Exceptions to sonority distance generalizations

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1 Introduction

Generalizations about sonority sequencing are often marred by exceptions. Having acceptable sonority distance does not guarantee well-formedness. How should exceptions to sonority distance generalizations be handled? This paper argues that sonority distance should be a primitive in the grammar. Apparent exceptions to sonority sequencing are due to other, independently motivated constraints. This theory is applied to a well-known sonority sequencing principle, Syllable Contact.

Syllable Contact compares the distance along the sonority hierarchy between adjacent consonants, and states a preference for a coda to exceed the following onset in sonority: *al.pa* and *a.pla* are preferred to *ap.la* (Hooper 1976, Murray and Vennemann 1983). I claim that Syllable Contact is a universally fixed constraint hierarchy in Optimality Theory (Prince and Smolensky 1993). This is necessary to account for the rich typology of Syllable Contact effects. I also argue that the constraints in the Syllable Contact hierarchy must be relational—they refer only to the distance between codas and onsets but are insensitive to their individual sonority.

Many apparent exceptions to sonority sequencing generalizations follow from the interaction of markedness and faithfulness constraints with the Syllable Contact hierarchy, as expected in OT. I consider evidence from Icelandic, where sequences with the same sonority distance syllabify differently. The predictions of this model are borne out in Icelandic: the split pattern is the result of an independently motivated process.

I examine the alternative of not referring to sonority distance directly, the Local Conjunction of sonority constraint hierarchies. I argue that the Local Conjunction approach is too powerful, and that the more conservative theory presented here is sufficient.

2 Exceptions to sonority distance generalizations

The notion of sonority distance is appealing because it captures strong tendencies in sonority sequencing within languages, as well as differences between languages. However, just about every sonority generalization has some exceptions. In English, stop-lateral onsets (*plea*, *claw*) are generally allowed, unless the stop is a coronal (**tlee*). In Kazakh, sonority is normally not allowed to be flat across a syllable boundary, but this prohibition does not apply to sequences of two stops (Davis 1998). How should these exceptions be handled?

One way is to not refer to sonority distance directly. A proposal of this sort is the Local Conjunction of constraint hierarchies (Baertsch 1998, 2002). In this system, marked sequences are not admitted unless the less marked ones are acceptable. However, no predictions are made about the patterning of sequences with the same sonority distance. This is because sequences with the same sonority distance are represented by

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separate constraints, which can be ranked differently in individual languages. For example, although *stop-nasal* and *fricative-lateral* sequences have the same sonority rise, they don't have to pattern as a class. One language can choose to ban *stop-nasal* (*STOP-NASAL >> **FAITH** >> *FRICATIVE-LATERAL), another—*fricative-lateral* (*FRICATIVE-LATERAL >> **FAITH** >> *STOP-NASAL)[1]. (I return to this in section 4.4.)

I suggest that a more conservative approach is sufficient. Direct reference to sonority distance makes a strong, desirable prediction: all sequences that have the same sonority distance should pattern as a class. Exceptions are still possible, because the sonority distance constraints can be violated when they are outranked by other constraints. This follows from the dynamic interaction of constraints in OT.

To illustrate the proposal, I first sketch out a general approach to sonority sequencing constraints, concentrating on Syllable Contact.

3 The relational nature of Syllable Contact

Syllable Contact is complex. First, it evaluates the sonority difference between a coda and the following adjacent onset. Second, it demands that the difference be as large as possible. Third, it dictates the direction of the difference: codas must exceed onsets in sonority, and not the other way around. Because of its similarity to the well-known constraints on onset and coda sonority[2], it has been claimed that no separate Syllable Contact principle is needed and that Syllable Contact follows from larger principles (Clements 1990).

The main difference between onset/coda sonority constraints and Syllable Contact is that Syllable Contact is relational, not absolute. It doesn't exactly require codas to be as sonorant as possible, and onsets to be as non-sonorant as possible. What an onset or a coda must look like depends on the adjacent consonant. For instance, Kazakh restricts onset sonority only in contact, that is, when the onset follows a root coda (Davis 1998). Nasal and lateral onsets desonorize after codas of equal or higher sonority, e.g. /murin-lar/ → [murindar] 'nose+pl,' /koŋɯz-ma/ → [koŋɯzba] 'bug+interrog.' However, word-initially or after vowels, all onsets are tolerated: [almalar] 'apple+pl,' [mandajlar] 'forehead+pl.'

Kazakh and similar cases have convinced researchers that Syllable Contact is distinct from onset and coda sonority constraints. However, the exact formulation of Syllable Contact in OT is controversial. The debate mostly concerns the gradient vs. categorical nature of the constraint (Bat-El 1996, Davis and Shin 1999, Davis 1998), and whether it requires sonority to drop, categorically prohibits it from rising, or prohibits it from rising above a certain threshold (Alderete 1995). A notable exception to the single-constraint approach is Ham's (1998) analysis of West Germanic gemination, which uses a

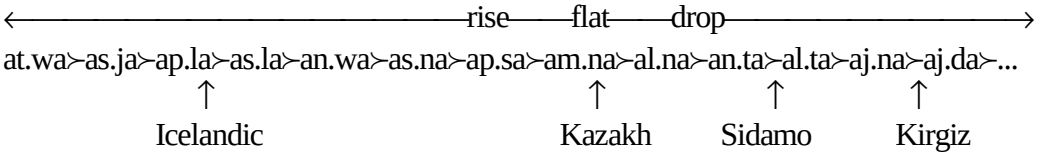
[1] Ham (1998) proposes a formally identical (sub)hierarchy, though he does not couch it in terms of Local Conjunction.

