2007

Consonant harmony via correspondence: Evidence from Chumash

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1. Introduction

Hansson (2001), Rose & Walker (2004), and Walker (2000a, 2000b) have recently proposed that long-distance consonant assimilation is accomplished via segmental correspondence rather than autosegmental linking. The phonology of the feature [anterior] in Chumash supports this idea: linking of the feature [anterior] is forbidden across morpheme boundaries, but long-distance [anterior] harmony is allowed across morpheme boundaries. The Chumash evidence therefore shows that assimilation can occur without autosegmental spreading.

2. The Phenomena of Interest

Chumash (isolate, California) has a consonant harmony process that causes sibilant consonants to agree in [anterior][2] with the rightmost sibilant in the word (Applegate 1972, Beeler 1970, Gafos 1996, Hansson 2001, Harrington 1974, Lieber 1987, Poser 1982, 1993, 2004). The Ineseño Chumash (hereafter just Chumash) data in (1) illustrate:[3]

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[1] I am grateful to the participants in Ling 730 (Fall, 2004) for their comments. Special thanks go to Joe Pater, whose comments suggested the approach in section 3, to Michael Becker, whose questions led me to the analysis in section 4, and to Gunnar Hansson and Rachel Walker for their generous and helpful comments on an earlier draft of this paper.

[2] I assume that specification for [anterior] is universally limited to [coronal] segments (McCarthy 1988) (also see fn. 10). Lieber (1987), who assumes the traditional definition of [anterior], proposes that [distributed] is the harmonizing feature. The available descriptions do not decide the question. My analysis uses [anterior], but it could just as well have used [distributed].

[3] The Chumash consonant system consists of [p], [t], [c], [č], [k], [q], [s], and [š], the glottalized and aspirated counterparts of the preceding, [x], [m], [n], [l], [w], and [y], the glottalized counterparts of the preceding, [ʔ], and [h] (Applegate 1972:8-9). The vowels are [i], [e], [ɨ], [a], [u], [o].

(1) Sibilant harmony in Ineseño Chumash

	/ha-s-xintila-waš/	[haš̲xintilawaš]	‘his former gentile’
cf.	/ha-s-xintila/	[hasxintila]	‘his gentile’
	/s-iš-sili-uluaqpey=us/	[s̲is̲ʰuleqpeyus]	‘they two want to follow it’[4]
cf.	/p-iš-al-nanʔ/	[pišananʔ]	‘don’t you two go’

Examples like these show that harmony is feature-changing in Chumash, since it affects both values of [anterior], mapping /s/ to [š] and /š/ to [s].[5] Although this process is not without occasional exceptions (Applegate 1972:119), there is clear evidence of its productivity from loan words (2).[6]

(2) Productivity of sibilant harmony in loan words (Applegate 1972:164)

/k-sapatu-Vč/	[kšapatuč]	‘I wear shoes’ (< Sp. *zapato*)
/s-kamisa- Vč/	[škamišač]	‘he wears a shirt’ (< Sp. *camisa*)

Chumash has another process affecting sibilants: when a [+anterior] sibilant is immediately followed by one of the [+anterior] nonsibilant coronals [t], [l], or [n], it dissimilates and becomes [–anterior].[7] The data are given in (3):

(3) [anterior] dissimilation (data from Applegate 1972, via Poser 1993:317)

/s-nanʔ/	[š̲nanʔ]	‘he goes’
/s-tepuʔ/	[š̲tepuʔ]	‘he gambles’
/s-loxitʔ/	[š̲loxitʔ]	‘he surpasses me’

When a [+anterior] sibilant is derived by [anterior] dissimilation, it does not *undergo*, but it does *trigger* sibilant harmony, as shown in (4) and (5), respectively:

(4) Output of [anterior] dissimilation does not undergo harmony (Poser 1993:318)

/s-ti-yep-us/	[š̲tiyepus]	‘he tells him’

(5) Output of [anterior] dissimilation does trigger harmony (Hansson 2001:59)

/s-is-tɨʔ/	[š̲iš̲tɨʔɨ]	‘he finds it’

Example (6) shows that the same is true for sibilants that are already [–anterior] in underlying representation but that occur in the appropriate context for [anterior] dissimilation:

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4 The reduction of /…š-sili-uluaq…/ to […s̲ʰuleq…] conforms to the regular phonology of Chumash.

