhibit lenition. Hume and Johnson (2001) refer to these forces as filters, and suggest they play independent, and sometimes antagonistic, roles in mapping a cognitive representation  $p$  onto a different cognitive representation  $p'$  (the relationship between  $p$  and  $p'$  representing sound change and necessarily being bidirectional). The model proposed by Hume and Johnson is in Figure 5.

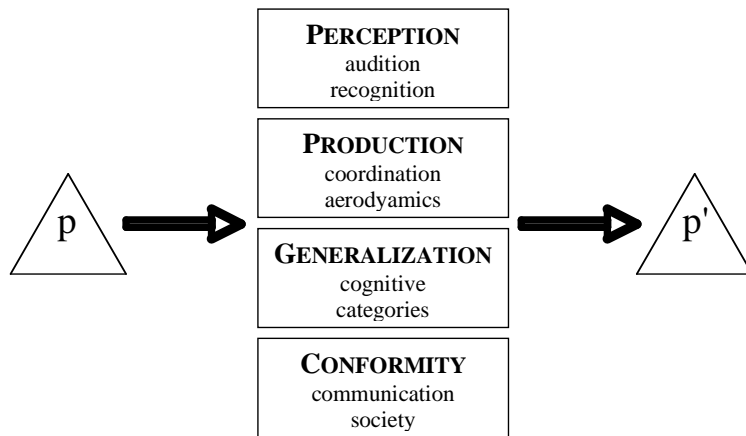


Figure 5: Filtering model (Hume and Johnson 2001:16)

In order to implement this model, Hume and Johnson propose 1) a fine-grained time scale during which the filters convert  $p$  to  $p'$ , and 2) the dependence of these forces on an individual language's existing sound system. These characteristics result in variation and language-specificity, respectively. In other words, the independent filters of PERCEPTION, PRODUCTION,

GENERALIZATION, and CONFORMITY work to generate  $p'$  from  $p$  in different, and often opposing ways, sometimes resulting in a type of backlash that subsequently reverts to  $p$ . The change from  $p$  to  $p'$  and vice-versa occurs within a finely-grained time scale, surfacing as synchronic variation of the type observed in GT, but not ruling out historical patterns occurring over larger stretches of time.

The model also takes into account the fact that an existing cognitive representation  $p$  is but one part of a larger group of  $p$ 's in any given language's phonological system. The filtering forces, then, work to mutate  $p$ , but not without reference to the larger system unique to a specific language. In this way, even if we suppose identical filters, the mapping of  $p$  to  $p'$  will not necessarily result in an identical change cross-linguistically—particularly given a near impossibility of the PERCEPTION, GENERALIZATION, AND CONFORMITY filters acting identically across all languages or dialects.

## 4.2 The Filtering Model and *Gorgia Toscana*

Applying Hume and Johnson's filters to the GT data, we can see how cognitive representations, and actual surface realizations, might be affected, keeping in mind that the nature of the filters themselves are dependent on the existing Italian sound system. For example, alterations allowed by the PERCEPTION filter will be affected by contrasts in the phoneme inventory; simplifications encouraged by the GENERALIZATION filter will take into account Italian's use of distinctive features. The following sections explore how each of the filters can assist in explaining the GT patterns reported earlier.

### 4.2.1 The PERCEPTION Filter

This filter discourages alterations that reduce contrast. Recalling that velars tend to lenite more than non-velars, we see that from a perceptual point of view this pattern is predictable: Italian has two labiodental fricatives, but no velar fricatives, as Table 2 illustrates.

Bilabial	Labio-dental	Dental	Alveolar	Post-alveolar	Palatal	Velar	Labio-velar
	f v	s z		ʃ			

(3)

Table 2: Italian fricative inventory

While a perceptual constraint disfavors degraded contrast, it might not rule out lenition of labials and dentals altogether. Figures 6 and 7 show a

considerable difference in acoustic energy between lenited non-velars.