[2] The connection between moraicity and sonority is well known: the more sonorant a coda, the better (Hooper 1976, Vennemann 1988, Zec 1995, among others). The preference for onsets to be obstruent is harder to demonstrate for adult languages. There is evidence that obstruent onsets are preferred in child language (Gnanadesikan 1995/to appear). In adult languages, the emergence of the unmarked in reduplication (i.e. Sanskrit) shows a preference for obstruent onsets.

hierarchy of constraints against various degrees of sonority rise. However, Ham explicitly denies the existence of constraints against various degrees of sonority drop.

These issues can be put to rest if Syllable Contact is analyzed as not one or two constraints but as a hierarchy of constraints, based on the sonority scale (Gouskova 2001, 2002). The typology of Syllable Contact effects is rich enough to necessitate a detailed hierarchy. In this theory, variation among languages is encoded in the different cutoff points along the hierarchy, as shown in (1).

(1) *Languages select different cutoff points along the hierarchy*



While this idea is by no means new (see Clements 1990 for an articulated proposal), its implementation in OT is not straightforward. I explore the theoretical issues raised by relational constraints and their formulation in OT in the next section.

4 Scales and relational markedness

4.1 Relational constraints

The relational aspect of Syllable Contact sets it apart from other markedness constraints. An example of a non-relational markedness constraint is ONSET. It evaluates syllables in isolation, not in relation to other syllables. Context-free (paradigmatic) markedness constraints such as *[ŋ] are also non-relational.

Less recognized is the class of constraints that assess markedness based on some relation between the elements compared. One example of a relational constraint is GROUPING HARMONY (Prince 1990). GRPHARM compares the weight of the head syllable in a foot to the weight of the non-head, and deems the ratio of 2:1 most harmonic. Violations of GRPHARM cannot be determined by looking at the foot head alone.

Like GRP HARM, Syllable Contact compares two adjacent elements along a well-formedness parameter—in this case, the onset/coda sonority scales[3]. These scales are created by the mechanism of Harmonic alignment (Prince and Smolensky 1993).

4.2 Harmonic and Relational alignment

Informally[4], Harmonic alignment relates natural scales such as the sonority scale (2) to linguistic prominence scales, such as *moraic>non-moraic*. The more prominent element in the linguistic scale, here the *moraic* element, will gravitate to the more salient sonorant end of the sonority scale (4). The less prominent *non-moraic* position is better suited for obstruents (3). Thus, Harmonic alignment produces two harmonic scales. They are then

[3] Unlike Syllable Contact, Prince's GRPHARM evaluates a *ratio* rather than a *difference*. But, see McCarthy's (to appear) use of GRPHARM, which evaluates *differences* in weight.
[4] For the formal definition of Harmonic alignment, see Prince and Smolensky (1993:136).

converted into universally ranked, negatively stated constraints (e.g., *ONS/GLIDE>>*ONS/LATERAL>>...). Thus, Harmonic alignment adds structure to the set of constraints CON in OT by creating universal, innate constraint hierarchies out of extra-linguistic scales.

(2) *Sonority scale (after Jespersen 1904)* Voiceless stops>voiceless fricatives >voiced stops>voiced fricatives>nasals>laterals>rhotics>glides

(3) *Onset/non-moraic harmony scale:*
Ons/t≻Ons/s≻Ons/d≻Ons/z≻Ons/n≻Ons/l≻Ons/r≻Ons/w

(4) *Coda/Moraic harmony scale:* μ/w≻μ/r≻μ/l≻μ/n≻μ/z≻μ/d≻μ/s≻μ/t

I propose that relational constraints are derived from harmonic scales using a similar mechanism, which I call Relational alignment. Intuitively, the idea behind Relational alignment is the following: the more marked the individual members in a relation, the more marked the overall relation[5]. A sequence of a stop coda followed by a glide onset (e.g., *ap.ja* or *ak.wa*) is the worst possible contact because a stop is the worst coda and a glide is the worst onset. Conversely, the most harmonic coda will make the best contact with the most harmonic onset.

While the ends of the scales in (3-4) align straightforwardly, it is not obvious how the middles should combine. I propose to use the ranks of the two elements on their respective scales to determine the harmony of their relation. For example, a fricative coda is the second worst coda, and a glide onset is the worst possible onset. Therefore, their sequence will form the second worst relation. Likewise, the worst possible coda combined with a second-rate onset, *stop-rhotic*, will also fall into the second relational stratum. The two sequences in the stratum, *stop-rhotic* and *fricative-glide*, cannot really be compared to each other—they are equal. Once the strata are calculated in this way, the result is the partially ranked relational scale given in (5).

Crucially, this scale is not a constraint hierarchy. The combinations in each stratum have no independence from the rest of the stratum in the grammar of any language. This is because only one actual constraint refers to each stratum: for example, *DISTANCE+6 covers both of the combinations with a sonority rise of 6—*fricative-glide* and *stop-rhotic*. In this sense, the proposal echoes Clements's notion of complexity scores, which are calculated based on the individual complexity of the elements in contact. Parametric variation across languages is due to their tolerance of complexity.[6] In OT, the difference between languages is due to the interaction of the hierarchy in (6) with markedness and faithfulness constraints.

