*Voicing and consonantal strength in Kazakh suffixes**

© Alex Eulenberg <aeulenbe@indiana.edu>
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1 Introduction

1.1 Overview

In Kazakh, there appear to be three constraints governing the choice of initial consonant for suffixes. The first is an assimilation constraint, Share Larynx, which requires that two consecutive obstruents have the same laryngeal properties (i.e. voicedness). The second is another assimilation constraint, Spread Nasal, which requires that an onset be nasal if the surrounding consonants are nasal. The third is a syllable structure constraint, Contact Strength Harmony, which prefers syllable contacts where the second consonant is stronger than the first. These three constraints, understood as ranked and violable in the sense of Prince and Smolensky (1993), in combination with various other "faithfulness to the base (input) form" constraints, appear to account for the variation among suffix-initial consonants. However, there is an exceptionality in the behavior of suffixes with base-initial /n/ that is shared by other Turkic languages.

1.2 Transcription

This article will use the following transcription conventions:

(1a.1) š.....unvoiced palatal alveolar fricative
ž.....voiced " " "
x..... unvoiced velar fricative
ŋ..... velar nasal
j.....palatal glide
i.....IPA [ɪ]
y..... backed *i*,
ä ö ü..... fronted *a, o, u*
All other letters carry their approximate Latin values.

The allophonic distinction between uvular obstruents (which occur exclusively in the context of back vowels) and velar obstruents (which occur exclusively in the context of front vowels) will not be expressed in the phonetic transcription. Thus, [kazak], not [qazaq] 'Kazakh'. Nor will the fricative nature of the voiced uvular obstruent be represented, thus [sagat] 'watch', not [saɣat].

2 Obstruent Voicing constraints

2.1 Share Larynx

The first of the three voicing constraints that we will be considering, Share Larynx *(Sh-Lnx),* requires that while any two consecutive obstruents in a row are pronounced, the state of the voice box is unchanged; i.e., the obstruents are either both voiced or both unvoiced:

(2.1.1) *Share Larynx.*
Given obstruent sequence C_1C_2, C_1 and C_2 have the same laryngeal specification.

In contrast to Lombardi's (1995a, 1995b) similar proposed constraints for handling voice assimilation in onset-maximizing languages such as Polish and Yiddish, this constraint applies across syllable boundaries, not just within a syllable coda or onset (Kazakh has a simple, basically CVC syllable structure). Thus, [ka**z.b**en] 'goose (instr.)' and [ka**s.p**en] 'eyebrow (instr.)' satisfy this constraint, while *[ka**z.p**en] and *[ka**s.b**en] violate it. Note, however, that obstruents need not agree with sonorants in voice: [a**l.t**y] 'six' is acceptable.

One may object that (2.1.1) is not general enough. So suppose that we instead identify a more abstract constraint:

(2.1.2) *Share Larynx (version 2)*
There is at most one Laryngeal specification for any onset, coda, or onset-coda sequence (syllable contact).

The constraint in (2.1.2) would apply to all consonants, not just obstruents. But if we understood (2.1.2) to be the "real" constraint behind the assimilation phenomena, would an additional higher ranking constraint be necessary to assure that /alty/ would not be pronounced with a devoiced [l]? (My observation is that nasals, liquids, and glides in Kazakh are *not* devoiced before unvoiced obstruents.) To answer this question, we have to probe deeper into what it means to share laryngeal specification.

According to the theory of universal privative voicing (Mester and Itô 1989; Lombardi 1995a, 1995b), sharing a laryngeal specification means that the two consonants are 'linked' to the same laryngeal node, which may or may not contain a [voice] feature. If it does, then the two are voiced, if it doesn't, the two are unvoiced. One answer, then, is that as for sonorants, they are not a part of this assimilatory process, simply because they are realized as voiced whether or not they have (are linked to) a [voice] feature. If they are linked to [voice], this is only redundant.

However, if we assume the privative model of laryngeal specification, with laryngeally unmarked sonorants, there is evidence that Kazakh specifies not [voice], but [spread glottis], which *devoices* and, if possible, *aspirates* the segment to which it is attached (Iverson & Salmons 1996). In such a system, all segments are voiced *unless otherwise specified* by the [spread glottis] feature

or other phonotactic constraints. As for the evidence that Kazakh has such a system, Kazakh stops are pronounced with "strong aspiration" (Dzhunusbekov 1991:30–33), and as we will see, the "strengthening" of sonorants into voiced stops is dealt with much more efficiently if sonorants and voiced stops have the same laryngeal "input" (i.e., none). Furthermore, words with word-final [p] or word-final *or* -initial [k] in citation form have those segments become [b] or [g] in "phonetically unmarked" positions, i.e., between vowels. All this points towards a classic English or German-like lenis / fortis classification for Kazakh consonants, with the *un*voiced consonants being marked as "fortis" rather than the Romance or Japanese-like voiced / unvoiced classification with [voice] being the mark.

