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LABIALIZATION AND PALATALIZATION IN JUDEO-SPANISH PHONOLOGY*

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Judeo-Spanish (JS) presents a number of phonological processes involving secondary articulations. This paper establishes novel descriptive generalizations based on labialization and palatalization phenomena across different JS dialects. I show how these generalizations are part of a broader cross-linguistic typology of secondary articulation patterns, which would remain incomplete on the basis of non-Sephardic Spanish alone. I propose an analysis in Optimality Theory (OT) that accounts for this variation using the same universal constraints that are active in languages beyond Ibero-Romance. This paper demonstrates the utility of OT as an analytical framework for doing JS phonology and in turn highlights the importance of JS to phonological theory by bringing new generalizations and data to bear on the analysis of secondary articulations.

1. *Introduction*

Judeo-Spanish (henceforth, JS) refers to those varieties of Spanish preserved by the Sephardic Jews who were expelled from Spain in 1492 and have emigrated throughout Europe, North Africa, the Middle East, and later, the United States. JS is intriguing to study from both diachronic and synchronic perspectives. The linguistic system retains many archaic features, which gives us a unique, albeit indirect, window into the structure of Old Spanish (henceforth, OS). Having evolved in relative isolation from the linguistic norms of the Iberian Peninsula and often in contact with other languages in the areas of Sephardic settlements, JS also has structural innovations that set it apart from both OS and other varieties of Mainstream Spanish (henceforth, MS). An impressive body of descriptive work

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makes JS a perfect testing ground for phonological theory, yet data and generalizations from JS dialects have gone largely unnoticed within contemporary work. According to Harris (1994), there were only sixty thousand proficient speakers in the early 1990s, very few fluent speakers under the age of fifty-five, and no longer any monolingual speakers. The ongoing status of JS as an endangered language makes the need for continued description and theoretical analysis even more pressing.

Although secondary articulations are cross-linguistically common, MS is not particularly known as a language that allows them. A secondary articulation is "an articulation of a lesser degree of stricture accompanying a primary articulation of a higher degree" (Ladefoged & Maddieson 1996: 354). This paper focuses on two types of secondary articulation and their variation across JS dialects: labialization, the addition of a lip rounding gesture, e.g. [C^w], and palatalization, the raising of the front of the tongue, e.g. [C^j]. Generalizations from JS are argued to complete a broader cross-linguistic typology of secondary articulation patterns, which would remain incomplete on the basis of MS data alone. After a review of Bradley's (2009) account of JS labialization, additional data are presented showing palatalization and labialization in JS dialects not examined thus far. Building on work by Bateman (2007), I propose an analysis in Optimality Theory (henceforth, OT; Prince & Smolensky 1993/2004) using faithfulness, markedness, and gestural alignment constraints. The analysis demonstrates the utility of OT as an analytical framework for doing JS phonology. The typological variation observed across dialects corresponds with the surface patterns predicted by different rankings of the same set of universal constraints. This paper also highlights the importance of JS to phonological theory by bringing novel generalizations and data to bear on the analysis of secondary articulations and their variation across time and space.

2. *Labialization*

In MS, prevocalic glides syllabify as onsets when no preceding consonant is available (1a) but as part of a complex nucleus after a consonantal onset (1b) (Colina 2006, 2009, Harris 1983, Harris & Kaisse 1999, Hualde 1989, 1991; see Yip 2003 for a general discussion and critique of diagnostics used in determining prevcocalic glide syllabification). The main evidence for this difference is that in most dialects, glides exhibit strengthened variants in syllable-initial position (2a) but not after a tautosyllabic consonant (2b).

(1) a. $[G[V]_N]_\sigma$
    b. $[C[GV]_N]_\sigma$

(2)	a.	kɾe.jó > kɾe.ʝó, kɾe.ɟó, kɾe.ʒó, kɾe.ʤó	*creyó*	'believed'
		wé.so > gwé.so	*hueso*	'bone'
	b.	kɾe.sjó	*creció*	'grew'
		pwén.te	*puente*	'bridge'

twéɾ.to	*tuerto*	‘twisted’
kwéɾ.ða	*cuerda*	‘rope’

Bradley (2009) argues that prevocalic /w/ behaves differently in the JS of Turkey, southeast Bulgaria, Greece, Macedonia, and Jerusalem (Crews 1935, Crews & Vinay 1939, Hualde & Şaul 2011, Luria 1930, Penny 1992, 2000, Quintana 2006, Sala 1971, and Wagner 1914). In these varieties, which I refer to as “labializing” JS (henceforth, JS-lab), syllable-initial [gw] is obligatory in the absence of a preceding consonant (3a), [w] appears after labials and dorsals (3b), and non-etymological [w] appears after labials and dorsals in the context of a preceding /u/ (3c). However, [w] no longer appears after coronals, and coronal+/w/ sequences show different resolutions: medial vowel epenthesis after a stop, affricate, or trill (4a), prothesis before a lateral or fricative (4b), and nasal place assimilation to a labial point of articulation (4c).