[5] This aspect of the approach bears some similarity to Local Conjunction. The differences will be addressed in section 4.4.

[6] There are some differences. Clements's complexity scores are calculated on demisyllables (...VC and CV...) in contact, which takes into the account the sonority of the vowel. Vowel sonority plays no role in my proposal—vowel and consonant sonority are not assumed to interact.

(5) *The Syllable Contact Scale*

–7	*–6*	*–5*	*–4*	*–3*	*–2*	*–1*	*0*	*+1*	*+2*	*+3*	*+4*	*+5*	*+6*	*+7*
w/t ≻	w/s≻	w/d≻	w/z≻	w/n≻	w/l≻	w/r≻	w/w≻	r/w≻	l/w≻	n/w≻	z/w≻	d/w≻	s/w≻	t/w
	r/t	r/s	r/d	r/z	r/n	r/l	r/r	l/r	n/r	z/r	d/r	s/r	t/r	
		l/t	l/s	l/d	l/z	l/n	l/l	n/l	z/l	d/l	s/l	t/l		
			n/t	n/s	n/d	n/z	n/n	z/n	d/n	s/n	t/n			
				z/t	z/s	z/d	z/z	d/z	s/z	t/z				
					d/t	d/s	d/d	s/d	t/d					
						s/t	s/s	t/s						
							t/t							

(6) *The Syllable Contact Hierarchy*

largest sonority rise ←——←——←–flat sonority–→——→——→ largest sonority drop

*DIS+7>>*DIS+6>>*DIS+5...>>*DIS0>>*DIS–1>>*DIS–3>>...>>*DIS–6>>*DIS–7

4.3 Partial stratum behavior through constraint interaction

In addition to the usual predictions associated with any fixed hierarchy, there is one that is specific to the *DISTANCE proposal. The prediction is that the combinations with the same sonority distance should be either all well-formed or all ill-formed in a given language, *all things equal*.

At first blush, this prediction appears to be false: for example, a language that accepts the relatively unmarked sequences such as *n.d* (from the stratum with the sonority distance of –2) is also required to accept the dubious *z.s* and *d.t*. Clearly, this is not the case in many languages, such as Sidamo, which bans the sequences in which voicing disagrees but allows *n.d*.

In Sidamo, suffix onsets become the second half of a geminate with the features of the root in two cases: 1) when the sonority drops less than –2 (7a,b), 2) when the two consonants are obstruents that differ in voicing (8a,b). Sequences with a sonority drop of –2 or more, such as *n.d*, are well-formed[7] (9).

(7) *Sidamo gemination* (Moreno 1940)

	a. /hab-tôti/	habbôti	‘non dimenticare’
	b. /amad-tino/	amaddino	‘essa prese’
(8)	a. /af-tinonni/	affinonni	‘avete visto’
	b. /ful-nemmo/	fullemmo	‘usciamo’
(9)	a. /gud-nonni/	gundonni	‘they finished’

The reason for this apparent exception is simple: in Sidamo, AGREE-VOICE (Lombardi 1999) rules out some of the –2 stratum. The dual action of AGREE-VOICE and the Syllable Contact constraint *DIST–1 is illustrated in (10). The sonority profile of each output is indicated in parentheses, with (–) appearing next to geminates, which do not get evaluated.

Thus, the interaction of the Syllable Contact hierarchy with other markedness

[7] These output sequences are themselves the result of metathesis. See Gouskova (2002).

constraints can result in partial stratum patterning in some grammars, where some sequences are bad even though they are predicted to be acceptable.

(10) *Ranking*: AGREE-VOICE, *DIST–1 >> IDENT

		AGREE-VOICE	*DIST–1	IDENT
/amad-tino/ (voicing gemination)	a. amadtino (–2)	*!		
	b. →amaddino (–)			*
/af-tinonni/ (sonority gemination)	c. aftinonni (–1)		*!	
	d. →affinonni (–)			*
/gud-nonni/ (no gemination)	e. →gundonni (–2)			
	f. gunnonni (–)			*!

It is also possible for some sequences to be acceptable even though they are expected to be bad. This too is the result of constraint interaction. For example, Kazakh generally gets rid of sequences with flat sonority[8] (i.e. those violating *DIST 0), for example, /murin–ma/ → [murinba] 'nose+interrog.' and /kol-lar/ → [koldar] 'hand+pl.' This indicates that *DIST 0 dominates IDENT. However, this ranking does not automatically exclude all sequences with flat sonority. Given the nature of the Kazakh repair, some flat sonority sequences cannot be fixed. Thus, /syjek-ma/ must surface as [syjekpe] 'bone+interrog,' because a violation of *DIST 0 cannot be avoided: deletion, epenthesis, and alternations in the root are prohibited. The high-ranking faithfulness constraints ensure that the Kazakh ban on flat sonority is not a surface-true generalization but a tendency (11).

(11) *When no other repairs are available, flat sonority is the best option*

/syjek-ma/	IDENT [ROOT]	MAX	DEP	*DIST +3	*DIST 0	IDENT
a. syjek.me				*!		
b. → syjek.pe					*	*
c. syje.ke		*!				
d. syje.ke.pe			*!			
e. syjej.pe	*!					

