

The role of comprehension, reinterpretation and the Uniformity Condition
in historical change: the case of the development of *Cl* clusters from Latin
to Hispano-Romance

D. Eric Holt
Georgetown University

0. Introduction.* As shown in (1), clusters of voiceless consonant and /l/
/k, p, f + l/ undergo a series of changes from Latin to Hispano-Romance:

0.1 Data:

(1)		<i>Latin</i>	<i>Spanish</i>	<i>Galician/Portuguese</i>	
(a)	<i>initial</i>				
	CL	CLAVE	<i>llave</i> (ʎ)	<i>chave</i> (tʃ)	‘key’
		CLAMARE	<i>llamar</i>	<i>chamar</i>	‘to call’
	PL	PLUVIA	<i>lluvia</i>	<i>chuva</i>	‘rain’
		PLANCTU	<i>llanto</i>		‘weeping’
		PLORARE	<i>llorar</i>	<i>chorar</i>	‘to weep’
		PLAGA	<i>llaga</i>	<i>chaga</i>	‘wound’
		PLICARE	<i>llegar</i>	<i>chegar</i>	‘to arrive’
		PLENU	<i>lleno</i>	<i>cheio</i>	‘full’
	FL	FLAMMA	<i>llama</i>	<i>chama</i>	‘flame’
		FLACCIDU	<i>llacio</i> (later <i>lacio</i>)		‘lank’
(b)	<i>medial</i> ¹				
	CL	* <i>mancla</i> ²	<i>mancha</i> (tʃ)	<i>mancha</i> (tʃ)	‘stain’
		CONCHULA	<i>concha</i>	<i>concha</i>	‘shell’
		TRUNCULU	<i>troncho</i>		‘stalk’
		HINNIT-*ULARE	<i>reninchar</i>	<i>r(el)inchar</i>	‘to whinny’
	PL	IMPLARE	<i>(h)enchir</i>	<i>encher</i>	‘to fill’
	FL	INFLARE	<i>(h)inchar</i>	<i>inchar</i>	‘to inflate’
		* <i>masclo</i>	<i>macho</i>	<i>macho</i>	‘male, macho’
		CICERCULA	<i>cizercha</i>		‘blue vetch’
		SARCULARE	<i>sachar</i>	<i>sachar</i>	‘to weed’
		AFFLARE	<i>hallar</i>	<i>achar</i>	‘find, think’

(For exceptions, see Malkiel 1963-4)

The data can be summarized as follows: In both Spanish and Galician/Portuguese in medial position the result is /tʃ/, while in initial position the two languages differ, with Galician/Portuguese showing /tʃ/ (later /ʃ/), but Spanish showing a different outcome, /ʎ/. Previous authors' proposed derivations are in (2).

0.2 Previous accounts. Other researchers have addressed these changes:

- (2) Williams (1938): Cl > Cj > tʃ (only Galician/Portuguese treated)
 Bourciez (1967): Cl > ll > ʎ > tʃ
 Lloyd (1987): Cl > Cʎ > ʎ (> tʃ medially; later generalized to initial position in Galician/Portuguese)

The first two authors fail to consider that Upper Aragonese shows /Cʎ/ (where 'C' represents /k, p, f/), and fail to treat Galician/ Portuguese as having once shared a stage with Spanish. Lloyd, however, recognizes the importance of the Modern Upper Aragonese data, shown in (3), which allows him to develop a more unified approach:

(3)	Latin	Upper Aragonese³
CL	CLAVE	<i>cllau</i> [kʎ] 'key'
PL	PLOVERE	<i>pllover</i> [pʎ] 'to rain'
FL	FLAMMA	<i>fllama</i> [fʎ] 'flame'

Nonetheless, all previous researchers assume some sort of 'magic leap' from /*Cʎ/, /*ʎ/ or /*Cj/ to /tʃ/. That is, it is assumed that a voiceless consonant + front semivowel (in the case of Williams), a voiceless consonant + /*ʎ/ (in the case of Lloyd), or just the /*ʎ/ (in the case of Bourciez) develops directly to /tʃ/. However, these are very different sounds, and none of these authors proffers an analysis as to *how* or *why* the situation and change should be as they are. Phonetically, many of these proposed changes are just plain hard to justify given that they assume some kind of articulatory or acoustic gap for which they do not account.

