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Sonority Distance and Similarity Avoidance Effects in Moroccan Judeo-Spanish*

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This article investigates consonant gemination in late 19th- and early 20th-century *haketía,* a now moribund, regional dialect of Judeo-Spanish spoken in northern Morocco since the late 15th century. Some, but not all, consonant clusters arising across a word boundary undergo regressive total assimilation, e.g. [n.n] *siudad ninguna* 'no city' but [z.n] *laz niñas* 'the girls'. We present novel descriptive generalizations to show that regressive gemination is sensitive to the degree of sonority distance between the coda and the onset. Evidence of parasitic harmony comes from lateral+consonant clusters, which undergo gemination only if the target and trigger consonants are already similar in some respect. In the framework of Optimality Theory, we formalize syllable contact as a relational hierarchy of *DISTANCE constraints and capture parasitic harmony effects by similarity avoidance, or Obligatory Contour Principle, constraints against adjacent consonants with identical manner and/or place features. These markedness constraints interact with other universal faithfulness and markedness constraints in a language-specific ranking that predicts the attested patterns of regressive gemination. This study lends further support to sonority distance effects and gradient syllable contact in phonological theory and shows that similarity avoidance is also necessary to give a full account of regressive gemination in Moroccan Judeo-Spanish.

Keywords: Moroccan Judeo-Spanish (*haketía*), syllable contact, sonority distance, similarity avoidance, Obligatory Contour Principle

1. Introduction

Sonority has long been used in phonological theory to describe and explain cross-linguistic preferences in segmental sequencing within and between syllables. Many accounts of cluster phonotactics in both sound change and synchronic alternations have used some formulation of the Syllable Contact Law (Hooper 1976, Murray and Vennemann 1983, Vennemann 1988), which captures the preference for coda+onset clusters in which the coda has greater sonority than the onset. In Optimality Theory (OT; Prince and Smolensky 2004[1993]), many analyses have formalized syllable contact as a single markedness constraint against rising sonority across the syllable boundary. A challenge for this approach comes from sonority distance effects: a phonological process shows sensitivity to the degree of sonority difference between the coda and the onset, which is hard to explain with a single categorical constraint that bans all cases of rising sonority without regard to distance. Recent research has seen the proposal of more articulated models of syllable contact that use universally-ranked hierarchies of either relational markedness constraints on sonority distance (e.g. Gouskova 2001, 2002, 2004, Pons-Moll 2011) or conjoined markedness constraints on split syllable margins (e.g. Baertsch 2002, Baertsch and Davis 2008, 2009). The development of such models reflects a growing recognition that the syllable contact

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constraint of early OT is essentially a shorthand constraint and that a more complex markedness hierarchy is necessary to formalize the gradient nature of syllable contact.

In this article, we examine data from late 19th- and early 20th-century *haketía,* a now moribund, regional dialect of Judeo-Spanish spoken in northern Morocco since the late 15th century. Regressive gemination in heterosyllabic consonant clusters across the word boundary is shown to be sensitive to sonority distance. Formalizing syllable contact as a relational hierarchy of *DISTANCE constraints (Gouskova 2001, 2002, 2004), we propose an analysis that captures sonority distance effects in a way that a single syllable contact constraint cannot. Evidence of parasitic harmony is found in the patterning of lateral+consonant clusters, in which assimilation occurs only if the target and trigger consonants are already similar to one another in some respect. We capture parasitic harmony effects by using similarity avoidance, or Obligatory Contour Principle (OCP), constraints against adjacent consonants with identical manner and/or place features. This study lends further support to the role of sonority distance constraints in phonological theory and shows that similarity avoidance constraints are also necessary to give a full account of regressive gemination in *haketía.*

This article is organized as follows. Section 2 presents data illustrating regressive gemination in Moroccan Judeo-Spanish. Section 3 establishes generalizations in terms of sonority distance and develops an OT analysis that predicts the attested patterns of gemination. Section 4 focuses on lateral+consonant clusters and shows that similarity avoidance constraints are also at play. Section 5 shows how the analysis explains the complexities of regressive gemination in Moroccan Judeo-Spanish and discusses the theoretical implications and possible origins of syllable contact and similarity avoidance effects. Section 6 summarizes and concludes.

2. Geminate consonants in Moroccan Judeo-Spanish

Judeo-Spanish refers to those varieties of Spanish spoken by the Sephardic Jews. After their expulsion from Spain in 1492 by King Ferdinand and Queen Isabella, the Sephardic Jews became dispersed throughout the Mediterranean, carrying their language with them. Judeo-Spanish is known for preserving various archaic features of Old Spanish that have been lost in non-Sephardic varieties of contemporary Spanish, referred to here as Mainstream Spanish (henceforth, MS). At the same time, Judeo-Spanish is not simply an archaic form of Old Spanish that has survived into the present day. Often in contact with languages spoken in the areas of Sephardic settlements, many Judeo-Spanish dialects have developed innovative features that are not found in Old Spanish or MS (Bunis 2008, Penny 2000: 174–193, Quintana 2006). One such innovation is the formation of geminate consonants in *haketía,* or Moroccan Judeo-Spanish (henceforth, MJS), a now moribund variety spoken up through the late 19th and early 20th centuries (Bénichou 1945, Benoliel 1977[1926–8]).[1] In MJS, certain consonant clusters arising across the word (or clitic) boundary are subject to regressive gemination: the coda assimilates to the onset, resulting in a lengthened realization of the latter. Sequences of non-identical consonants show a complex pattern of regressive gemination targeting some clusters but not others. Sequences of identical consonants are always phonetically long.

[1] Beginning with the Spanish involvement in Morocco in the mid-19th century, language contact has led to dialect leveling with Peninsular Spanish (Penny 2000: 192–193). MJS has adopted some of the more modern phonemes and allophonic processes of MS, which continues to be used as a communicative code in present-day northern Morocco, due to mass media influence and to close socioeconomic links with Spain (Scipione and Sayahi 2005). Bunis (2008) provides a sociolinguistic and structural linguistic comparison of MJS and the JS dialects that developed in the Ottoman Empire. For more recent discussion of MJS, see Kirschen (2015) and Raz (2015).

The only common word-final coda consonants in MJS are the same as in MS, namely coronal /d,s,ɾ,l,n/, except that MJS lacks the interdental fricative /θ/ found in Castilian Spanish (Hualde 2005: 76). The data presented below are from Benoliel (1977[1926–8]: 8–27) and Bénichou (1945: 229–232), each of whom employs his own transcription system adapted from Castilian orthography. We use the vertical line to denote a word boundary in our phonemic transcriptions, and we underscore the relevant consonants in each example. The most susceptible word-final consonant is /d/, which assimilates to a following word-initial liquid (1a,b), nasal (1c,d), and voiceless coronal stop (1e).

(1)	a. /d|ɾ/ → [r]	*una siudar rica*	‘a rich city’
	b. /d|l/ → [lː]	*la verdal la diré yo*	‘the truth, I will say it’
	c. /d|n/ → [nː]	*siudán ninguna*	‘no city’
	d. /d|m/ → [mː]	*la libertam me gusta*	‘liberty pleases me’
	e. /d|t/ → [tː]	*de verdat te lo digo*	‘in truth I tell you’

Neither Bénichou nor Benoliel mentions any assimilation of word-final /d/ to a following word-initial non-coronal obstruent /p,b,f,k,g/ or coronal sibilant /s,ʃ,ʒ/. Just by way of illustration, the lack of regressive gemination in hypothetical *siudad briyante* ‘shining city’ contrasts with the assimilation in (1d), where the word-initial bilabial is nasal instead of obstruent. Similarly, hypothetical *siudad sekreta* ‘secret city’ contrasts with (1e), where the word-initial coronal obstruent is a stop instead of a sibilant.

Word-final /s/ assimilates to a following word-initial liquid (2a,b) and to a following word-initial sibilant, whether voiced (2c) or voiceless (2d).

(2)	a. /s|ɾ/ → [r]	*gaínar refritas*	‘thoroughly fried hens’
		mir ricaz mangas	‘my rich sleeves’
		lor ratones	‘the mice’
		dor reloxes	‘two watches’
		dor rozas	‘two roses’
		trer ramas	‘three branches’
	b. /s|l/ → [lː]	*todal laz aves*	‘all the birds’
		el la que quiero yo	‘it’s the one that I want’
		otro día el la mañana	‘tomorrow is another day’
		lol libros	‘the books’
		lal letras	‘the letters’
	c. /s|ʃ/ → [ʃː]	*loš šarales*	‘the thickets’
	d. /s|ʒ/ → [ʒː]	*donzeyaž žaze*	‘maidens lie’

Word-final /n/ assimilates to a following word-initial liquid (3a,b) and to the bilabial nasal (3c).

(3)	a. /n|ɾ/ → [r]	*el huer rey*	‘the good king’
	b. /n|l/ → [lː]	*el la siudad*	‘in the city’
	c. /n|m/ → [mː]	*em mano*	‘in hand’
		com Martinico	‘with Martinico’

With respect to the phonetic trill (3a), Bénichou is clear to point out that “the rolling of *r* can come only from the assimilation of the *n;* normally the word is not pronounced *rrey* but *rey* [our translation—TGB and JJA]” (p. 230, fn.3). In MJS, word-initial rhotics are realized phonetically as a tap [ɾ] after a vowel, e.g. *la* [ɾ]*eina* ‘the queen’ and *vistióse de* [ɾ]*omerita* ‘dressed herself as a little pilgrim’, in contrast to the word-initial trill [r] found in Castilian Spanish, e.g. *la* [r]*eina* and *de* [r]*omerita* (p. 213). We assume that Bénichou’s description of /n|ɾ/ holds true for /d|ɾ/ (1a) and /s|ɾ/ (2a), as well as /l|ɾ/ (4a) and /ɾ|ɾ/ (12d) below.

As for word-final /l/, regressive gemination is most widely attested in the context of the masculine singular definite article *el* ‘the’ and its contractions with prepositions, *al* < *a* + *el* ‘to/in the’ and *del* < *de* + *el* ‘of the’. The lateral assimilates to a following word-initial /ɾ/, surfacing as a trill [r] (4a), and to a following word-initial nasal, surfacing as [nː] (4b). Benoliel (1977[1926–8]: 19) first observed lateral assimilation in /l|d/ (4c) in late 19th-century MJS. According to Bénichou’s later description, /l|d/ had ceased to undergo assimilation by the early 20th century.

(4)	a.	/l|ɾ/ → [r]	*er ratón*	‘the mouse’
			er rey	‘the king’
			er rico mansano	‘the rich apple tree’
			er relox	‘the clock’
			er rebbí	‘the rabbi’
			der rubio	‘of the blond’
	b.	/l|n/ → [nː]	*en niño*	‘the child’
			an nombre de Dió	‘in the name of God’
			den negro mazzal	‘of the dark fate’
	c.	/l|d/ → [dː]	*Ad Dió*	‘to the God’
			A mi el Dió > Amid Dió	‘to me the God’
			ed de	‘the one from’
		(cf. [ld] by the early 20th century)		

Although most common in the masculine singular definite article and its contractions, the assimilation of word-final /l/ is not limited to this morphological context. The examples in (5) show lateral assimilation in the context of adjectives and determiners before a following word-initial /ɾ/ (Benoliel (1977[1926–8]: 22):

(5)	/l|ɾ/ → [r]	*mar rayo*	‘bad lightning’
		un mar rato	‘a bad time’
		¿cuar razón?	‘which reason?’
		aquer remedio	‘that remedy’

Additional examples from Bénichou (1945: 215–216,230–231) show that /l/ is maintained in definite articles before a coronal other than /ɾ,n,d/ (6a) and before non-coronals (6b,c), as well as before non-coronals in morphemes other than the definite article, such as the demonstrative determiner (6d).

(6)	a.	/l|s/ → [ls]	*por una la'ntra'l sol*	'through one the sun enters it'
	b.	/l|bw/ → [lw]	*el huer rey*	'the good king'[2]
		/l|m/ → [lm]	*mañanal medio día*	'tomorrow at noon'
	c.	/l|k/ → [lk]	*a casar va'l cabayero*	'to hunt goes the knight'
			por meatad del corazón	'for half of the heart'
	d.	/l|k/ → [lk]	*d'aquel camino*	'from yonder path'

Bénichou describes the assimilation of final /ɾ/ to a following morpheme-initial /l/ in infinitive+clitic sequences (7a) and in the context of a preposition followed by a noun (7b) (pp. 229–231).

(7)	a.	/ɾ|l/ → [lː]	*contal-le*	'to tell him'
	b.	/ɾ|l/ → [lː]	*vas pol leña*	'you go to get wood'

The same pattern is observed by Benoliel, who documents the assimilation of infinitival /ɾ/ before /l/-initial clitic pronouns (8a) and definite articles (8b) (p. 23).