In sum, the *DISTANCE approach to Syllable Contact effects makes the strong prediction that all sequences with the same sonority distance should pattern together. Apparent exceptions to sonority distance class patterning are expected, however, when the Syllable Contact constraints interact with other OT constraints.

4.4 Distance constraints vs. the Local Conjunction of constraint hierarchies

One aspect of this proposal must be emphasized: all exceptions to sonority distance class patterning are principled. A sonority distance stratum can only be disrupted by the

[8] Unlike Sidamo, Kazakh does not have geminates, so [kol.lar] does violate *DIST 0 because it contains a sequence of two segments (i.e. a 'fake geminate').

activity of an independently motivated markedness or faithfulness constraint, and is not random. In this, the sonority distance theory differs from the Local Conjunction theory.

Under Local Conjunction, a partially stratified constraint hierarchy is created by locally conjoining every onset constraint with every coda constraint[9] in the domain of adjacent segments (or syllables—see Baertsch 2002 for more details):

(12) [*CODA/P&*ONS/W] >>{[*CODA/P &* ONS/R], [*CODA/S&*ONS/W]}>>...

The Local Conjunction of fixed hierarchies predicts that sequences with the same sonority distance do not have to pattern as a class at all. The difference between the Local Conjunction theory and the Relational alignment theory stems from the different nature of the objects in the strata.

In the Relational alignment theory, each constraint refers to a whole stratum: *DIST+6 encompasses both kinds of sequences with the sonority rise of 6, *fricative-glide* or *stop-rhotic*. The sonority sequences are not constraints but objects in harmonic scales, which do not interact with constraints.

In the Local Conjunction theory, the notion of a sonority distance stratum does not have a direct expression in the grammar. Instead, each sequence is represented by an independent constraint. Although these constraints against sequences with the same sonority distance are not inherently ranked with respect to each other, they can enter into domination relationships through transitivity.

Local Conjunction can produce the same patterns as the Relational alignment theory, when the constraint hierarchy in (12) interacts with other markedness and faithfulness constraints in the way shown in (13). However, the Local Conjunction approach also predicts that each stratum can be randomly interrupted by other constraints, as shown in (14). Thus, (14a) is just as possible as (14b). This is a pattern that the Relational theory cannot replicate.

(13)	a. {[*CODA/P&*ONS/R], [*CODA/S&*ONS/W]} >> **X**	*t.r, *s.w
	b. **X** >> {[*CODA/P& *ONS/R], [*CODA/S&*ONS/W]}	✓t.r, ✓s.w
(14)	a. [*CODA/P& *ONS/R]>>**X**>>[*CODA/S &* ONS/W]	*t.r, ✓s.w
	b. [*CODA/S&*ONS/W]>>**X**>>[*CODA/P& *ONS/R]	✓t.r, *s.w

Ultimately, the difference between the more conservative Relational alignment theory and the richer Local Conjunction theory is an empirical matter. If the uniform patterning of sequences with the same sonority distance is only disrupted by independently motivated constraints, then Relational alignment is all we need. However, if we find cases of split patterning that cannot be explained by independently motivated constraints, then something like Local Conjunction is necessary. In the next section, I examine a challenging case of split stratum behavior in Icelandic. I show that the Relational

[9] Baertsch's proposal is more general: it applies to both onset sonority and Syllable Contact. Her constraints refer to positions like Margin 1 (the first segment of the onset) and Margin 2 (a simplex coda or the second segment of the onset). Here, I abstract away from the difference in order to compare the two theories.

alignment approach can adequately deal with it, so I conclude that Icleandic does not provide evidence for the Local Conjunction approach.

5 Icelandic and Faroese

Because of its ability to distinguish fine degrees of rising sonority, Icelandic syllabification has long attracted attention (Árnason 1980, 1985, Baertsch 1998, Berg 2001, Einarsson 1945, Ham 1998, Ito 1986, Morén 1999, Murray and Vennemann 1983, Vennemann 1972). Icelandic allows sonority to rise across the syllable boundary, but sets a threshold. This is significant for two reasons. First, it supports the need for a detailed hierarchy that can distinguish between degrees of sonority rise. Second, Icelandic presents an apparent challenge to the sonority distance approach advocated here, because sequences with the same sonority pattern differently. I argue that a closer examination of the Icelandic facts proves them compatible with the sonority distance approach.

Before presenting the fairly complicated Icelandic pattern, I will start by laying out the similar but more straightforward facts of Faroese.

5.1 Faroese syllabification

In Faroese, initial syllables are stressed and heavy. The weight requirement can be satisfied either by a long vowel or by a coda consonant. Vowels do not contrast for length: long vowels are confined to stressed open syllables (a-c), while short vowels are found elsewhere (d-f). Vowel length is a diagnostic for syllabification: the syllable boundary follows the second mora of the stressed syllable.

(15) *Faroese vowel distribution* (Lockwood 1955)[10]

a. e:.^{h}ta	'to eat'	d. vɛs.tʊr	'west'
b. mi:.ja	'must (pl)'	e. no̥d.d̥ɪ	'approached (sg.)'
c. t^{h}ɔu.mʊr	'empty'	f. mɛn̥.tan	'culture'

This pattern results from the conflict of the familiar constraints STRESS-TO-WEIGHT, NOLONGV, and IDENT-LENGTH (16). The interaction of these constraints ensures that, regardless of vowel length in the input, the output can only contain long vowels in stressed open syllables.