		JS-lab	MS	
(3)	a.	gwéso	wéso > gwéso	‘bone’
		gwéko	wéko > gwéko	‘hollow’
	b.	pwéðe	pwéðe	‘can’
		bwendá(ð)	bondáð	‘goodness’
		fwénte	fwénte	‘fountain’
		kwéðɾa	kwéɾða	‘rope’
		gwaðɾáɾ	gwaɾðáɾ	‘to keep’
	c.	tu pwáðɾe	tu páðɾe	‘your father’
		uŋ gwáto	uŋ gáto	‘a cat’
		asúkwaɾ	asúkaɾ	‘sugar’
		luɣwáɾ	luɣáɾ	‘place’
(4)	a.	tuɣwéɾto	twéɾto	‘twisted’
		duɣwéle	dwéle	‘hurts’
		ʤuɣwéves	xwéβes	‘Thursday’
		ruɣwéða	rwéða	‘wheel’
	b.	elɣwéɣo	lwéɣo	‘later’
		esʌwéɲo	swéɲo	‘sleep, dream’
	c.	mwéve	nwéβe	‘nine’
		mwévo	nwéβo	‘new’

These regular sound correspondences raise the question of why prevocalic /w/ is sensitive to the place of articulation of a preceding consonant in JS-lab but not in MS. Bradley (2009) proposes that whereas MS prevocalic glides are syllabified as part of a complex nucleus, in JS-lab /w/ forms a complex segment with a preceding consonant, where it is subject to a constraint against labialized coronals:

(5)

		Labial	Coronal	Dorsal
a.	MS:	$[P[wV]_N]_\sigma$	$[T[wV]_N]_\sigma$	$[K[wV]_N]_\sigma$
b.	JS-lab:	$[P^w[V]_N]_\sigma$	—	$[K^w[V]_N]_\sigma$

The structural difference in (5) reveals a similarity between JS-lab and other languages whereby coronals tend to avoid secondary labialization, while labials and especially dorsals are favored targets. In Trique (Oaxaca, Mexico), dorsals are labialized after the vowel /u/ but coronals are not (Hollenbach 1977). In Chaha and Inor (West Gurage zone, Ethiopa), the masculine morpheme is realized as labialization on the rightmost labial or dorsal consonant of the stem but never on coronals (Rose 1994). Cross-linguistically, contrastive labialization occurs more often on velar, uvular, and labial consonants than on dental, alveolar, or palatal (Ohala & Lorentz 1977).

Formalized in OT, the universal preference for labialized dorsals suggests a fixed ranking of markedness constraints against secondary labialization on different places of articulation, shown in (6a). The hierarchies in (6b,c) capture the preference for onsets of lesser sonority and for nuclei of greater sonority. The markedness constraint in (6d) penalizes the hiatus between adjacent heterosyllabic vowels, while faithfulness in (6e) is violated when an input glide strengthens to an obstruent in the output.[1] The basic ranking in (6f) accounts for the generalization that Spanish prevocalic glides belong to the nucleus unless there is no preceding consonant to avoid vowel hiatus, in which case the glide strengthens to an obstruent.

(6)
a. $*T^w$, $*P^w$ » $*K^w$
b. *ONS/GLIDE » *ONS/LIQ » *ONS/NAS » *ONS/FRIC » *ONS/STOP
c. *NUC/STOP »*NUC/FRIC » *NUC/NAS » *NUC/LIQ » *NUC/GLIDE
d. *HIATUS
   Avoid two adjacent vowels that belong to different syllables.
e. IDENT(son)
   The specification for the feature [sonorant] of an input segment must be preserved in the segment's output correspondent.
f. *HIATUS, *ONS/GLIDE » *NUC/GLIDE, IDENT(son)

MS and JS-lab share the ranking in (6f) but differ in the ranking of $*P^w$. In MS, high-ranking $*P^w$ rules out labialized labials in the output, which forces input /w/ to strengthen to a labialized dorsal obstruent in syllable-initial position (Tableau 1) but to remain part of a complex nucleus after a labial onset (Tableau 2).

[1] Following Colina (2006), Bradley (2009) used the constraint ONSET to drive syllable-initial glide strengthening. In the present analysis, ONSET is replaced by *HIATUS to allow for the possibility of onsetless word-initial syllables when strengthening does not apply, e.g. MS [we].so 'bone' (3a).

/weso/	*T^w	*P^w	*HIATUS	*ONS/GLIDE	*NUC/GLIDE	*K^w	IDENT(SON)
a. [wé].so					*!		
b. [u].[é].so			*!				
c. w[é].so				*!			
☞ d. g^w[é].so						*	*
e. b^w[é].so		*!					*

Tableau 1: *Glide strengthening in MS* g^{w}é.so *'bone'*

/pweðe/	*T^w	*P^w	*HIATUS	*ONS/GLIDE	*NUC/GLIDE	*K^w	IDENT(SON)
☞ a. p[wé].ðe					*		
b. p[u].[é].ðe			*!				
c. pw[é].ðe				*!			
d. p^w[é].ðe		*!					

Tableau 2: *Complex nucleus after a labial onset in MS* pwé.ðe *'s/he can'*

In JS-lab, *P^w ranks below *NUC/GLIDE. While the outcome for syllable-initial /w/ is the same as in MS (compare Tableau 3 with Tableau 1), the demotion of *P^W now predicts that prevocalic /w/ will move out of the nucleus to be realized as secondary labialization on a preceding labial onset (Tableau 4).

