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Yakut Assimilation and the Strength/Sonority Hierarchy
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In this paper I want to review some claims about the strength/sonority hierarchy, (henceforth, only "strength hierarchy"), primarily as made by Hankamer and Aissen in their 1974 paper entitled 'The Sonority Hierarchy', in light of data from Yakut, a Siberian Turkic language.

First, I want to demonstrate that an analysis of Yakut phonotactics can be made using a strength hierarchy formulation. Then I want to look at assimilatory phenomena in Yakut and show that they can also be described—in the formal sense—with the strength hierarchy. Finally, I want to comment on two major claims made by H&A—which are also implicit or overt in other literature on the subject of strength/sonority hierarchies, first that the existence of a strength hierarchy means that major class features are, in H&A's words, "artifacts of the binary feature system" and secondly, that the strength hierarchy is to be considered a phonological prime—by which I take it to mean that it is an element in phonological theory which is irreducible and universal.

In recent years, a number of proposals have been made to incorporate the notion of a hierarchy of sonority or strength into phonological description as a prime. As all of these proposals have noted, it is a time-honored observation that segments interact with each other in a manner which can often be described in terms of inherent sonority or strength.¹

Hankamer and Aissen (H&A) show that in Pali, various progressive and regressive assimilations can be accounted for in a unitary fashion by the incorporation of the notion of a sonority hierarchy into phonological description. Thus, assimilations such as $\underline{r}+y \rightarrow \underline{yy}$, $\underline{s}+y \rightarrow \underline{ss}$, $\underline{r}+\underline{s} \rightarrow \underline{ss}$, $\underline{s}+\underline{t} \rightarrow \underline{tt}^h$, $\underline{l}+\underline{m} \rightarrow \underline{mm}$, $\underline{l}+\underline{b} \rightarrow \underline{bb}$ etc., are neatly accounted for by assuming a sonority hierarchy for Pali as follows: $\underline{r} \rightarrow \underline{y} \rightarrow \underline{l} \rightarrow \underline{N} \rightarrow \underline{s} \rightarrow \underline{t}$, where sonority diminishes from left to right. Exceptional instances of assimilation aside, assimilating is determined by relative sonority, less sonorous elements assimilating to more sonorous ones. (H&A, 132-134).

Other proposals are numerous. Kim 1972 bases a phonological hierarchy proposal on aperture. Hooper proposes a strength hierarchy for optimal syllable structure. Venneman 1972 deals with Icelandic assimilation with a strength hierarchy. Hooper 1976 proposes a universal hierarchy (p. 206) and also a language specific one for American Spanish. Foley 1977 analyses historical change with strength hierarchies; Stampe 1979 deals with h and glide deletion in English with a strength hierarchy. There is a great deal of accord on the general internal structure of these hierarchies. All of them range segments along a scale which, it is claimed, is generally correlated to a large extent with inherent acoustic sonority which, it is also claimed, can in turn be correlated with the general degree of closure in the vocal tract (including the nasal passages) and among the obstruents with voicing. All proposals expect a certain degree of language-specific variability to occur in the hierarchies, due to the non-categorical nature of sonority differences among closely related classes of sounds. H&A (p. 138) particularly

emphasize this.

Allowing, then, for language specific variation in certain areas, the six proposed hierarchies I have examined generally agree that the strength scale will follow along these lines:

1. (vowels) → glides → liquids → Nasals → voiced stop → fric → vcles
 stop → (?) affricate

where the long arrows indicate language specific possibilities for re-alignment. Thus, for Icelandic, Venneman groups f and the voiced stops; for Pali, Hankamer and Aissen propose that the glides are stronger than r, and l is stronger than the glides; for Hungarian they propose that r and y are stronger than l; Hooper's universal strength hierarchy suggests that the relation between voiceless continuants and voiced stops may be entirely non-significant or language specific; her hierarchy for American Spanish ranks trilled r higher than the fricatives.

It is possible to make use of a strength hierarchy to describe phonotactic and assimilatory phenomena in Yakut. It does not appear, however, that a language-specific hierarchy for Yakut will correspond to the proposals cited above in at least one major way, namely, the strength hierarchy approach to Yakut will require us to rank nasals as weaker than liquids and glides. I suggest that the following strength hierarchy will be necessary to describe Yakut assimilation and phonotactics:

2. h → nasals → l → glides → voiced obstruents → voiceless continuants → voiceless obstruents → geminates

Before examining the data which lead to the proposal of this hierarchy, consider first the original Yakut phonological hierarchy proposal. In a remarkable work published in 1851, Otto Böhntlingk proposed a set of relations among the 21 consonantal 'simple elements' (einfache Elemente) in Yakut.² He groups the consonants into classes according to sonority, 'concreteness', and quantity, as well as what we might now call their phonological relation to each other on the basis of distribution and assimilation patterns. He further ranks each set of consonants hierarchically with other sets based on the same criteria. In presenting his arrangement, I translate his terms harte, weiche, flüssige and schwache as 'hard', 'soft', 'labile', and 'weak', and his cover terms starre and starke as 'fixed' and 'strong'.