(16) STRESS-TO-WEIGHT: 'Stressed syllables are heavy.'
NOLONGV: 'A vowel must not be associated with two morae.'
IDENT-LENGTH[11]: 'The length specifications in the input match the length specifications in the ouput.'

[10] Data sources for Faroese: P98 (Petersen et al. 1998), L55 (Lockwood (1955). I standardized the transcription according to the conventions in Petersen et al.
[11] IDENT-LENGTH is a cover constraint. For a more sophisticated view, see Morén (1999).

(17) *Vowels shorten in unstressed syllables*

/b̥at^{h}na:/	NoLongV	Ident-length
a. →b̥a^{h}t.na		*
b. b̥a^{h}t.na:	*	

(18) *Vowels lengthen in stressed open syllables*

/et^{h}a/	Stress-to-Weight	NoLongV	Ident-length
a. →e:^{h}ta		*	*
b. ɛ.^{h}ta	*!		

Although vowels are normally short preceding any geminate or two-consonant sequence, they are long before the following sequences: {pr, pl, tr, kr, kl, kv} (Árnason 1980, Lockwood 1955, Petersen et al. 1998). These sequences happen to have the highest sonority rise possible in Faroese: five or more points along the sonority scale. Thus, Faroese syllabification obeys the following generalization:

(19) **Generalization for Faroese**: when sonority rises 5 points or more across a syllable boundary, the two consonants are syllabified into a complex onset and the vowel is long. When sonority rises 4 points or fewer, the consonant sequence is heterosyllabic.

(20) *Long vowels or diphthongs: sonority rise is 5 or more*

a:.^{h}kvamarɪn	(+7)	P98	'beryl'	d̥ɛa:.^{h}prɪr	(+6)	'sad'	P98
vɛa.^{h}krɪr	(+6)	P98	'beautiful(m.pl)'	mi:^{h}klɪr	(+5)	'great (m.pl)'	L55
ai.^{h}trantɪ	(+6)	L55	'poisonous'	e:^{h}plɪ	(+5)	'potato'	P98

(21) *Short vowels: sonority rise is fewer than 5 points (all data from Lockwood)*

sɪg̊rɪ	(+4)	'further south'	rɔ^{h}k.tɪ	(0)	'smoked (sg.)'
b̥a^{h}t.na	(+4)	'to improve'	vɛs.tʊr	(-1)	'west'
ɪd̥.la	(+3)	'or'	hɛn.d̥ʊr	(-2)	'hands'
vɛs.na	(+3)	'to worsen'	ɟœr.d̥ɪ	(-4)	'did (sg.)
ɟar.na	(+2)	'gladly'	nod̥.d̥ɪ	(−)	'approached (sg.)'

The decision of whether to lengthen the vowel or to syllabify the consonant into the coda is up to Syllable Contact. Stress-to-Weight is preferentially satisfied by linking a consonant to a mora, because this avoids having a long vowel (22). When this would create a sonority rise of more than 4 points, the vowel is lengthened instead. The Syllable Contact constraints against the highest sonority rise, *Dist+7, *Dist+6 and *Dist+5, block the heterosyllabic parsing (23).

(22) *Ban on long vowels overrides constraints against moderate sonority rise*

/sɪg̊rɪ/	NoLongV	*Dist +4
a. →sɪg̊.rɪ		*
b. si:.g̊rɪ	*!	

(23) *Long vowels are tolerated when sonority rises 5 points or more*

		*Dist +6	*Dist +5	NoLongV
/ep^{h}lɪ/	a. → e:^{h}plɪ			*
	b. ɛ^{h}p.lɪ		*!	
/vɛak^{h}rɪr/	a. → vɛa.^{h}krɪr			*
	b. va^{h}k.rɪr	*!		

The one wrinkle in the pattern is the syllabification of /tl/, which appears as a heterosyllabic sequence (24) even though its sonority rise of (+5) is acceptable in Faroese. This deviant syllabification of /tl/ is not surprising—homorganic onset clusters of this kind are avoided in many European and non-European languages.

(24) *TL onsets disallowed*

stʊ^{h}t.lɪ.jʊr (+5) 'pleasant' lʊ̆ʏ̆^{h}t.lɪ (+5) 'little one (masc.)'

To sum up, with the exception of [t.l], whose resistance to being syllabified as an onset can be explained on independent grounds, sonority distance strata pattern as expected in Faroese. The division between well-formed and ill-formed contacts falls cleanly between *Dist +5 and *Dist +4. The summary ranking is given in (25). The key point about this ranking is that the markedness constraint NoLongV interrupts the *Dist hierarchy, admitting most sonority profiles but banning the three most marked degrees of rise. The *Dist hierarchy is only partially active, resulting in the sonority distance threshold effect.

(25) *Faroese summary ranking*

{*Dist +7>>*Dist+6>>*Dist5}, S-to-W, *[$_{\sigma}$*TL >> **NoLongV** >> Ident-Length, {*Dist+4>>*Dist+3>>*Dist+2>>...>>*Dist–7}

I next turn to Icelandic, whose pattern differs in one crucial respect: it appears that some of the sequences in the stratum of *Dist +5 are well-formed, but not all are.