/weso/	*T^w	*HIATUS	*ONS/GLIDE	*NUC/GLIDE	*P^w	*K^w	IDENT(SON)
a. [wé].so				*!			
b. [u].[é].so		*!					
c. w[é].so			*!				
☞ d. g^w[é].so						*	*
e. b^w[é].so					*!		*

Tableau 3: *Glide strengthening in JS-lab* g^{w}é.so *'bone'*

/pweðe/	*T^w	*HIATUS	*ONS/GLIDE	*NUC/GLIDE	*P^w	*K^w	IDENT(SON)
a. p[wé].ðe				*!			
b. p[u].[é].ðe		*!					
c. pw[é].ðe			*!				
☞ d. p^w[é].ðe					*		

Tableau 4: *Labialized labial in JS-lab* p^{w}é.ðe *'s/he can'*

The innovations in JS-lab (4) show that coronal+/w/ sequences are repaired in different ways, depending on the manner of the coronal consonant. From an OT perspective, these patterns constitute yet another example of 'homogeneity of target/heterogeneity of process' (McCarthy 2002). Formalizing these changes as separate rules of epenthesis and assimilation fails to explain why coronal+/w/ sequences pattern together as a target in JS-lab. As Bradley (2009) shows, an OT approach unifies the markedness of coronal+/w/ targets under a single constraint, *T^{w}, and explains the different repairs in terms of its interaction with other constraints in the grammar. For example, the constraints in (7) explain why /n/ changes to labial before /w/ while non-nasal coronals before /w/ are resolved by vowel epenthesis.

(7) a. IDENT$_{OBS}$(place)
The primary place features of an input obstruent segment must be preserved in the segment's output correspondent.
b. IDENT$_{NAS}$(place)
The primary place features of an input nasal segment must be preserved in the segment's output correspondent.
c. DEP(V)
Every vowel in the output has a correspondent in the input.
d. *ONS/ŋ

The ranking of IDENT$_{OBS}$(place) » DEP(V) predicts vowel epenthesis as the optimal repair of coronal+/w/ sequences when the coronal is an obstruent (Tableau 5). IDENT$_{OBS}$(place) is irrelevant when the coronal is nasal. Together with *ONS/ŋ, lower-ranking DEP(V) ensures nasal labialization (Tableau 6).

/twerto/	*T^{w}	*ONS/ŋ	ID$_{OBS}$(PLACE)	DEP(V)	*P^{w}	ID$_{NAS}$(PLACE)	*K^{w}
a. t^{w}[é]ɾ.to	*!						
b. p^{w}[é]ɾ.to			*!		*		
c. k^{w}[é]ɾ.to			*!				*
☞ d. t[u].ɣ^{w}[é]ɾ.to				*			*

Tableau 5: *Vowel epenthesis in JS-lab* tu.ɣ^{w}éɾ.to *'twisted'*

/nwevo/	*T^{w}	*ONS/ŋ	ID$_{OBS}$(PLACE)	DEP(V)	*P^{w}	ID$_{NAS}$(PLACE)	*K^{w}
a. n^{w}[é].vo	*!						
☞ b. m^{w}[é].vo					*	*	
c. ŋ^{w}[é].vo		*!				*	*
d. n[u].ɣ^{w}[é].vo				*!			*

Tableau 6: *Nasal place assimilation in JS-lab* m^{w}é.vo *'new'*

The asymmetry between prothesis and medial vowel epenthesis emerges from the interaction of *T^{w}, DEP(V) and the constraints in (8). When the input contains a coronal stop, *CODA/STOP moves it into the onset before the epenthetic vowel, even though the segments of input /tw/ are no longer adjacent in the output (Tableau 7). When the coronal is a fricative (or a lateral, not shown here), *CODA/STOP is irrelevant, and CONTIGUITY favors prothesis (Tableau 8).

(8) a. *CODA/STOP »*CODA/FRIC » *CODA/NAS » *CODA/LIQ » *CODA/GLIDE
b. CONTIGUITY
Elements adjacent in the input must be adjacent in the output.

		/tweɾto/	*T^{w}	*CODA/STOP	DEP(V)	CONTIGUITY	*CODA/FRIC
	a.	t^{w}[é]ɾ.to	*!				
☞	b.	t[u].ɣ^{w}[é]ɾ.to			*	*	
	c.	[e]t.g^{w}[é]ɾ.to		*!	*		

Tableau 7: *Medial vowel epenthesis in JS-lab* tu.ɣ^{w}éɾ.to *'twisted'*

		/sweɲo/	*T^{w}	*CODA/STOP	DEP(V)	CONTIGUITY	*CODA/FRIC
	a.	s^{w}[é].ɲo	*!				
	b.	s[u].ɣ^{w}[é].ɲo			*	*!	
☞	c.	[e]s.ʍ^{w}[é].ɲo			*		*

Tableau 8: *Prothesis in JS-lab* es.ʍ^{w}éɲo *'sleep'*

Bradley's (2009) analysis of JS-lab leaves several issues unaddressed. Although labialized labials and dorsals are predicted to be possible surface segments, no explicit account is given of progressive labialization after /u/ (3c). Furthermore, rising diphthongs with palatal /j/ in JS-lab are immune to the innovations that affect /Cw/ sequences, which points to an asymmetry between /w/ and /j/. Can innovations involving labialization and palatalization ever co-occur within the same JS variety? The rest of this paper presents data from JS dialects not examined thus far and develops an analysis that accounts for progressive assimilation and correctly predicts the existence of a dialect like Moroccan JS, which exhibits both labialization and palatalization.

