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Total Identity in Co-occurrence Restrictions

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0. Introduction

In this paper, I look at languages that require complete identity between certain classes of non-adjacent consonants and discuss the implications of these data for the Agreement by Correspondence (ABC) analysis of long-distance consonant agreement (Hansson 2001, Rose and Walker 2004).

Some languages exhibit what MacEachern (1999) calls the TOTAL IDENTITY EFFECT. In languages of this type, pairs of similar segments are prohibited from cooccurring in a root while identical segments may cooccur.

(1) Chol (Mayan: Aulie and Aulie 1978, Coon and Gallagher 2008)

non-identical ejectives:	*ts'-k', *ts'-tʲ', *p'-k'
identical ejectives:	✓ts'-ts', ✓k'-k', ✓p'-p'

(2) Muna (Austronesian: van den Berg 1989, Coetzee and Pater in press)

non-identical homorganic:	*m-b, *b-p, *p-f
identical homorganic:	✓m-m ✓b-b ✓p-p

In (1) and (2), a certain class of non-adjacent consonants (ejectives and homorganics, respectively) must be totally identical in order to cooccur.

Total identity requirements contrast with another phenomenon where similar non-adjacent segments are required to agree in a single feature only. In Chumash, for example, stridents must agree in anteriority, but may disagree in other features.

(3) Chumash (data from Hansson 2001:58, taken from Applegate 1972)

ʃapitʃʰolit	/s-api-tʃʰo-it/	'I have a stroke of good luck'
ʃapitʃʰouʃwaʃ	/s-api-tʃʰo-us-waʃ/	'he had a stroke of good luck'
haʃxintilawaʃ	/ha-s-xintila-waʃ/	'his former Indian name'

In this talk, I argue that total identity is formally distinct from partial identity. In the ABC framework, total and partial identity are analyzed uniformally as effects of constraints demanding identity in *single features* between interacting segments. I argue instead that total identity is an explicit requirement of interacting consonants. It is not the composite effect of multiple single feature identities, as is implicit in the original formulation of ABC. There are two arguments in favor of the proposal. First, single feature harmonies of the type required to analyze total identity are systematically unattested. Second, gradient grammaticality patterns reveal a preference for totally identical pairs of consonants, but not for increasingly similar pairs.

Eliminating feature specific harmony constraints has ramifications for the analysis of cases of partial identity like (3). I show that the ABC account of single feature harmonies overgenerates, predicting many unattested patterns. Competing analyses of minor place harmony as local spreading are preferred, supporting the elimination of feature specific harmony constraints. The rest of this paper is organized as follows. Section 1 presents data on total identity requirements and Section 2 presents the ABC framework. The analysis of total identity within ABC is discussed in Section 3. In Section 4, I address cases of single feature agreement and Section 5 concludes.

1. Data: Cases of Total Identity

In languages with co-occurrence restrictions on similar segments, identical segments may be grammatical. In these languages, identical segments are exceptional. They are not treated by the grammar as maximally similar. In this section, I will present two examples of languages which treat identical consonants as exceptional, Chol and Muna.

1.1. Chol

Chol (Aulie and Aulie 1978, Coon and Gallagher 2008) is a Mayan language spoken in Chiapas, Mexico by around 150,000 people.

(4) Chol consonant inventory

	labial	coronal	velar	glottal
implosive	b			
plosive	p	tʲ	k	ʔ
ejective	**p’**	**ts’ tʃ’ tʲ’**	**k’**	
fricative		s ʃ		h
affricate		ts tʃ		
nasal	m	ɲ		
approximant	w	l j		

Lexical roots in Chol and other Mayan languages are predominately CVC in shape. The co-occurrence of the five ejective consonants is restricted in Chol. While all ejectives may appear in either initial or final position, two non-identical ejectives may not cooccur. Roots with identical ejectives are given in (5a). The hypothetical roots in (5b), with non-identical ejectives, are all unattested. [1]

(5)	a:	k'ok'	'healthy'	b:	*k'ats'
		ts'uhts'	'kiss'		*p'otʃ'
		tʃ'ɨtʃ'	'absorb'		*t^{j}'uk'

The pattern in (5) is not unique to Chol. Other languages with laryngeal co-occurrence restrictions that allow identical pairs of consonants include the Mayan languages Tzotzil (Weathers 1947), Yucatec (Straight 1975), Tzutujil (Dayley 1985), as well as Bolivian and Peruvian Aymara (MacEachern 1999).