- 3.
- | | | | | | | | | |
|--------|--------|------|---|---|---|----|---|---------------------------|
| | fixed | hard | k | x | t | č | s | p |
| | | soft | g | ɣ | d | ʃ | | b |
| strong | labile | | ŋ | | n | ń | | m |
| | | | | | l | r | | |
| | | weak | | | ɣ | yh | | (ɣ = nasal palatal glide) |

I have made adjustments in the alignment of the elements to correspond with Böhntlingk's interpretation of their relations in his explanatory text; I have also substituted the transcription used in this paper for his adapted Cyrillic. Böhntlingk makes some very clear statements about the relation of classes to each other within his hierarchy. Hard and soft consonants alternate; in some cases, both hard and soft consonants alternate with the labile set: through the use of the class features 'fixed', 'strong', 'hard', 'soft', 'labile', and 'weak', and his cover terms 'starre' and 'starke'.

can speak of these alternations generally. He can also effectively sum up phonotactic relations:

3. "...among the fixed consonants, only hard consonants appear in final position and only hard consonants can follow each other; the labile consonants can succeed each other and also appear before (but not after) fixed consonants; finally, the weak consonants are only found intervocalically. [italics are B's; footnotes omitted]³

With Böhlingk's analysis in mind, consider now unit morpheme and syllable structure in Yakut.

All consonants occur in word-initial position except p, ɣ, ɲ, ɾ, ʏ (except in one word) and ɥ (h is purely allophonic, a fact also recognized by Böhlingk; it occurs intervocalically as an allophone of s). In final position, devoicing precludes the appearance of voiced obstruents; none of the phonetic palatals (ç, ʝ, ɲ) appear here either, though the phonologically palatal s and ɾ do. Unit-morpheme internally, contrastive gemination is found, but not among s, ɲ, ɾ, ʏ and ɥ, which (along with certain alternations presented below) leads me to consider this group phonologically palatal. We need, then, to set up groups that include s and ɾ versus ʝ, ɲ, ɣ and ɥ—the latter being the true phonetic palatals that are excluded from appearing in final position; and we want to set up the group s, ɲ, ɾ, ʏ, and ɥ which do not geminate internally in unit morphemes—the phonological palatals. This is no problem within the feature system, using the features [coronal], [high], and (possibly redundantly) [anterior]. A strength scale can be employed in describing consonant clusters, however. Consider first those found unit morpheme internally.

Table 1 shows possible sequences of consonants in unit morpheme internal position (where the term unit morpheme excludes sequences across morpheme boundaries; I will henceforth simply refer to these as 'morpheme-internal' sequences). This table is based on Kreuger's and Böhlingk's glossaries, and Böhlingk's 'Consonant Index, pp. 203 ff. (Note that the table suggests that p and k are weaker than t in clusters.) From this material emerges the operative principle in morpheme-internal consonant sequences: the first consonant must be less than or equal to the second in strength. I will refer to this as the Weak-Strong condition (W-S). This is nothing more than the requirement that (stated in major class terms) sonorants always precede non-sonorants and not vice-versa. Note, however, that there is a constraint on gemination: the phonological palatal continuants do not geminate. This can also be captured using a strength hierarchy notation. It seems equally possible, however, to make the same statements using major class features in the form of a negative constraint. In both cases, we must assume a voicing rider that states where two non-sonorant (or two segments above n strength) are found in succession, their voicing must agree.

Table 1. Unit morpheme internal -CC- sequences in Yakut

	k	t	p	č	ǰ	s	x	b	d	g	ʎ	m	n	n'	ŋ	l	r	
r	x	x	x	x	x		x	x	x	x	x							o
l	x	x		x	x		x	x	x	x	x							•
ŋ	x					x	x		x									•
n'									x						o			
n	x	x		x		x	x		x		x							•
m		x	x	x	x	x			x									•
ʎ									x									
g									x									
d																		
b																		x
x		x		x		x												•
s	x	x	x			o	x											
ǰ																		
č				•														
p	x	x	•	x		x	x											
t		•																
k	•	x																

x indicates a sequence
rk rt rp etc.