3. *Palatalization*

Palatalization of coronal and dorsal stops is attested in the JS of Bosnia, Serbia, Croatia, Macedonia, western Bulgaria and Romania, and Greece (Kastoria) (Crews 1935, Kovačec 1986-7, and Quintana 2006). Henceforth, I refer to these varieties as "palatalizing" JS (JS-pal). As shown in (9), dorsal stops /k/ and /g/ in JS-pal develop secondary palatalization after stressed /i/. The corresponding dorsals in JS-lab have no secondary palatalization.

		JS-pal	JS-lab	
(9)	a.	kantíkʲa	kantíka	'song'
		fiʒíkʲa	fiʒíka	'young girl'
		ríkʲa	ríka	'rich'
		butíkʲa	butíka	'shop'
	b.	amígʲu	amíɣo	'friend'
		kantígʲa	kantíɣa	'song'
		trígʲu	tríɣo	'wheat'

Another possible realization of dorsal stops after stressed /i/ involves full palatalization (10a), i.e. a shift in primary place of articulation to a palatal stop or prepalatal affricate. A palatal glide /j/ also triggers regressive full palatalization of a preceding dorsal (10b) or coronal (10c).

		JS-pal	JS-lab	
(10)	a.	rícu ~ rítʃu	ríko	'rich'
		tʃícu ~ tʃítʃu	tʃíko	'small'
		amíɟu ~ amídʒu	amíɣo	'friend'
		tríɟu ~ trídʒu	tríɣo	'wheat'
	b.	céro ~ tʃéro	kjéro	'I want'
		cén ~ tʃén	kjén	'who'
	c.	micó ~ mitʃó	metjó	's/he put'
		méɟo día ~ médʒo día	méðjo ðía	'noon'

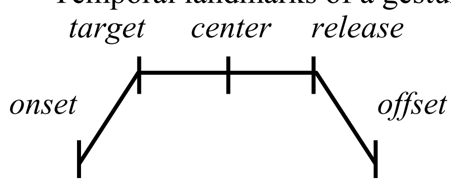
Palatalization is described as a variable phenomenon of casual, spontaneous speech in JS-pal (Kovačec 1986-7: 160,162, Crews 1935: 42,121,n.1030). Kovačec (1986-7: 162) observes that "in both Sarajevo and Dubrovnik, a person can, in the same sentence, use tʃíkʲu alongside tʃícu or tʃítʃu, and trígʲu alongside tríɟu or trídʒu, but at the same time can use forms with non-palatalized consonants tʃíku and trígu [my translation]." To my knowledge, the descriptive literature on JS-pal contains no reports of labials undergoing secondary palatalization.

Bateman (2007) examines phonological and morpho-phonological patterns of palatalization in a balanced survey of 117 languages, based on descriptive grammars. The results of her survey reveal two important generalizations about secondary palatalization: (i) coronal and dorsal consonants can palatalize independently, or both may palatalize in the same language, and (ii) labial secondary palatalization always co-occurs with either coronal or dorsal secondary palatalization, or both (p. 51). With respect to full palatalization, (i) coronal and dorsal consonants may be fully palatalized independently of each other, or both places of articulation may be targeted in the same language, and (ii) labial consonants do not palatalize fully at all (p. 46). In JS-pal, dorsals, but not coronals, show secondary (9) and full (10a) progressive palatalization. Both dorsals (10b) and coronals (10c) show regressive full palatalization. Labials do not palatalize.

3.1 *Analysis of progressive secondary palatalization*

Bateman analyzes palatalization using a version of OT that adopts the phonetically-based representations of Articulatory Phonology (Browman & Goldstein 1989). The grammar is assumed to operate on abstract articulatory *gestures,* which (i) are dynamically defined along both spatial and temporal dimensions to produce a constriction in the vocal tract, (ii) specify the location and degree of the constriction produced by the active articulator, and (iii) are coordinated with each other as speech is produced through time. Bateman's approach is in line with previous work seeking to integrate gestures within constraint-based OT (e.g. Boroff 2007, Bradley 2006, 2007, Davidson 2003, Gafos 2002, Hall 2003). These works formalize gestures in terms of temporal landmarks (11) and specify gestural coordination with alignment constraints (12).

(11) Temporal landmarks of a gesture (Gafos 2002)

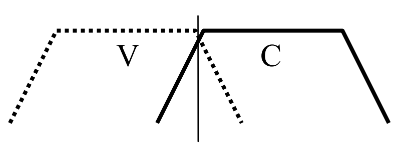


(plateau = *target* → *release*)

(12) ALIGN(G_1,LANDMARK$_1$,G_2,LANDMARK$_2$)
Align landmark$_1$ of gesture$_1$ with landmark$_2$ of gesture$_2$.

I analyze the secondarily palatalized dorsals in (9) as an interaction of constraints on gestural coordination in VC sequences. The alignment constraint in (13a) keeps the consonant's plateau from overlapping the plateau of the vowel gesture, denoted below as a broken line. When (13b) ranks above (13a), the release of a high vowel extends past the release of the following consonant, resulting in a superimposed secondary articulation.

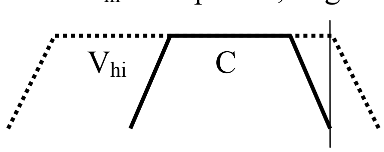
(13) a. ALIGN(V,REL,C,TAR) (Gafos 2002: 281)
In /VC/ sequence, align the release of V with the target of C.