0.3 Principal issues of this paper. The present account provides a unified approach to the various Hispano-Romance dialects, and provides an explanation for the 'magic leap' previously stipulated. In addition, the present account also raises a number of theoretical issues, some of which have not been addressed in Optimality Theory:

- (4) (a) Phonetics → phonology → lexicon (then repeat the cycle)
- (b) The Uniformity Condition played a role in this varied development (in OT via conjunction of constraints and ranking of conjoined constraints)
- (c) The role of the listener in historical change (cf. Ohala, Janson, Jonasson, etc.): Perception and comprehension lead to reinterpretation (here via acoustic equivalence, emergence of the unmarked and lexicon optimization)
- (d) Certain similarity of historical change to child language acquisition and learning algorithms

1. Analysis. Here I wish to maintain the unity of Spanish and Galician-Portuguese, and follow Lloyd in assuming that Upper Aragonese shows an intermediate stage in the development from Lat. *Cl* to OSp., Gal./Ptg. *ch*. I further motivate this change for both Spanish and Galician/Portuguese in medial position, and for Galician/Portuguese in initial position, rather than having [tʃ] be generalized from medial to initial position.

I now offer my analysis of the series of changes that occurred.

The first stage is the assimilation of /l/ to /k/, yielding [**kʎ*]. The articulation of /l/ is drawn toward the velar region where /k/ is pronounced. The data from Rumanian (where only the /kl/ clusters palatalized, leaving /pl, fl/ as is; see Tuttle 1975, Lloyd 1987, others) are generally taken as supporting the assumption that this is the first step.

- (5) First proposed historical stage: Assimilation. /kl/ > [**kʎ*]
(Hispano-Romance, medial position; later also initial position in pre-Old Spanish)

/kl/ > <i>*kʎ</i> /	ASSIMILATE[PA]	IDENT[PA]
kl	*!	
<input checked="" type="checkbox"/> kʎ		*

Hispano-Romance forms:

*MACULA > [**maŋkla*] > [**maŋkʎa*]
AURICULA > [**orekla*] > [**orekʎa*]

Later, also in pre-Old Spanish:

CLAMARE > [klamar] > [**kʎamar*]
CLAVE > [klave] > [**kʎave*]

This begins as a phonetic process, but is then phonologized and lexicalized by the listener.⁴

However, since not only CL but also PL and FL developed to /tʃ/ or /ʎ/, the next stage in this development is the extension of /ʎ/ to /pl, fl/. For these clusters the initial consonant is produced with the lips, not the hard

palate, and therefore there is no phonetic factor that would cause /l/ to become palatal [ʎ]:

- (6) Second proposed historical stage: ‘Allophonic unification’.
/pl, fl/ > [*pʎ, *fʎ] by influence of /*kʎ/ (Tuttle 1975:407-8)

/*kʎ/ was the most frequent *Cl* cluster, and as such it could have served as a robust model for analogical change: [*ʎ] is thus extended to /*pʎ, *fʎ/, as in Modern Upper Aragonese *pllover*, *fllama*.

The predominant source of /*kʎ/ was by reduction of the diminutive suffix -ICULUS > -CLO, OCULUS > [*okʎo]. Additional examples are given below (I show the complete historical derivation for only the first example):

- (7) /*kʎ/ as model for ‘allophonic unification’ of /pl/, /fl/ to /*pʎ/, /*fʎ/:

AURICULA (for AURIS) > [*orek’la] > [*orekʎa]	‘ear’
OVICULA (for OVIS) > [*ovekʎa]	‘sheep’
APICULA (for APIS) > [*abekʎa]	‘bee’
CLAVICULA (from CLAVE) > [*k(l)avekʎa]	‘peg, pin’
OCULUS > [*okʎo]	‘eye’
SPECULUM > SPECLUM > [*espekʎo]	‘mirror’
VETULUS > VECLUS > [*vekʎo]	‘old’
LENTICULA > [*lentekʎa]	‘lentil’
VERMICULU ‘little worm’ > [*bermekʎo]	‘red’
COAGULU > [*koagʎo]	‘curds’
REGULA ‘metal bar’ > [*r:egʎa]	‘plowshare’
TEGULA > [*tegʎa]	‘roof tile’

I tentatively suggest that ‘allophonic unification’ may be considered to aid in the economy of lexical representations, and that this kind of sequential constraint is a kind of lexicon optimization. Due to limitations of space, I will have to leave it at that for the present discussion. (I explore this further in Holt in preparation.)