(8)	a.	/ɾ|l/ → [lː]	*cortal-le'l pelo*	'to cut his hair'
			cortal-la las uñas	'to cut her nails'
			tomal-lo todo	'to take it all'
			buxcal-los	'to look for them (masc.)'
			cural-las	'to cure them (fem.)'
			dal-los algo	'to give them (masc.) something'
			pedil-los algún dinero	'to ask them (masc.) for some money'
			querel-los mucho bien	'to love them (masc.) a lot'
			desseal-los algún mal	'to wish them (masc.) something bad'
	b.	/ɾ|l/ → [lː]	*subil la 'scalera*	'to go up the stairs'
			abaxal loz ojos	'to look down'
			bezzal las manos	'to kiss the hands'

Some general observations emerge from the data presented thus far. In most of the examples of regressive gemination, the word-final coda consonant assimilates to the manner class of the following word-initial consonant. In a subset of cases, the adjacent consonants already share the same manner, and assimilation involves changing other features of the coda: voicing in /d|t/ → [tː] (1e), place of articulation in /s|ʃ/ → [ʃː] (2c) and /n|m/ → [mː] (3c), or both voicing and place in /s|ʒ/ → [ʒː] (2d). Neither Bénichou nor Benoliel mentions if there are any syntactic constraints on the domain of regressive gemination. The syntactic relations between the words that comprise the target and trigger of assimilation in (1) – (8) are quite diverse and include the following pairs: noun+adjective, noun+proclitic, noun+verb, verb+determiner, verb+enclitic, adjective+noun, adjective+determiner, determiner+adjective, determiner+noun, preposition+determiner, preposition+noun, and preposition+adjective. It seems clear that regressive gemination is triggered by the juxtaposition of any two words regardless of their syntactic relation, as long as the phonological environment is met.

[2] Bénichou's transcription of word-initial /bwe/ as *hue* reflects an independent change involving the loss of initial bilabial and velar voiced stops before prevocalic /w/ (Benoliel 1977[1926–1928]: 15).

Another possibility is that regressive gemination depends not on syntactic structure but on prosodic boundaries. Prosodic structure is built up in systematic and language-specific ways, and phonological processes can be restricted to apply within a prosodic domain or at the juncture between domains (Nespor and Vogel 1986, Selkirk 1984, 1996, Selkirk and Lee 2015, Zec and Inkelas 1990). Some commonly assumed prosodic constituents that have been proposed above the foot level include the following: Utterance (U) > Intonational Phrase (IP) > Phonological Phrase (PP) > Prosodic Word (PW). The available data suggest that regressive gemination in MJS applies both within and across the PW domain. In the following prosodic representations, unstressed function words (determiners, pronouns, and prepositions) are analyzed as clitics that adjoin to an adjacent PW to form an outer PW.[3]

(9) a. (*los* (*libros*))$_{PW}$ 'the books'
b. (*en* (*la* (*siudad*)))$_{PW}$ 'in the city'
c. ((*contar*) *le*)$_{PW}$ 'to tell him'

(10) a. (*siudad*)$_{PW}$ (*ninguna*)$_{PW}$ 'no city'
b. (*bezzar*)$_{PW}$ (*las* (*manos*))$_{PW}$ 'to kiss the hands'
c. (*la* (*libertad*))$_{PW}$ (*me* (*gusta*))$_{PW}$ 'liberty pleases me'

The clusters targeted by regressive gemination are internal to the outer PW domain in (9) but span across two distinct PW domains in (10), where the first word is stressable, but the following word need not be. What remains unknown, based on Bénichou's and Benoliel's descriptions, is the extent to which gemination applies across higher prosodic domains such as PP and IP.

While gemination is productive across morpheme boundaries, Bénichou cites only a handful of examples in which regressive assimilation derives morpheme-internal geminates, e.g. *horra* (< *honra*) 'honor', *bulla* (< *burla*) 'taunt', *pella* (< *perla*) 'pearl' (p. 231).[4] Further data suggest that most heterosyllabic consonant sequences are generally immune to regressive gemination if both consonants belong to the same morpheme. Apart from the examples in (2), coda /s/ otherwise surfaces intact in MJS and is not subject to the debuccalization and elision processes that characterize Andalusian Spanish. According to Bénichou, MJS has a process of regressive sibilant voicing both within and across morpheme boundaries, whereby /s/ surfaces as [z] before voiced obstruents (11a) and most sonorants (11b,c), as well as in morpheme-final prevocalic position (11d) (p. 217). As for the realization of the voiced stops in (11a), Bénichou's description makes it clear that /b,d,g/ in MJS show the same allophonic distribution as in Castilian Spanish (pp. 211–212). In this and other normative varieties of MS, stops [b,d,g] appear after a pause, after homorganic nasals, and in the case of /d/, after /l/, while continuants [β,ð,ɣ] appear elsewhere (Hualde 2005:139).

[3] Alternatively, unstressed function words can be included as proclitics directly in the PW domain of a following word, without the recursive structure (see Hualde 2007). See Quilis (1988: 314-318) for a complete list of stressable and unstressable words in Spanish.

[4] Bénichou also gives examples of "spontaneous" morpheme-internal intervocalic geminates, e.g. *pezzar* 'to weigh', *assar* 'to grill', *au̯wa* 'water', *lu̯uwar* 'place', *mai̯yor* 'older' (p. 232). These long segments are etymologically unexpected because they all correspond to singletons in MS, i.e. *pesar, asar, agua, lugar, mayor.* Variant forms are attested for several lexical items, e.g. *pIzziera* ~ *puziera* 'might have put', *ju̯uwar* ~ *juwar* 'to play', *seppamos* ~ *sepamos* 'we might know', *fummo* ~ *humo* 'smoke'.

(11)	a.	/sb/ → [zβ]	*rezbalar*	'to slip'
			loz bienes	'the goods'
		/sd/ → [zð]	*dezde*	'since'
			dez-dicha	'misery'
		/sg/ → [zɣ]	*juzgar*	'to judge'
			dez-gracia	'misfortune'
	b.	/sm/ → [zm]	*mizma*	'same'
			loz mayores	'the oldest ones'
		/sn/ → [zn]	*rebuznar*	'to bray'
			laz niñas	'the girls'
	c.	/sl/ → [zl]	*izla*	'island'
		/sɾ/ → [sɾ]	*Israel*	'Israel'[5]
	d.	/sV/ → [zV]	*laz aves*	'the birds'
			ez ángel	'it is an angel'
			dez-esperado	'desperate'

The contrast between gemination in *mir ricaz* and *el la* (2a,b) versus cluster maintenance in *loz mayores* and *laz niñas* (11b) shows that /s/+liquid clusters pattern differently than /s/+nasal clusters across morpheme boundaries. The contrast between gemination in *mir ricaz* and *el la* (2a,b) versus cluster maintenance in *Israel* and *izla* (11c) shows that /s/+liquid clusters surface as geminates across but not within morphemes.

As for other morpheme-internal clusters, Bénichou gives examples in which obstruent sequences are realized intact: *bušcar* 'to look for', *mošca* 'fly', *cašca* 'shell', *sibdad* 'city', *yebdo* 'leavened', *xebdo* 'bland' (p. 221). Benoliel also documents morpheme-internal nasal+obstruent clusters: *ando* 'I walk', *mundo* 'world', *mango* 'handle', *cinco* 'five' (p. 20). Neither author makes any other mention of systematic coda liquid assimilation, apart from the heteromorphemic clusters in (4), (5), (7), and (8). It seems reasonable to conclude that in MJS, regressive consonant gemination is largely confined to heteromorphemic clusters.

Finally, when two identical coronal consonants come into contact across the word boundary, the result is a phonetically long consonant. The examples in (12a–d) show this realization of /d|d/, /s|s/ and /l|l/ clusters, whereas /ɾ|ɾ/ surfaces as a trill (Bénichou 1945: 219, 229, Benoliel 1977[1926–8]: 19).

(12)	a.	/d|d/ → [dː]	*la siudad de Toledo*	'the city of Toledo'
			por meatad del corazón	'for half of the heart'
	b.	/s|s/ → [sː]	*déme sus señas señora*	'give me your address, ma'am'
			vos serís	'you (pl.) will be'
			dossientos	'two hundred'
			tressientos	'three hundred'
	c.	/l|l/ → [lː]	*mal lograda*	'poorly carried out'
			el libro	'the book'
			al libro	'to the book'
			del libro	'of the book'
			'nel libro	'in the book'

[5] "*Israel* is pronounced with a voiceless *s* under influence from Hebrew [our translation]" (Bénichou 1945: 217).

d. /ɾ|ɾ/ → [r] *dar razón* ‘to give reason’
tener recelo ‘to have suspicion’
hazer retratos ‘to do portraits’

Bénichou’s description is clear that nasal and lateral clusters are pronounced the same as in Castilian Spanish, e.g. *u*[nː]*iño* ‘a boy’ and *e*[lː]*ibro* ‘the book’ (p. 229). Recall that word-initial rhotics in MJS are realized phonetically as a tap [ɾ]. When a word-initial [ɾ] follows a word-final [ɾ], the resulting sequence is pronounced with longer duration as a trill (see Bénichou’s summary chart on p. 231), which is in keeping with our transcription of the surface [r] that results from regressive gemination in (1a), (2a), (3a), and (4a).

In contrast to MJS, geminate consonants are mostly absent from MS (Hualde 2005: 95–98). Unlike Latin or Italian, MS has no geminate segments within the word domain, apart from a few exceptions involving learned words. Normative MS also lacks any process of regressive assimilation that systematically derives word-boundary geminates. Sequences of identical final and initial coronals undergo partial reduction if both consonants are continuant (13a–d) but are realized with longer duration if they have a complete closure formed by the tongue tip (13e,f). Hualde’s transcriptions use the symbol ‘~’ to show that reduction is not complete but instead approaches the length of the corresponding singleton.

(13) a. /s|s/ → ~[s] *ojos secos* ‘dry eyes’
b. /θ|θ/ → ~[θ] *paz cercana* ‘approaching peace’
c. /d|d/ → ~[ð] *ciudad destruida* ‘destroyed city’
d. /ɾ|r/ → ~[r] *Mar Rojo* ‘Red Sea’
e. /n|n/ → [nː] *avión nuevo* ‘new airplane’
f. /l|l/ → [lː] *mal lago* ‘bad lake’

In MS, /d/ is realized as a continuant [ð] after another continuant segment (Hualde 2005: 139), so the alternation in (13c) plausibly involves the reduction of intervocalic [ð|ð](</d|d/) to ~[ð]. This contrasts with MJS (12a), in which /d|d/ is realized as a geminate stop [dː].

Regressive gemination in MJS poses an analytical puzzle because it is not immediately obvious how to explain which clusters are targeted by the process and which are immune to it. The data give rise to several questions about the contexts of assimilation and the consonants that pattern as targets and triggers:

(14) a. Why does each one of the commonly occurring word-final coronals /d,s,ɾ,l,n/ assimilate to a word-initial liquid /ɾ,l/ but not necessarily to other consonant types?
b. Why is assimilation less likely to target clusters that combine a sibilant fricative and a non-sibilant consonant?
c. Why does word-final /d/ assimilate to a word-initial obstruent only if it is also coronal but to a word-initial nasal whether it is coronal or bilabial?
d. Within the class of coronal liquids, why is word-final /ɾ/ less susceptible to assimilation than word-final /l/?

In the following section, we show that the key to understanding these patterns begins with a particular theory of syllable contact that makes reference to degrees of sonority distance.

3. Sonority distance effects in regressive gemination

Cross-linguistically, codas prefer to be more sonorous (i.e. louder, in acoustic terms), while onsets prefer to be less sonorous. Languages tend to avoid coda+onset sequences in which the following onset is more sonorous than the preceding coda, a tendency referred to as the Syllable Contact Law (Murray and Vennemann 1983; Vennemann 1988; see Seo 2011 for a recent summary and overview of syllable contact in phonological theory). A common approach in the OT literature is to formalize syllable contact as a single markedness constraint SYLLABLECONTACT (SYLLCON), that penalizes a rise in sonority across the syllable boundary (e.g. Baertsch and Davis 2004, Bradley 2006a, 2007, Davis and Shin 1999, Holt 2004, among others). Some accounts, like that of Korean by Davis and Shin (1999), which use a single syllable contact constraint do so as a shorthand or as a matter of convenience, since some languages like Korean do not show a preference for different types of non-rising syllable contact. A language like Korean disallows any rising sonority cluster and generally accepts other cluster types. Other languages show sonority distance effects, whereby a phonological process is sensitive to the degree of sonority distance between the coda and the onset. This sensitivity cannot be captured by a single SYLLCON constraint that treats all rising sonority clusters the same. Recent research has led to the development of more articulated models of gradient syllable contact, based on universally-ranked hierarchies of either relational markedness constraints on sonority distance (e.g. Gouskova 2001, 2002, 2004, Pons-Moll 2011) or conjoined markedness constraints on split syllable margins (e.g. Baertsch 2002, Baertsch and Davis 2008, 2009). We argue that regressive gemination in MJS gives further empirical evidence of sonority distance effects, which motivates a gradient model of syllable contact optimization.