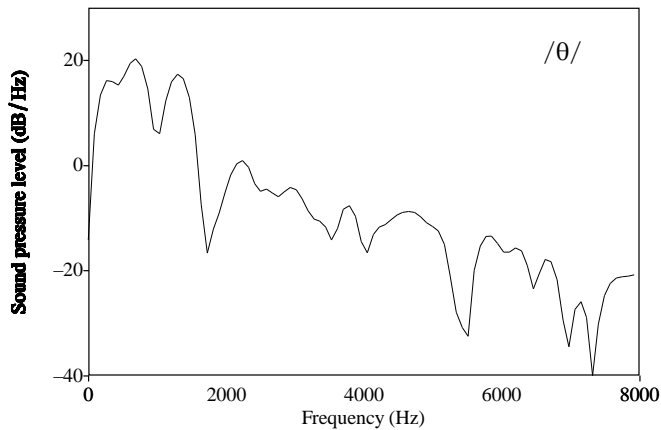


Figure 6: Spectrum of lenited /t/

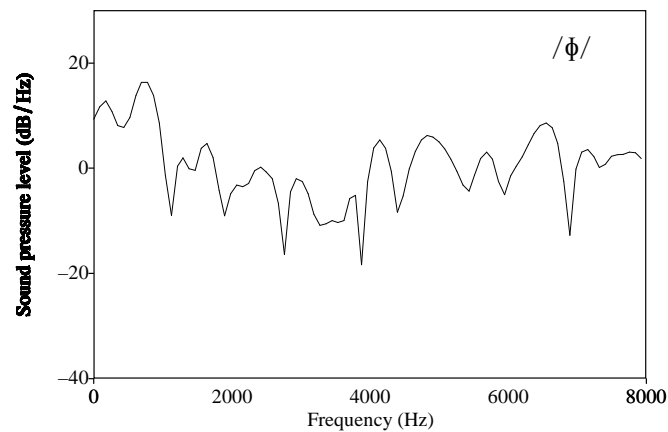


Figure 7: Spectrum of lenited /p/

Finally, any constraining force on the part of a perceptual filter would be militated by the availability of additional linguistic information (lexical, contextual, etc.) that enables listeners to discern contrasts even when the acoustic information is degraded. Thus while a PERCEPTION filter disfavors non-velar lenition, weakening of all stops may still be permitted—patterns which are exhibited in the data.

#### 4.2.2 The PRODUCTION Filter

This filter favors alterations that are articulatorily simpler, thus accounting for the historical innovation targeting only velars and for the synchronic place asymmetry in the data. Looking at the GT data in an articulatory phonology (Browman and Goldstein 1990) framework, the gradual reduction in constriction degree and duration occurring when articulators are identical is predictable. In the case of velars occurring intervocalically, the tongue dorsum is active throughout the sequence of sounds: minor fluctuations in its movement result in infinite acoustic forms.

Additionally, the historic pattern of velars leniting first provides indirect support for an articulatory motivation in GT. To the extent that innovative sound change is governed by purely phonetic conditions at its point of origin (Janda and Joseph 2003:206), the diachronic facts outlined by Izzo (1972) lend credibility to a PRODUCTION filter encouraging velar lenition, and neutrally affecting non-velar weakening.

#### 4.2.3 The GENERALIZATION Filter

GT affects all oral stops, despite the fact that perceptual and articulatory constraints favor velars. The diachronic spread of a phonetic innovation allowed by the PRODUCTION filter is not surprising if phonetically induced changes spread throughout natural classes, yielding a simpler system. Such spread is supported by work on exaggeration of phonetic innovations (Janda 2000) and symmetry (Hayes 1999).

Furthermore, the bimodal distribution of lenition scores for /k/ in Figure 3 indicates the possibility of phonologization (Hyman 1977), at least in the case of the voiceless velar. To the extent /k/'s behavior verges on a categorical alteration, the GENERALIZATION filter may also play a role in the shift from phonetically-motivated change to simpler, more easily-acquired phonological rules (Hayes 1999:253).

#### 4.2.4 The CONFORMITY Filter

Several sociolinguistic studies of GT exist and previous work by Cravens (2000) specifically addresses Florentine lenition in terms of its social marking, noting the following points (2000:13–15):

- “In . . . Florence, the spirants also carry high status . . . there is no negative judgment conferred on their use.”
- /k/ lenition is a “stereotypical marker of regional association.”
- Italians are more aware of /k/ lenition than /p/ and /t/ lenition.

- Unlenited /k/ is a possible marker of “Italianness.”

The intersubject variation in the data shown in Figure 4 does not seem explainable by perceptual, articulatory, or phonological factors. We saw that two speakers, F1 and M1, lenite /k/ more than any other consonant, while the remaining speakers exhibit a dispreference for /k/ lenition. One logical explanation is that speakers with certain social characteristics might purposefully lenite /k/ more, while other speakers avoid leniting /k/, which carries with it some amount of social baggage. This hypothesis is not surprising when we examine the social characteristics of the subjects:

subject	higher education	white-collar employment	second language(s)	international travel	domestic travel
F1	✗	✗	✗	✗	✗
F2	✓	✓	✓	✓	✓
F3	✓	✓	✓	✓	✓
M1	✗	✗	✗	✗	✗
M2	✓	✓	✓	✓	✓
M3	✓	✓	✓	✓	✓

Table 3: Subject characteristics

Although the present study was not set up to control for many ethnographic or sociolinguistic details, the background data collected on each subject does yield interesting patterns meriting further exploration. As Table 3 illustrates, the only two speakers who do not avoid leniting /k/ (or who lenite /k/ more) possess strikingly different profiles, having significantly lower educational backgrounds, different employment experience, no second languages, and no social or business dealings outside Florence.