This assimilation applied only word-internally in Hispano-Romance at first, but its application spread to initial position, and did so more quickly in Old Spanish than in Old Portuguese. This is supported by the fact that there is much more variability of outcome in initial position, particularly in Portuguese. (See Wireback 1996 for discussion of the

(11) Simplification of /bl/ and /gl/ to /l-/ in Hispano-Romance:

BLASPHEMARE	>	<i>lastimar</i>	‘to damage’
BLATTA	>	OSp. <i>lad-illa</i>	‘crab louse’
GLATTIRE ‘to bark’	>	<i>latir</i>	‘to beat’
GLANDINE ‘acorn’	>	OSp. <i>landre</i>	‘tumor’
GLIRE	>	OSp. <i>lir</i> (MSp. <i>lirón</i>)	‘dormouse’
GLOBELLU	>	OSp. <i>loviello</i> (MSp. <i>ovillo</i>)	‘ball [of yarn]’
FABULARE	>	Ptg. <i>falar</i>	‘to speak’

To recapitulate the discussion thus far: What begins in Late Latin as assimilatory palatalization of /kl/ to /*kʎ/ is extended by analogy to the medial clusters /pl, fl/ to /*pʎ,*fʎ/ (and to initial position in pre-Old Spanish), and these articulatorily complex clusters are simplified from /*Cʎ/ to /ʎ/.

Here is where we reenter the written record. Written documentation goes from Lat. *-Cl-* to OSp. *-ll-*, OPtg. *-lh-* (= [ʎ]), and from Lat. #*Cl-* > OSp. *ll-*. Also at this historical stage, *ch* ([tʃ]) now appears in medial position in both Old Spanish and Old Portuguese.

To the best of my knowledge, no previous analysis has adequately, if at all, explained why medial position should have developed differently than in initial position. This difference has been observed, but not explained. The question is what the difference is between the two cases (i.e., initial vs. medial position, (1a) vs. (1b)).

I begin with the observation that what previous authors have called ‘medial position’ in most cases is more precisely ‘after a nasal consonant’.⁷ We know that nasals tend to assimilate to a following obstruent, and my explanation for the difference between initial and medial position lies there. That is, this linking of phonological structure increases resistance to the constraint favoring simplification of the marked cluster /Cʎ/. That is, the intuition is that loss affecting more than one segment is more costly than loss affecting a single segment. That is, /nCʎ/ is more resistant to reduction than simple (word-initial or intervocalic) /Cʎ/ because more segments would be affected.

How may this be formalized? I suggest that this may be handled via the OT instantiation of the Uniformity Condition, whose traditional formulation is given here:

(12) **The Uniformity Condition**

In order to change the feature content of a segment [A], every skeletal slot linked to [A] must satisfy the rule. (Kenstowicz 1994:413)

How may this be captured in a constraint-based approach like OT? I suggest that the effect of this condition may be characterized via constraint conjunction and the formation of a power hierarchy of conjoined constraints with relation to other constraints (see Smolensky 1995). I call this conjoined constraint LINKEDMAX, which is ranked higher than both *COMPLEX and simple MAX (that is, deletion is thwarted because of the linking in [ŋk, mp, ɱf]).⁸

(13) Fourth proposed historical stage: Retention via Linking.
(Hispano-Romance, medial position)

‘Blocking’ of cluster reduction because of nasal assimilation

/*nCɰ/ retained	LINKEDMAX (NEIGHBORHOOD)	*COMPLEX (ONSET)	MAX
η_ɰ ∨ m_ɰ ∨ ɱ_ɰ ∨	*!		(*)
<input checked="" type="checkbox"/> ηkɰ ∨ mpɰ ∨ ɱfɰ ∨		*	

I propose that the retention of this cluster via nasal assimilation allows other processes of assimilation to occur, in this case in voicing between the initial consonant and /*ɰ/. This should not be surprising given the analogous devoicing of liquids in English (*truck, plane*, etc.; Fromkin and Rodman 1988:99), French (*sucre* ‘sugar’, *pourpre* ‘purple’, *piéd* ‘foot’, etc.; Carton 1974: 30-1, 85) and even many varieties of Modern American Spanish, where /tr/ takes on an acoustic similarity to *ch* (= [tʃ]), as in *tronco* ‘trunk’, often interpreted as *chonco* by the uninitiated (Canfield 1981:7, 13, and *passim*). Furthermore, these changes often go

unnoticed consciously, and so may never be recorded in writing. This is shown in the following tableau:

(14) Voicing assimilation prevails

/*nCλ/ > [*jncλ]	LINKEDMAX (NEIGHBORHOOD)	*COMPLEX (ONSET)	MAX	ASSIMILATE
nCλ		*		*!(vce, PA)
nCλ̡		*		*!(PA)
nøλ	*!		(*)	
<input checked="" type="checkbox"/> jncλ		*		

Examples: MACULA > [*majkλa] > [*majncλa]
 IMPLARE > [*empλar] > [*ejncλir]
 INFLARE > [*injλar] > [*ijnncλar]

This leads to the next stage in the historical process, that of reinterpretation of [(j)ncλ] as [(n)tʃ] due to their high acoustic similarity:

(15) Fifth proposed historical stage: Reinterpretation. High acoustic similarity of [cλ] to [tʃ]

This acoustic similarity leads to (mis)interpretation of [cλ] by the listener as [tʃ], and then reanalysis as /tʃ/.⁹ This would be favored by markedness considerations because given the two very different articulations for what is acoustically quite similar, the listener-turned-speaker may choose the simpler of the two. This further optimizes the lexicon by maximizing the harmony of the system (i.e., what is perceived is what is mentally represented, thus reducing the work of the constraints in the grammar.)

Examples: [*majncλa] perceived as [mantʃa], reanalyzed as /mantʃa/
 [*ejncλir] = [entʃir] → /entʃir/ *henchir* (*encher* in MPtg.)
 [*ijnncλar] = [intʃar] → /intʃar/ *hinchar* (*inchar* in MPtg.)

(Additionally, /tʃ/ already exists in Old Spanish (< [jt], e.g., MULTU > H-R, MPtg. *muito* > OSp. *mucho*.)

Thus far I have given an account of the development of initial *ll-* in Spanish, medial [-*l-*] (*lh*) in Portuguese (which in Spanish then became [x]), and of medial *-ch-* for both Spanish and Portuguese. I have not yet presented an explanation of how Portuguese came to show initial *ch-*.

Recall that I and others have argued that Galician/Portuguese is a more conservative variety of the development of Late Latin. One manifestation of this is that the assimilation of /l/ to /k/ and the extension of /**kl*/ to /**pkl*, /**fl*/ was suggested not to have occurred at the same rate in pre-Old Spanish and Galician/Portuguese. Thus, the simplification of /**Ck*/ to /*k*/ did not occur in initial position in Galician/Portuguese because this cluster existed only medially, not initially as in pre-Old Spanish. Once all the /**Ck*/ clusters are simplified, the constraint *COMPLEX no longer has any candidates that it eliminates, and it fails to play any role in the continued development of these clusters. Given this, I suggest that it is demoted because it is ‘inactive’. This is the sixth historical change that I propose:

- (16) Sixth proposed historical stage: Demotion. Once /*(n)*Ck*/ is reanalyzed in Hispano-Romance as /(n)tʃ/ there will no longer be any input forms violating the constraint requiring simplification.

At this or a later historical stage, the tendency to assimilate /l/ to /k/ does indeed affect the initial *Cl* clusters of Galician/Portuguese, yielding [**Ck*] (again, see Wireback 1996 for factors involved in retarded spread of change in Galician/Portuguese). The result is that simplification is no longer the optimal outcome, and more fully assimilated forms prevail:¹⁰

- (17) Creation of *ch-* in Galician/Portuguese

Gal./Ptg. /* <i>Ck</i> / > [* <i>c_l</i>]	LINKED MAX	MAX (SON)	MAX (OBS)	*COMPLEX (ONSET)	ASSIMILATE
C∅		*!			
∅ <i>l</i>			*!		
<i>Ck</i>				*	*!(vce, PA)
<i>C_l</i>				*	*!(PA)
<input checked="" type="checkbox"/> <i>c_l</i>				*	

Examples: CLAVE > [**k*lave] > [**c_l*ave]
 PLUVIA > [**p*luvja] > [**c_l*uvja]

FLAMMA > [*fɫama] > [*çɫama]

[cɫ] is perceived as [tʃ], and is reanalyzed as /tʃ/ (*chave, chuva, chama*).

This concludes the analysis of the changes of CL, PL, FL from Late to Old Spanish and Galician/Portuguese. In the next sections I elaborate on several of the theoretical points I raised in the previous discussion.