5.2 Icelandic: explaining the split pattern

Icelandic syllabification and vowel lengthening are quite similar to that of Faroese. Normally, two medial consonants are heterosyllabic, as long as sonority does not rise above a certain threshold between them:

(26) *Icelandic short vowels (Southern Dialect)*[12]

hăĭɣ.rɪ	'right'	(+4)	E45	vɛl.ja	'choose'	(+2)	Á80
b̥ɪð.ja	'to ask'	(+4)	Á80	vɛr.ja	'to defend'	(+1)	E45
stœð.va	'to stop'	(+4)	Á80	t^{h}ɛv.ja	'to delay'	(0)	Á80
b̥lað.ra	'balloon'	(+3)	Á80	hɛs.tʏr	'horse'	(–1)	E45
sɪg̊.la	'to sail'	(+3)	E45	ɛv.rɪ	'upper'	(–1)	E45
vɪs.na	'wither'	(+3)	E45	av.laɣa	'to bend out of shape'	(–2)	E45
t^{h}ɛm.ja	'domesticate'	(+3)	E45	d̥vɛr.g̊ʏr	'dwarf'	(–4)	E45

The environment for vowel lengthening is slightly different in Icelandic: it applies only before a sequence of {p, t, k, s} followed by {r, j, v}[13] (Einarsson 1945).

(27) *Icelandic: lengthened vowels, the entire cluster forms an onset*

vɪ:.tja	'to visit'	(+7)	E45	skɔ:.pra	'roll'	(+6)	E45
vœ:kva	'to water'	(+7)	V72	tvɪ:.svar	'twice'	(+6)	E45
a:.krar	'fields'	(+6)	E45	ɛ:.sja	'the mountain Esja'	(+6)	E45
t^{h}ɪ:.tra	'to vibrate'	(+6)	E45	løy.sra	'loose (Gen. Pl.)	(+5)	E45

Unlike Faroese, Icelandic does not lengthen vowels before stop-lateral sequences. Thus, stop-lateral sequences syllabify differently from fricative-rhotic sequences (e.g. løy.sra), although they have the same sonority rise of +5:

(28) *Icelandic: short vowels*

ɛ^{h}p.lɪ	'apple'	(+5)	V72
ɛ^{h}k.la	'lack'	(+5)	V72
ăĭ^{h}t.la	'intend'	(+5)	E45

The split behavior of fricative-rhotic and stop-lateral sequences suggests that syllabification is not affected by sonority distance alone. There is an additional process that interacts with sonority in Icelandic, which makes it different from Faroese.

Part of a sonority distance class can be ruled out by independently motivated constraints. In Icelandic, sequences with the sonority rise of +5 are generally prohibited[14], so [løy.sra] behaves as expected. Stops are the ones following an exceptional pattern, because they participate in a special process that does not affect fricatives. In a nutshell,

[12] The data sources are indicated next to each example. The abbreviations are: E45 (Einarsson 1945), Á80 (Árnason 1980), V72 (Vennemann 1972). I would like to thank Gunnar Ólafur Hannson for helping me understand the Icelandic data.

[13] The standard assumption in Icelandic phonology is that that /v/ is a glide.

[14] Although [s] is the only fricative that appears in such configurations in the native vocabulary, loanwords with [fr] clusters pattern the same way, e.g. [a:frɪka] 'Africa' (Gunnar Hannsen, p.c.)

stops can preserve an aspiration contrast (and avoid being post-aspirated) by syllabifying as preaspirated codas, which they will do as long as sonority rises no more than 5 points. Fricatives, on the other hand, have nothing to gain by violating *DIST+5.

Since Thráinsson's (1978) original analysis of Icelandic preaspiration, much has been written on the subject. I will only concentrate on the aspects of the phenomenon that interact with Syllable Contact. For more comprehensive recent treatments in OT, see Keer (1998), Morén (1999), and Ringen (1999).

Maintaining the aspiration contrast is important, but there are various conditions attached to it. Thus, in the Southern dialect, a stop can only keep its aspiration in a word-initial onset (post-aspirated), or in a moraic coda position (preaspirated). If an underlyingly aspirated stop surfaces medially, it must be either moraic or post-aspirated. Appearing in moraic position means violating some *DIST constraints (*DIST+5 or lower), but this risk is taken to satisfy IDENT [SPREAD GLOTTIS]:

(29) *Aspiration is preserved when sonority rises as much as 5 points*

/ɛp^{h}lɪ/	IDENT [SG]	*DIST+5
a. → ɛ^{h}p.lɪ		*
b. ɛ:plɪ	*!	

An alternative is to preserve aspiration by syllabifying the post-aspirated stop in the onset, but this violates *POST-ASP STOP (30b). Post-aspirated stops are preferably avoided.

(30) *Post-aspiration can be avoided by violating *DIST+5*

/ɛp^{h}lɪ/	*POST-ASP STOP	*DIST+5
a. → ɛ^{h}p.lɪ		*
b. ɛ:p^{h}lɪ	*!	