1.2. Muna

Muna (van den Berg 1989, Coetzee and Pater in press) is an Austronesian language spoken in parts of Indonesia. The consonant inventory of Muna is in (6).

(6) Consonant inventory of Muna

	labial	coronal	velar	uvular	glottal
voiceless	p	t	k		
voiced	b	d	g		
implosive	ɓ	ɗ			
nasal	m	n	ŋ		
voiceless prenasal	^{m}p	^{n}t, ^{n}s	^{ŋ}k		
voiced prenasal	^{m}b	^{n}d	^{ŋ}g		
voiceless fricative	f	s		ʁ	h
trill		r			
lateral		l			
glide	w				

The vast majority of roots in Muna are either CVCV or CVCVCV[2]. Coetzee and Pater (in press) calculated the Observed/Expected(O/E) ratio (Pierrehumbert 1993, Frisch et al. 2004) of all pairs of consonants in "adjacent" position, those separated only by a vowel. An O/E of 1 shows that two consonants cooccur freely. An O/E of less than 1 means that the two consonants cooccur less often than expected, showing the effect of some grammatical restriction. An O/E of greater than 1 means that two consonants cooccur more often than expected. Coetzee and Pater's calculations reveal that Muna has a gradient, place based co-occurrence restriction. Within a major place class, two consonants are less likely to cooccur the more subsidiary features (voicing, stricture, sonorancy) they share.

[1] Pairs of non-identical ejectives all have an O/E of 0 (they are completely unattested). Pairs of non-identical ejectives all have O/Es of well over 1.

[2] There are also vowel initial roots, as well as roots with VV sequences.

The overall pattern for non-identical consonants can be illustrated by a subset of the labials, given in (7).

(7) Co-occurrence of labials in Muna

consonants	**O/E**	**disagreeing features**
m-f	1.04	continuant, nasal, voice
b-f	0.58	continuant, voice
m-p	0.39	nasal, voice
b-p	0.10	voice
p-f	0.07	continuant
m-b	0.07	nasal

In (7), the O/E decreases as the number of disagreeing features decreases. In other words, there is an inverse correlation between similarity and degree of attestation.

While highly similar pairs of consonants are very under-attested in Muna, pairs of identical consonants are over-attested, (8).

(8) m-m 1.24 b-b 2.79 p-p 1.46 f-f 2.5

Other languages with place based co-occurrence restrictions which treat identical consonants as exceptional include Javanese (Uhlenbeck 1949, 1950, Mester 1986) and Ngbaka (Thomas 1963, Mester 1986).

2. ABC: The Framework

In the ABC framework, the total identity effect and single feature harmonies are given a unified analysis as effects of correspondence between non-adjacent consonants. Correspondence relations between output consonants are established by CORR-C⇔C constraints (the definition in (9) is from Rose and Walker 2004:491).

(9) CORR-C⇔C Let S be an output string of segments and let C_i C_j be segments that share a specified set of features F. If C_i, $C_j \in S$, then C_i is in a relation with C_j: that is, C_i and C_j are correspondents of one another.

Rose and Walker propose that CORR-C⇔C constraints are in a fixed hierarchy. Constraints referring to more similar pairs of consonants outrank those referring to less similar pairs. The partial hierarchy in (10) shows the interaction of place and ejection in stops.

(10) CORR-T'⇔T' >> CORR-T'⇔T >> CORR-T'⇔K

The ranking of IO-faithfulness constraints within this hierarchy determines which class of segments are affected by co-occurrence restrictions in a language.

If two segments stand in correspondence, they are required to agree in certain features by constraints from the CC-IDENT[F] family.

(11) CC-IDENT[F] Let C_i be a segment in the output and C_j be any correspondent of C_i in the output. If C_i is [αF] then C_j is [αF].

As illustration, take the analysis of laryngeal agreement in Bolivian Aymara (de Lucca 1987, MacEachern 1999, Rose and Walker 2004). Homorganic stops must have matching laryngeal features (*k’-k, *k^h-k, ✓k’-k’, ✓k^h-k^h).