(heard as [VC])

V rel = C tar

b. ALIGN(V_{hi},REL,C,OFF) (cf. Bateman 2007: 291)
In a /V_{hi}C/ sequence, align the release of V with the offset of C.



(heard as [iC^j] / [uC^w])

V_{hi} rel = C off

Following Bateman (2007: 240), I adopt the universal markedness hierarchy in (14), which penalizes the superimposition of a secondary palatal gesture on consonants at different places of articulation.

(14) $*P^j » *T^j, *K^j$

Gestural alignment constraints interact with (14) to generate the attested patterns of palatalization. Tableau 9 gives the analysis of progressive secondary palatalization in JS-pal. ALIGN(V_{hi},REL,C,OFF) optimizes the palatalized dorsal after stressed /i/ in (f), but higher-ranking $*P^j$ and $*T^j$ favor plain labials and coronals in the same context, as in trí.pa 'belly' (a) and grí.tu 'scream' (c).

				$*P^j$	$*T^j$	ALIGN (V_{hi},REL,C,OFF)	ALIGN (V,REL,C,TAR)	$*K^j$
☞	a.	/tɾipa/	tɾí.pa			*		
	b.		tɾí.p^ja	*!			*	
☞	c.	/gɾitu/	gɾí.tu			*		
	d.		gɾí.t^ju		*!		*	
	e.	/tɾigu/	tɾí.gu			*!		
☞	f.		tɾí.g^ju				*	*

Tableau 9: *Progressive palatalization in JS-pal* tɾíg^ju *'wheat'*

Tableau 10 shows how the same gestural alignment constraints interact with the hierarchy in (6a) to generate progressive labialization in JS-lab (3c). ALIGN(V_{hi},REL,C,OFF) optimizes (b,f), but $*T^w$ rules out tu.t^wa.βló 'your painting'.

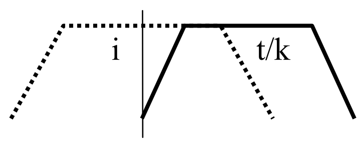
				$*T^w$	ALIGN (V_{hi},REL,C,OFF)	ALIGN (V,REL,C,TAR)	$*P^w$	$*K^w$
	a.	/tu paðɾe/	tu.pá.ðɾe		*!			
☞	b.		tu.p^wá.ðɾe			*	*	
☞	c.	/tu taβlo/	tu.ta.βló		*			
	d.		tu.t^wa.βló	*!		*		
	e.	/luɣaɾ/	lu.ɣáɾ		*!			
☞	f.		lu.$ɣ^w$áɾ			*		*

Tableau 10: *Progressive labialization in JS-lab* tu p^wáðɾe *'your father' and* lu$ɣ^w$áɾ *'place'*

3.2 *Analysis of progressive full palatalization*

Progressive secondary palatalization and labialization involve the rightward extension of a high vowel gesture, which is heard as an offglide after the release of the following consonant. Full palatalization arises from a slightly different gestural configuration (Bateman 2007: 227,291). As formalized in (15), the plateau of the high vowel gesture overlaps that of a following coronal or dorsal consonant, although not to the same degree as in secondary palatalization. Blending of the overlapped tongue gestures shifts the constriction location of the stop from dental or velar to the palatal region, violating faithfulness constraints on constriction location (16). Coronal palatalization violates IDENT(TTCL), while dorsal palatalization violates IDENT(TBCL).

(15) ALIGN(V_{hi},CEN,C,ONS)
In a /V_{hi}C/ sequence, align the center of V with the onset of C.



(gestural blending produces [ic] ~ [itʃ])

V_{hi} cen = C ons

(16) a. IDENT-Tongue Tip Constriction Location — IDENT(TTCL)
An oral gesture specified for a particular tongue tip constriction location in the input must have the same constriction location in the output.

b. IDENT-Tongue Body Constriction Location — IDENT(TBCL)
An oral gesture specified for a particular tongue body constriction location in the input must have the same constriction location in the output.

The failure of coronal stops to undergo full palatalization in JS-pal shows that IDENT(TTCL) ranks higher than ALIGN(V_{hi},CEN,C,ONS). In Tableau 11, *T^j rules out secondary palatalization in (b). Candidates (a,c) are tied on ALIGN(V_{hi},REL,C,OFF), and the decision is passed down to IDENT(TTCL), which selects the plain coronal in (a).

/gɾitu/	*T^j	ALIGN (V_{hi},REL,C,OFF)	IDENT (TTCL)	*K^j	ALIGN (V_{hi},CEN,C,ONS)	IDENT (TBCL)
☞ a. gɾí.tu		*			*	
b. gɾí.t^ju	*!				*	
c. gɾí.ʧu		*	*!			

Tableau 11: *No progressive palatalization in JS-pal* gɾítu *'scream'*

Recall that in JS-pal, palatalization of dorsals after stressed /i/ can be either secondary (9) or full (10a). This variation can be accounted for by a variable ranking between *K^j and ALIGN(V_{hi},REL,C,OFF). When alignment takes priority, as in Tableau 12, secondarily palatalized dorsals (b) are selected at the expense of violating lower-ranked *K^j. In Tableau 13, the opposite ranking rules out secondary palatalization (b). The tie between the remaining candidates is broken by ALIGN(V_{hi},CEN,C,ONS) in favor full palatalization (c), despite the violation of lower-ranked IDENT(TBCL).