So let us consider a phonological model for Kazakh where sonorants are laryngeally non-specified, laryngeal features are privative, and [spread glottis] (and not [voice]) is the active laryngeal feature. However, if we assume that voicing distinctions are due to the presence/absence of the consonant "fortifying" feature [spread glottis], then would sonorants sharing the same laryngeal node as an unvoiced consonant *not be* immune after all? Would they *turn devoiced?* Recall the *l* "devoiced by *s"* in English *slip,* or *r* "devoiced by *t"* in *trip*, correctly predicted by Iverson and Salmon's [spread glottis] theory of active devoicing. This *does not happen* in a word such as [a**lt**y] 'four'. I think the answer lies in the following low level (gestural?) constraint, which I put forth as a potential universal, since it can accommodate both Kazakh [a**l**ty] and English [s**l**^{h}ip] etc.

(2.1.3) *Spread Glottis on Obstruent:*
When a segment sequence is linked to a [spread glottis] feature, the glottis will spread coincidentally with the first vocal tract stricture (i.e. beginning of obstruent).

To wrap this section up, then, let us say first, that Kazakh has a Share Larynx constraint, which may be understood as (2.1.1) for brevity, or as a combination of (2.1.2) and (2.1.3) for the sake of theoretic generality and compatibility with the theory of Universal Privativity, and second, that in Kazakh, the active laryngeal feature is [spread glottis], which indicates both voicelessness and aspiration.

2.2 Unvoiced Coda Stops

The second voicing constraint to consider is Unvoiced Coda Stops *($T^{\$}$)*:

(2.2.1) *Unvoiced Coda Stops.*
Given any syllabic coda segment C, if C is a stop then C has the feature [spread glottis].

Thus, [ki.ta.**b**ym] 'my book' but [ki.tap] 'book', not *[ki.ta**b**]. Also [kita**p**.tar] books', not *[kita**b**.tar] or even (respecting Share Larynx) *[kita**b**.dar]. This

constraint is similar to the often proposed constraint (e.g. in analyzing German devoicing; see Iverson & Salmons, p. 392, n. 19) that prohibits all codas from licensing (having segments that contain) laryngeal features. Lombardi (1995), according to whom voiced obstruents are universally marked as such, makes extensive use of a No Laryngeal for Coda constraint in her discussion of laryngeal neutralization and assimilation with reference to German, Polish and Thai. She and others have used a No Laryngeal for Coda constraint to account for the absence of syllable-final voiced obstruents in languages such as these (see Lombardi 1995 for a discussion). The positing of this constraint easily explains both word-internal voice assimilation from the coda to the following onset, and syllable- or word-final lack of voiced obstruents. Lombardi even uses it for Yiddish, which neutralizes voice distinctions in obstruent sequences, yet allows voiced obstruents at the ends of words. (In other words, Yiddish word-internal codas, when voiced, get their [voice] from the following onset, but word-final codas get their own [voice] specification.) In Kazakh, such a word-final "license", whether the active feature is [voice] or [spread glottis], would have to exist for syllable final fricatives, for /s/ contrasts with /z/, word-finally:

(2.2.2) a. [be**s**] 'five' / [be**z**] 'iron'
b. [ta**s**] 'stone' / [ta**z**] 'bald spot'

Although there are no minimal pairs, there occurs a rare word-final /ž/ [muktaž] needy' as well as a more common /š/ [kyš] 'brick'. However, as stated above, there are absolutely no instances of word-final voiced stops. So a general laryngeal license for word-final codas would be missing a generalization; the phonology of syllable-final devoicing in Kazakh cannot be handled strictly in terms of coda licensing, as Lombardi has done for Yiddish; manner of articulation must also be taken into account.

Before we move on to the next voice constraint, I will answer an anticipated objection, which is that it may be OK to neutralize segments coda-finally, but to stipulate that a highly marked feature be present for a select group of coda segments is asking too much from a constraint. After all, it goes completely against the whole coda constraint tradition. Besides, my straw man points out...

> everybody knows that "obstruents without phonological specification for laryngeal features are ... interpreted phonetically as voiceless, generally without aspiration" (Iverson & Salmons 1995, p. 392, n. 19). If you need to have a reason to devoice word-final stops, there you go. It's neutralization, pure and simple. I refuse to give up the position of my precious coda neutralization universal as the sole cause of syllable-final devoicing! I will not accept your proposal until you can show me the exception that proves the constraint. That is, show me a [spread glottis] marking language that neutralizes its codas and comes up with a *voiced stop* in that position. Only then will I accept your constraint as valid.

A difficult challenge, to be sure. However, I think I have just the language my imaginary adversary is looking for: Lakota, which sports plain, glottalized,

and aspirated obstruents. It has for the most part a CV syllable structure, but there are cases, short forms and reduplications, where one loses the final vowel of a CVCV word and ends up with a CVC syllable. In such cases, *k* becomes *g,* and *p* becomes *b* as in:

(2.2.2) From Buechel 1939, p. 6:
a. *waš'ag* ← *waš'aka* 'strong'
b. *nap^{h}ob* ← *nap^{h}opa* 'burst and pop'
c. *ob* ← *op^{h}a* 'with'

I have heard a native speaker of a related dialect with the same opposition (Assiniboine), and was convinced that I was hearing an actual voiced stop, not just a plain unvoiced stop, which many Englsh speakers do confuse with voiced stops.