(12) a: homorganic stops must have identical laryngeal features

/k’…k/	CORR-T’⇔T	CC-IDENT[cg]	IO-IDENT[cg]	CORR-T’⇔K
☞ $k'_x \ldots k'_x$			*	
$k'_x \ldots k'_y$	* !		*	
$k'_x \ldots k_x$		* !		
$k'_x \ldots k_y$	* !			

b: heterorganic stops may disagree in laryngeal features

/k’…p/	CORR-T’⇔T	CC-IDENT[cg]	IO-IDENT[cg]	CORR-T’⇔K
☞ $k'_x \ldots p_y$				*
$k'_x \ldots p_x$		* !		
$k'_x \ldots p'_x$			* !	
$k'_x \ldots p'_y$			* !	*

In ABC, languages differ from one another on two dimensions: 1. the set of consonants that must correspond (e.g. stridents, homorganic stops, voiceless stops) and 2. the feature in which corresponding segments must agree (laryngeal features, minor place, etc.). In Section 3, I propose to eliminate the second locus of variation by replacing feature specific CC-IDENT[F] constraints with a single, total identity constraint CC-IDENT. Support for this move comes from languages with a total identity requirement. In Section 4 I look at the ramifications of CC-IDENT for the analysis of single feature agreement. I show that feature specific CC-IDENT[F] constraints predict unattested harmony patterns. Many single feature harmonies can be better analyzed as either the effect of the total identity constraint CC-IDENT, or of local spreading (Flemming 1995, Gafos 1999, Ní Chiosáin and Padgett 1997).

3. Total Identity in ABC

As originally formulated, interacting consonants in an ABC analysis are required to agree with one another on a feature by feature basis. A language with total identity between interacting consonants, then, must have multiple CC-IDENT[F] constraints outranking their IO counterparts. In Chol, for example, ejectives contrast for major place, stridency, and anteriority. Consequently, a feature specific analysis of total identity requires the CC-IDENT[F] constraints in (13).

(13) CC-IDENT[place] CC-IDENT[α strident] CC-IDENT[α anterior]

(14) Total identity is required between Chol ejectives

/ts'…k'/	CORR	CC-ID[pl]	CC-ID[strid]	CC-ID[ant]	IO-ID[pl]	IO-ID[strid]	IO-ID[ant]
☞ $ts'_x…ts'_x$					*	*	*
$ts'_x…k'_x$		* !	*	*			
$ts'_x…t^{j}{}'_x$			* !	*	*		
$ts'_x…tʃ'_x$				* !	*	*	

I propose that total identity is *not* the result of multiple feature specific constraints. Instead, total identity is explicitly required between corresponding segments by a general, non-feature specific constraint, CC-IDENT, given in (15).

(15) CC-IDENT Given two segments in the output C_i and C_j, If C_i and C_j stand in correspondence, then C_i and C_j are identical.

The new analysis of Chol is in (16).

(16)

/ts'…k'/	CORR	CC-IDENT	IO-ID[place]	IO-ID[strid]	IO-ID[ant]
☞ $ts'_x…ts'_x$			*	*	*
$ts'_x…k'_x$		* !			
$ts'_x…t^{j}{}'_x$		* !	*		
$ts'_x…tʃ'_x$		* !	*	*	

There are two arguments in favor of the analysis in (16) over that in (14). First, the feature specific CC-IDENT[F] constraints in (14), which are needed to analyze total identity, are independently unmotivated. Second, under the CC-IDENT[F] formulation, there is nothing special about being *totally* identical as opposed to being *partially* identical. Gradient effects, as in Muna, reveal a preference for totally identical pairs of consonants, but not for increasingly similar pairs.

3.1. Some CC-IDENT[F] Constraints are Unmotivated

If the analysis of Chol in (14) were correct, we should be able to motivate each of the three feature specific CC-IDENT[F] constraints independently. Besides the pattern in Chol, we should see languages with *only* major place harmony, or *only* stridency harmony or *only* anteriority harmony among ejectives. The unattested languages in (17) and (18) are predicted.