To show that gemination is sensitive to sonority distance in heterosyllabic clusters, we assume a basic, uncontroversial sonority scale (15) dividing segments into five separate classes of increasing sonority (see Clements 1990, Parker 2002, 2011, Seo 2011, among many others; for Spanish in particular, see Martínez-Gil 1996, 1997, Holt 2004, Colina 2009).

(15)	obstruents	nasals	liquids	glides	vowels
	1	2	3	4	5

These sonority values form the basis of the phonotactic chart in Figure 1, which summarizes the relevant possible combinations of word-final and word-initial consonants in MJS:

<table>
<tr><th></th><th colspan="10">onset</th></tr>
<tr><td></td><td>ɾ
3</td><td>l
3</td><td>n
2</td><td>m
2</td><td>s
1</td><td>ʃ
1</td><td>ʒ
1</td><td>d
1</td><td>t
1</td><td>b
1</td></tr>
<tr><td>coda d
1</td><td>d|ɾ
+2</td><td>d|l
+2</td><td>d|n
+1</td><td>d|m
+1</td><td>d|s
0</td><td>d|ʃ
0</td><td>d|ʒ
0</td><td>d|d
0</td><td>d|t
0</td><td>d|b
0</td></tr>
<tr><td>s
1</td><td>s|ɾ
+2</td><td>s|l
+2</td><td>s|n
+1</td><td>s|m
+1</td><td>s|s
0</td><td>s|ʃ
0</td><td>s|ʒ
0</td><td>s|d
0</td><td>s|t
0</td><td>s|b
0</td></tr>
<tr><td>n
2</td><td>n|ɾ
+1</td><td>n|l
+1</td><td>n|n
0</td><td>n|m
0</td><td>n|s
–1</td><td>n|ʃ
–1</td><td>n|ʒ
–1</td><td>n|d
–1</td><td>n|t
–1</td><td>n|b
–1</td></tr>
<tr><td>l
3</td><td>l|ɾ
0</td><td>l|l
0</td><td>l|n
–1</td><td>l|m
–1</td><td>l|s
–2</td><td>l|ʃ
–2</td><td>l|ʒ
–2</td><td>l|d
–2</td><td>l|t
–2</td><td>l|b
–2</td></tr>
<tr><td>ɾ
3</td><td>ɾ|ɾ
0</td><td>ɾ|l
0</td><td>ɾ|n
–1</td><td>ɾ|m
–1</td><td>ɾ|s
–2</td><td>ɾ|ʃ
–2</td><td>ɾ|ʒ
–2</td><td>ɾ|d
–2</td><td>ɾ|t
–2</td><td>ɾ|b
–2</td></tr>
</table>

Figure 1: Sonority distances in MJS consonant clusters arising across word boundaries.

In the chart, coda and onset consonants are ordered by their sonority values, with sonority increasing from top to bottom and from right to left. The rightmost column includes the voiced bilabial stop /b/, which stands in for any non-coronal obstruent in word-initial onset position. Consonant clusters formed by the intersection of rows and columns are shown in broad transcription, abstracting away from the voicing alternation in coda /s/ and the continuancy alternation in /d,b/. Sonority distances are given under each cluster and are calculated by subtracting the sonority value of the coda from that of the following onset. Positive distance values denote a sonority rise; zero, a flat sonority plateau; and negative values, a sonority fall. Double lines indicate degrees of sonority difference in cases of non-falling syllable contact, and shading indicates which clusters surface as geminates. The thicker the double lines and the darker the shading, the higher the sonority distance between coda and onset. The steepest rises appear at the top left, and the greatest sonority falls at the bottom right.

Viewing syllable contact in terms of sonority distances makes it possible to state new generalizations about regressive gemination in MJS, shown in (16). The clusters listed after each generalization can be matched up with those in Figure 1, starting within each sonority distance class at the top left and moving generally rightward and downward within the figure. These generalizations define natural classes of heterosyllabic consonant clusters in terms of sonority distance. Exceptions to regressive gemination in (16b,c) make reference to the manner and place of articulation of the consonants involved. The interaction between sonority distance and manner and place features lends itself readily to an OT analysis based on constraint conflict.

(16) A syllable contact with...
a. a sonority distance of +2 results in a geminate without exception: /d|ɾ/, /d|l/, /s|ɾ/, /s|l/
b. a sonority distance of +1 results in a geminate, except for clusters with a coda sibilant: /d|n/, /d|m/, /n|ɾ/, /n|l/ vs. /s|n/, /s|m/
c. a sonority distance of 0 results in a geminate, except for clusters with (i) a coronal stop and sibilant or (ii) obstruents that differ in primary place of articulation: /d|d/, /d|t/, /s|s/, /s|ʃ/, /s|ʒ/, /n|n, /n|m/, /l|ɾ/, /l|l/, /ɾ|ɾ/, /ɾ|l/ vs. (i) /d|s/, /d|ʃ/, /d|ʒ/, /s|d/, /s|t/ and (ii) /d|b/, /s|b/
d. a negative sonority distance does not result in a geminate, except for /l|n/ and, marginally, /l|d/

We formalize syllable contact in terms of the relational markedness hierarchy in (17), which penalizes successively higher sonority distances (Gouskova 2001, 2001, 2004). The hierarchy is relational in the sense that well-formed codas and onsets are determined not by the sonority of the individual segments in isolation but by the sonority distance between the adjacent consonants in relation to each other. This ranking shows only those *DISTANCE constraints that are relevant to our account of MJS.[6]

(17) … » *DIST +2 » *DIST +1 » *DIST 0 » *DIST –1 » *DIST –2 » …

According to this universal ranking, a sonority rise of two degrees is more marked than a rise of one degree, which is more marked than a sonority plateau. In turn, a plateau is worse than a sonority fall of one degree, which is worse than a fall of two degrees, and so on. Unlike a single syllable contact constraint that bans all sonority rises, the hierarchy in (17) distinguishes among multiple degrees of both rising and falling sonority, as well as flat sonority.

For the purposes of this paper, we adopt a distinction between *fake geminates,* with a one-to-one relation between two segments and their associated timing units, and *true geminates,* with a one-to-many association between a single segment and two timing units (compare (20a) and (20b,c) below). The formation of true geminate consonants in MJS is governed by the interaction of *DISTANCE constraints with the markedness constraint (18a) and the faithfulness constraints (18b–d).

(18) a. *GEMINATE
Avoid a one-to-many association between a single segment and two timing units. (“Avoid true geminates.”)
b. PRES-CC(dur)
The overall duration of an input consonant cluster is preserved in the output. (“Preserve consonant cluster duration.”)
c. MAX-C
Every consonant in the input has a correspondent in the output. (“Don’t delete a consonant.”)

[6] If it turns out that other *DISTANCE constraints play no role elsewhere in the MJS grammar, then it would make sense to conflate the contiguous inactive constraints into a set of constraints that maintain a stringency relation and are freely rankable (de Lacy 2002, 2004, Pons-Moll 2011:112-13, Prince 2001; also see Section 4 on stringency relations among similarity avoidance constraints).

d. UNIFORMITY
No segment of the output has multiple correspondents in the input. ("Don't coalesce multiple segments into one.")

A cluster of identical consonants is a fake geminate and violates the constraint against flat sonority, *DIST0. On the other hand, a true geminate consonant violates *GEMINATE but is immune to sonority distance constraints, which evaluate only segmental clusters (see Gouskova 2004: 226, Pons-Moll 2011: 143). PRES-CC(dur) is violated whenever the overall duration of an input cluster is not maintained in the output. Jun (1995: 132–137) proposes to account for compensatory lengthening in assimilated clusters with constraints that preserve perceptual cues for consonantal manner features. PRES-CC(dur) plays the same role in our analysis but makes direct reference to duration of the input cluster (also see Kirchner 1998: 243 and Gess 2009: 243, who use similar PRES(duration) constraints). The input-output correspondence constraints (18c,d) regulate consonant deletion and segmental fusion, or coalescence (McCarthy and Prince 1999: 294,296). MAX-C is violated when an input consonant has no correspondent in the output, and UNIFORMITY when two or more input segments are merged into a single segment in the output.

The correspondence constraints in (19) capture the role that manner and place of articulation features play in conditioning gemination in MJS:

(19) a. IDENT(strid)
Corresponding segments are identical with respect to the feature [±strident]. ("Be faithful to [±strident].")

b. MAX_{OBS}(place)
The primary place feature of an input obstruent segment is realized in the output. ("Don't delete an obstruent place feature.")

c. MAX(nas)
The feature [nasal] of an input segment is realized in the output. ("Don't delete a [nasal] feature.")

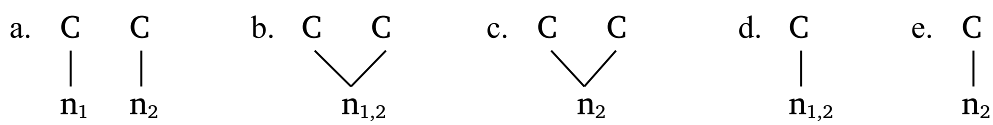
d. MAX(lat)
The feature [lateral] of an input segment is realized in the output. ("Don't delete a [lateral] feature.")

e. MAX(rho)
The feature [rhotic] of an input segment is realized in the output. ("Don't delete a [rhotic] feature.")

Our use of IDENT versus MAX constraints depends on whether the relevant feature is binary or privative (see Davis and Shin 1999, who make the same distinction). We assume that [±strident] is a binary feature and that consonants may be specified for positive or negative values. For example, IDENT(strid) is violated when a [–strident] consonant in the input becomes [+strident] in the output, or when a [+strident] consonant becomes [–strident]. Such a change does not also violate MAX(strid) because the consonant still has a value for the feature [±strident]. On the other hand, we assume that primary place of articulation features {LABIAL, CORONAL, PALATAL, DORSAL} as well as the manner features [nasal], [lateral], and [rhotic] are all privative, having only a single value. A privative feature is either present or absent in a segment. If a [nasal] consonant in the input becomes oral in the output, then the loss of the [nasal] feature violates MAX(nas).[7]

As an illustration of how the constraints are violated, let us assume an input cluster /d|n/, whose faithful realization violates the sonority distance constraint *DIST+1. The output candidates in (20) represent several possible repair strategies that avoid this violation, albeit at the expense of violating other constraints. Subscripts indicate the output correspondents of each consonant in the input cluster. Phonetic transcriptions are given below each phonological representation.

(20) Input: /d_1|n_2/



a.	b.	c.	d.	e.
[nn]	[nː]	[nː]	[n]	[n]
fake geminate	*true geminate*	*true geminate*	*singleton*	*singleton*

In (20a), the coda stop takes on the manner of the following nasal but remains a separate consonant, producing a fake geminate in violation of *DIST0. This mapping satisfies MAX-C because /d_1/ has an output correspondent in [n_1], UNIFORMITY because the input segments do not undergo coalescence, and PRES-CC(dur) because the duration of the input cluster is maintained.[8] In (20b), the input cluster undergoes coalescence to a true geminate nasal. This mapping violates UNIFORMITY and *GEMINATE but satisfies both MAX-C because /d_1/ still has an output correspondent in [$n_{1,2}$] and PRES-CC(dur) because the dual association to two timing slots preserves the overall duration of the input cluster. The true geminate in (20c) arises not by coalescence but by deletion of the first consonant, violating MAX-C, and gemination of the second, violating *GEMINATE. The phonological singletons in (20d,e) differ in their violation of UNIFORMITY and MAX-C, but both fail to preserve the duration of the input cluster, violating PRES-CC(dur).

We argue that marked sonority distances in MJS are repaired by coalescence to a true geminate (20b) because UNIFORMITY and *GEMINATE are crucially dominated by higher-ranking constraints that are fatally violated by the competing output candidates: *DIST0 by the fake geminate (20a), MAX-C by consonant deletion (20c,e), and PRES-CC(dur) by the failure to maintain consonant cluster duration (20d,e). We also assume a high-ranking constraint UNIFORMITY$_{\text{ROOT}}$, which rules out coalescence of morpheme-internal consonant clusters while still allowing coalescence across morpheme boundaries (Pater 1999). To simplify the

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[7] A reviewer asks for independent evidence to support our assumptions about binary and privative features. In their OT account of Korean syllable contact, Davis and Shin (1999) also use privative [nasal] and [lateral] but point out that "the same analysis with minor changes would work if we made other assumptions about feature specification" (p. 303). For evidence based on the phonology of coronals that [±strident] is a binary feature, see Hall (1997: 34-41).

[8] The mapping would also incur a violation of DEP(nas), which penalizes the insertion of non-underlying [nasal] features. Alternatively, the nasalization of /d_1/ by regressive spreading of the feature [nasal] from /n_2/ would incur a violation of DEP(link), which penalizes non-underlying association lines. Since these constraints play no role in our analysis, we do not consider them further.

presentation of the analysis, our tableaux generally omit low-ranking UNIFORMITY, as well as high-ranking UNIFORMITY$_{\text{ROOT}}$, MAX-C, and PRES-CC(dur).