The prestige of velar lenition within a limited geographical area, and possibly within a restricted subset of the population, supports the concept of the CONFORMITY filter at work in GT, serving to bring representations into line with the linguistic community’s norms. The precise role of the filter, of course, is dependent on the individual speaker’s association with a given linguistic community: on the one hand, the filter may encourage velar lenition for subjects with a “Florentine” identity; on the other, it may work to suppress velar lenition for those subjects with a bias towards an “Italian” identity.

## 5 Conclusions

This paper has attempted to answer five questions concerning lenition in Florentine Italian:

- (1) Why might both voiced and voiceless velars exhibit special status diachronically and synchronically in this sound-changing process?
- (2) How can we account for gradience in the surface manifestations?
- (3) Why did non-velars eventually become susceptible to the process?
- (4) Why does the voiceless velar /k/ tend towards categorical deletion?
- (5) How can intersubject variation, particularly with reference to the preference or dispreference of velars, be explained?

Taking the patterns observed in a process like GT, Hume and Johnson's model seems to be exactly the type of interactive system needed to account for the process under investigation. GT appears to require reference to articulatory, perceptual, featural, and social factors, some of which work cooperatively, and some antagonistically. Velar lenition is encouraged by articulatory factors, neutrally affected by perceptual factors, phonologized by generalization factors, and either suppressed or encouraged by social factors. Non-velar lenition, on the other hand, is neutrally affected by articulatory factors, constrained by perceptual factors, encouraged by generalization factors, and probably not affected at all by social factors. The overall pattern that emerges is that the filters in Hume and Johnson's model favor velar lenition to a greater extent than non-velar lenition, as the representations in Figures 8 and 9 illustrate.

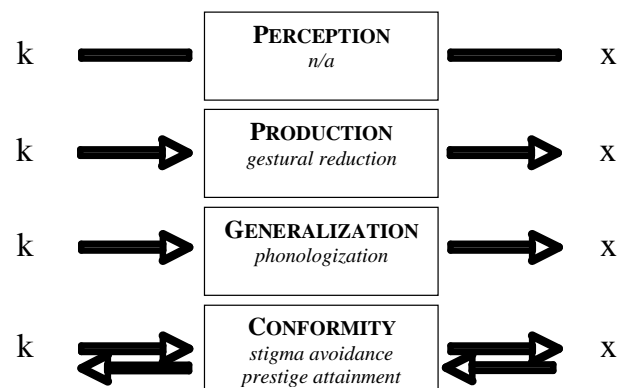


Figure 8: Schematic filtering of /k/ lenition

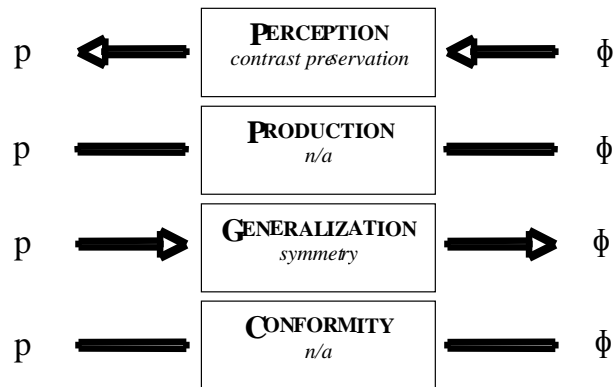


Figure 9: Schematic filtering of /p/ lenition

The abstract representations of the /k/-[x] and /p/-[ϕ] alternations do not include any weightings of the individual filters, a feature that must be included, and able to change over time, in order to account for the variation observed in the process. They do, however, generalize over the observed patterns in GT in a way that is both descriptively and explanatorily adequate, and provide us with a mechanism that incorporates interactions among the independent forces involved in the sound change process under investigation.

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Department of Language and Communication Science  
 City University London  
 Northampton Square  
 London ECV 0HB United Kingdom  
 cvd1@city.ac.uk