(17) Major place harmony between ejectives: *t^{j}'-k', *ts'-p' ✓t^{j}'-ts', ✓t^{j}'-tʃ'
CC-IDENT[place] >> IO-IDENT[place]
IO-IDENT[α strid] >> CC-IDENT[α strid]
IO-IDENT[α ant] >> CC-IDENT[α ant]

(18) Stridency harmony between ejectives: *t^{j}'-ts', *t^{j}'-tʃ' ✓tj'-k' ✓ts'-tʃ'
CC-IDENT[α strid] >> IO-IDENT[α strid]
IO-IDENT[α ant] >> CC-IDENT[α ant]
IO-IDENT[place] >> CC-IDENT[place]

The languages in (17) and (18) show major place harmony and stridency harmony between ejectives, respectively. Both major place harmony and stridency harmony are unattested in Hansson's (2001) survey of consonant harmony systems, whether applying to the class of ejectives or to any other class of segments. Moreover, no language restricts the co-occurrence of only *some* ejectives. In MacEachern's survey of laryngeal co-occurrence restrictions, languages come in two varieties: either all pairs of ejectives (or aspirates or implosives) are prohibited from cooccuring, including identical ones: *k'-p' *k'-k', or only non-identical pairs are disallowed and identical ones are fine: *k'-p', ✓k'-k'. The two CC-IDENT[F] constraints needed to analyze total identity, CC-IDENT[place] and CC-IDENT[strident], are unmotivated.

3.2. Gradient Co-occurrence Restrictions and Total Identity

In a feature specific analysis, *total* identity is an accident. Under the CC-IDENT[F] formulation, there is nothing special about being totally identical as opposed to being partially identical. Looking at languages with a total identity requirement, however, it seems that there is something quite special about being totally identical. In languages with place co-occurrence restrictions, for example, identical pairs of consonants may be allowed while increasingly similar pairs of consonants are increasingly disfavored.

The co-occurrence restrictions in Muna expemplify the exceptional status of identical consonants. In Muna, homorganic consonants are increasingly disfavored the more similar they are. Identical consonants, while maximally similar, are completely grammatical.

(19) O/E of Muna root consonants

consonants	**O/E**	**disagreeing features**
m-f	1.04	continuant, nasal, voice
b-f	0.58	continuant, voice
m-p	0.39	nasal, voice
b-p	0.10	voice
p-f	0.07	continuant
m-b	0.07	nasal
m-m	1.24	none
b-b	2.79	none
p-p	1.46	none
f-f	2.5	none

The feature specific analysis of total identity predicts that a gradient co-occurrence restriction would have exactly the opposite profile from Muna. Increasingly similar pairs of homorganic consonants should be increasingly favored, since they violate fewer CC-IDENT[F] constraints.[3]

(20) Unattested pattern predicted by CC-IDENT[F] analysis

consonants	**O/E**	**violates**
m-f	0	CC-IDENT[αvoi], CC-IDENT[αson], CC-IDENT[αcon]
b-f	0.3	CC-IDENT[α voice], CC-IDENT[α con]
m-p	0.3	CC-IDENT[α voice], CC-IDENT[α son]
b-p	0.7	CC-IDENT[α voice]
p-f	0.7	CC-IDENT[α continuant]
m-b	0.7	CC-IDENT[α sonorant]
m-m	1	none
b-b	1	none
p-p	1	none
f-f	1	none

In order to account for attested gradient patterns, the grammar must favor totally identical pairs of consonants without favoring partially identical pairs of consonants. This is possible if there are no feature specific CC-IDENT[F] constraints, but only a single total identity constraint.

[3] This of course depends on the theory of gradience in the grammar. I am assuming a model like that developed in Coetzee and Pater (in press), who analyze Muna as a gradient OCP effect with weighted constraints (they do not provide an account of identical consonant grammaticality).

3.3. Summary

This section has argued that total identity is not the composite effect of multiple single feature harmonies, it is an independent process. The proposed total identity constraint reflects this difference.

In the original ABC proposal, languages vary in two ways – the set of consonants that must correspond (the CORR-C⇔C constraints) and the features corresponding segments must agree in (the CC-IDENT[F] constraints). The proposal here eliminates one of these locuses of variation: corresponding segments must always be completely identical. Languages may only differ in what consonants are required to correspond, i.e. the strength of the co-occurrence restriction. In the next section I evaluate the evidence in favor of feature specific constraints.

4. Single Feature Agreement

The evidence for feature specific CC-IDENT[F] constraints comes from the large number of cases where non-adjacent consonants must agree in a single feature only. The original ABC proposal is designed to account for a number of cases of long-distance assimilation that do not result in total identity. In these cases, two non-adjacent consonants are required to agree in a single feature that does not spread through intervening segments. In (21) and (22) I give examples of phenomena of this type from Hansson's survey of consonant harmony systems.

(21) Laryngeal agreement: some or all obstruents must have the same laryngeal features, but may differ in place of articulation

Kalabari Ijo (Jenewari 1989) *d-ɓ, *ɗ-b ✓d-b, ✓ɓ-ɗ

(22) Nasal agreement: an oral consonant is nasal following a root with a nasal.