2.3 Express Larynx, Voice

Express Larynx requires that a segment be realized as [spread glottis] if the corresponding input form has the feature [spread glottis]. Its lower-ranked complement, Voice, sees to it that any obstruents (along with all other sounds) unmarked for laryngeal features are voiced. It is overriden, through Express Larynx, whenever a segment is specified for [spread glottis] *or* when Unvoiced Coda Stops requires it.

(2.3.1) *Express Larynx*
If a segment in the input form has [spread glottis], so does the corresponding segment in the output form.

(2.3.2) *Voice*
Sounds are produced with vocal folds vibrating.

2.4 Interaction of Voicing Constraints

Let us take for example the locative suffix, whose input form we will take to be /-da/ (laryngeally unspecified onset, as are all underlying /d/, /b/, /g/, as per the [spread glottis] theory; in square brackets, these letters are to be taken as voiced), and for candidates, its two attested realizations (allomorphs) [-da] and [-ta], affixed to the root /alma/ 'apple':

(2.4.1) /alma-da/ 'apple (loc.)' → [alma-da]

/alma-da/	*Sh-lnx*	*T$*	*Voice*
☞ alma-da			
alma-ta			✠ !

In (2.4.1) we see that candidate [alma-da] is preferred by the posited grammar (☞) because it violates neither Share Larynx, Unvoiced Coda Stops, nor Voice; there is one violation (✠) for the second [t] in [alma-**t**a], due to the failure of this candidate realization to be voiced. This is fatal for this candidate (❗). Similar results obtain when adding [-da] to any stem ending in a nasal ([m] [n] [ŋ]), liquid ([l] or [r]) or glide ([w] or [j]):

(2.4.2) a. [kol-da] / *[-ta] 'on the hand'
b. [kyjar-da] / *[-ta] 'on the cucumber'
c. [taw-da] / *[-ta] 'on the mountain'
d. [mandaj-da] / *[-ta] 'on the forehead'

Share Larynx is violated by neither [-da] nor [-ta] in these cases; in fact, there are no two obstruents in a row to even qualify for the application of this constraint: it applies *vacuously*. A similar situation holds for Unvoiced Coda Stops: no coda stops to speak of.

Now consider the locative suffix applied to /koŋyz/ 'bug': /koŋyz-da/. In (2.4.3) we see that although again the [-da] realization is preferred, the crucial issue in the selection is the agreement between /z/ and /d/ — Share Larynx. We need not even consider the relative harmonies according to Unvoiced Coda Stops, as before, nor this time, according to Voice, since the results of the Share Larynx evaluation have decided the matter:

(2.4.3) /koŋyz-da/ 'bug (loc.)' → [koŋyz-da]

	/ata-da/	*Sh-Lnx*	*T$*	*Voice*
☞	koŋyz-da			
	koŋyz-ta	✠❗		✠

In (2.4.4), the winning candidate has [-ta]. Though, as before, this suffix causes a violation of the Voice constraint, the form that contains [-ta] wins over the alternative [zat-da] because the latter fatally violates the higher-ranked Share Larynx constraint, while the other alternative, [zad-da], though it satisfies both Share Larynx and Voice, violates Unvoiced Coda Stop:

(2.4.4) (Unvoiced Coda Stop, Share Larynx) » Voice:
/zat-da/ 'thing (loc.)' → [zat-ta] (*[zadda], *[zat-da])

	/zat-da/	*Sh-Lnx*	*T$*	*Voice*	
	zat-da	✠❗			
	zad-da		✠❗		
☞	zat-ta			✠	

3 Spread Nasal

Let us consider the ablative suffix, which is [dan] after vowels and voiced consonants, [tan] after voiceless consonants, and [nan] after nasals:

(3.1) a. [almaty-**d**an] 'from Almaty'
b. [teŋiz-**d**an] 'from the sea'
c. [kol-**d**an] 'from the hand'
d. [žeŋ-**n**an] 'from the sleeve'
e. [tam-**n**an] 'from the wall'
f. [nurlan-**n**an] 'from Nurlan'

To account for this variation, I propose a constraint, Spread Nasal *(Sp-N),* which says the following:

(3.2) *Spread Nasal.*
If a non-continuant onset's two neighboring codas are nasals, that onset must be nasal.

Thus:

(3.3) /zeŋ-dan/ 'sleeve (abl.)' → [žeŋ-nan] (*[zeŋ-dan])

/žeŋ-dan/	*Sp-N*	
žeŋ-dan	✠ ❗	
☞ žeŋ-nan		

One may ask why the candidate with nasalization of the initial consonant was chosen, instead of one with one or the other of the offending consonants altered or missing? To help answer this question, I offer two constraints, Parse and Express Coda Flow *(X-Fl$)*. Parse sees to it that each segment position in the input form is realized in the output, and Express Coda Flow says that input coda obstruents should be output as obstruents, input coda nasals, output nasals and so on. (More will be said on the subject of flow and its expression, with the general, lower ranked Express Flow, in the next section). Let us consider for input /žeŋ-dan/ the output [žeg-dan] which satisfies (vacuously) Spread Nasal. Here, the /ŋ/ is realized without its nasal feature to avoid violating Spread Nasal. However, in so doing, the non-continuant becomes an obstruent, [g]. Output [žeŋ-nan] over [žeg-dan] is preferred because its coda is realized faithfully with respect to flow.