Giving the post-aspirated stop a mora (ɛp^{h}.lɪ) violates a constraint that is undominated in Icelandic: a ban on normal post-aspirated stops in moraic position[15] (Morén's *μ/POST-ASP STOP). This constraint is responsible for preaspiration.

Preserving aspiration is not important enough to cause violations of *DIST+6 and *DIST+7. When sonority rises more than 6 points, it is impossible to preserve the underlying aspiration in a moraic coda without violating *DIST +6 and/or *μ/POST-ASP STOP (31a,b). The vowel must be lengthened.

(31) *Vowel lengthening before stops followed by rhotics or glides*

/ak^{h}rar/	*DIST +6	*μ/POST-ASP STOP	NOLONGV
a. a^{h}k.rar	*!		
b. ak^{h}.rar	*!	*	
c.→ a:krar			*

[15] Under Richness of the Base, there must be a mirror ban on pre-aspirated stops in onsets, which I assume is undominated in Icelandic.

Depending on the dialect, post-aspiration may or may not be preserved in cases like (31c). In Southern Icelandic, the ranking is IDENT [SG]-σ1>>*POST-ASP-STOP>>IDENT [SG], so aspiration is lost in non-initial syllables (a:krar ≻ ak^{h}rar).

The important difference between stops and fricatives is that fricatives are not subject to these conditions, so they never have to lose their [spread glottis] feature. The ranking of IDENT-LENGTH is the same in Icelandic as in Faroese, so fricatives will be codas only when sonority rises less than 5 points.

(32) *Fricatives pattern as in Faroese*

		*DIST +6	*DIST +5	**NO LONG V**	*DIST +4	*DIST +3
/løysra/	a. → løy.sra			*		
	b. lǿy̆s.ra		*!			
/vɪs.na/	a. → vɪs.na					*
	b. vɪ:.sna			*!		

The final rankings for Icelandic and Faroese are shown in (33). The *DIST+5 stratum is split in Icelandic because a markedness constraint specific to a subset of the +5 stratum, *POST-ASP STOP, dominates it. The higher ranking faithfulness constraint, IDENT [SG], forces some of the sequences to violate *DIST+5 in order to faithfully parse the aspiration feature. In Faroese, IDENT [SG] does not affect sonority sequencing: preaspiration appears after long and short vowels, on moraic and non-moraic stops, and only serves the function of marking underlying aspiration in non-word-initial position.

(33) *Faroese*

*DIST+7>>
*DIST+6>>
S-TO-W *TL *DIST+5
NOLONGV
ID-LENGTH *DIST+4
....*DIST-7

Icelandic (Southern dialect)

*DIST+7 *PASP-STOP
*μ/ PASPSTOP *DIST+6 IDENT[SG]
S-TO-W *DIST+5
NOLONGV
ID-LENGTH *DIST+4 —*DIST–7

It should be emphasized that this analysis of split stratum behavior Icelandic makes use of constraints that are independently needed to explain preaspiration in the language. This is a general feature of the Relational alignment approach: whenever sequences with the same sonority distance appear to pattern differently, they do so because of independently motivated faithfulness and markedness constraints.

The Local Conjunction account of Icelandic and Faroese is much simpler: in Icelandic, the constraint against stop-lateral sequences [*CODA/P&*ONS/L] dominates

[*CODA/S &*ONS/R] through transitivity, while in Faroese, the two constraints are ranked at the same level. The problem with this simplicity is that it overpredicts: the pattern opposite of Icelandic is predicted to exist as well. Patterns like this may well exist, but until they are found, there is no motivation for the powerful Local Conjunction approach.

6 Conclusion

The main goal of this paper was to show that sonority distance is a useful primitive of the grammar, and that exceptions to sonority distance generalizations are always principled. Using the example of Syllable Contact, I presented a theory that encodes this primitive in OT. I claimed that Syllable Contact is relational: it evaluates the *distance* between adjacent codas and onsets. This is expressed formally through Relational alignment, which assigns sequences with the same sonority distance to a stratified scale. Each stratum in the scale has a corresponding constraint, and the constraints form a universally fixed hierarchy.

The proposal has two chief consequences: first, the resulting hierarchy of constraints against various degrees of sonority distance has enough power to express the observed typology of Syllable Contact effects. Differences between languages like Faroese and Icelandic would be difficult to express without a detailed hierarchy. Second, sequences with the same sonority are expected to pattern differently *only when* other constraints demand it. These constraints can render some sequences unacceptable even though they are well-formed with respect to sonority, resulting in apparent exceptions to sonority sequencing generalizations.

The predictions of this approach were compared with another hierarchy theory of Syllable Contact: the Local Conjunction of constraint hierarchies (Baertsch 1998, 2002). Local Conjunction predicts that sequences with the same sonority distance can freely pattern as if they were different. I argued that even the more difficult cases of split patterning, of the kind found in Icelandic, can be explained on principled grounds. In the absence of evidence of such free patterning, the power of Local Conjunction is unnecessary.

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References

Alderete, John. 1995. Winnebago accent and Dorsey's law. In *Papers in Optimality Theory*, eds. Jill Beckman et al., 21-52. Amherst, MA: GLSA Publications.

Árnason, Kristján. 1980. *Quantity in Historical Phonology: Icelandic and Related Cases*: Cambridge Studies in Linguistics 30. Cambridge: Cambridge University Press.