Yaka (Hyman 1995)

kém-ene	'to moan'	kéb-ele	'be careful'
nók-ene	'to rain'	lók-ele	'to bewitch'

While phenomena like those above do show long-distance agreement in a single feature, the original formulation of ABC massively overgenerates. It predicts many unattested harmony patterns and, moreover, fails to explain why certain harmony patterns are common and others completely absent.

The problems with the ABC account of single feature harmonies is best shown by looking at minor place harmonies. Many of the single feature harmonies that result in partial identity involve agreement in a minor place specification. Coronal harmonies, as in Chumash, are the most prevalent example. Navajo has a similar pattern, alveolar and alveopalatal stridents may not cooccur.

(23) Navajo (Hansson 2001:7 and references therein):

ʃí-tʃí:h	'my nose'
si-ts'a:ʔ	'my basket'
si-zid	'my scar'

Minor place harmonies all share an important property: they have been analyzed as local agreement. Flemming (1995), Ní Chiosáin and Padgett (1997) and Gafos (1999) show that minor place specifications may spread through intervening segments without any acoustic consequences. They analyze these apparent cases of non-local assimilations as local assimilations. The action-at-a-distance in minor place harmonies is then only apparent: assimilation is local, but has no audible effect on segments that don't contrast for the spreading feature.

A CC-IDENT[F] analysis predicts that stridents or coronals should be able to harmonize for any feature, or any combination of features. Beyond the well-attested minor place harmonies shown above, we also predict languages where stridents must agree in continuancy but not minor place (24), or in both minor place and voicing (25).

(24) *s-ts, *ʃ-tʃ ✓ts-tʃ, ✓s-ʃ

(25) *s-z *s-ʃ ✓s-ts

The predictions in (24) and (25) are not borne out. Coronal harmonies are overwhelmingly minor place harmonies, other contrastive features like voicing and stricture are ignored. This is predicted in a spreading analysis, since voicing and stricture cannot spread unnoticed through intervening segments.

The current proposal predicts that coronal harmonies should either be minor place harmonies, or total identity effects. Indeed, cases of total identity appear to be the only ones that involve multiple harmonies. In Chol and other Mayan languages stridents are required to agree for both anteriority and continuancy, the result of which is total identity.

(26) Total identity (=agreement in [α anterior] *and* [α continuant])

a:	sus	'scratch'	b:	*ts-s
	ʃeʃ	'shrimp'		*s-ʃ
	tsɨts	'difficult'		*s-tʃ
	tʃitʃ	'older sister'		

In the original ABC proposal, both the set of consonants that must stand in correspondence and the harmonizing feature are independently variable. Consequently, we should find languages that have minor place harmony between only a sub-set of the possible targets.

(27) a: CORR[-continuant], CC-IDENT[α anterior] >> IO-IDENT
b: *ts-tʃ s-ʃ

If there are no feature specific harmony constraints, then the only range of variation is in the set of consonants that must be in correspondence. This seems to be a good prediction. In Chol, total identity is only required between a sub-set of the stridents, depending on their similarity. Plain stridents must be totally identical to cooccur. An ejective strident and a fricative, however, may cooccur.

(28) Total identity is not required of all stridents in Chol

sɨts’	‘stretch’	tʃ’oʃ	‘worm’
sits’	‘saliva’	ʃutʃ’	‘thief’

While there aren’t any languages that pick out a sub-set of the stridents for minor-place harmony, there are languages that pick out a sub-set of the stridents for total identity.

The feature specific CC-IDENT[F] proposal generalizes to the lowest common denominator. It accounts for (21) and (22) at the expense of accounting for anything. The challenge for future research is to find an alternative explanation for phenomena like (21) and (22) without resorting to feature specific CC-IDENT[F] constraints.

5. Conclusion

In this talk I have argued that total identity requirements are formally distinct from partial identity requirements. Total identity must be the result of a general, non-feature-specific constraint. The feature specific constraints needed to account for total identity are unmotivated. Feature specific constraints cannot account for gradient co-occurrence restrictions. Eliminating feature specific CC-IDENT[F] constraints has desirable consequences for the analysis of minor place harmonies. CC-IDENT[F] constraints make unattested typological predictions that an analysis with only spreading and total identity does not.

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