(3.4) /zeŋ-dan/ ‘sleeve (abl.)’ → [žeŋ-nan] (*[zeŋ-dan])

/žeŋ-dan/	*Sp-N*	*Parse*	*X-Fl*$
žeŋ-dan	✠!		
☞ žeŋ-nan			
žeŋ-<d>an		✠!	
že<ŋ>-dan		✠!	
žeg-dan			✠!

4 Contact Strength Harmony

4.1 Introduction

In Kazakh, there are many suffixes that begin with [l], [m], or [n] when added to a stem that ends in a vowel. For example:

(4.1) a. [alma] ‘apple (nom.)’
b. [alma-**n**y] ‘apple (acc.)’
c. [alma-**l**ar] ‘apple (pl.)’
d. [alma-**m**a] ‘is it an apple?’

These suffixes are realized with a “stronger,” or obstruent version of the initial consonant, when occurring after obstruents:

(4.2) a. [koŋyz] ‘bug (nom.)’
b. [koŋyz-**d**y], *[koŋyz-**n**y] ‘bug (acc.)’
c. [koŋyz-**d**ar], *[koŋyz-**l**ar] ‘bug (pl.)’
d. [koŋyz-**b**a], *[koŋyz-**m**a] ‘is it a bug?’

As (4.2) illustrates, both coronal sonorants ([l] and [n]) are replaced by Kazakh’s single voiced coronal stop ([d]), while [m] is replaced by its single voiced labial stop ([b]). The following analysis suggests itself:

1. We are dealing with underlying ‘input’ forms /ny/, /lar/, and /ma/
2. The first consonant of these forms may be realized either ‘faithfully’, or as a corresponding obstruent form [d], [d], or [b], respectively, under certain conditions.
3. In particular, the obstruent form is used when it would help create a more harmonious contact than the input form.

Examples (4.3) through (4.5) show how /ny/, /lar/, and /ma/ are realized as [dy], [dar], and [ba], respectively, when a “better” contact between stem and suffix could be obtained.

(4.3) a. [kalam] ‘pen (nom.)’
b. [kalam-**d**y] ‘pen (acc.)’
c. [kalam-**d**ar] ‘pen (pl.)’
d. [kalam-**b**a] ‘is it a pen?’

(4.4) a. [kol] ‘hand (nom.)’
b. [kol-**d**y] ‘hand (acc.)’
c. [kol-**d**ar] ‘hand (instr.)’ *but*
d. [kol-**m**a] ‘is it a hand?’

(4.5) a. [kyjar] ‘cucumber (nom.)’
b. [kyjar-**d**y] ‘cucumber (acc.)’ *but*
c. [kyjar-**l**ar] ‘cucumber (pl.)’
d. [kyjar-**m**a] ‘is it a cucumber?’

But just what is it that makes a contact better? As a first step towards explaining these alterations, we may refer to what Venneman (1988, 40–50) has called the Contact Law. First clearly identified by Hooper for its role in determining Spanish nasal place assimilation (1972; 1976:195–226), and later elaborated by Murray and Venneman (1983) on the material of Germanic vowel lengthening, the Contact Law may be formulated in terms of Optimality theory as a *harmony,* characterized informally thus (Adapted from Vennemann 1988, p. 40):

(4.6) *Contact Strength Harmony (informal)*
A syllable contact A.B is the more harmonious, the stronger B is, relative to A.

In other words, of two adjacent syllables, the end, or coda, of the first syllable should not have a “stronger” pronunciation than the beginning, or onset, of the second syllable. Venneman notes that this harmony is the motive force behind many historical sound changes. Here we will see that the concept of contact harmony can help explain consonant alterations in Kazakh suffixes.

In order to understand this harmony, we must understand what is meant by consonantal strength. Briefly, consonants may be placed on a scale from weakest to strongest, vocalic consonants (glides) being the weakest, followed by liquids, then nasals, and finally obstruents, which are the strongest[1]. This classification, crucial to the understanding of many phenomena concerning the sturcture of syllables, goes back at least as far as Otto Jespersen, who, according to Hooper (1976), was one of the first to record the observation that stronger sounds tend towards the margins of syllables, while weaker ones tend toward the nucleus.