• indicates attested gemination

4. W-S Condition:

C	C	==?	*C	C
[p strength]	[q strength]		[-son][+son]	
where p < q and p ≠ q			& *C'C'	
	[+palatal +continuant]		[+palatal +continuant]	

Loanwords that violate the W-S condition are adjusted through epenthesis: Russ: tiratka 'notebook' > tetereet (the final ka sequence may have been analyzed as the dative case and eliminated through back formation); daklat 'report' > doklaat; saxmat 'chess' > saaxmat.

Native and loanword evidence supports the analysis of l as stronger than r. In native words, only l is found word initially (labaa 'branch', lökö 'stout'), and only l is found geminate morpheme internally. But recall that no phonologically palatal continuants are found geminate, so this latter distribution is not decisive. Note that this relative strength relation only holds in word initial position (cf. Table

5. Russ. luk 'onion' > luuk, Russ. lafka '(a) shop' > laapp#. Borrowings with initial r, however, epenthesize:

Russ. rajon 'region' > oroyon; repa 'turnip' > erieppe.

This suggests that l is 'strong' enough to form a syllable margin, but r must be reinforced by the epenthetic vowel.

Cross-boundary assimilation in inflection: progressive. Like the other Turkic languages, Yakut is agglutinating and exclusively suffixing. There is considerable assimilation across morpheme boundaries. Progressive assimilation can be described in terms of a strength hierarchy more effectively than by using traditional feature values here. I shall call the general operative principle in Yakut progressive assimilation 'strength matching'. It operates under these conditions:

6. i. the articulatory integrity of the assimilating segment is maintained
- ii. the assimilating segment matches the strength of the preceding segment in conformity with the W-S condition and other phonotactic constraints.

Table 2 shows the distribution of suffix-initial segments after stem finals. I shall assume that the underlying representation of the suffix-initial segments is that which appears after stem-final vowels (there are some indicated instances of voicing and articulatory adjustment). If we assume the strength hierarchy as proposed above, it is clear how the assimilating segments, t, l, p, č, and k pattern according to the strength matching conditions. The alternation of underlying tt with t can also be interpreted as a strength adjustment; here the 'stronger' geminate is reduced to its weaker counterpart. The deletion of t and n in the 3POSS and accusative is paradigmatically conditioned.

Table 2. Distribution of suffix-initial segments in Yakut

	/-tt	-t	-t	-l	-n	-p	-č	-k
C [-vce]		-t		-t		-p t→p/_+p	-č,-s	-k t→k/_+k k→x/_x+_
r,y	-t	-d	-∅	-d	-∅	-b	-j	-g
l		-l		-l				
N		-n		-n				
V	-tt	-t	-t	-l	-n	-b	-h	-g /Vhi__ -s /Vlo__
ABL -ttan	PART -ta	3POSS -ta	PL -lar	ACC -ni	1PLPOSS lsVB	AGT -sit	DAT -ka	
	ADV -tik		SOCs -liin		NEG -pat		2PSVP -gin	
	PAST -ti		-lari		PrDUR -bin		2PLVB, 2PLPOSS -git	
	CAUS -tar		ADV -lii		PstPT -bit			
	COMP		DnmVB -laa					

These adjustments call for a problematic rearrangement of the hierarchy compared to its apparent alignment in word-initial position. The glides, for example, are weak in word initial position and never appear there. It has also been shown that \underline{r} is weaker than \underline{l} in word initial position. Yet, if we are going to accept that voiced stops are stronger than liquids, apparently an uncontroversial placement in all other published hierarchies, then to maintain the claim that there is a strength hierarchy involved in these Yakut assimilations we will have to rank \underline{r} and \underline{y} higher than \underline{l} . It is possible that what is being manifested here is the phonological role of \underline{r} and \underline{y} as palatal continuants, that is, voiced fricatives. They are simply excluded from word initial position and from gemination for reasons that have nothing to do with strength.

I have ranked nasals lower than $\underline{r}, \underline{y}$, and \underline{l} on the assumption (as above) that \underline{d} is stronger than \underline{l} and \underline{n} . Note that in the $\underline{p}, \underline{\check{c}}$, and \underline{k} alternations, $\underline{r}, \underline{y}$, and \underline{l} group as a conditioning class; to rank the nasals above this class in strength seems natural enough, but it then requires us to rank the (suffix initial) voiced stops as lower in strength than the nasals.