Repair strategies other than regressive gemination are ruled out by high-ranking constraints not shown here. Positional input-output faithfulness constraints (Beckman 1998[1999]) have been argued to protect segments in phonologically strong, perceptually salient contexts, such as prevocalic onsets. We assume that high-ranking positional faithfulness constraints relativized to the syllable onset protect prevocalic consonants from undergoing change, which explains why gemination is regressive and not progressive. For example, faithfulness constraints relativized to onset position rule out changes in manner features of word-initial consonants, such as binary [±voice] and [±sonorant] (/d|t/ → *[dː]; /l|d/ → *[lː]) and privative [nasal], [lateral], and [rhotic] (/d|n/, /d|l/, /d|ɾ/ → *[dː]; /s|l/, /s|ɾ/ → *[sː]; /n|l/, /n|ɾ/ → *[nː]; /l|ɾ/ → *[lː]; /ɾ|l/ → *[r]), as well as changes in place of articulation (/s|ʃ/ → *[sː]; /n|m/ → *[nː]). The constraint LINEARITY keeps metathesis from transposing rising sonority clusters into their falling sonority counterparts (/d|n/ → *[nd]; /d|l/ → *[ld]).[9]

3.1 Rising sonority clusters

According to the first generalization (16a), the steepest sonority rises make the best targets of regressive gemination. This pattern is captured by ranking *DIST+2 above IDENT(strid) and *GEMINATE, as shown in tableau (21) for /s|l/ and /d|l/ clusters. To help connect the formal analysis back to the original data set, we provide corresponding examples (in a few cases, hypothetical but well motivated) above this and subsequent tableaux. Furthermore, output candidates abstract away from the continuancy alternation in /d/. The intact clusters in candidates (21a,c) fatally violate *DIST+2. The clusters are repaired by the formation of geminate laterals, which violates low-ranking IDENT(strid) in (21b) and *GEMINATE in (21b,d).

(21) Clusters with a sonority distance of +2
lol libros 'the books', *la verdal la diré yo* 'the truth, I will say it'

	*DIST+2	IDENT(strid)	*GEMINATE
a. /s$_1$|l$_2$/ z$_1$l$_2$	*!		
☞ b. lː$_{1,2}$		*	*
c. /d$_1$|l$_2$/ d$_1$l$_2$	*!		
☞ d. lː$_{1,2}$			*

An alternate mapping not shown in tableau (21) involves deletion of the input sibilant, i.e. /s$_1$|l$_2$/ → [lː$_2$]. Since there is no longer any corresponding output segment whose [±strident] feature can be evaluated against that of input /s$_1$/, a candidate like [lː$_2$] vacuously satisfies IDENT(strid) and should be preferred over (21b), which violates the same constraint. In order to rule out sibilant deletion, MAX-C must be assumed to dominate IDENT(strid). The same argument holds for an output candidate [r$_2$] mapped from input /s$_1$|ɾ$_2$/ (see tableau (22) below).

Recall that regressive assimilation in the context of a word-initial tap results in a single phonetic trill. Based on auditory impression alone, the two rhotics would appear to differ in the number of lingual contacts: one for the tap versus two or more for the trill. However, evidence

9 See Bradley (2006a, 2007) for an OT account of sonorant metathesis in other Judeo-Spanish dialects in which LINEARITY and alignment interact with a markedness constraint against rising sonority across the syllable boundary.

from phonetic studies indicates that a trill articulation is not a simple repetition of the lingual gesture of a tap, which is ballistic and involves a single, extra-short contact, but instead requires an entirely different aerodynamic mechanism to passively induce a prolongable vibration of the tongue tip (Catford 1977: 130, Ladefoged and Maddieson 1996: 217–18, Martínez Celdrán and Fernández Planas 2007: 147–151, Recasens 1991, Recasens and Pallarès 1999). Presumably, a true geminate tap is phonetically uninterpretable because a consonant that is simultaneously [+long] and [+extra-short] would require contradictory motor commands. The question is how this universal restriction should be captured in the grammar, especially for languages like MJS in which a phonetic trill patterns as the geminate counterpart of the singleton tap. One possibility is that the optimal output contains a dually-linked geminate tap structure, represented here in narrow transcription as [ɾː], which is subsequently converted to a single trilling gesture [r] in phonetic implementation.[10] However, it seems counterintuitive to relegate such a radical articulatory change to the phonetic implementation component, which is conventionally understood as being limited to low-level, gradient phonetic detail.

Our assumption is that the change from geminate tap to singleton trill should be accounted for in the phonology. Specifically, we encode the articulatory restriction against a dually-linked tap as an inviolable constraint in GEN, which has the effect of preventing output candidates with a true geminate [ɾː] from being generated in any grammar.[11] We propose a perceptual explanation for why the singleton trill [r] is chosen instead. Given the durational equivalence between a two-contact, singleton trill [r] and a sequence of two taps, it seems reasonable to assume that the mapping /C_1|$ɾ_2$/ → [$r_{1,2}$] would satisfy PRES-CC(dur) just as well as the mapping /C_1|$ɾ_2$/ → [$ɾː_{1,2}$] could. Simply stated, [r] is easier to pronounce than the phonetically uninterpretable geminate [ɾː] and sounds at least just as long.

Tableau (22) gives the analysis of /s|ɾ/ and /d|ɾ/ clusters, this time including the high-ranking constraint PRES-CC(dur) and a low-ranking markedness constraint against trills. In addition to the intact clusters in (22a,d), the tableau includes candidates that show coalescence to a singleton tap (22b,e) and to a singleton trill (22c,f). *DIST+2 eliminates candidates (22a,d) with too steep a sonority rise. Mapping the input clusters to a singleton tap (22b,e) fatally violates PRES-CC(dur) because the extra-short tap fails to preserve the relatively longer duration of the input cluster. Mapping the clusters to a singleton trill is optimal because (22c,f) satisfy both PRES-CC(dur) and *DIST+2, despite their violation of low-ranking *TRILL.[12] To save space in subsequent tableaux that evaluate /C|ɾ/ clusters, we omit PRES-CC(dur), as well as candidates with singleton taps.

[10] For example, Lipski (1990: 163) proposes a phonetic interpretation rule that converts a dually-linked geminate tap into a single trill. In an OT account of the diachrony of Spanish rhotics, Colina (2010: 78, fn.5) argues that in Latin, the geminate tap would have been implemented phonetically as a trill.

[11] Instead of placing constraints directly in GEN, de Lacy (2007) proposes to expand the OT architecture with an Interpretative Loop that deletes phonetically uninterpretable winners and allows EVAL to re-evaluate the candidate set until an output is found that is interpretable. Furthermore, placing a constraint like *[+long, +extra-short] in CON would render it violable, incorrectly predicting the emergence of uninterpretable [ɾː] in some language.

[12] A reviewer points out that having an output trill as the correspondent of an input tap would also violate a faithfulness constraint on whatever feature distinguishes taps from trills, which therefore must also rank below PRES-CC(dur) and *DIST+2. A fuller discussion of the phonology of Spanish rhotics would lead us too far afield, but see Bradley (2006b) and Colina (2010) for two OT accounts that make different theoretical assumptions.

(22) Trilling preserves longer duration of input clusters
dor rozas ‘two roses’, *una siudar rica* ‘a rich city’

			Pres-CC(dur)	*Dist+2	Ident(strid)	*Trill
	a. /s$_1$|ɾ$_2$/	z$_1$ɾ$_2$		*!		
	b.	ɾ$_{1,2}$	*!		*	
☞	c.	r$_{1,2}$			*	*
	d. /d$_1$|ɾ$_2$/	d$_1$ɾ$_2$		*!		
	e.	ɾ$_{1,2}$	*!			
☞	f.	r$_{1,2}$				*

The second generalization (16b) is that clusters with a sonority distance of +1 undergo gemination except for those with a coda sibilant. Part of this pattern is accounted for by ranking *Dist+1 above Max(nas), as shown in tableau (23). The intact clusters (23a,c,e) fatally violate *Dist+1. The singleton trill (23b) and the geminates (23d,f) are optimal, given the ranking of *Dist+1 above *Trill and *Geminate.

(23) Clusters with a sonority distance of +1
el huer rey ‘the good king’, *el la siudad* ‘in the city’, *siudán ninguna* ‘no city’

			*Dist+1	Max(nas)	*Geminate	*Trill
	a. /n$_1$|ɾ$_2$/	n$_1$ɾ$_2$	*!			
☞	b.	r$_{1,2}$		*		*
	c. /n$_1$|l$_2$/	n$_1$l$_2$	*!			
☞	d.	lː$_{1,2}$		*	*	
	e. /d$_1$|n$_2$/	d$_1$n$_2$	*!			
☞	f.	nː$_{1,2}$			*	

Clusters with a sonority distance of +1 that have a coda sibilant are immune to regressive gemination because Ident(strid) ranks above *Dist+1, as shown in tableau (24). This ranking requires output candidates to be faithful to the [+strident] specification of the input sibilant in (24a,c), even though sonority distances of +1 are otherwise avoided, as in (23).

(24) Faithfulness to coda sibilants in clusters with a sonority distance of +1
loz mayores ‘the oldest ones’, *laz niñas* ‘the girls’

			Ident(strid)	*Dist+1
☞	a. /s$_1$|m$_2$/	z$_1$m$_2$		*
	b.	mː$_{1,2}$	*!	
☞	c. /s$_1$|n/	z$_1$n$_2$		*
	d.	nː$_{1,2}$	*!	

The comparatively high ranking of Ident(strid) in (24) can be motivated on perceptual grounds. Wright (2004: 39–40) notes that the relative degree to which an oral constriction attenuates the signal serves as a strong cue to consonant manner. “A complete attenuation of the harmonic signal but with fricative noise provides the listener with cues to the presence of a fricative; the higher the intensity of frication, the more reliably a fricative is heard instead of a stop" (p. 39). Relative to other fricatives, sibilants have greater turbulence and increased amplitude because of the lower teeth, which create an obstacle downstream from the constriction noise (Shadle 1985). However, the enhanced perceptibility of sibilants does not operate in all-or-nothing fashion, as /s/+liquid clusters pattern differently than /s/+nasal clusters. Our analysis explains this asymmetry as a sonority distance effect involving faithfulness to [±strident], formalized as the ranking of *DIST+2 » IDENT(strid) » *DIST+1.

Figure 2 combines the ranking arguments presented thus far in the form of a Hasse diagram. Not shown here are low-ranking UNIFORMITY and high-ranking UNIFORMITY$_{\text{ROOT}}$.

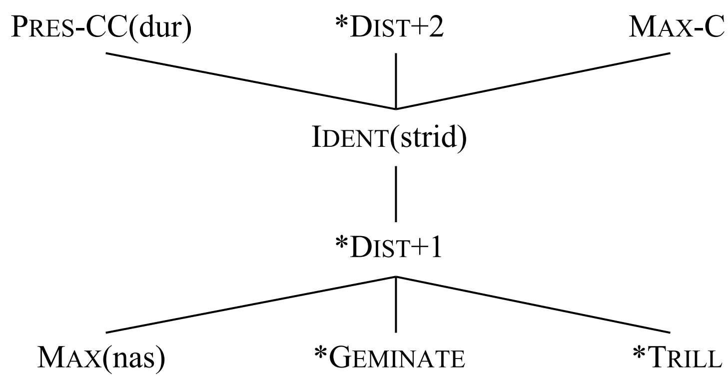


Figure 2: Interim ranking summary based on rising sonority clusters

3.2 Flat sonority clusters

The third generalization (16c) shows that regressive gemination targets not only rising sonority but also flat sonority clusters. In tableau (25), clusters that contain non-identical consonants of identical sonority violate *DIST0, compelling unfaithfulness to coda rhotics and laterals (25b,d). The mapping in (25f) does not involve a loss of nasality because the [nasal] feature of each input segment corresponds to a single [nasal] feature in the coalesced output geminate. Since MAX(nas) is not violated, the decision is made by the ranking of *DIST0 » *GEMINATE. Although its ranking with respect to *DIST0 cannot be determined, MAX(nas) must rank below *DIST+1 to allow for regressive assimilation in nasal+liquid clusters (23b,d).