5 Kiparsky (1993:299) shows the morphemes /s-/ and /-iš/ as both having archisegmental /S/ in underlying representation. If this is not just a typographical error, it presents obvious problems of analysis, since there would seem to be no way of deriving the [š] in [pišananʔ].

6 Bird (1995) and Russell (1993) have proposed that Chumash sibilant harmony is a “phonetic process” that lies outside the scope of phonological theory. See Poser (2004) for convincing argumentation that this view is incorrect.

7 According to Applegate (1972:117-118), [anterior] dissimilation is regular with /s/ but less regular with /c/, which moreover occurs less frequently than /s/ in preconsonantal position.

(6) Effect of vacuous [anterior] dissimilation (Poser 1993:318)
/s-iš-lu-sisin/ [š̲iš̲lusisin] ‘they two are gone awry’

Even though the second [š] in [šišlusisin] is not literally derived by [anterior] dissimilation, it behaves the same as the derived [š]s in (4) and (5): it does not undergo harmony with the following [s]s, and it does trigger harmony in the preceding /s/.[8]

Now we get to the interesting part, the significance of which was first noted by Poser (1982). The process of [anterior] dissimilation only affects heteromorphemic consonant sequences. When the sequence is tautomorphemic, as in (7), then there is no change and [anterior] is contrastive:

(7) Blocking of [anterior] dissimilation in tautomorphemic sequences (Poser 1993:319)

	/stumukun/	[s̲tumukun]	‘mistletoe’
	/slowʔ/	[s̲lowʔ]	‘eagle’
	/wastuʔ/	[was̲tuʔ]	‘pleat’
cf.	/wašti-nanʔ/	[waš̲tinanʔ]	‘to spill’

Remarkably, sibilants that occur in this contrastive environment *do* undergo sibiliant harmony, as shown in (8):[9]

(8) Harmony affects tautomorphemic ST sequences (Poser 1993:319)
/s-wašti-lokʔin-us/ [s̲was̲tilokʔinus] ‘the flow stops on him’

This is the main analytic challenge that Chumash presents: how to account for the different behavior of heteromorphemic and tautomorphemic sibilant + [t], [n], [l] sequences under [anterior] dissimilation and harmony.

3. Dissimilation and Its Interaction with Consonant Harmony

If [anterior] dissimilation is what its name suggests it is, then it is presumably a consequence of ranking the constraint OCP(anterior) above faithfulness to anteriority, as shown in the comparative tableau (Prince 2002) in (9):

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[8] Poser (1982:133) cites an exception to this generalization: [s-iš-tiši-yep-us/ → [sistisiyepus] ‘the two show him’. He notes, however, that the generalization is exceptionless in Ventureño Chumash, according to Harrington (1974).

[9] Kiparsky (1993:309-310) points out that attestation of examples that are like (8) but with opposite values of [anterior] is limited to /ha p-xosloʔ-š/ → [apxošloš] ‘you blow your nose’ (Applegate 1972:522), and the underlying /s/ in this form is not explicitly argued for by Applegate. The analysis I propose here, like all other analyses except Kiparsky’s, predicts that derivations like this one should exist.

(9) OCP(anterior) >> IDENT(anterior)

/s-nanʔ/	OCP(anterior)	IDENT(anterior)
→ šnanʔ		1
a. ~ snanʔ	1 W	L

The data in (4) and (6) show that OCP(anterior) crucially dominates the markedness constraint responsible for sibilant harmony. I will postpone serious discussion of the harmony constraint until section 4; for now, I will adopt the ad hoc expedient of positing a constraint AGREE(anterior) that is violated once by every sequence of the form …[αant, +strid]X[–αant, +strid]…, where *X* ⊅ [+strid]. Tableau (10) accounts for the interaction of sibilant harmony and anteriority dissimilation:

(10) OCP(anterior) >> AGREE(anterior) >> IDENT(anterior)

/s-iš-lu-sisin/	OCP(anterior)	AGREE(anterior)	IDENT(anterior)
→ šišlusisin		1	1
a. ~ sišlusisin		2 W	L
b. ~ sislusisin	1 W	L	1

Because OCP(anterior) dominates AGREE(anterior), harmony cannot force a sibilant to be [+anterior] before [t], [n], or [l]. But violation of AGREE(anterior) is minimized, so [šišlusisin] beats [sišlusisin], which is less harmonizing and therefore less harmonic.

Dissimilation of anterior only occurs in hetermorphemic sequences (cf. (7)). This means that tautomorphemic sequences somehow avoid the effects of OCP(anterior). The explanation is that tautomorphemic sequences have a linked structure, as Kiparsky (1993:297-299) proposes in his analysis of Chumash.

Autosegmental theory (Goldsmith 1976) offers (at least) two ways of representing a sequence like [st]. In one representation, which I will write as [s͡t], a single instance of the feature value [+anterior] is shared by the two segments. The other representation, which I will write as [s|t], has two instances of the feature value [+anterior].[10]

In general, a constraint OCP(x) is sensitive only to literal sequences of *x* and not to sequences of segments that share a linked value of *x* (McCarthy 1979, 1981 and much subsequent work). Therefore, the cluster [s|t] violates OCP(anterior), whereas the cluster [s͡t] obeys it. Because heteromorphemic clusters are observed to dissimilate, they must not be allowed to take on the [s͡t] structure that would give them immunity from OCP(anterior). The constraint responsible for this limitation is a version of CRISPEDGE (Ito and Mester 1994, 1999).

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[10] Feature geometry (Clements 1985) offers other options for representing [st] as a linked structure: it could share a single instance of [coronal] or a single Place node. Either of these possibilities would also entail sharing of [anterior] under the assumption that [anterior] is a dependent of [coronal] (McCarthy 1988). This richer range of structures has no effect on the analysis presented here since it is still necessary to rule out [+anterior]-linked [st] across morpheme boundaries.

The CrispEdge constraints were proposed by Ito and Mester as a way of limiting linked structure across the edges of certain domains. CrispEdge(x) is violated if and only if some linked structure transgresses an edge of the domain *x*. Kawahara (to appear) and Walker (2001:852) argue that a second argument is required: CrispEdge(x, y) is violated if and only if some node *y* is linked across an edge of some *x*. In Chumash, the constraint CrispEdge(Morpheme, anterior) crucially dominates Ident(anterior), as shown in (11).

(11) CrispEdge(Morpheme, anterior) >> Ident(anterior)

/s-nanʔ/	OCP(anterior)	CrispEdge(Morph, ant)	Ident(anterior)
→ šnanʔ			1
a. ~ s͡nanʔ		1 W	L
b. ~ s|nanʔ	1 W		L

The candidate *[s͡nanʔ] succeeds in dodging the OCP bullet, but it steps into CrispEdge's line of fire. The problem is that *[s͡nanʔ]'s linked [+anterior] straddles a morpheme boundary, and this is inconsistent with the requirement imposed by CrispEdge(Morpheme, anterior).

Morpheme-internally, however, CrispEdge(Morpheme, anterior) is irrelevant. Morpheme internal [s͡t] clusters satisfy OCP(anterior) without further ado, so dissimilation is unnecessary. This result is certified in (12).

(12) Morpheme-internal sibilant + [t], [n], [l] clusters

/was͡tuʔ/ *or* /was|tuʔ/	OCP(anterior)	CrispEdge(Morph, ant)	Ident(anterior)
→ was͡tuʔ			
a. ~ waš|tuʔ			1 W
b. ~ was|tuʔ	1 W		

Because the linked structure is a viable option, dissimilation need not occur and is in fact ruled out by low-ranking Ident(anterior). The unlinked [s|t] structure of [was|tuʔ] is banned by OCP(anterior). Observe that it doesn't matter whether the input contains /s͡t/ or /s|t/. This is important because, under richness of the base (Prince and Smolensky 2004), we cannot presuppose that tautomorphemic /s|t/ is absent from inputs. The OCP-motivated fusion of /s|t/ to [s͡t] happens automatically, since it exacts no cost in faithfulness because Ident(anterior) is satisfied either way (Keer 1999).