There has been some discussion as to whether stops are stronger than fricatives, or voiceless stronger than voiced (see Hooper 1976, ch. 11 for an extended discussion of this issue, also Vennemann 1988, p. 9, Rice 1992), but for the problem at hand, it is best to consider all obstruents to be of the highest strength, regardless of voicing or manner of articulation. Thus we may speak of a function Strength (*St)* that takes as its input a segment and gives as its output

a ranking. The strength of a consonant is a function of the type of flow feature (if any) it possesses. *Flow* I define here as a class consisting of mutually exclusive privative features — [trill], [liquid], [nasal], [obstruent] — that determines exactly where the air flows as it leaves the vocal tract[2]. A consonant unmarked for flow is a glide. Segments may thus be compared on the basis of strength:

(4.7) St(*obstruent*) > St(*nasal*) > St(*liquid*) > St(*trill)* > St(*glide*)

So we may say:

(4.8) a. St(m) > St(l) / [m] is stronger than [l]
b. St(p) > St (m) / [p] is stronger than [m]
c. St(b) = St(p) / [p] is as strong as [b]
d. St(w) < St (n) / [w] is not as strong as (is weaker than) [n]
e. St(C_1) ≥ St(C_2) / C_1 is at least as strong as C_2
f. St(C_1) ≤ St(C_2) / C_1 is not stronger than C_2

What Vennemann and his colleagues found is that syllable contacts of the form (A.B), where St(A) > St(B), are unstable; that forms containing such contacts tend to change to more preferable forms, according to the Syllable Contact Law. He noted a variety of ways in which this unstable form has been supplanted by a more harmonious form in the history of various languages. Here are a few examples of various types of change over time, motivated by the Syllable Contact Law, taken from Venneman 1988:

(4.9) *Contact Epenthesis*
Spanish. *ven.ra* → *ven.**d**ra* 'sell (1p. fut)'
n.r: St(n) > St(r): bad contact
n.d: St (n) < St (d): good contact

(4.10) *Gemination of offset into onset position*
Lat. *radium* [rad'.jum] → Ital. *raggio* [rad'.d'jo] 'ray'
d'.j: St(d) > St(j): bad contact
d'.d': St(d) = St(d): good contact

(4.11) *Strengthening of onset*
German *var.**w**e* → *var.**b**e*
r.w: St(r) > St(w): bad contact
r.b: St (r) < St (b): good contact

Thus, the differential alternation patterns we observed may be partially explained by a confomity to the Contact Strength Harmony. As an Optimality-style constraint, it is perhaps best phrased as in (4.12).

(4.12) *Contact Strength Harmony (technical)*
Given a syllable contact (A.B), the possible strength relations are ranked as follows:

$$St(A) < St(B) \succ St(A) = St(B) \succ St(A) > St(B)$$

Or, in shorthand:

$$< \succ =$$
$$= \succ > \textit{ and}$$
$$< \succ >$$

Here $\mathfrak{R}_1 \succ \mathfrak{R}_2$ means that strength relation $\mathfrak{R}_1$ beats strength relation $\mathfrak{R}_2$ in the competition for harmonic forms, and the $\succ$ operator is transitive. Spelled out, this means that given syllable contact of the form (A.B), a realization where segment A is not as strong as segment B is better than one where A and B are the same strength, which in turn is better than one where A is stronger than B. It turns out that this formula makes the correct predictions for suffixes in /-l/ and /–m/, but it is not sufficient to explain (though it does not contradict) the behavior of suffixes in /-n/. Let us first explore this harmony as it relates to /l/ and /m/.

4.2 Interaction of Contact Strength Harmony with Express Flow

What we would like to do next is to construct some Tableaux that will illustrate how the suffix-initial consonant is chosen, according to the Contact Strength Harmony. Before we do this, we should establish another constraint, a faithfulness constraint, to guard against any unnecessary obstruence. This constraint we shall call Express Flow. Here is the constraint Express Flow:

(4.2.1) *Express Flow*
If an input segment contains a Flow feature — [trill], [liquid], [nasal], [obstruent] — that feature should be expressed in the corresponding output segment.

When a consonant-initial suffix is added to a stem ending in a vowel, Contact Strength Harmony does not apply, and Express Flow decides that the suffix should be realized as [lar] and not [dar]:

(4.2.2) /alma-lar/ 'apple (pl.)' → [alma-lar]

/alma-lar/	*H-Ctct*	*X-Fl*	
☞ alma-**l**ar			
alma-**d**ar		✠!	

When, however, the stem ends in a consonant, Contact Strength Harmony comes into play and may override Express Flow:

(4.2.3) *H-Ctct » X-Fl:*

/kalam-lar/ 'pen (pl.)' → [kalam-dar]

	/kalam-lar/	*H-Ctct*	*X-Fl*	
	kala**m-l**ar	>!		
☞	kala**m-d**ar	<	✠	

The > and the < in the Contact Strength Harmony column is shorthand for St(m) > St(l) and St(m) < St(d), respectively. Candidate [kalam-dar] (St(m) **<** St(d)) wins over [kalam-lar] (St(m) **>** St(l)) because < ≻ >. The next example shows how /m/ is realized as [b] in the same environment:

(4.2.4) *H-Ctct » X-Fl:*

/kalam-ma/ 'is it a pen?' → [kalam-ba]

	/kalam-ma/	*H-Ctct*	*X-Fl*	
	kala**m-m**a	=!		
☞	kala**m-b**a	<	✠	

In contexts after /l/, the suffix beginning in /l/ will show its stronger variant, while the suffix beginning in /m/ will not. This is predicted by their differing places on the consonantal strength scale (4.2.5). We will postpone the question of why [kol-**d**ar] is chosen over *[kol-**n**ar] until the end of section 4.7. "[n] and the Contact Strength Harmony."