2. The listener as source of sound change. Given that different vocal tract arrangements may yield similar acoustic speech signals, for the listener there may be articulatory ambiguity. However, the listener aims to pronounce words as nearly as possible in the way she has heard them from others (or thinks she has heard them) (Ohala 1974a,b, 1981, Slobin 1977, Greenlee and Ohala 1980, and for related points, Inkelas 1995, Hale and Reiss 1996, Yip 96).

Given the acoustic similarity of [cɫ] to [tʃ], the listener reconstructs /tʃ/ (incorrectly). This is parallel to the learning systems proposed by Clark and Roberts (1993:301) and Pulleyblank and Turkel (1995a,b,c): Several alternate grammars may adequately account for the input. When this happens, other factors determine the optimal grammar, which in the case described by Pulleyblank and Turkel (1995b) evolves to a more unmarked system. This is ‘emergence of the unmarked’ (McCarthy and Prince 1993, Smolensky 1996, etc.).

To take the case of the linked clusters, in schematic graphic form we have the following, which shows the passage of phonetic processes to lexicon optimization and the emergence of the unmarked:

(18)

/kɫ/ > [kɫ]	Does not violate ASSIM(PA) (as much)
/kɫ/ > [kɫ̥]	Does not violate ASSIM(VOICE)
(?) /kɫ̥/ > [cɫ̥]	Does not violate ASSIM(PA)
/tʃ/ > [tʃ]	Does not violate MARKEDNESS(*ɫ̥), IDENT

3. Summary and conclusion. To summarize, I explain why Spanish shows different outcome for *Cl* in initial and medial positions, and motivate the ‘magic leap’ others assumed for the passage of *Cl* to [tʃ]. This was argued to follow from the increased resistance to simplification due to there being linked phonological structure. This was enforced by the OT version of the Uniformity Condition, which then allowed the common processes of voicing and place assimilation to continue. Here the role of the listener is important: there is reinterpretation based on acoustic similarity, markedness considerations and lexicon optimization.

In schematized form, the principal points of the paper are these:

Data: The historical order of changes is summarized below:

palatal assimilation > analogy/allophonic unification > simplification vs. linking (UC) > assimilation and reinterpretation. (The spread of assimilation of #Cɫ to *Cɫ was slower in Galician/Portuguese than in Spanish; when it did occur, the constraint ranking had changed so that reduction was no longer the optimal outcome.)

An additional advance of the proposed analysis is that the process of simplification of Cɫ clusters has now been related to the creation of /tʃ/, which had not connected before.

Issues: Phonetics > phonology > lexicon
The role of the listener (acoustic equivalency, intent to repeat faithfully what heard)
The Uniformity Condition (conjunction and hierarchization), which here prevented simplification from occurring
Lexicon optimization and the emergence of the unmarked ([ɫ̞] vs. [tʃ], etc.)
Similarity of historical change to child language acquisition and learning systems

Notes

* I'd like to thank Alfonso Morales-Front and Regina Morin for comments and suggestions for improvements. I remain responsible for any deficiencies.

¹ In those Latin forms where the consonant and /l/ are not adjacent these two segments came into contact after syncope of the unstressed vowel that separates them. This is exemplified in (5), (7) and (10) below.

² Here and throughout, a form that has an asterisk before it is not reflected in the written record, but is hypothesized to have existed as an (historically) intermediate stage. Italicized forms show orthography, and words written in small capital letters are Latin forms. Latin H = [h].

³ Modern Upper Aragonese is spoken in the upper regions of the province of Aragon, in Spain (near Zaragoza). During the Middle Ages the area where Aragonese was spoken was much greater than that today.

⁴ This type of ‘lifecycle’ of a rule is explored in great detail in Janda (1987); I am indebted to Stuart Davis for making me aware of this work.

⁵ Later, Old Spanish [-ʎ-] was velarized to [x], as in *oreja* ‘ear’; Modern Portuguese maintains the final stage cited here. All examples of (7) undergo this change in Old Spanish, and Modern Portuguese maintains the simplified forms without further modification, written *lh* in Portuguese orthography.

⁶ However, the ranking is opposite that proposed for child language by Gnanadesikan (1995) (Eng. *please* /pliz/ → [piz]).

⁷ For reasons of space I must omit from consideration those cases where the consonant that precedes the *Cl* cluster is not a nasal. These are treated in Holt (in preparation).