To complete the picture, we now need to look at how hetero- and tautomorphemic clusters fare in harmony contexts. The introduction of the [s͡t]/[s|t] representational distinction requires us to reopen the hetermorphemic case in (10). As shown in (13), CrispEdge(Morpheme, anterior) ensures that there is no change in the winning candidate despite the wider range of losers, provided that it dominates Agree(anterior).

(13) CRISPEDGE(Morpheme, anterior) >> AGREE(anterior)

/s-iš-lu-sisin/	OCP(anterior)	CRISPEDGE(Morph, ant)	AGREE(ant)	IDENT(ant)
→ šišlusisin			1	1
a. ~ sišlusisin			2 W	L
b. ~ sis͡lusisin		1 W	L	1
c. ~ sis|lusisin	1 W		L	1

This ranking result concurs with the earlier observations: CRISPEDGE(Morpheme, anterior) dominates IDENT(anterior) by direct argument (see (11)) and by transitivity via AGREE(anterior) (see (13) and (10)).

Even though it dominates AGREE(anterior), CRISPEDGE(Morpheme, anterior) does not block long-distance consonant harmony, which is obviously not impeded by morpheme boundaries. This is an indication that consonant harmony does not involve autosegmental spreading of [anterior]. Section 4 deals with this matter in detail.

In the tautomorphemic case, CRISPEDGE(Morpheme, anterior) is irrelevant and sibilant harmony is not affected by OCP(anterior). Tableau (14) shows why.

(14) Harmony in tautomorphemic clusters

/s-wašti-lokʔin-us/	OCP(anterior)	CRISPEDGE(M, ant)	AGREE(ant)	IDENT(ant)
→ swas͡tilokʔinus				1
a. ~ šwaštilokʔinus			1 W	1
b. ~ swaštilokʔinus			2 W	W
c. ~ swas|tilokʔinus	1 W			1

Even though OCP(anterior) dominates AGREE(anterior) and is therefore able to block harmony in heteromorphemic cases like (13), it has no comparable effect on tautomorphemic clusters because they have the option of assuming a linked structure — an option that is not available to hetermorphemic clusters because of high-ranking CRISPEDGE(Morpheme, anterior).

This section concludes with some remarks about alternative analyses.

The fact that only heteromorphemic clusters dissimilate looks like a derived environment or strict cycle effect, and it has been analyzed as such by Poser (1982, 1993). Łubowicz (2002) proposes an Optimality-Theoretic account of derived environment effects based on local constraint conjunction (Smolensky 1995). The idea is that a markedness constraint M can be limited to derived environments by conjoining M with some constraint that is only violated in a derived environment. Environments derived by morpheme concatenation, as in Chumash, require that M be conjoined with a constraint on stem-syllable alignment — with prefixing morphology, this would be

ALIGN-L(Stem, σ).[11] The local conjunction of OCP(anterior) and ALIGN-L(Stem, σ) in the domain of adjacent segments — written as [OCP(anterior)&ALIGN-L(Stem, σ)]$_{AdjSeg}$ — would then replace OCP(anterior) in tableaux above.

Some general criticisms of this approach to derived environment effects can be found in McCarthy (2003:24-28). A Chumash-specific problem concerns syllabification. This analysis will only work if, e.g., /s-is-tɨʔ/ is syllabified as [ši.štɨ.ʔɨ] in the output, since it is crucial that the prefix de-align the stem /tɨʔ/. Although Chumash does have word-initial clusters like [št] (Applegate 1972:39), the parsing of medial clusters as complex onsets does not fit what we know of Chumash syllabification. From Harrington's testimony and from the evidence of reduplication and stress, all of it reviewed for Barbareño Chumash by Wash (1995), intervocalic biconsonantal clusters are heterosyllabic: [šiš.tɨ.ʔɨ]. If so, then ALIGN-L(Stem, σ) is satisfied and [OCP(anterior)&ALIGN-L(Stem, σ)]$_{AdjSeg}$ will not produce the desired effect, though perhaps ALIGN-L(Stem, Word) would be more successful.