/trigu/	*T^j	ALIGN (V_{hi},REL,C,OFF)	IDENT (TTCL)	*K^j	ALIGN (V_{hi},CEN,C,ONS)	IDENT (TBCL)
a. trí.gu		*!			*	
☞ b. trí.gʲu				*	*	
c. trí.ʤu		*!				*

Tableau 12: *Progressive secondary palatalization in JS-pal* trígʲu *'wheat'*

/trigu/	*T^j	*K^j	ALIGN (V_{hi},REL,C,OFF)	IDENT (TTCL)	ALIGN (V_{hi},CEN,C,ONS)	IDENT (TBCL)
a. trí.gu			*		*!	
b. trí.gʲu		*!			*	
☞ c. trí.ʤu			*			*

Tableau 13: *Progressive full palatalization in JS-pal* tríʤu *'wheat'*

3.3 *Analysis of regressive full palatalization*

The remaining pattern to account for in JS-pal is the full palatalization of dorsal and coronal stops before the palatal glide /j/ (10b,c). Building on Bradley's (2009) analysis of prevocalic /w/ in JS-lab, I propose that in JS-pal, prevocalic /j/ is syllabified as part of the nucleus after a labial onset but moves out of the nucleus to induce full palatalization of a preceding coronal or dorsal stop. The analysis developed below combines syllabification constraints with Bateman's gestural faithfulness and markedness constraints governing palatalization.

The analysis is illustrated in the following tableaux. In Tableau 14, higher-ranking markedness constraints rule out the labialized labial in (d), the hiatus between vowels in (b), and the onset glide in (c). The optimal syllabification is candidate (a), in which the palatal glide belongs to a complex nucleus. When the input stop is coronal (Tableau 15) or dorsal (Tableau 16), syllabic constraints eliminate candidates with hiatus (b), onset glides (c), and nuclear glides (a). The rankings of *T^j above IDENT(TTCL) and of *K^j above IDENT(TBCL) favor full palatalization of both coronal and dorsal stops in (e).

/limpju/	*P^j	*HIATUS	*ONS/GLIDE	*T^j	*NUC/GLIDE	IDENT (TTCL)	*K^j	IDENT (TBCL)
☞ a. lím.p[ju]					*			
b. lím.p[i].[u]		*!						
c. lím.pj[u]			*!					
d. lím.p^j[u]	*!							

Tableau 14: *Complex nucleus in JS-pal* límpju *'clean'*

/mitjo/	*P^j	*HIATUS	*ONS/GLIDE	*T^j	*NUC/GLIDE	IDENT (TTCL)	*K^j	IDENT (TBCL)
a. mi.t[jó]					*!			
b. mi.t[i].[ó]		*!						
c. mi.tj[ó]			*!					
d. mi.t^j[ó]				*!				
☞ e. mi.ʧ[ó]						*		

Tableau 15: *Full palatalization in JS-pal* miʧó *'s/he put'*

/kjen/	*P^j	*HIATUS	*ONS/GLIDE	*T^j	*NUC/GLIDE	IDENT (TTCL)	*K^j	IDENT (TBCL)
a. k[jé]n					*!			
b. k[i].[é]n		*!						
c. kj[é]n			*!					
d. k^j[é]n							*!	
☞ e. ʧ[é]n								*

Tableau 16: *Full palatalization in JS-pal* ʧén *'who'*

4. *Labialization and palatalization in Moroccan JS*

There is a fundamental asymmetry between the two JS varieties analyzed thus far: JS-lab has labialization but no palatalization, whereas JS-pal has palatalization but no labialization (apart from the strengthening of word-initial /w/ to [g^w]/[ɣ^w]). As Bradley (2009: 63) originally theorized, the independence of these phenomena is predicted by an OT analysis that assumes separate constraints for labialized and palatalized consonants. The ranking of *ONS/GLIDE » *NUC/GLIDE generally favors nuclear glides, and the interaction of hierarchies (6f) and (14) with *NUC/GLIDE determines which types of complex segments are allowed. If this approach is correct, then it also predicts that labialization and palatalization should be able to co-occur within a single grammar, given the appropriate ranking. This theoretical prediction is confirmed by data from late 19th-century Moroccan JS, documented by Benoliel (1977[1926-8]) in his seminal description and dictionary. The examples below have been converted to modern IPA, based on his original transcriptions and phonetic descriptions.

Prevocalic /w/ is realized as secondary labialization on a preceding velar stop (17), and voiced [g^{w}]/[ɣ^{w}] can be further weakened in pronunciation, resembling the initial sound of English *well* (Benoliel 1977: 12,15).[2]

(17)	a.	k^{w}ándo	‘when’	k^{w}éʝo	‘neck’
		k^{w}éɾo	‘leather’	k^{w}ál	‘which’
		k^{w}éɾða	‘rope’	pásk^{w}a	‘Easter’
		k^{w}ánto	‘how much’		
	b.	g^{w}éso > wéso	‘bone’	antíɣ^{w}o > antíwo	‘old’
		g^{w}éko > wéko	‘hollow	antiɣ^{w}eðáð > antiweðáð	‘antiquity’
		fɾáɣ^{w}a > fɾáwa	‘forge’	iŋg^{w}énte > iŋwénte	‘ointment’
		léɣ^{w}a > léwa	‘league’	veɾɣ^{w}énza > veɾwénza	‘shame’
		náɣ^{w}a > náwa	‘underskirt’		

Velar stops are progressively labialized in the context of a preceding /u/ (18), and voiced [g^{w}]/[ɣ^{w}] is weakened and lengthened (pp. 12,15,24).