(25) Clusters with a sonority distance of 0
contal-le 'to tell him', *mar rayo* 'bad lightning', *em mano* 'in hand'

	*DIST0	MAX(rho)	MAX(lat)	*GEMINATE	*TRILL
a. /ɾ$_1$|l$_2$/ ɾ$_1$l$_2$	*!				
☞ b. lː$_{1,2}$		*		*	
c. /l$_1$|ɾ$_2$/ l$_1$ɾ$_2$	*!				
☞ d. r$_{1,2}$			*		*
e. /n$_1$|m$_2$/ n$_1$m$_2$	*!				
☞ f. mː$_{1,2}$				*	

We have argued that IDENT(strid) dominates *DIST+1 because coda /s/ is maintained before a nasal consonant (24a,c). Given the fixed ranking of *DIST+1 » *DIST0, it follows by transitivity that IDENT(strid) also dominates *DIST0. This transitive ranking predicts a manner-based asymmetry in the patterning of flat sonority clusters, which accounts for the first exception to generalization (16c): obstruents that differ in [±strident] will surface faithfully, but obstruents that agree in [±strident] will undergo regressive gemination. This prediction is confirmed in tableau (26). In clusters with a coronal stop and sibilant, the adjacent obstruents differ in stridency. Coalescence (26b,d) fatally violates IDENT(strid), so flat sonority clusters are maintained instead in (26a,c). In /s|ʃ/ and /d|t/, the obstruents agree in stridency. There is no violation of IDENT(strid) under coalescence, and the ranking of *DIST0 » *GEMINATE selects the true geminates (26f,h). These mappings do not involve a change in stridency because the [±strident] feature of each input segment corresponds to a single identical [±strident] feature in the output geminate.

(26) Flat sonority clusters of non-identical obstruents
loz dedos 'the fingers', *siudad sekreta* 'secret city' vs.
loš šarales 'the thickets', *de verdat te lo digo* 'in truth I tell you'

			IDENT(strid)	*DIST+1	*DIST0	*GEMINATE
☞ a.	$/s_1\|d_2/$	z_1d_2			*	
b.		$d{:}_{1,2}$	*!			*
☞ c.	$/d_1\|s_2/$	d_1s_2			*	
d.		$s{:}_{1,2}$	*!			*
e.	$/s_1\|ʃ_2/$	$s_1ʃ_2$			*!	
☞ f.		$ʃ{:}_{1,2}$				*
g.	$/d_1\|t_2/$	d_1t_2			*!	
☞ h.		$t{:}_{1,2}$				*

The predicted manner asymmetry supports our interpretation of [±strident] as a binary feature regulated by an IDENT(feature) constraint. If [strident] were a privative feature, a high-ranking MAX(strid) constraint would be unable to rule out the coalescence of /d/ with /s/ in (26d). This is because only the sibilant would be specified with a privative [strident] feature, which would be realized in the output under coalescence. Since IDENT(strid) refers to binary feature values, it can prevent the mapping of a [–strident] stop to a [+strident] fricative in (26d), as well as the opposite change in (26b).

Our analysis also captures the parallel behavior of [nasal] and [±strident] features in flat sonority clusters of nasals (25f) and non-identical obstruents (26f,h). In both cases, the adjacent input segments already share the same value for the feature in question. The relevant MAX and IDENT feature constraints are vacuously satisfied, and coalescence to an output geminate is favored by the ranking of *DIST0 » *GEMINATE. The analysis captures the insight that assimilation/coalescence in flat sonority clusters requires that both the target and trigger consonant already agree in [nasal] and [±strident] features (see Section 4 for more discussion).

The second exception to generalization (16c) involves clusters of two obstruents that differ in primary place of articulation. We have shown that in cases of flat sonority syllable contact in (26), the ranking of IDENT(strid) » *DIST0 » *GEMINATE limits gemination to clusters of consonants that already have the same specification for [±strident]. As for heterorganic obstruent clusters, the same ranking correctly predicts the lack of gemination in /s|b/ but overgenerates assimilation in /d|b/, which is incorrectly predicted to pattern like /d|t/ in (26h). We propose to capture the role of place of articulation in constraining regressive gemination by ranking the faithfulness constraint MAX$_{OBS}$(place) between *DIST+1 and *DIST0, as shown in tableau (27). The coalescence of coronal /d/ with the bilabials /b/ (27b) and /m/ (27d) violates MAX$_{OBS}$(place) because the primary CORONAL place feature of the input obstruent /d/ is not realized in the output. The violation is fatal for flat sonority clusters, which surface faithfully (27a). For clusters showing a sonority rise of +1, the higher ranking of *DIST+1 overrides the effects of faithfulness, and regressive gemination becomes optimal (27d). The ranking of MAX$_{OBS}$(place) » *DIST0 still allows for gemination in /n|m/ (25f), as faithfulness to obstruent place is not violated by the loss of nasal place features.

(27) Heterorganic clusters with a coda stop
siudad briyante 'shining city' vs. *la libertam me gusta* 'liberty pleases me'

	*DIST+1	MAX$_{OBS}$(place)	*DIST0	*GEMINATE
☞ a. /d_1|b_2/ d_1b_2			*	
b. $b\!:_{1,2}$		*!		*
c. /d_1|m_2/ d_1m_2	*!			
☞ d. $m\!:_{1,2}$		*		*

As we argued above for IDENT(strident), the comparatively high ranking of MAX$_{OBS}$(place) can also be motivated by perceptual factors. The acoustic cues to nasal place are universally weaker than cues to obstruent place (Wright 2004: 44–45), which accounts for the fact that cross-linguistically, nasal consonants show a greater tendency to undergo place assimilation than do obstruents. Previous accounts in the OT literature have formalized the nasal-obstruent asymmetry by splitting place faithfulness constraints into manner-specific versions (Bradley 2009, 2015, Colina 2006, Jun 2004, Padgett 1995, Piñeros 2006). The present account gives a similar explanation for the asymmetry between heterorganic obstruent clusters, which surface faithfully (27a), and heterorganic nasal clusters, which undergo gemination (25f). Losing the input CORONAL place feature of an obstruent /d/ is more costly than losing the CORONAL feature of a nasal /n/. We assume that unfaithfulness to nasal place involves a violation of MAX$_{NAS}$(place), whose ranking is universally fixed below MAX$_{OBS}$(place). Specifically, MAX$_{NAS}$(place) must rank at least below *DIST0 in order to allow for the loss of nasal CORONAL place (25f).

When two identical coronal consonants come into contact across the word boundary, the resulting cluster is a fake geminate with flat sonority, as exemplified in (20a). Given the ranking of *DIST0 » *GEMINATE motivated above, clusters of identical coronals are predicted to surface as true geminates (28b,d,f,h).[13] The input cluster of taps is realized as a singleton trill (28j), for the reasons explained above surrounding (22).

[13] An analysis of the continuancy alternation in voiced obstruents is beyond the goals of this paper (for phonetically-based OT accounts, see Kirchner 1998, Piñeros 2002, and Katz 2016). Interestingly, the asymmetry between MJS (12a) and MS (13c) conforms to one of Kirchner's key typological generalizations about geminates and lenition, namely that geminate stops never lenite to a continuant unless they concomitantly degeminate.

(28) Clusters of identical coronals
la siudad de Toledo ‘the city of Toledo’, *vos serís* ‘you (pl.) will be’, *un niño* ‘a boy’, *mal lograda* ‘poorly carried out’, *dar razón* ‘to give reason’

				*DIST0	*GEMINATE	*TRILL
	a.	/d$_1$|d$_2$/	d$_1$d$_2$	*!		
☞	b.		dː$_{1,2}$		*	
	c.	/s$_1$|s$_2$/	s$_1$s$_2$	*!		
☞	d.		sː$_{1,2}$		*	
	e.	/n$_1$|n$_2$/	n$_1$n$_2$	*!		
☞	f.		nː$_{1,2}$		*	
	g.	/l$_1$|l$_2$/	l$_1$l$_2$	*!		
☞	h.		lː$_{1,2}$		*	
	i.	/ɾ$_1$|ɾ$_2$/	ɾ$_1$ɾ$_2$	*!		
☞	j.		r$_{1,2}$			*

Figure 3 summarizes the ranking arguments presented in this section on the basis of flat sonority clusters.

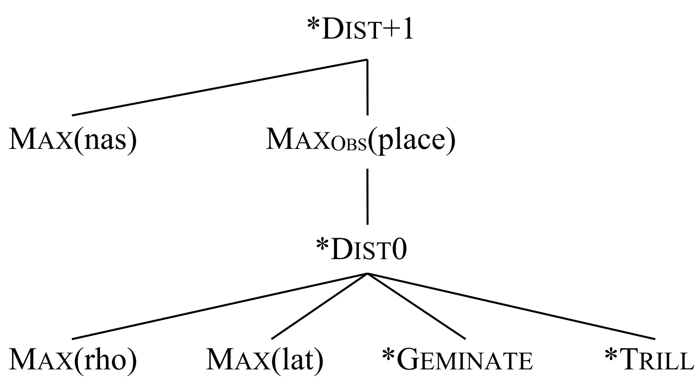


Figure 3: Interim ranking summary based on flat sonority clusters

3.3 Falling sonority clusters

The final generalization (16d) is that falling sonority clusters are generally maintained except for /l|n/ and, marginally, /l|d/. The ranking of MAX(nas) and MAX(rho) above *DIST–1 and *DIST–2 protects coda nasals and rhotics from regressive gemination in falling sonority clusters (29a,c,e).

(29) Falling sonority clusters with coda nasals and rhotics
un dedo ‘a finger’, *tener dinero* ‘to have money’, *ver nada* ‘to see nothing’

	MAX(nas)	MAX(rho)	*DIST–1	*DIST–2
☞ a. $/n_1\|d_2/$ n_1d_2			*	
b. $dː_{1,2}$	*!			
☞ c. $/ɾ_1\|d_2/$ $ɾ_1d_2$				*
d. $dː_{1,2}$		*!		
☞ e. $/ɾ_1\|n_2/$ $ɾ_1n_2$			*	
f. $nː_{1,2}$		*!		

Since coda /l/ is maintained in most of the falling sonority clusters listed in Figure 1, *DIST–1 and *DIST–2 must also rank below MAX(lat), which favors the faithful candidates in (30a,e). For lateral+sibilant clusters, coalescence to a true geminate (30d) also violates high-ranking IDENT(strid), as shown above for sibilant+nasal clusters (24b,d) and for clusters of non-identical obstruents that differ in stridency (26b,d).

(30) Falling sonority clusters with coda laterals
mañanal medio día ‘tomorrow at noon’, *la’ntra’l sol* ‘the sun enters it’, *el tío* ‘the uncle’

	IDENT(strid)	MAX(lat)	*DIST–1	*DIST–2
☞ a. $/l_1\|m_2/$ l_1m_2			*	
b. $mː_{1,2}$		*!		
☞ c. $/l_1\|s_2/$ l_1s_2				*
d. $sː_{1,2}$	*!	*		
☞ e. $/l_1\|t_2/$ l_1t_2				*
f. $tː_{1,2}$		*!		

Figure 4 presents the ranking summary for falling sonority clusters.

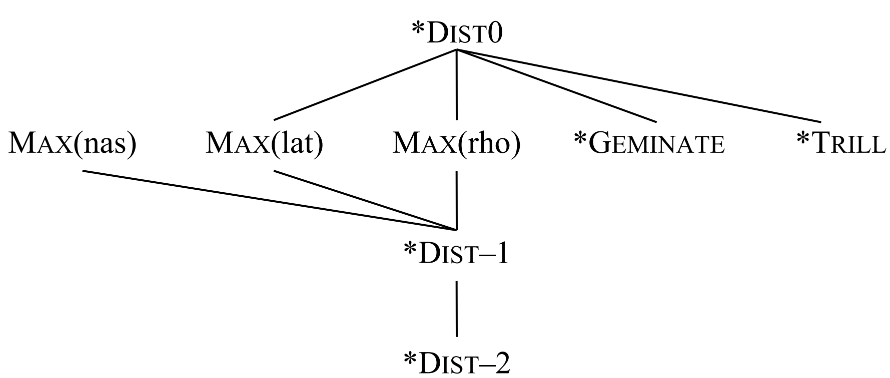


Figure 4: Interim ranking summary based on falling sonority clusters

4. Similarity avoidance effects in coda lateral assimilation

The sonority distance account successfully predicts the complexity of syllable contact optimization in MJS. However, the analysis of coda laterals remains incomplete because it does not explain why the falling sonority clusters /l|n/ and /l|d/ pattern as targets of regressive gemination. Although ranking MAX(lat) below *DIST–1 and *DIST–2 would allow for lateral assimilation in these two clusters, exactly the opposite ranking is needed to ensure lateral survival in (30a,e) and in other falling sonority clusters with coda laterals.