Another possible approach to Chumash, suggested by Inkelas (1999), is to invoke the distinction between root and affix faithfulness (McCarthy and Prince 1995, 1999). Since OCP(anterior) is observed to compel unfaithfulness in affixes but not roots, the ranking IDENT$_{Root}$(anterior) >> OCP(anterior) >> IDENT$_{Affix}$(anterior) (or just IDENT(anterior)) seems like a promising alternative. The problem is that, by transitivity of domination, this gives us IDENT$_{Root}$(anterior) >> AGREE(anterior), which predicts that sibilants within a root can be disharmonic in anteriority. This is not the case. Anterior harmony is exceptionless within morphemes (Applegate 1972:34-35); see Lieber (1987:145) for some examples of roots with multiple sibilants. Therefore, Chumash cannot be analyzed in terms of greater faithfulness to root features.

4. Consonant Harmony Itself

When we look more closely at consonant harmony in Chumash, a paradox emerges. The analysis in section 3 relies on the claim that [anterior]-linked clusters like [s͡t] are prohibited across morpheme boundaries by CRISPEDGE(Morpheme, anterior). In this way, hetermorophemic clusters feel the full force of OCP(anterior). Furthermore, as (13) shows, CRISPEDGE(Morpheme, anterior) must dominate AGREE(anterior), since there are situations where allowing a noncrisp morpheme edge would improve performance on the harmony constraint, yet harmony is blocked. But if CRISPEDGE(Morpheme, anterior) dominates AGREE(anterior), how is it possible to have [anterior] harmony across morpheme boundaries?

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[11] Inkelas (1999), citing Chumash as an example, argues against Łubowicz's proposal on the grounds that locally conjoining M with ALIGN-R(Stem, σ) will not work, since the morphemes involved are prefixes, so they do not fall at the right edge of a stem. This argument does not seem valid; although Łubowicz uses ALIGN-R(Stem, σ) in a couple of her examples, I cannot find any indication that she disallows derived environment effects involving left-edge alignment, nor is this limitation suggested by anything in Łubowicz's theory.

Recent proposals by Hansson (2001), Rose & Walker (2004), and Walker (2000a, 2000b) suggest a well-motivated way out of this paradox.[12] They observe that long-distance consonant harmony processes, of which Chumash is a typical example, have a different constellation of properties than local harmony processes that affect, say, vowel features or nasality. Reserving autosegmental spreading for phenomena like vowel or nasal harmony, they claim that long-distance consonant harmony is the result of a different kind of mechanism, a type of correspondence relation (McCarthy and Prince 1995, 1999) between segments in the output. In fact, Hansson (2001:336ff., 386ff.) develops an analysis of Chumash in these terms, though he does not address the problem that has been my focus here.

Assimilation via correspondence works approximately like this. GEN freely emits candidates that may be identical except that different output segments may be in correspondence with one another. This type of correspondence, called CC-correspondence, has nothing to do with the input or the morphology; it is simply the case that any output segment may (or may not) be in CC-correspondence with any other output segment. Constraints from the CORR-X↔Y family favor CC-correspondence, and they favor it most strongly in segments that are most similar to one another. For example, CORR-T↔T requires that identical stops be in CC-correspondence, and it is in a stringency relation with CORR-T↔D, which requires that stops differing in no more than voicing stand in CC-correspondence. IDENT constraints proper to the CC correspondence relation require that CC-correspondent segments be identical in their featural composition. For example, IDENT_{CC}(anterior) is active in Chumash, crucially dominating the IO faithfulness constraint IDENT(anterior). (It should perhaps be noted that CORR-X↔Y and IDENT_{CC} are technically *markedness* constraints, since they evaluate output forms without reference to the input or any other form.)