(4.2.5) *H-Ctct » X-Fl:*

/kol-lar/ 'hand (pl.)' → [kol-dar]

	/kol-lar/	*H-Ctct*	*X-Fl*	
	ko**l-l**ar	=!		
☞	ko**l-d**ar	<	✠	

but:

/kol-ma/ 'is it a hand?' → [kol-ma]

	/kol-ma/	*H-Ctct*	*X-Fl*	
☞	ko**l-m**a	<		
	ko**l-b**a	<	✠!	

4.3 Interaction with Voicing Constraints

Note that in the foregoing examples, the strengthened segment is always voiced. /m/ is realized as /b/, not as /p/. This would make sense either if /m/ and /l/ carry the [voice] feature, in which case the stronger realization would take this feature from the input form; or if obstruents are voiced by default (à la the Voice constraint). Either way, it seems we must reject at least one of the following hypotheses of Mester and Itô (1989): that sonorants are underlyingly lacking a laryngeal specification, or that every voiced obstruent gets its voice from the presence of a privative [voice] feature. At the present stage of my analysis of the phonology of Kazakh, I have decided that the reason the "desonorized" obstruents are voiced in position after a sonorant is because it is the unvoiced obstruents that are marked. In other words, [m] is a labial nasal (no laryngeal specifications), and [b] is a labial obstruent (no laryngeal specifications). Likewise, [l] is a coronal liquid (no laryngeal specifications), and [d] is a coronal obstruent (no laryngeal specifications). Thus, in terms of features, [b] is more 'faithful' to /m/ than [p], and [d] is more 'faithful' to /l/ than [t]. Again, this would also be the case if sonorants were specified for [voice], but, as we saw at the beginning of this paper, obstruents are not necessarily voiced when they share a contact with a sonorant — evidence against sonorants carrying laryngeal features. So, given that sonorant inputs are unspecified for voice, the constraint that prefers [b] over [p] and [d] over [t] is Voice, not "Express Larynx" or any other similar faithfulness constraint, because the input sonorants have no laryngeal feature to express:

(4.3.1) /kol-lar/ 'hand (pl.)' → [kol-dar]

/kol-lar/	*H-Ctct*	*X-Lnx*	*Voice*	
☞ ko**l-d**ar	<			
ko**l-t**ar	<		✠!	

4.4 Interaction with Share Larynx, No Voiced Coda Stops

When the stem ends in a voiceless obstruent, the initial segment of the suffix is devoiced as well as strengthened. This is due to an interaction between Contact Strength Harmony and the Voicing Constraints. Here is an example with /-m/ after an unvoiced consonant. As an example, we will use /durys/ 'correct' + /ma/. The relevant constraints are Contact Strength Harmony, Share Larynx, Express Larynx, and Voice. Notice that the winning candidate, [durys-pa], since it contains two unvoiced segments, violates Voice twice. Candidate [duryz-ba] does not violate it at all, but since it did violate a higher constraint, Express Laryngeal (i.e. the /s/ was realized with [spread glottis] unexpressed), the victory

goes to [durys-pa], which expresses the laryngeal marking.

(4.4.1) (Contact Strength Harmony, Share Larynx, Express Larynx) » Voice
/durys-ma/ 'is it correct' → [durys-pa]

	/durys-ma/	*H-Ctct*	*Sh-Lnx*	*X-Lnx*	*Voice*
	durys-ma	>!			✠
	durys-ba	=	✠!		✠
☞	durys-pa	=			✠✠
	duryz-ba	=		✠!	

Similarly, input /kitab-ma/ yields [kitap-pa] and not [kitab-ba] due to Unvoiced Coda Stops:

(4.4.2) (Contact Strength Harmony, Share Larynx, Unvoiced Coda Stops) » Voice
/kitab-ma/ 'is it a book?' → [kitap-pa]

	/kitab-ma/	*H-Ctct*	*Sh-Lnx*	*T$*	*Voice*
	kitab-ma	>!			
	kitab-ba	=		✠!	
	kitap-ba	=	✠!		✠
☞	kitap-pa	=			✠✠

Lastly, we note that [kitam-ba], with a still better contact harmony than any of the above candidates (<), is not chosen because it violates the higher-ranked Express Coda Flow (4.4.3).

(4.4.3) Express Coda Flow » Contact Strength Harmony
/kitab-ma/ 'is it a book?'