⁸ This is quite similar in spirit to the constraint NEIGHBORHOOD proposed by Itô and Mester 1996 and earlier work by Joe Pater. This constraint penalizes processes that would affect structure on both sides of a given segment.

⁹ A very similar proposal is made in Ohala (1974a), where he refutes the purely phonological explanation given by Foley (1973) for the pronunciation in Norwegian of [oʃlo] for *Oslo*. He argues instead for the partial devoicing of [l] by [s]: he then shows that this [l̥] is acoustically similar to [ʃ], which he believes led to reinterpretation as /ʃ/. For fuller discussion of this and other similar data from Navajo, Algonquian and Itelman, see Holt (in preparation.).

¹⁰ Alternatively, the Galician/Portuguese reaction to *#Cʎ (or perhaps *#Cʎ̥) was different, with simplification to [ʎ-] in Spanish but reinterpretation as [tʃ-] in Galician/Portuguese. Since these changes happened in the preliterate period of both Old Spanish and Galician/Portuguese, it is impossible to rule out this alternative, but the proposal given in the text is more in line with the more conservative tendencies attributed to Galician/Portuguese.

Appendix: Other cases of the ‘Uniformity Condition’

In addition to the case mentioned in the text, I present here two other sets of data which appear to be amenable to a similarly-reformulated Uniformity Condition:

- (a) Loss of stop element of Proto Indo-European *g^w is blocked when a nasal consonant precedes it: e.g. PIE *g^wiōu > CL VIVUS ‘living’ vs. *d̥ŋh^wā > LINGUA ‘tongue’ (Ohala 1981).
- (b) Vocalization-cum-palatalization in Old Spanish: e.g. OCTO ‘eight’ > *[oxto] > [ojto] > *ocho*
Thwarted when more than one consonant would be affected: e.g., VULTURE > *buitre*, not [*butʃr’e] (Penny 1991) (also FRAXINU, SEX, PECTINARE, PIGNORA, etc.)

In each case a conjoined constraint dominates a structural constraint (simplification or palatalization, respectively), which in turn dominates the relevant simple constraint.

References

- Bourciez, Edouard. 1967. *Eléments de linguistique romane*. 5th. ed. Paris: Klincksieck.
- Canfield, D. Lincoln. 1981. *Spanish Pronunciation in the Americas*. Chicago: University of Chicago Press.
- Carton, Fernand. 1974. *Introduction a la phonétique du français*. Paris: Bordans.
- Clark, Robin and Ian Roberts. 1993. A computational model of language learnability and language change. *Linguistic Inquiry* 24.299-345.
- Foley, James. 1973. Assimilation of phonological strength in Germanic. In Stephen R. Anderson and Paul Kiparsky, eds., *A Festschrift for Morris Halle*. New York: Holt, Rinehart and Winston. 51-58.
- Fromkin, Victoria and Robert Rodman. 1988. *An Introduction to Language*. New York: Holt, Rinehart and Winston. 4th. ed.
- Gnanadesikan, Amalia E. 1995. Markedness and faithfulness constraints in child phonology. Ms. Rutgers University. Rutgers Optimality Archive.
- Greenlee, Mel and John J. Ohala. 1980. Phonetically motivated parallels between child phonology and historical sound change. *Language Sciences* 2.283-304.
- Hale, Mark and Charles Reiss. 1996. The comprehension/production dilemma in child language: A response to Smolensky. Ms. Concordia University, Montréal. Rutgers Optimality Archive.
- Hargus, Sharon. 1995. The first person plural subject prefix in Babine/Witsuwit’en. Ms. University of Washington. Rutgers Optimality Archive.