In Chumash, the set of sibilants includes the fricatives [s] and [š], the affricates [c] and [č], and their glottalized and aspirated counterparts. CC correspondence among these consonants is demanded by the constraint in (15).

(15) CORR-S↔Č

For every pair of segments […α….β…]
if α and β are [+strident]
and α and β are not in CC correspondence
assign a violation-mark.

CC-corresponding segments must agree in their values of [anterior] if they are to conform with the constraint in (16).

[12] Also relevant are proposals by Kitto and de Lacy (2000) and Zuraw (2003) about nonreduplicative segmental correspondence. See Kawahara (2004) for a different view.

(16) Ident$_{CC}$(anterior)

For every pair of segments […α….β…]

if α and β are in CC correspondence

and α and β have different values for [anterior]

assign a violation-mark.

Corr-S↔Č and Ident$_{CC}$(anterior) are applied to a simple example of harmony in (17). CC correspondence is indicated by coindexation.

(17) Corr-S↔Č, Ident$_{CC}$(anterior) >> Ident(anterior)

/ha-s-xintila-waš/	Corr-S↔Č	Ident$_{CC}$(anterior)	Ident(anterior)
→ haš$_j$xintilawaš$_j$			1
a. ~ has$_j$xintilawaš$_j$		1 W	L
b. ~ has$_j$xintilawaš$_k$	1 W		L
c. ~ haš$_j$xintilawaš$_k$	1 W		1

The winning candidate, [haš$_j$xintilawaš$_j$], has established a CC correspondence relation between its two stridents, and they agree in anteriority. Therefore, both of the high-ranking constraints are satisfied. The loser in (a), *[has$_j$xintilawaš$_j$], has the right correspondence relation but it violates Ident$_{CC}$(anterior). The homophonous loser in (b), *[has$_j$xintilawaš$_k$], doesn't have the right correspondence relation, so Corr-S↔Č is breached, though Ident$_{CC}$(anterior) is satisfied vacuously. The final candidate is harmonically bounded within the scope of these constraints; it has harmonized, but for no reason, since the harmonizing segments are not in correspondence.

This analysis does not address the problem of directionality — why is the winner [haš$_j$xintilawaš$_j$] and not *[has$_j$xintilawas$_j$]? — though see Hansson (2001:336ff.) for relevant discussion. I will not deal with directionality in this paper and will instead just assume that a correspondence chain always obtains its [anterior] value from the rightmost segment in the chain.

When sibilant harmony is blocked, as in [štiyepus], there are two logical possibilities under this theory:

(i) The nonharmonizing sibilants are in correspondence but violate Ident$_{CC}$(anterior), like [š$_j$tiyepus$_j$]. This analysis requires the ranking Corr-S↔Č >> Ident$_{CC}$(anterior), so [š$_j$tiyepus$_j$] will beat [š$_j$tiyepus$_k$].

(ii) the nonharmonizing sibilants are not in CC correspondence, like [š$_j$tiyepus$_k$], so they violate Corr-S↔Č while vacuously satisfying Ident$_{CC}$(anterior). This analysis requires the opposite ranking, Ident$_{CC}$(anterior) >> Corr-S↔Č, so [š$_j$tiyepus$_k$] will beat [š$_j$tiyepus$_j$].

Although Hansson (2001:389) takes option (i), option (ii) looks like the better bet. Option (ii)'s advantage is shown by words with two separately harmonizing sequences, such as [šišlusisin]. If Corr-S↔Č were to dominate Ident$_{CC}$(anterior), then we could not explain why [šišlusisin] is more harmonic than *[sišlusisin], as tableau (18) shows.[13]

(18) Wrong result if Corr-S↔Č >> Ident$_{CC}$(anterior)

/s-iš-lu-sisin/	Corr-S↔Č	Ident$_{CC}$(anterior)	Ident(anterior)
→ *s$_k$iš$_k$lus$_k$is$_k$in		3	
a. ~ š$_k$iš$_k$lus$_k$is$_k$in		4 W	1 W
b. ~ š$_j$iš$_j$lus$_k$is$_k$in	4 W	L	1 W
c. ~ s$_j$iš$_k$lus$_l$is$_l$in	5 W	L	

The violation-marks for Corr-S↔Č and Ident$_{CC}$(anterior) have been determined in accordance with the definitions in (15) and (16): one mark for every linearly ordered pair of non-conforming segments.[14]

On the other hand, if Ident$_{CC}$(anterior) dominates Corr-S↔Č, as option (ii) demands, then there is no difficulty in obtaining the right result, as tableau (19) shows.