A solution to the ranking paradox comes from maintaining the necessary ranking of MAX(lat) above both *DIST–1 and *DIST–2 and positing some higher ranking markedness constraint(s) that /l|n/ and /l|d/ violate. What is the motivation for assimilation in these clusters? A key observation regarding word-final /l/ is that it assimilates to sounds that are already featurally or perceptually similar to it. Such behavior is reminiscent of "parasitic harmony" where an assimilation process occurs only if the target and trigger are already similar to one another in some respect. The notion of similarity is developed in work by Pierrehumbert (1993), Frisch (2004), Frisch et al. (2004), among others. In their OT analysis of Korean, Davis and Shin (1999) make use of a constraint, SIMILARITY, to account for the unexpected assimilation of falling sonority /l + n/ clusters. Their constraint encodes an Obligatory Contour Principle (OCP)-type restriction against adjacent segments that are identical in the features [+sonorant] and [+coronal]. We adopt and extend this approach to cover the exceptional behavior of coda laterals in MJS. The basic idea is that, while they do present an unmarked falling sonority syllable contact, /l|n/ and /l|d/ clusters are nonetheless avoided because the adjacent segments are too similar in place and manner features, as expressed by the following constraints:

(31)
a. OCP(COR,+son)
   Avoid a sequence of adjacent coronal sonorant consonants.
b. OCP(COR,+voi)
   Avoid a sequence of adjacent coronal voiced consonants.
c. OCP(COR)
   Avoid a sequence of adjacent coronal consonants.

There is an implicational relationship between [+sonorant] and [+voice] such that, in the unmarked case, all sonorant segments are voiced, but not all voiced segments are sonorant. This implication, combined with the fact that (31a–c) all target coronal consonants, means that these constraints are in a stringency relationship and, therefore, do not need to be universally ranked with respect to each other (de Lacy 2002, 2004, Prince 2001). This is illustrated in tableau (32), which shows how the OCP constraints are violated by seven different clusters with coda laterals. Broken lines between constraint columns denote the lack of a fixed ranking between the two adjacent constraints.

(32) Stringency relationship among similarity avoidance constraints

	OCP(COR,+son)	OCP(COR,+voi)	OCP(COR)
a. ln	*	*	*
b. ld		*	*
c. lʒ		*	*
d. ls			*
e. lʃ			*
f. lt			*
g. lm			

There is a specific-to-general relationship among the OCP constraints, such that if a candidate violates a more specific constraint to the left in (32), it also violates the more general constraint(s) to the right. The more general the constraint, the more "stringent" it is in terms of the number of violations it assigns to the candidates.

Recall from the discussion surrounding (4) that the clusters /l|ɾ/, /l|n/, and /l|d/ were all targets of regressive gemination in the late 19th century (Benoliel 1977[1926–8]: 19), but by the early 20th century, /l|d/ had ceased to participate in the alternation (Bénichou 1945: 230). Since it does not share the [±sonorant] value of /l/, /d/ is the member of the set of consonants {/ɾ/, /n/, /d/} that is the least similar to /l/ and thus could change from a segment that undergoes assimilation to one that does not. We account for this change in terms of different rankings of OCP(COR,+voi) and MAX(lat), as illustrated in the following tableaux. Since OCP(COR,+son) and OCP(COR,+voi) are unranked with respect to each other, either of the violations incurred by (33a) can be considered fatal, as indicated by the parentheses. OCP(COR,+voi) eliminates (33c). The ranking of OCP(COR,+voi) above MAX(lat) ensures regressive gemination in both clusters (33b,d). Although not shown in the tableau, the optimal candidates violate both *GEMINATE and UNIFORMITY, which rank below OCP(COR,+voi).

(33) Lateral assimilation to coronal nasals and voiced stops (19th-century MJS)
en niño 'the child', *ed de* 'the one from'

	OCP(COR,+son)	OCP(COR,+voi)	MAX(lat)	*DIST–1	*DIST–2
a. /l_1|n_2/ l_1n_2	*(!)	*(!)		*	
☞ b. $n\!:_{1,2}$			*		
c. /l_1|d_2/ l_1d_2		*!			*
☞ d. $d\!:_{1,2}$			*		

In the case of /l|ʒ/, the adjacent consonants are both coronal and voiced, violating OCP(COR,+voi). On the basis of similarity avoidance alone, /l|ʒ/ is expected to pattern like /l|d/ (33d). However, recall from the discussion surrounding (30d) that coalescence in lateral+sibilant clusters violates not only MAX(lat) but also IDENT(strid). The high ranking of IDENT(strid) overrides the effects of OCP(COR,+voi) in the 19th-century MJS grammar by keeping coda /l/ from becoming [+sibilant] in (34b), while still allowing /l/ to assimilate to the

[–strident] voiced stop in (34d). The role of IDENT(strid) in blocking similarity avoidance effects lends further support to our interpretation of [±strident] as a binary feature.[14]

(34) No lateral assimilation to coronal voiced sibilant (19th-century MJS)
él žaze 'he lies' vs. *ed de* 'the one from'

	IDENT (strid)	OCP (COR,+son)	OCP (COR,+voi)	MAX (lat)	*DIST–1	*DIST–2
☞ a. /l$_1$|ʒ$_2$/ l$_1$ʒ$_2$			*			*
b. ʒː$_{1,2}$	*!			*		
c. /l$_1$|d$_2$/ l$_1$d$_2$			*!			*
☞ d. dː$_{1,2}$				*		

The demotion of OCP(COR,+voi) below MAX(lat) predicts the pattern of assimilation found in early 20th-century MJS. The mapping of /l$_1$|d$_2$/ to [dː$_{1,2}$] in (35d) now fatally violates MAX(lat), so the cluster surfaces faithfully instead in (35c). The violation of higher-ranking OCP(COR,+son) remains fatal in (35a), and regressive gemination continues to target the lateral+nasal cluster in (35b), just as it did under the late 19th-century ranking in (33b).

(35) No lateral assimilation to coronal voiced stops (20th-century MJS)
en niño 'the child' vs. *el de* 'the one from'

	OCP(COR,+son)	MAX(lat)	OCP(COR,+voi)	*DIST–1	*DIST–2
a. /l$_1$|n$_2$/ l$_1$n$_2$	*!		*	*	
☞ b. nː$_{1,2}$		*			
☞ c. /l$_1$|d$_2$/ l$_1$d$_2$			*		*
d. dː$_{1,2}$		*!			

In both the 19th- and 20th-century MJS grammars, the remaining lateral+consonant clusters with falling sonority are all tolerated. In /l|s/, /l|ʃ/, and /l|t/, the adjacent consonants are both coronal but differ in the features [sonorant] and [voice]. In /l|m/, the consonants are voiced sonorants but are not both coronal. Because OCP(COR,+son) or OCP(COR,+voi) are satisfied by the faithful realization of these clusters, the ranking of MAX(lat)—and for lateral+sibilant clusters, IDENT(strid)—above *DIST–1 and *DIST–2 prevents regressive gemination, as argued above in (30). The most general similarity avoidance constraint OCP(COR) must be ranked below MAX(lat) to allow /l|s/, /l|ʃ/, and /l|t/ to surface faithfully.

Beyond the coda lateral context, all other clusters with a falling sonority syllable contact surface faithfully. Tableau (36) repeats the evaluation of candidates from (29) and incorporates similarity avoidance constraints from the present section. The faithful realization of each cluster in (36a,c,e) violates both an OCP constraint and a *DISTANCE constraint, which must rank below MAX(nas) and MAX(rho) to prevent regressive gemination. The demotion of OCP(COR,+voi)

[14] Regressive voicing in /sd/ results in a cluster of adjacent voiced coronals, also violating OCP(COR,+voi). In this context, high-ranking IDENT(strid) overrides the effects of both similarity avoidance and *DIST0, as shown in (26a).

below MAX(lat) in early 20th-century MJS does not change the optimality of (36a,c), which are still protected by high-ranking MAX(nas) and MAX(rho).[15]

(36) No assimilation in other falling sonority clusters (19th-century MJS)
un dedo 'a finger', *tener dinero* 'to have money', *ver nada* 'to see nothing'

	MAX (nas)	MAX (rho)	OCP (COR,+son)	OCP (COR,+voi)	MAX (lat)	*DIST –1	*DIST –2
☞ a. $/\mathrm{n}_1\vert\mathrm{d}_2/$ $\mathrm{n}_1\mathrm{d}_2$				*		*	
b. $\mathrm{d\!:}_{1,2}$	*!						
☞ c. $/\mathrm{ɾ}_1\vert\mathrm{d}_2/$ $\mathrm{ɾ}_1\mathrm{d}_2$				*			*
d. $\mathrm{d\!:}_{1,2}$		*!					
☞ e. $/\mathrm{ɾ}_1\vert\mathrm{n}_2/$ $\mathrm{ɾ}_1\mathrm{n}_2$			*			*	
f. $\mathrm{n\!:}_{1,2}$		*!					

The final ranking summary in Figure 5 formalizes the interplay of conflicting pressures that give rise to sonority distance and similarity avoidance effects in regressive gemination. At the root of this ranking is the universal hierarchy of *DISTANCE constraints, which establish different tolerance thresholds for syllable contact. Interspersed along the hierarchy are faithfulness and other markedness constraints, some of which are OCP-based restrictions against similar adjacent segments. As shown in Figure 6, early 20th-century MJS moves OCP(COR,+voi) to a lower stratum in the constraint ranking, below MAX(lat) and *GEMINATE. This single re-ranking explains the change in status of /l|d/ from a cluster that undergoes regressive gemination to one that does not.

[15] Based on assimilation patterns in Korean clusters, Davis and Shin (1999) motivate the ranking of MAX(lat) » MAX(nas), which they hypothesize to be universal (pp. 308–309, fn.13). However, our analysis of 19th-century MJS gives language-specific evidence of the opposite ranking in MAX(nas) » OCP(COR,+voi) » MAX(lat).