Árnason, Kristján. 1985. Icelandic word stress and metrical phonology. *Studia Linguistica* 39:93-129.

Baertsch, Karen. 1998. Onset sonority distance constraints through local conjunction. In *CLS 34, Part 2: The Panels*, eds. M. Catherine Gruber et al., 1-15. Chicago: Chicago Linguistic Society.

Baertsch, Karen. 2002. An Optimality-theoretic approach to syllable structure: The Split Margin Hierarchy, Indiana University: Ph.D. Dissertation.
Bat-El, Outi. 1996. Selecting the best of the worst: The grammar of Hebrew blends. *Phonology* 13:283-328.
Berg, Thomas. 2001. An experimental study of syllabification in Icelandic. *Nordic Journal of Linguisics* 24:71-106.
Clements, G. N. 1990. The role of the sonority cycle in core syllabification. In *Papers in Laboratory Phonology 1: Between the Grammar and Physics of Speech*, eds. John Kingston and Mary Beckman, 283-333. New York: Cambridge University Press.
Davis, Stuart, and Shin, Seung-Hoon. 1999. The Syllable Contact Constraint in Korean: An Optimality-Theoretic Analysis. *Journal of East Asian Linguistics* 8:285-312.
Davis, Stuart. 1998. 'Syllable Contact in Optimality Theory.' *Journal of Korean Linguistics* 23:181-211.
Einarsson, Stefan. 1945. *Icelandic*. Baltimore, MD: Johns Hopkins Press.
Gnanadesikan, Amalia. 1995/to appear. Markedness and faithfulness constraints in child phonology. In *Fixing Priorities: Constraints in Phonological Acquisition*, eds. René Kager et al. Cambridge: Cambridge University Press.
Gouskova, Maria. 2001. 'Falling Sonority Onsets, Loanwords, and Syllable Contact.' In *CLS 37: The main session*, eds. Mary Andronis et al. Chicago, IL: Chicago Linguistic Society.
Gouskova, Maria. 2002. Sidamo and Turkic. In *Proceedings of the 21st West Coast Conference on Formal Linguistics*, eds. L. Mikkelsen and C. Potts. Somerville, MA: Cascadilla Press.
Ham, William. 1998. A new approach to an old problem: Gemination and constraint reranking in West Germanic. *Journal of Comparative Germanic Linguistics* 1:225-262.
Hooper, Joan. 1976. *An Introduction to Natural Generative Phonology*. New York: Academic Press.
Ito, Junko. 1986. Syllable Theory in Prosodic Phonology, University of Massachusetts, Amherst: Doctoral dissertation.
Jespersen, Otto. 1904. *Lehrbuch der Phonetik*. Leipzig and Berlin: B. G. Teubner.
Keer, Edward. 1998. Icelandic preaspiration and the moraic theory of geminates. In *Proceedings of the Xth Conference on Nordic and General Linguistics. ROA #312.*
Lockwood, W.B. 1955. *An introduction to modern Faroese*. Copenhagen: Ejnar Munksgaard.
Lombardi, Linda. 1999. Positional faithfulness and voicing assimilation in Optimality Theory. *Natural Language and Linguistic Theory* 17:267-302.
McCarthy, John J. to appear. Sympathy, cumulativity, and the Duke-of-York gambit. In *The Optimal Syllable*, eds. Caroline Féry and Ruben van de Vijver. Cambridge: Cambridge University Press.
Morén, Bruce. 1999. Distinctiveness, Coercion and Sonority: A Unified Theory of Weight, University of Maryland: Doctoral dissertation.
Moreno, Martino Mario. 1940. *Manuale di Sidamo*. Milan: Mondadori.
Murray, Robert, and Vennemann, Theo. 1983. 'Sound Change and syllable structure in Germanic phonology.' *Language* 59:514 -528.
Petersen, Hjalmar, Jakobsen, Jógvan í Lon, Hansen, Zakaris, and Thráinsson, Höskuldur. 1998. Faroese: An overview for students and researchers. Ms. Tórshavn and Reykjavík.
Prince, Alan. 1990. Quantitative consequences of rhythmic organization. In *Parasession on the Syllable in Phonetics and Phonology*, eds. M. Ziolkowski et al., 355-398. Chicago: Chicago Linguistic Society.
Prince, Alan, and Smolensky, Paul. 1993. Optimality Theory: Constraint interaction in generative grammar. New Brunswick, NJ: Rutgers University Center for Cognitive Science.
Ringen, Catherine. 1999. Aspiration, preaspiration, deaspiration, sonorant devoicing, and spirantization in Icelandic. *Nordic Journal of Linguisics* 22:137-156.
Rose, Sharon. 2000. 'Epenthesis Positioning and Syllable Contact in Chaha.' *Phonology* 17:397-425.
Thráinsson, Höskuldur. 1978. On the phonology of Icelandic preaspiration. *Nordic Journal of Linguistics* 1:3-54.
Vennemann, Theo. 1972. On the theory of syllabic phonology. *Linguistische Berichte* 18:1-18.
Vennemann, Theo. 1988. *Preference Laws for Syllable Structure and the Explanation of Sound Change: With Special Reference to German, Germanic, Italian, and Latin*. Berlin: Mouton de Gruyter.
Zec, Draga. 1995. Sonority constraints on syllable structure. *Phonology* 12:85-129.