(19) Ident$_{CC}$(anterior) >> Corr-S↔Č

/s-iš-lu-sisin/	Ident$_{CC}$(anterior)	Corr-S↔Č	Ident(anterior)
→ š$_j$iš$_j$lus$_k$is$_k$in		4	1
a. ~ š$_k$iš$_k$lus$_k$is$_k$in	4 W	L	1
b. ~ s$_k$iš$_k$lus$_k$is$_k$in	3 W	L	L
c. ~ s$_j$iš$_k$lus$_l$is$_l$in		5 W	L

Other definitions are possible, of course, as long as Corr-S↔Č correctly distinguishes [š$_j$iš$_j$lus$_k$is$_k$in] from *[s$_j$iš$_k$lus$_l$is$_l$in].[15]

Integrating these results with those of the previous section is a straightforward matter. We know from (13) that consonant harmony is blocked by the joint agency of OCP(anterior) and CrispEdge(Morpheme, anterior). And we know from (19) that blocked consonant harmony involves violation of Corr-S↔Č. Therefore, OCP(anterior) and CrispEdge(Morpheme, anterior) must dominate Corr-S↔Č, as the ranking argument in (20) demonstrates.

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[13] Hansson (2001:391) deals with this problem by taking the winning candidate to be [š$_j$iš$_{j,k}$lus$_k$is$_k$in], with the second [š] assigned to two different correspondence domains simultaneously. As (19) shows, however, this sort of dual allegiance is unnecessary and can perhaps be dispensed with universally.

[14] The definition of Corr-S↔Č in (15) refers to the linear order of the segments in each pair simply to avoid doubling the number of violation marks. (That is, […x…y…] contains two pairs of *x* and *y*, (x,y) and (y,x), but only one pair in the order *x*…*y*.) For example, [š$_j$iš$_j$lus$_k$is$_k$in] incurs 4 violation-marks, one for each of the italicized pairs in [*š*$_j$iš$_j$lu*s*$_k$is$_k$in], [*š*$_j$iš$_j$lus$_k$i*s*$_k$in], [š$_j$i*š*$_j$lu*s*$_k$is$_k$in], and [š$_j$i*š*$_j$lus$_k$i*s*$_k$in]. In contrast, [s$_j$iš$_k$lus$_l$is$_l$in] gets 5 marks: [*s*$_j$i*š*$_k$lus$_l$is$_l$in], [*s*$_j$iš$_k$lu*s*$_l$is$_l$in], [*s*$_j$iš$_k$lus$_l$i*s*$_l$in], [s$_j$i*š*$_k$lu*s*$_l$is$_l$in], and [s$_j$i*š*$_k$lus$_l$i*s*$_l$in].

[15] Rachel Walker points out that [s$_j$iš$_k$lus$_j$is$_j$in] is also a logical possibility, with one harmony domain embedded inside another. The matter deserves further study, but for now it is probably safe to assume that such forms are not supplied by Gen and therefore are banned universally.