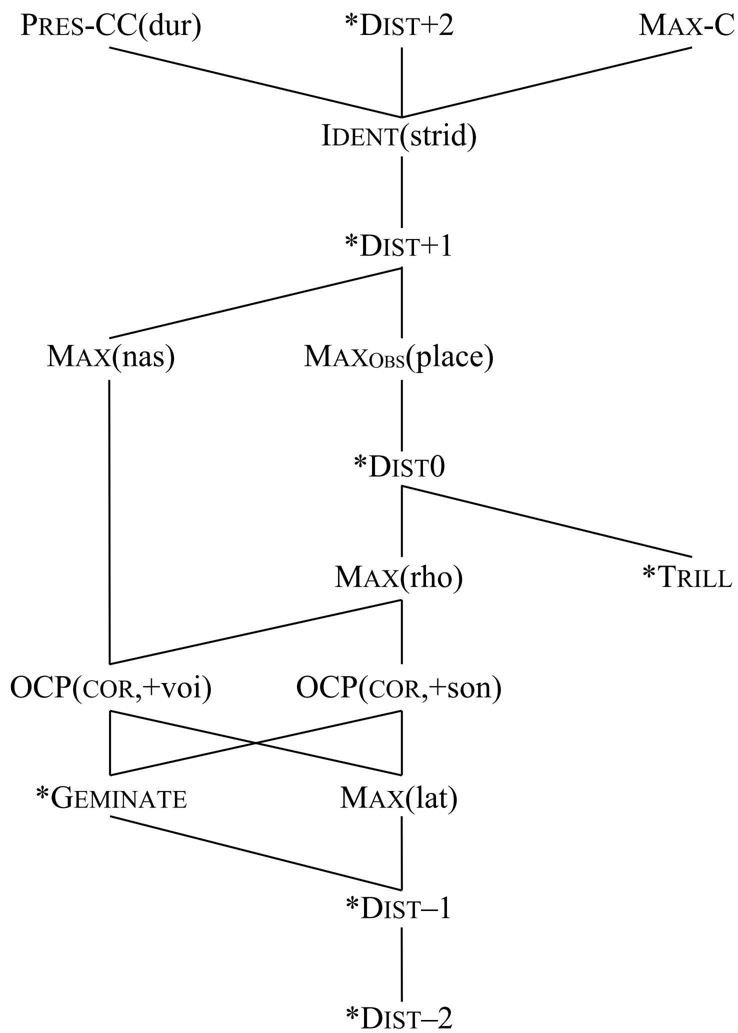


Figure 5: Final ranking summary for late 19th-century MJS

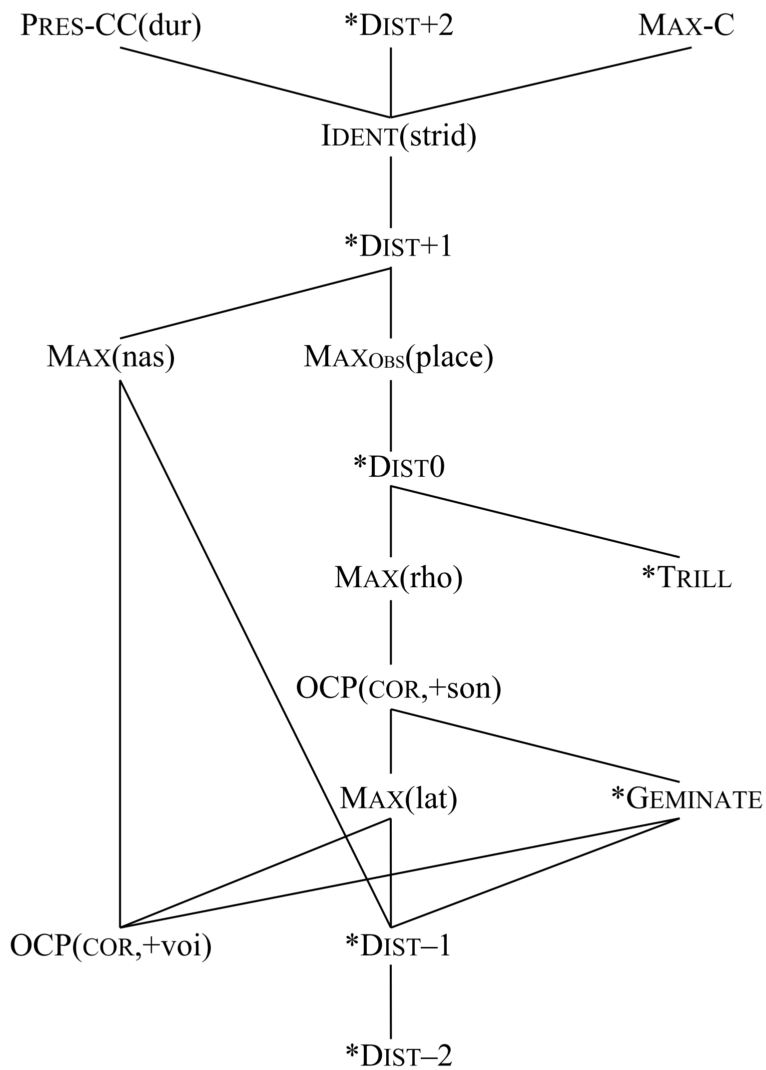


Figure 6: Demotion of OCP(COR,+voi) in early 20th-century MJS

5. Discussion

5.1 Explaining the complexities of regressive gemination in MJS

The observations made by Bénichou (1945) and Benoliel (1977[1926–8]) have been part of the descriptive record of Judeo-Spanish for some time, yet, to our knowledge, the significance of the MJS data to phonological theory has not been established until now. An important contribution of the present study has been to examine MJS consonant clusters through the theoretical lens of syllable contact, which led us to uncover new generalizations about regressive gemination based on sonority distance, shown in (16). The OT analysis summarized in Figure 5 explains the complexities of regressive gemination in terms of a language-specific ranking of three types of universal constraints: faithfulness constraints on place and manner features, markedness constraints on sonority distance in syllable contact, and markedness constraints on featural similarity in adjacent consonants. For each of the puzzles originally presented in (14), our analysis gives an explanatory solution, formulated as a particular way of satisfying two or more conflicting constraints:

Why does each one of the commonly occurring word-final coronals /d,s,ɾ,l,n/ *assimilate to a word-initial liquid* /ɾ,l/ *but not necessarily to other consonant types?* Since they have the highest sonority value among the onset consonants in Figure 1, word-initial liquids are the most likely to create a syllable contact of non-falling sonority when juxtaposed with a word-final coronal. Sonority distance constraints are fatally violated by coronal+liquid clusters in the output: *DIST+2 by [zl], [dl] (21a,b) and by [zɾ], [dɾ] (22a,d); *DIST+1 by [nɾ], [nl] (23a,c); and *DIST0 by [ɾl], [lɾ] (25a,c) and by [ll], [ɾɾ] (28g,i). Regressive gemination is the optimal repair because these sonority distance constraints crucially dominate the relevant conflicting constraints that disfavor the assimilation candidates, namely IDENT(strid), MAX(nas), MAX(rho), MAX(lat), *GEMINATE, and *TRILL.

Why is assimilation less likely to target clusters that combine a sibilant fricative and a non-sibilant consonant? IDENT(strid) blocks assimilation in clusters whenever the adjacent consonants differ in [±strident]. Ranked above both *DIST+1 and *DIST0, faithfulness to stridency ensures the maintenance of rising sonority clusters [zm], [zn] (24a,c) and of flat sonority clusters [zd], [ds] (26a,c) as well as [st], [zb], [dʃ], and [dʒ]. Because the adjacent consonants already show [±strident] agreement in /d|n/, /d|m/, /d|d/, /d|t/, /s|s/, /s|ʃ/, and /s|ʒ/, the constraints *DIST+1 and *DIST0 can trigger assimilation in these clusters without a violation of higher-ranking IDENT(strid). Given the ranking of *DIST+2 » IDENT(strid), even the lack of stridency agreement is not enough to block the assimilation of word-final /s/ in clusters showing a sonority rise of +2, i.e. [zl] (21a) and [zɾ] (22a).

Why does word-final /d/ *assimilate to a word-initial obstruent only if it is also coronal but to a word-initial nasal whether it is coronal or bilabial?* MAX_{OBS}(place) blocks regressive gemination in obstruent clusters that combine word-final /d/ with a following non-coronal. Ranked above *DIST0, faithfulness to obstruent place ensures the maintenance of [db] (27a). Because the adjacent consonants are both CORONAL in /d|t/, *DIST0 can trigger assimilation without a violation of higher-ranking MAX_{OBS}(place). Given the ranking of *DIST+1 » MAX_{OBS}(place), the homorganicity restriction on assimilation can be overridden by the need to avoid a sonority rise of +1. For both homorganic [dn] (23e) and heterorganic [dm] (27c), a fatal violation of *DIST+1 triggers assimilation, despite the loss of CORONAL place in the mapping of $/\text{d}_1|\text{m}_2/ \rightarrow [\text{mː}_{1,2}]$ (27d).

Within the class of coronal liquids, why is word-final /ɾ/ *less susceptible to assimilation than word-final* /l/? Falling sonority clusters are generally tolerated because *DIST–1 and *DIST–2 are dominated by faithfulness to manner features. Assimilation in the falling sonority clusters /l|n/ and /l|d/ is unexpected on the basis of syllable contact but falls out naturally from the interaction of MAX(lat) and markedness constraints enforcing similarity avoidance. For late 19th-century MJS, OCP(COR,+voi) ranks above MAX(lat) and is fatally violated by clusters that combine a lateral and a voiced coronal consonant, i.e. [ln] (33a) and [ld] (33c). The re-ranking of OCP(COR,+voi) below MAX(lat) generates the pattern observed in early 20th-century MJS, in which high-ranking OCP(COR,+son) is fatally violated by [ln] (35a) while MAX(lat) blocks assimilation in /l|d/ (35c). MAX(rho) dominates the OCP constraints in both grammars, which explains why only coda laterals succumb to similarity avoidance effects.

5.2 Sonority distance effects and gradient syllable contact

Our analysis of regressive gemination in MJS makes a significant contribution to phonological theory by providing further support for sonority distance effects. Whether a given consonant cluster undergoes regressive gemination depends in part on the degree of sonority distance between the coda and the onset, formalized here as a relational hierarchy of *DISTANCE constraints (Gouskova 2001, 2002, 2004, Pons-Moll 2011). Explicit support for a gradient model using multiple constraints comes from demonstrating that an analysis with a categorical SYLLCON constraint fails to predict which consonant clusters pattern as targets of regressive gemination. To demonstrate this, let us assume the constraint definition in (37) (Davis and Shin 1999: 290, Holt 2004: 49, among others):

(37) SYLLABLECONTACT (SYLLCON)
Avoid rising sonority over a syllable boundary.

First, SYLLCON has trouble explaining why regressive gemination in clusters with coda /s/ is sensitive to differences in the degree of sonority rise. Because (37) is violated equally by *any* positive sonority distance, the constraint cannot distinguish between the rise of +2 in [zɾ] and [zl] and the rise of +1 in [zm] and [zn]. The ranking of SYLLCON » IDENT(strid) is needed in order to trigger gemination in /s/+liquid clusters, but the opposite ranking of IDENT(strid) » SYLLCON is needed to block gemination in /s/+nasal clusters. In our analysis, this paradox is avoided by the ranking of *DIST+2 » IDENT(strid) » *DIST+1, which correctly predicts sibilant assimilation to liquids (21b) and (22c) but sibilant survival before nasals (24a,c).

Second, since a constraint against rising sonority is not violated by heterosyllabic consonants of equal sonority, SYLLCON fails to explain why gemination targets flat sonority clusters like /ɾ|l/, /l|ɾ/, /n|m/, /s|ʃ/, /d|t/, as well as clusters of identical coronal consonants. As defined in (37), SYLLCON allows both flat and falling sonority transitions across the syllable boundary. Rose (2000: 401) proposes a stricter definition of the constraint in (38), allowing only falling sonority transitions:

(38) SYLLABLECONTACT (SYLLCON) (Rose 2000: 401)
The first segment of the onset of a syllable must be lower in sonority than the last segment in the immediately preceding syllable.

Rose (2000: 420) further proposes that (38) exists alongside the looser version in (37) and that the two constraints are universally ranked: SYLLCON(loose) » SYLLCON (see also Baertsch and Davis 2004: 113–114, who assume the same constraints and ranking). We note here that a universally fixed ranking is actually unnecessary because the two constraints are in a stringency relationship. SYLLCON(loose) is the more specific constraint, banning only clusters of rising sonority, while SYLLCON is the more general constraint, banning any cluster of non-falling sonority. When SYLLCON(loose) ranks higher than SYLLCON in some language, it becomes possible for an intervening faithfulness constraint to block gemination in clusters of equal sonority but still allow it in rising sonority clusters. Tableau (39) shows how such a ranking makes the correct predictions for /d|b/ and /d|m/ clusters in MJS. SYLLCON is violated by both clusters of non-falling sonority (39a,c), and only the rising sonority cluster (39c) incurs an additional violation of SYLLCON(loose). MAX_{OBS}(place) favors the intact obstruent cluster (39a), and SYLLCON(loose) forces gemination in the rising sonority cluster (39d).

(39) Two versions of SYLLCON in a stringency relationship
siudad briyante ‘shining city’ vs. *la libertam me gusta* ‘liberty pleases me’

	SYLLCON(loose)	MAX$_{OBS}$(place)	SYLLCON	*GEMINATE
☞ a. /$d_1 \vert b_2$/ d_1b_2			*	
b. $bː_{1,2}$		*!		*
c. /$d_1 \vert m_2$/ d_1m_2	*!		*	
☞ d. $mː_{1,2}$		*		*

Although the asymmetry between /d|b/ and /d|m/ clusters can be modeled by having a loose and a strict version of SYLLCON, the categorical nature of these constraints remains problematic. SYLLCON(loose) cannot distinguish between the rise of +2 in [zɾ] and [zl] and the rise of +1 in [zm] and [zn]. As argued above, this distinction is crucial in order to avoid a ranking paradox with respect to IDENT(strid). In our analysis, *DIST0 is fatally violated by flat sonority clusters that contain non-identical liquids (25a,c), nasals (25e), sibilants (26e), and stops (26g), as well as by fake geminates that arise in the juxtaposition of identical coronals (28a,c,e,g,i). The ranking of *DIST+1 » MAX$_{OBS}$(place) » *DIST0 explains the sonority distance effect involving faithfulness to place in obstruents, as shown in (27). A similar problem faces the strict version of SYLLCON in (38), which cannot distinguish among degrees of falling sonority. We have found no evidence in the available data and descriptions to motivate any distinction among negative sonority distances in MJS. However, such arguments have been made by Gouskova (2004) based on data from Kirghiz and Kazakh and by Pons-Moll (2011) based on data from Romance languages, although these authors assume a much finer-grained sonority scale than the relatively uncontroversial (15).

The proposal to split SYLLCON into two separate versions is already a step in the direction of a gradient model of syllable contact, but it does not go far enough. We have argued that sonority distance effects in MJS are predicted by a particular ranking that interleaves faithfulness constraints along a universal hierarchy of sonority distance constraints: *DIST+2 » IDENT(strid) » *DIST+1 » MAX$_{OBS}$(place) » *DIST0 » MAX(rho), MAX(lat) » *DIST–1. The data and generalizations from MJS thus contribute to the mounting cross-linguistic evidence in support of a gradient model of syllable contact, formalized here as a relational markedness hierarchy (Gouskova 2001, 2002, 2004, Pons-Moll 2011).

A question arises as to the origin of the sonority distance effects that we have uncovered in MJS. A strikingly similar pattern is found in Majorcan and Minorcan Catalan, as described and analyzed by Pons-Moll (2011: 116–129). Heterosyllabic clusters of flat and falling sonority are generally maintained intact, e.g. *dos peus* [dos.pɛws] ‘two feet’, *un peu* [um.pɛw] ‘one foot’, while rising sonority clusters are avoided by regressive gemination, e.g. *dos llits* [doʎ.ʎi͡ts] ‘two beds’, *dos rius* [dor.riws] ‘two rivers’, *un llum* [uʎ.ʎum] ‘one light’, although there are exceptions to both generalizations. For example, /s/+nasal and /n/+trill clusters surface intact, despite their rising sonority syllable contact, e.g. *dos nius* [doz.niws] ‘two nights’, *un riu* [un.riw] ‘one river’. Assuming a slightly more articulated sonority scale than (15), Pons-Moll accounts for exceptional rising sonority clusters by ranking faithfulness to privative [sibilant] and [nasal] features between *DIST+2 and *DIST+1. The result is that word-final sibilants and nasals only assimilate to the following consonant when the syllable contact is higher than +1.