	/kitab-ma/	*X-Fl$*	*H-Ctct*	
☜	kitam-ba	✠!	<	
	kitab-ma		>!	
	kitab-ba		=	
	kitap-ba		=	
	kitap-pa		=	

4.5 Interaction of Contact Strength Harmony with Spread Nasal

Consider the /adam/ 'human'. As expected, when we combine this with the first person plural predicate suffix /myz/ (cf. [aŋšy-myz] 'We are hunters' ← /aŋšy/ 'hunter' + /myz/), the output form is [adam-**b**yz] 'we are human' (c.f. [kalam-ba] in (4.2.4)). However, when we change the subject to first person singular, using the suffix /myn/ (cf. [aŋšy-myn] 'I am a hunter), the output form is not *[adam-**b**yŋ] but [adam-**m**yŋ]. We therefore conclude that Spread Nasal is ranked higher than Contact Strength Harmony:

(4.5.1) *Spread Nasal » Contact Strength Harmony:*

/adam-myz/ 'we are human' → [adam-byz]

	/adam-myz/	*Sp-N*	*H-Ctct*	
	ada**m-m**yz		✠!	
☞	ada**m-b**yz			

but:

/adam-myŋ/ 'I am human' → [adam-myŋ]

	/adam-myŋ/	*Sp-N*	*H-Ctct*	
☞	ada**m-m**yŋ		✠	
	ada**m-b**yŋ	✠!		

And indeed, both /myŋ/ and /men/ '(instrumental)' always show an [m] initially after nasals [m n ŋ], violating the Contact Strength Harmony where /ma/, /myz/, and other suffixes beginning with /m/ and *not* ending in a nasal are realized with an initial [b].

4.6 Summary of suffix-initial /l/ and /m/

The constraints so far discussed are sufficient to account for the behavior of all suffixes realized with [l] or [m] suffix initially after vowels. These suffixes may be taken as having as input forms initial consonants /l/ and /m/. Whenever such a suffix comes after a consonant that is weaker than the suffix's initial consonant — glides and trills for [l]; glides, trills, and liquids for [m] — the initial consonant will be realized with the corresponding sonorant. Otherwise, as the Contact Strength Harmony requires, the initial consonant will be realized in strengthened form, voiced or unvoiced according to the Laryngeal constraints, unless Spread Nasal dictates that the /m/ should be realized as an [m] due to surrounding nasals.

4.7 [n] and the Contact Strength Harmony

As a stem-final coda, [n] seems to fit perfectly well into the above scheme as a nasal. That is, it will always cause a following suffix /l/ to be realized as /d/:

(4.7.1) /kan-**l**ar/ → [kan-**d**ar] ‘khans’

Underlying /n/ will also cause a following /m/ to be realized as a [b]. When this happens, the /n/ itself assimilates its place to the following consonant, as is typical of Turkic languages (e.g. *Istanbul* is pronounced [istambul] in Turkish):

(4.7.2) /kan-**m**a/ → [kam-**b**a] ‘is he a khan?’

The assimilation may be because, as Avery and Rice (1989) argue, coronals are universally unspecified for place — that is, the input /n/ is really just an input /[nasal]/. In any case, as a coda, [n] seems to be as strong as the other nasals, [m] and [ŋ], causing a following /l/ to be realized as /d/. At least it is not weaker than /l/; if it were, we would get *[kan-lar] ← /kan-lar/, according to the Contact Strength Harmony.

However, in suffix onset position, [n] acts “weak” — very weak. All suffixes with /n/ as the initial consonant after vowels have their initial /n/ almost always realized as [d] after all sonorant codas, including the glides [w j].

(4.7.3) a. /alma-**n**y/ → [alma-**n**y] ‘apple (acc.)’, *but*
b. /taw-**n**y/ → [taw-**d**y] ‘mountain (acc.)’
c. /maŋdaj-**n**y/ → [maŋdaj-**d**y] ‘forehead (acc.)’
d. /bor-**n**y/ → [bor-**d**y] ‘chalk (acc.)’
e. /kol-**n**y/ → [kol-**d**y] ‘hand (acc.)’

The only exception is when Nasal spread overrides the strengthening, as with the possessive suffix /nyŋ/:

(4.7.4) a. /änšy-**n**yŋ/ → [änšy-**n**yŋ] ‘singer (acc.)’,
b. /galym-**n**yŋ/ → [galym-**n**yŋ] ‘scholar (possesive).’ *but*
c. /galym-**n**y/ → [galym-**d**y] ‘scholar (acc.).’

What may account for this anomaly?

Dobrovolsky (1983) confronted a similar situation studying Yakut, a Turkic language distantly related to Kazakh. Dobrovolsky also understood the affixation allomorphy in that language as a manifestation of the Contact Strength Harmony, which he called the “Weak-Strong Condition.” In Yakut, this constraint is satisfied by assimilation and deletion in addition to strengthening. Dobrovolsky found that /n/ suffix-initially would be realized as ∅ after all stems except those ending in a vowel. This includes stems ending in a glide (/j/). Underlying /l/, on the other hand, would be realized as [l] in position after another /l/ or vowel, turn into [n] after nasals (i.e. assimilate nasality), strengthen to an obstruent after /r/, /j/, and obstruents. On this basis he concluded, arguing for language specific strength hierarchies, that in Yakut,