But are we dealing with a strength hierarchy here at all, or are we facing a condition that in effect maintains part (i) of the strength matching requirement and simply matches segments by class, voiceless stop with voiceless stop, lateral with lateral, nasal with nasal, and voiced with the only remaining voiced consonantal segments? (Note that when $\underline{p}, \underline{\check{c}}$, and \underline{k} assimilate, $\underline{r}, \underline{y}$, and \underline{l} form a class because there is no labial lateral available for assimilation.) This class-matching strategy seems to me to be more likely an explanation than any strength matching one, but it leads to another problem—there is no convenient and explanatory way to describe it within current phonological theory.

Consider a formulation of these assimilation rules in feature terms. While strictly possible, they have an air of spuriousness about them. For the suffixes which begin with underlying \underline{l} we require the rule below:

$$7. \quad [+lateral] \rightarrow \begin{array}{c} \text{C} \\ \left[\begin{array}{l} -lateral \\ \alpha \text{ nasal} \\ \beta \text{ voice} \end{array} \right] \end{array} / \begin{array}{c} \text{C} \\ \left[\begin{array}{l} -lateral \\ \alpha \text{ nasal} \\ \beta \text{ voice} \end{array} \right] \end{array} + \underline{\hspace{2cm}}$$

We require a somewhat different and more complex formulation for the segments in underlying initial \underline{t} .

$$8. \quad \begin{array}{c} \text{C} \\ \left[\begin{array}{l} +anterior \\ +coronal \\ -continuant \\ -vce \end{array} \right] \end{array} \rightarrow \begin{array}{c} \left[\begin{array}{l} +vce \\ \alpha \text{ nasal} \\ -\alpha \text{ lat} \end{array} \right] \end{array} / \begin{array}{c} \text{C} \\ \left[\begin{array}{l} +vce \\ \alpha \text{ nasal} \\ -\alpha \text{ lateral} \end{array} \right] \end{array} + \underline{\hspace{2cm}}$$

If we attempt to write a general rule for all the assimilating segments based on an archiphonemic underlying segment, the situation becomes still more unsatisfactory.

9.

$$C \rightarrow \begin{bmatrix} a \text{ vce} \\ \beta \text{ nas} \\ -\beta \text{ lat} \\ \gamma \text{ ant} \\ \gamma \text{ cor} \end{bmatrix} / \begin{bmatrix} a \text{ vce} \\ \beta \text{ nas} \\ -\beta \text{ lat} \end{bmatrix} + \underline{\hspace{2cm}}$$

(This rule of course is to be followed by the other indicated adjustments whose formulation is straightforward).

Yet there remains an obvious generality about these assimilations that we find difficult to express with equal generality in the notation.⁴ Strength-hierarchy notation, however, provides us with a straightforward unitary description of the phenomena whatever its ultimate explanatory value may turn out to be.

Cross-boundary assimilation in inflection: regressive.

Regressive assimilation is less frequent than progressive assimilation in Yakut, and it is generally lexically conditioned. I will not dwell on it here, except to point out that even the lexically conditioned cases show their phonologically motivated origin, as the W-S condition operative regressively across suffix boundaries here as well. For example, the initial l of the plural suffix -lar, when employed as a marker in verb paradigms, does not alternate with d after stem final r as shown in Table 2; rather, the stem final r assimilates to suffix-initial l:

10.	ah̄r	'take, 3 p.s.'	ah̄l+lar	'3 p. pl.'
	oloror	'sit, 3 p.s.'	olorol+lor	'3 p. pl.'
	baar	'there is'	baal+lar	'there are'

It is not the case, however, that regressive assimilation operates unexceptionally in the verb paradigm. Only dentals assimilate regressively, whether they are obstruents or nasals:

11.	sot-	'wipe'	sop+pot	'3 p.s. neg.'
	suun-	'wash'	suum+mat	'3 p.s. neg.'
	but			
	tik-	'sew'	tik+pet	'3 p.s. neg.'
	ton-	'freeze'	ton+mot	'3 p.s. neg.'

Note, however, that r and l do not alternate with a voiced obstruent in this position, indicating a lower rank than the nasals on a Yakut strength scale, which suggests that a notation involving major class feature appears to be required for the progressive assimilations.

12.	kel-	'come'	kel+bet	'3 p.s. neg.'
	onor-	'make'	onor+bot	'3 p.s. neg.'