Although we assume a simpler sonority scale and binary [±strident], our account of sonority distance effects in MJS is similar to Pons-Moll's account of Majorcan and Minorcan Catalan in that faithfulness to stridency is ranked between *DIST+2 and *DIST+1. However, it is not clear whether this formal similarity can be traced historically to these particular Catalan varieties. Minervini (2011: 131) argues that Catalan probably had little influence on the development of the Judeo-Spanish *koiné* after the Expulsion, due to the relatively smaller numbers of Catalan-speaking Sephardic Jews, but may have played a supporting role for phonetic and morphological phenomena shared by other Ibero-Romance languages. Sonority distance effects may have arisen in the Moroccan variety as an independent development of Judeo-Spanish, albeit formally similar to patterns attested elsewhere in the Iberian Peninsula. Since constraints in OT are universally available to all languages and dialects, distinct grammars might possibly converge on similar rankings of faithfulness against the *DISTANCE hierarchy, despite minimal linguistic influence otherwise.

5.3 Comparison with a split-margin approach

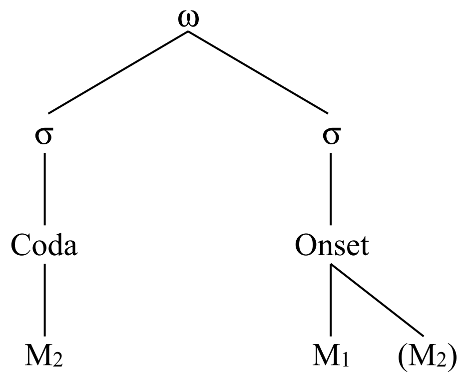
Another gradient approach to syllable contact in OT, developed by Baertsch (2002) and Baertsch and Davis (2008, 2009), involves the local conjunction of markedness constraints on split syllable margins. Baertsch (2002) proposes to distinguish between two margin positions within the syllable: M_1, which refers to the syllable-initial onset, and M_2, which includes both the second member of a complex onset and a coda consonant. Each position has its own hierarchy of markedness constraints governing the association of segments to syllable margins. Assuming the sonority scale in (15), the M_1 hierarchy in (40a) encodes a preference for less sonorous segments to appear as syllable-initial onsets, while the M_2 hierarchy in (40b) favors more sonorous segments as the second member of onset clusters and as codas.[16]

(40) a. *M_1/V » *M_1/GLIDE » *M_1/LIQ » *M_1/NAS » *M_1/OBS
b. *M_2/OBS » *M_2/NAS » *M_2/LIQ » *M_2/GLIDE » *M_2/V

Baertsch and Davis (2008, 2009) account for syllable contact by locally conjoining M_1 and M_2 constraints within the domain of the prosodic word. As illustrated in (41), this domain necessarily includes consonant clusters that span the boundary between two syllables, i.e. coda M_2 + onset M_1, as well as potential onset clusters that fall within a single syllable, i.e. M_1 + M_2. Additional margin constraints are conjoined within the domain of the syllable to account for tautosyllabic clusters, which we do not consider here.

[16] The M_2 hierarchy does not prefer vowels in coda position, even though *M_2/V is the lowest ranking constraint. The fact that vowels make better syllable peaks than they do margins can be accounted for by the ranking of *M_2/V » *PEAK/V (Baertsch and Davis 2008: 32, fn.6).

(41) Margin positions in syllable contact



Local conjunction of the M_1 and M_2 hierarchies produces a set of conjoined constraints that rank higher than the individual unconjoined constraints but still maintain the same ranking relationships as in (40a,b). Faithfulness constraints can then be ranked along the fixed hierarchies of conjoined constraints to establish language-specific thresholds of acceptable sonority distance in syllable contact situations.

Like Gouskova's approach using *DISTANCE constraints, a split-margin approach based on local conjunction of margin hierarchies is capable of distinguishing among different degrees of sonority distance across the syllable boundary. Therefore, it should also be able to model the sonority distance effects we have uncovered in MJS. For example, a ranking of $[{*}\text{OBS}_2\text{LIQ}_1]_{\text{WD}}$ » IDENT(strid) » $[{*}\text{OBS}_2\text{NAS}_1]_{\text{WD}}$ accounts for the asymmetry between $[z_2.l_1]$ and $[z_2.m_1]$, where the dot indicates a syllable boundary, and subscripts denote margin positions as illustrated in (41). The former cluster fatally violates the higher-ranking conjoined constraint against heterosyllabic obstruent+liquid sequences, so gemination is required despite the loss of the [+strident] feature of /s/ under coalescence. The latter cluster surfaces intact because faithfulness to [±strident] is more important than avoiding heterosyllabic obstruent+nasal clusters. Similarly, the ranking of $[{*}\text{OBS}_2\text{NAS}_1]_{\text{WD}}$ » MAX_{OBS}(place) » $[{*}\text{OBS}_2\text{OBS}_1]_{\text{WD}}$ explains the asymmetry between $[d_2.m_1]$, which undergoes gemination, and $[d_2.b_1]$, which surfaces intact.

A general argument in favor of the split-margin approach is that it can explain commonalities in the behavior of singleton codas and the second member of onsets, which are both M_2 positions. It also captures minimal distance requirements in onset clusters without an independent constraint referring to an external sonority scale, which is instead encapsulated directly as hierarchies of conjoined split-margin constraints (Baertsch and Davis 2008: 33–34). However, there are still unresolved problems facing local conjunction in general, including the possibility of freely conjoining any two constraints and freely conjoining in any domain. Another issue with locally conjoining split-margin constraints in particular has to do with stratal integrity of partially ranked conjoined constraints (see Gouskova 2004: 238–244 for further discussion). The OT account of MJS developed in Section 3 avoids the drawbacks associated with local conjunction by formalizing sonority distance as a relational hierarchy of *DISTANCE constraints, based on an uncontroversial sonority scale.

5.4 Similarity avoidance and parasitic harmony

One implication of having both *DISTANCE and OCP constraints is the need to examine other languages that reference syllable contact but in which /l + n/ assimilates despite being an unmarked falling sonority cluster, as happens in Korean (Davis and Shin 1999). As we have shown, the use of OCP constraints makes possible a simple and straightforward analysis of regressive gemination in MJS clusters that otherwise show a preferred syllable contact of falling sonority. We suspect that this type of interaction between similarity avoidance and sonority distance may be common cross-linguistically. Further research is needed to establish the typological behavior of /l + n/ and other such clusters in languages that allow for dispreferred syllable contact sequences as well.

Our analysis of coda laterals in MJS captures similarity avoidance effects as an instance of parasitic harmony: regressive gemination occurs only if the target and trigger consonants already have identical feature specifications, as formalized by the markedness constraints OCP(COR,+son) and OCP(COR,+voi). Another instance of parasitic harmony in MJS is observed in the blocking of assimilation by high-ranking faithfulness constraints. Assimilation is limited by IDENT(strid) to clusters whose sonority distance is +1 or less and whose adjacent consonants already agree in [±strident], and by MAX_{OBS}(place) to flat sonority clusters of obstruents that already agree in place. MJS thus constitutes an intriguing example of a language that shows parasitic consonantal harmony effects both in the triggering of assimilation by markedness constraints and in the blocking of assimilation by faithfulness constraints. In both cases, the relevant constraints can refer to a single place or manner feature, e.g. IDENT(strid), or to a combination of place and manner, e.g. OCP(COR,+son). Whether brought about by OCP constraints or by faithfulness, the end result is that clusters undergo assimilation only if the adjacent consonants already show some degree of featural similarity. The constraints responsible for parasitic harmony even interact among themselves, producing a cumulative similarity avoidance effect. For example, the ranking of IDENT(strid) » OCP(COR,+voi) simply adds [αstrident] to the calculation of featural similarity in adjacent coronal consonants. Assimilation applies only if the adjacent voiced coronals also agree in stridency, as in late 19th-century MJS $/\text{l}_1|\text{d}_2/ \rightarrow [\text{dː}_{1,2}]$ (34d) vs. $/\text{l}_1|\text{ʒ}_2/ \rightarrow [\text{l}_1\text{ʒ}_2]$ (34a).

The patterning of coda laterals in MJS bears a striking resemblance to assimilation patterns in Arabic involving coronal sonorant consonants, which have been analyzed as OCP effects from both a rule-based, derivational framework (Watson 2002) and constraint-based OT (Youssef 2013). For a fuller discussion and analysis, see Bradley (forthcoming), who argues that language contact with Moroccan Arabic (Heath 2002) is partially responsible for similarity avoidance effects in MJS falling-sonority clusters. The same constraint shown by Davis and Shin (1999) to be active in Korean, OCP(COR,+son), ranks high in Moroccan Arabic, and the more general OCP(COR) plays a key role in phonologically-conditioned allomorphy involving the Arabic definite lateral. A plausible hypothesis is that the relatively high ranking of OCP(COR,+son) in Moroccan Arabic was transferred into the MJS grammar of bilingual speakers at some point during the period of language contact. On the other hand, OCP(COR,+voi) does not seem to have been active in the phonology of Moroccan Arabic clusters, which suggests that its initially high ranking and subsequent demotion in 20th-century MJS were innovations internal to Judeo-Spanish.

The present study adds to a growing body of evidence documenting the role of similarity avoidance in various domains within Judeo-Spanish phonology. First, Bradley (2006a, 2007) develops an OT analysis of sonorant metathesis in eastern dialects of Judeo-Spanish varieties that developed in the Ottoman Empire. The transposition of heterosyllabic *-d.l-, -d.n-,* and *-n.r-* is analyzed as a repair strategy to avoid rising syllable contact. Since *-r.d-* has a preferred sonority drop, its transposition to tautosyllabic *-.dr-* cannot be motivated by syllable contact. The *-r.d-* >

-.dr- shift is instead explained as an OCP effect, whereby adjacent segments identical in place, manner, and voicing specifications are prohibited. Assuming lenition of coda taps, the cluster of adjacent voiced coronal approximants in [Vɾ̥.ðV] violates the OCP. Metathesis of the rhotic to the following onset cluster in [V.ðɾV] favors a non-continuant realization of the tap, which is sufficiently dissimilar from the preceding approximant [ð]. Regressive gemination in MJS further supports the argument based on sonorant metathesis in eastern dialects that similarity avoidance and syllable contact constraints are both necessary to explain the phonology of consonant clusters in Judeo-Spanish.

Second, Bradley and Smith (2011) propose an OT account of diminutive formation in eastern Judeo-Spanish varieties (Bunis 2003). One alternation involved in diminutivization is that nominals containing a stem-final dorsal consonant select the suffix *-ito/a* instead of the default suffix *-iko/a* that is otherwise preferred in disyllabic (or longer) words ending in *-o/a,* e.g. *sako* 'sack' > *sakito* vs. *palo* 'stick' > *paliko, rama* 'branch' > *ramika*. A constraint favoring the default allomorph /ik/ is dominated by an OCP constraint against DORSAL consonants that are adjacent across an intervening vowel. Similarity avoidance correctly predicts the suffixal allomorphy in *sakito (*sakiko) ~ paliko, ramika.*

A final case involves the optional deletion of the intervocalic palatal glide /j/ next to a front vowel, e.g. *kaveyo ~ kaveo* 'hair', *famiya ~ famia* 'family' vs. *gayo* 'rooster', which is widespread across Judeo-Spanish (Penny 2000: 180). Bradley (forthcoming) analyzes this alternation as a variable raking between a faithfulness constraint against segmental deletion and an OCP constraint against a sequence of adjacent front vocoids in intervocalic position. When given priority in a particular evaluation, similarity avoidance triggers the deletion of /j/ next to front vowels in *kaveo, famia* but leaves the glide intact in *gayo.*

6. Conclusion

In this article, we have shown that MJS phonology has implications for current linguistic theory. We have argued for an OT analysis that explains regressive gemination in consonant clusters as a strategy for repairing marked syllable contact. In particular, syllable contact must be formalized not as a single categorical constraint but instead as a hierarchy of sonority distance constraints. A gradient model of syllable contact is necessary to capture sonority distance effects but not sufficient to account for all contexts of regressive gemination in MJS, which in some clusters is motivated by similarity avoidance. A full account of the data requires similarity avoidance constraints in addition to sonority distance constraints, which calls for further typological research on the nature of their interaction in other languages.

Judeo-Spanish and its dialects have been the subject of increased linguistic investigation during the past decade. Given the assumption that its future as a distinct Spanish variety is not very certain, such research is of vital importance for studies on the history of Spanish and language contact. The present article has demonstrated the benefits of OT as a linguistic framework for doing MJS phonology and for understanding typological variation across Ibero-Romance. In turn, Judeo-Spanish continues to provide new insights that inform theoretical debates in contemporary phonology on the nature of syllable contact and the interaction of sonority distance and similarity avoidance in natural language grammars.

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