- Holt, D. Eric. In preparation. Constraint Interaction in the Development of Syllable Structure from Latin to Spanish and Portuguese. PhD Dissertation. Georgetown University.
- Inkelas, Sharon. 1995. The consequences of Optimization for Underspecification. *Proceedings of NELS 25*. 287-302.
- Itô, Junko and Armin Mester. 1996. Structural economy and OCP interactions in local domains. Paper presented at the Western Conference on Linguistics (WECOL), University of California, Santa Cruz, October 25-27, 1996. This volume.
- Janda, Richard David. 1987. On the Motivation for an Evolutionary Typology of Sound-Structural Rules. PhD Dissertation. UCLA.
- Janson, Tore. 1977. Latin vowel reduction and the reality of phonological rules. *Studia Linguistica* 31.1-17.
- Jonasson, J. 1971. Perceptual similarity and articulatory reinterpretation as a source of phonological innovation. *Speech Transmission Laboratory (Stockholm), Quarterly Progress and Status Report* 1.30-41.
- Kenstowicz, Michael. 1994. *Phonology in Generative Grammar*. Cambridge, Mass.: Blackwell.
- Lloyd, Paul M. 1987. *From Latin to Spanish*. Philadelphia: American Philosophical Society. Vol. 173.
- Malkiel, Yakov. 1963-4. The interlocking of narrow sound change, broad phonological pattern, level of transmission, areal configuration, sound symbolism: Diachronic studies in the Hispano-Romance consonant clusters *cl-*, *fl-*, *pl-*. *Archivum Linguisticum* 15.144-173, 16.1-33.
- McCarthy, John J. and Alan Prince. 1993. *Prosodic Morphology: Constraint Interaction and Satisfaction*. Ms. University of Massachusetts, Amherst and Rutgers University.
- Niyogi, Pradip and Robert C. Berwick. 1995. The logical problem of language change. AI Memo 1516. CBCL Paper 115, MIT.
- Ohala, John J. 1974a. Phonetic explanation in phonology. *Proceedings of CLS*. 251-274.
- Ohala, John J. 1974b. Experimental historical phonology. In J. M. Naderson and C. Jones, eds., *Historical Linguistics II. Theory and description in phonology*. *Proceedings of the First International Conference on Historical Linguistics, Edinburgh 2nd-7th September 1973*. New York: Elsevier. 353-389.
- Ohala, John J. 1980. The application of phonological universals to speech pathology. In N.J. Lass, ed., *Speech and Language: Advances in Basic Research and Practice*. Vol. 3. New York: Academic Press. 75-97.
- Ohala, John J. 1981. The listener as a source of sound change. In M.F. Miller, et al., eds., *Proceedings of CLS*.

- Ohala, John J. 1983. The origin of sound patterns in vocal tract constraints. In Peter F. MacNeilage, ed., *The Production of Speech*. New York: Springer.
- Penny, Ralph. 1991. *A History of the Spanish Language*. Cambridge: Cambridge University Press.
- Prince, Alan and Paul Smolensky. 1993. *Optimality Theory: Constraint Interaction in Generative Grammar*. Ms. Rutgers University and University of Colorado, Boulder.
- Pulleyblank, Douglas and William J. Turkel. 1995a. The logical problem of language acquisition in Optimality Theory. To appear in *Proceedings of the Workshop on Optimality in Syntax--Is the Best Good Enough?* MIT Press and MIT Working Papers in Linguistics.
- Pulleyblank, Douglas and William J. Turkel. 1995b. Optimality Theory and learning algorithms: The representation of recurrent featural asymmetries. Paper presented at *Current Trends in Phonology (CTIP)*, Abbaye de Royaumont, June 1995.
- Pulleyblank, Douglas and William J. Turkel. 1995c. Gradient ascent learning in an Optimality Theoretic Framework: Violable constraints and the treatment of local maxima. Paper presented at *Workshop on Derivations and Constraints in Phonology*, Essex, August 1995.
- Repetti, Lori and Edward F. Tuttle. 1987. The evolution of Latin *PL*, *BL*, *FL*, and *CL*, *GL* in Western Romance. *Studi Mediolatini e Volgari* 22.53-115.
- Slobin, Dan I. 1977. Language change in childhood and in history. In John Macnamara, ed., *Language Learning and Thought*. New York: Academic Press. 185-214.
- Smolensky, Paul. 1995. On the internal structure of the constraint component *Con* of UG. Handout of talk at Johns Hopkins University. Spring 1995.
- Smolensky, Paul. 1996. On the comprehension/production dilemma in child language. *Linguistic Inquiry* 27.
- Tuttle, Edward F. 1975. The development of *pl*, *bl* and *fl* in Italo-Romance: Distinctive features and geolinguistic patterns. *Revue de Linguistique Romane* 39.400-431.
- Williams, Edwin B. 1938. *From Latin to Portuguese: Historical Phonology and Morphology of the Portuguese Language*. Philadelphia: University of Pennsylvania Press.
- Wireback, Kenneth J. 1996. On the palatalization of /k/, /p/, and /f/ in Hispano-Romance. Paper presented at the 49th Kentucky Foreign Language Conference, University of Kentucky, April 19, 1996.