This data has been presented to show that the (perhaps somewhat procrustean) application of a phonological strength hierarchy can provide a unitary description of some rather complex assimilations. It is still an open question, however, as to whether the application of the strength hierarchy is truly explanatory or

truly phonological. It seems to me that the Yakut assimilations would be best notated and explained by a theory which allowed a straightforward 'class-matching' generalization to be made at some level of the analysis. The use of such a generalization would also capture the kind of assimilations H&A present from Pali.⁵ Many of the other general statements made by strength hierarchy notation would then have to be viewed again in terms of major class features. But recall that H&A in particular have made the strong claim that major class features are "artifacts of the binary feature system".

Or are they? Consider that on every strength hierarchy proposed in the literature referred to here, the only variation among members of the hierarchy occurs on either side of the [+sonorant]/[-sonorant] division. The only exception to this is Hooper's claim that trilled r in Spanish patterns along with the nonsonorants. But recall that there are two phonological r's in Spanish, one tapped and one trilled. This high-strength placement of trilled r could mean nothing more than that it is phonologically a fricative in Spanish, and thus patterns along with the other fricatives. This has nothing to do with inherent strength. In this respect, note that the Yakut r is described by Böhtlingk and Kreuger as 'strongly trilled', and yet there is no indication that it functions as a high-strength consonant. In other words, strength-ranking may be as much a function of the total phonological pattern of the language as of any inherent phonetic or phonological qualities of segments.

I would prefer to hypothesize that 'strength' is an as yet ill-understood phonetic aspect of language, possibly a complex of a number of traditionally cited features such as 'aperture' and force of articulation, which are acted upon and shaped language-specifically by syllable structure conditions, the language-specific influences such as available segment inventory, direction of assimilation, and paradigmatic conditioning of rules.

Whatever "strength" or "sonority" is, it does not appear to be a categorically definable phonetic prime that has a whole history of evolutionary refinement for its linguistic (i.e. phonological) employment behind it as does, say, voicing, tongue-tip control, velum control, or even tongue-flange control—this latter despite H&A's claim that 'the features distinguishing r from l are ad hoc' (p. 140). Yet it would be a mistake, I believe, to dismiss the strength hierarchy literature. There is too much evidence in it that some type of highly general linguistic operations are occurring.

Afternote: In a very stimulating intervention at the conference, John Ohala suggested that recourse to a strength scale in phonological description was merely a non-explanatory and reductionist rearrangement of the data, and that a more legitimate way to deal with phenomena of the sort discussed in the hierarchy literature is to be found in reference to multivalued phonetic primitives. ("...the inherent constitution of speech sounds, i.e., how they are made and how they sound, have as much or more importance than system-internal relations, in determining the behavior of speech sounds." Ohala, 1979,46). As I noted in reply, I agree to a great extent with this position.

Yet, I do not believe that reference to more and more refined levels of phonetic description—i.e., a kind of phonetic determinism—is by definition explanatory. To capture the general phonetic/phonological functions of a number of disparate phonetic elements, by the use of a unitary concept is, it seems to me, highly explanatory—if we use the right concept. And if the concept is functionally irreducible and universal, then I would say it is legitimate to call it a prime (at its level of description). This is not to say that I want to ascribe an "occult specific quality" (the phrase is Newton's) to a term like "strength". It was to avoid any premature assignment of phonetic properties to the phenomenon that I have preferred the term "strength" over the more specific term "sonority". But there are legitimate precedents in the history of science for the postulating of as yet unverified primitives to account for observed (but not yet fully understood) phenomena. The term "force" in physics is one of these. This, of course, does not rule out the possibility of what Ohala suggests, namely that the 'strength hierarchy' is only the appearance of unity—but this position, too, awaits testing and verification.

Footnotes

*Thanks are very much due to William O'Grady, Peter MacKinnon, and Aleksandra Steinbergs for discussion and criticism of this paper; they are, of course, not responsible for any errors of fact or emphasis.

1. DeSaussure, Fouché, Grammont, among others cited in H&A and Kim.
2. Böhntlingk was a noted Indologist who published this detailed and exhaustive study of Yakut as, in effect, a favor for a friend. See Kreuger's introduction to Böhntlingk 1851 (1964).
3. Böhntlingk makes no distinction between morpheme-internal and cross-boundary sequences of segments in his analysis.
4. I am obviously rejecting here a 'solution' which claims that there are merely lists of forms that speakers memorize. Even if we consider, as does Venneman 1972, that rules are in effect well-formedness conditions, it would be difficult to accept the idea that Yakut speakers use hundreds of independently varying variants of inflexional and derivational endings—thanks to the interaction of vowel harmony and consonant assimilation—without recourse to some kind of productive generalizations.
5. Note also, that while a class-matching generalization can describe the Pali assimilations presented in H&A, it does not suggest an explanatory account of the assimilations as does the strength-hierarchy approach.

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