(20) OCP(anterior), CRISPEDGE(Morpheme, anterior) >> CORR-S↔Č

/s-iš-lu-sisin/	OCP(ant)	CRISPEDGE(Morph, ant)	ID$_{CC}$(ant)	CORR-S↔Č	ID(ant)
→ š$_j$iš$_j$lus$_k$is$_k$in				4	1
a. ~ š$_k$iš$_k$lus$_k$is$_k$in			4 W	L	1
b. ~ s$_k$is$_k$͡lus$_k$is$_k$in		1 W		L	1
c. ~ s$_k$is$_k$|lus$_k$is$_k$in	1 W			L	1

The loser in (a), [š$_k$iš$_k$lus$_k$is$_k$in], perfectly satisfies CORR-S↔Č but it fatally violates undominated IDENT$_{CC}$(anterior), as we already saw in (19). The other two candidates are also perfect in their performance on CORR-S↔Č, but at the price of violating two other higher-ranked constraints: [s$_k$is$_k$͡lus$_k$is$_k$in] in (b) is out because the cluster's [+anterior] specification straddles a morpheme edge, and [s$_k$is$_k$|lus$_k$is$_k$in] in (c) violates OCP(anterior).

The analysis of the tautomorphemic clusters is unchanged, as tableau (21) indicates. Because the tautomorphemic cluster in [s$_k$was$_k$͡tilokʔinus$_k$] can share a single instance of the feature [anterior], its sibilant is free to harmonize at no risk of violating OCP(anterior).

(21) Harmony in tautomorphemic cluster

/s-wašti-lokʔin-us/	OCP(ant)	CRISPEDGE(M, ant)	ID$_{CC}$(ant)	CORR-S↔Č	ID(ant)
→ s$_k$was$_k$͡tilokʔinus$_k$					1
a. ~ š$_j$waš$_j$tilokʔinus$_k$				2 W	1
b. ~ s$_k$was$_k$|tilokʔinus$_k$	1 W				1
c. ~ s$_k$waš$_k$tilokʔinus$_k$			2 W		L

This now brings us to the point of the argument. As I previously noted, the analysis developed in section 3 leads to a paradox. CRISPEDGE(Morpheme, anterior) prevents heteromorphemic clusters from sharing a single instance of [+anterior], and that is why they must dissimilate. But consonant harmony assimilates [anterior] across morpheme boundaries with flagrant disregard for the requirements of CRISPEDGE(Morpheme, anterior). Moreover, the argument in (13) showed that CRISPEDGE(Morpheme, anterior) must dominate the constraint responsible for harmony (AGREE(anterior) in (13). Therefore, if long-distance consonant harmony involved autosegmental spreading, it would be blocked at morpheme edges because of the ranking CRISPEDGE(Morpheme, anterior) >> AGREE(anterior). This is obviously not the case.

This paradox only arises, though, if long-distance [anterior] harmony involves a linked structure. By design and by definition, CRISPEDGE constraints rule out multiply-linked autosegmental structures, but of course they say nothing about assimilation by CC correspondence. Long-distance consonant harmony is not the result of autosegmental spreading of [anterior] — it could not be, since CRISPEDGE(Morpheme, anterior) would not allow it. Rather, as this section has shown, consonant harmony is an effect of CC correspondence among sibilants coupled with undominated IDENT_{CC}(anterior). Edges remain crisp under this mode of assimilation.

This argument concurs with the claims of Hansson, Rose, and Walker that there are two distinct modes of assimilation: local, by autosegmental spreading, and long-distance, by correspondence. Chumash has local, OCP-induced autosegmental fusion of [+anterior], but it also has long-distance correspondence-based assimilation of [anterior]. Structurally-sensitive constraints like CRISPEDGE can be used to detect this difference in assimilation processes. Correspondence-based assimilation is not and could not be affected by CRISPEDGE, since this mode of assimilation derives from identity among correspondent segments rather than autosegmental spreading. (This is not to say, however, that correspondence-based assimilation is necessarily indifferent to morphological structure. It is not inconceivable that CORR constraints can be relativized to particular morphological domains.)

5. Conclusion

The phonology of [anterior] in Chumash supports recent proposals by Hansson (2001), Rose & Walker (2004), and Walker (2000a, 2000b) that long-distance consonant assimilation does not involve autosegmental spreading. Linking of the feature [anterior] is forbidden across morpheme boundaries, but long-distance [anterior] harmony is allowed across morpheme boundaries. The Chumash evidence therefore shows that assimilation can occur without autosegmental spreading.

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