(18)	a.	núŋk^{w}a	MS núŋka	‘never’
		xanukk^{w}á	Heb. ḥănukkāh	‘consecration’
		sukk^{w}á	Heb. sukkāh	‘thicket, hut’
		<u>Moroccan JS</u>	<u>MS</u>	
	b.	luɣ^{w}áɾ > luwːáɾ	luɣáɾ	‘place’
		ʒuɣ^{w}áɾ > ʒuwːáɾ	xuɣáɾ	‘to play’
		letʃúɣ^{w}a > letʃúwːa	letʃúɣa	‘lettuce’
		ʒuɣ^{w}áða > ʒuwːáða	xuɣáða	‘move, play’
		letʃúɣ^{w}a > letʃúwːa	letʃúɣa	‘lettuce’
		petʃúɣ^{w}a > petʃúwːa	petʃúɣa	‘breast’

[2] Benoliel’s description strongly suggests that *cua*/*cue* is pronounced with a labialized velar stop: “the *c* is absorbed in the *u* and forms with it a liquid consonant, in which the *u* is on the *k,* just like the *i* is on the *n,* in the consonant *ñ* [my translation]” (p. 12).

Labial stops change to velar before prevocalic /w/, which is realized as secondary labialization (19). Voiced [g^{w}]/[ɣ^{w}] (< /bw/) is subject to weakening (pp. 15,21).

		Moroccan JS	MS	
(19)	a.	k^{w}ésto	pwésto	‘set, laid’
		k^{w}éɾta	pwéɾta	‘door’
		k^{w}éɾko	pwéɾko	‘pig’
		k^{w}éðo	pwéðo	‘I can’
		ɾesk^{w}ésta	respwésta	‘answer’
	b.	aɣ^{w}élo > awélo	aβwélo	‘grandfather’
		g^{w}éno > wéno	bwéno	‘good’
		g^{w}éstɾo > wéstɾo	bwéstɾo	‘your’

Benoliel describes the nasal in postvocalic /mwe/, /nwe/, and /ɲwe/ sequences as “nasalo-cacuminal” and uses the transcriptions *ungw* and later *ũ-gw* (pp. 20,33). I interpret this as [Vŋ.g^{w}] > [Vũ̯.w], whereby the coda nasal is absorbed as a nasalized glide into a preceding syllable nucleus (Colina 2011, Holt 2000, Piñeros 2006), and labialized [g^{w}]/[ɣ^{w}] is weakened, as described above.

		Moroccan JS	MS	
(20)	a.	laŋ.g^{w}éɾte > laũ̯.wéɾte	la.mwéɾte	‘the death’
		laŋ.g^{w}éla > laũ̯.wéla	la.mwéla	‘the molar’
	b.	unaŋ.g^{w}és > unaũ̯.wés	una.nwés	‘a walnut’
		deŋ.g^{w}évo > deũ̯.wévo	de.nwéβo	‘again’
	c.	baŋ.g^{w}élo > baũ̯.wélo	ba.ɲwélo	‘little bath’
		paŋ.g^{w}élo > paũ̯.wélo	pa.ɲwélo	‘handkerchief’

Sequences of non-nasal coronal+/w/ remain intact in Moroccan JS. Benoliel’s dictionary gives the following examples of word-initial sequences:

(21)	tweddáɾse	‘to perform ritual ablutions’	ʃweáɾ	‘to burn’
	dwá	‘remedy, cure’	ʒwáβ	‘answer’
	dwána	‘customs’	ʒwanéte	‘bunion’
	dwiɾía	‘type of house’	ʒwáɾi	‘party’
	swáβ	‘politeness’	ʒwéɣo	‘game’
	swák	‘make-up’	ʒwés	‘judge’
	ʃwáɾ	‘consultation’	ʒwéves	‘Thursday’
	ʃwáɾi	‘knapsack’	ɾwéða	‘wheel’
	ʃwáj	‘a little’		

Moroccan JS exhibits progressive secondary palatalization of voiceless /t/ after stressed /i/, especially in the diminutive suffix *–ito/a* (Benoliel 1977: 24,58):

(22) ɾebbisítʲo < ɾebbí 'rabbi' meɣiítʲa < meɣía 'Book of Esther'
aʒamítʲo < aʒám 'wise' eʒalítʲo < eʒál 'cabinet'
seferítʲo < sefér 'book'

Additional evidence of coronal palatalization comes from the voiced palatal fricative /ʝ/, which has an allophone [ðʲ] that Benoliel transcribes as *dy* and describes as the voiced counterpart of voiceless palatalized [tʲ] (p. 25):

(23)

Moroccan JS	MS	
aðʲéɾ	aʝéɾ	'yesterday'
se kaðʲó	se kaʝó	's/he fell'
maðʲóɾ	maʝóɾ	'greater, older'

Regressive palatalization is also attested in the context of /k/ before /j/, with full palatalization to a prepalatal affricate in exaggerated speech (pp. 21-22):

(24)

Moroccan JS	MS	
kʲén > ʧén	kjén	'who'
kʲéɾo > ʧéɾo	kjéɾo	'I want'
kʲéɾes > ʧéɾes	kjéɾes	'you want'
kʲéɾe > ʧéɾe	kjéɾe	's/he wants'
kʲéɾa > ʧéɾa	kjéɾa	's/he want'

The data from Moroccan JS suggest that, as in JS-lab, prevocalic /w/ forms a complex segment with a preceding consonant. While labialized coronals are marked segments in JS-lab, Moroccan JS shows different targets and repairs: labialized labial stops become velar (19), and labialized nasals are resyllabified into a preceding syllable nucleus (20), but non-nasal coronal+/w/ sequences remain intact (21). These patterns suggest that labialized labials are more marked than labialized coronals. Furthermore, palatalization affects coronals and dorsals to the exclusion of labials in both JS-pal and Moroccan JS. The crucial differences are that (i) progressive secondary palatalization targets dorsals in JS-pal but coronals in Moroccan JS (22), which points to the unmarkedness of palatalization on dorsals in the former dialect but on coronals in the latter, and (ii) regressive full palatalization targets both coronals and dorsals in JS-pal but only dorsals in Moroccan JS (24). These generalizations from Moroccan JS match up with the surface patterns predicted by a re-ranking of the same constraints used in the analyses of MS, JS-lab, and JS-pal. Space limitations prevent me from illustrating the complete OT account here, but see Bradley (2014) for more details.

4.1 *A typology of secondary articulations in MS and JS*

Figure 1 summarizes the patterns of labialization and palatalization examined in this paper. The most common realization of word-initial /w/ is a labialized dorsal obstruent. In contexts other than word-initial /w/, JS-lab shows labialization of labials and dorsals but not coronals, while Moroccan JS shows labialization of coronals and dorsals but not labials. Both JS-pal and Moroccan JS show palatalization of coronals and dorsal but not labials.

	Labialization		Palatalization
	$_{\#}$[/w/		
MS	w > g^{w}/ɣ^{w}	—	—
JS-lab	g^{w}/ɣ^{w}	p^{w}, b^{w}/β^{w}, f^{w}, m^{w} k^{w}, g^{w}/ɣ^{w}	—
JS-pal	g^{w}/ɣ^{w}	—	c ~ ʧ < /tj/ ɟ ~ ʤ < /dj/ k^{j}, c ~ ʧ ɡ^{j}, ɟ ~ ʤ
Moroccan JS	g^{w}/ɣ^{w} > w	t^{w}, d^{w}, ɾ^{w}, s^{w}, z^{w}, ʃ^{w}, ʒ^{w} k^{w}, g^{w}/ɣ^{w} > w	t^{j}, ð^{j} < /j/ k^{j} ~ ʧ

Figure 1: Summary of labialized and palatalized consonants in MS and JS

It is clear from this summary that labialization and palatalization are separate processes that can occur independently of each other. It turns out that Moroccan JS combines both processes within one and the same variety, thereby rounding out a four-way typology of secondary articulation patterns:

(25) a. no labialization or palatalization
b. labialization only
c. palatalization only
d. both labialization and palatalization

The patterning of labialization and palatalization in MS and JS forms a cross-linguistic typology of complexity ranging from MS, in which neither phenomenon is attested (apart from word-initial /w/-strengthening), to Moroccan JS, which combines both. The typology established here would necessarily remain incomplete on the basis of non-Sephardic Spanish alone.

Taken together, these four varieties collectively instantiate all possible rankings of the markedness hierarchies on secondary labialization (6a) and palatalization (14). As shown in (26), all grammars share the universal rankings in which labialized dorsals are unmarked and palatalized labials are marked. The factorial typology of non-fixed constraints {*T^{w},*P^{w}} and {*T^{j},*K^{j}}, highlighted in italics, predicts the markedness differences observed across JS dialects. Secondary labialization is the most marked on coronals in JS-lab (26b) but on labials in Moroccan JS (26d). Secondary palatalization is the least marked on dorsals in JS-pal (26c) but on coronals in Moroccan JS (26d).

(26)	a.	MS:	$*\mathrm{P}^w, *\mathrm{T}^w \gg *\mathrm{K}^w$	$*\mathrm{P}^j \gg *\mathrm{T}^j, *\mathrm{K}^j$
	b.	JS-lab:	$*T^w \gg *P^w \gg *\mathrm{K}^w$	$*\mathrm{P}^j \gg *\mathrm{T}^j, *\mathrm{K}^j$
	c.	JS-pal:	$*\mathrm{P}^w, *\mathrm{T}^w \gg *\mathrm{K}^w$	$*\mathrm{P}^j \gg *T^j \gg *K^j$
	d.	Moroccan JS:	$*P^w \gg *T^w \gg *\mathrm{K}^w$	$*\mathrm{P}^j \gg *K^j \gg *T^j$

5. *Conclusion*

This paper has uncovered new generalizations about secondary labialization and palatalization in JS dialects and has proposed an OT account that uses universal constraints with strong cross-linguistic support. The analysis explains patterns across MS and JS dialects through different rankings of the same constraints and gives a unified account of labialization and palatalization phenomena that are phonological, involving differences in glide syllabification, and phonetic, involving variation in gestural coordination within VC sequences. The proposed account demonstrates the utility of OT as an analytical framework for doing JS phonology and in turn highlights the importance of JS to phonological theory by bringing new generalizations and data to bear on the analysis of secondary articulations.

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