"nasals" were weaker than all other consonants (except /h/, which could be understood as a voiceless vowel), which was evidenced in the fact that /n/ was always deleted after any consonant. He could allow himself to make this generalization because Yakut does not have any suffix-initial nasals other than /n/. Obviously, such an analysis cannot be adopted in the case of Kazakh, since the suffix-initial /m/, very much a nasal, has its "strong" realization only where one would expect given the more typical strength hierarchy where nasals are weaker than liquids, trills, and glides. On a more theoretical note, Dobrovolsky's analysis, which was derivationally based, cannot carry over into a theory that seeks to explain sonority relations at the level of phonetic output (such as the Optimality framework upon which this paper is based). Contact Strength Harmony acts equally against any candidate with a nasal-nasal sequence. In other words, N.[n] would always receive the same harmonic score relative to N.∅, including the cases where that [n] was /l/ "underlyingly". Therefore the presence of [n] after nasals as an output of /l/, but not as an output of /n/, could not be explained by the Contact Strength Harmony, no matter what the makeup of the Consonantal Strength Hierachy.

Imart, in his mammoth grammar of Kirgiz (1981), devoted several pages to suffix-initial strengthening in that language. Kirgiz is very closely related to Kazakh, and its Contact Strength disharmonies are, as in Kazakh, solved by the selection of a stronger consonant for the output of the suffix initial consonant. Kirgiz, in fact, shows almost the exact same pattern of sonorant strengthening as does Kazakh, the pattern for /l/ differing only after [r], and then only in certain cases (sometimes it is realized as [d], sometimes as [l]). Like Kazakh (and Yakut), Kirgiz /n/ initial suffixes (represented by Imart with an "archiphonème" /N/) are realized as [n] after vowels, and as a stop ([d] or [t]) after all consonants, according to the voice of the previous segment. Like Yakut, Kirgiz has hardly any /m/ initial suffixes. Where Kazakh has [m], Kirgiz has [b]. Interestingly, this similar state of affairs leads Imart towards a conclusion quite different from that of Dobrovolsky, that the realization of /n/ as [d] after sonorants is due to a tendency toward dissimilation, having nothing at all to do with nasality *or* strength. "L' impossibilité de */n/ ici [after m, n, l, p, j, ŋ] s'explique par une série d'incompatibilités de phonèmes à contraste insufissant." (§ 424) That is, /n/ "dissimilates" and turns into a [d] after /l/, /m/, /ŋ/ and /r/, and — /j/ (!). The similarity, evidently, has something to do with a rule against sonorous segments of the same place *or* nasality, but Imart does not elaborate on this notion.

Two facts emerge from the comparison of these two studies with the case of Kazakh. One is that /n/ seems to be an exceptional phoneme with regard to its interactions with adjacent segments in Turkic languages generally. The second is that the existence of /m/ in Kazakh suffix paradigms appears to be a recent development, and we should thus expect it to behave more in accordance with

universal harmonies of phonotactics, such as that of Contact Strength, whereas we might expect /n/ to behave in accordance with more archaic constraints. Indeed, in other lexical items, /n/ in syllable contacts asserts its strength quite well after other consonants, for example, in verbs such as [o**jn**u] ← /ojyn/ + /u/ 'to spoil', in common names [a**rn**a] and [gü**ln**ar].

The solution that I will adopt is to stipulate that in suffix onset position, [n] has the strength of a glide. No new constraints need be added, simply a license for [n] suffix-initially to have minimum strength. This is compatible with the notion that the constraint in question is overriden by Spread Nasal (e.g. example (4.7.4), since we have already shown that Spread Nasal outranks Contact Strength Harmony (sec. 4.5). We also gain an explanation of why /l/ suffix-initially after /l/ is realized as [d] and not [n]:

(4.7.5) a. /kol-**l**ar/ → [kol-**d**ar] 'hand (pl.)', *not*
b. /kol-**l**ar/ → *[kol-**n**ar]

If [n] were, like a typical nasal, stronger than [l], then both [kol-dar] and [kol-nar] would be equally good candidates, equally better than [kol-lar] according to both Contact Strength Harmony and Express Flow (4.7.6). However, since, suffix initially, [n] is treated as a glide, that is, weaker than [l], the chosen candidate is [kol-dar] (4.7.7).

(4.2.6) If [n] were stronger than [l]...

/kol-lar/	*H-Ctct*	*X-Fl*
ko**l-n**ar	**<**	✠
ko**l-d**ar	<	✠
ko**l-l**ar	=!	

(4.2.7) But [n] is weaker than [l], so...

/kol-lar/	*H-Ctct*	*X-Fl*
ko**l-n**ar	>!	✠
☞ ko**l-d**ar	<	✠
ko**l-l**ar	=!	

5 Summary and Conclusion

I hope I have shown that the concept of consonantal strength and a hierarchy of constraints can be a useful way to organize linguistic data. In particular, Kazakh morphology very clearly supports the idea of a consonantal strength hierarchy in

the way suffix-initial consonants pattern in their variation betwen sonorant and obstruent realizations. Strict surface-level constraints, however, are inadequate to describe some phenomena that could possibly be described in terms of strength. I have proposed 'theoretical' strength for suffix-initial [n] to account for the fact. A further study of Turkic comparative linguistics and Kazakh dialectal variations would improve the analysis. Meanwhile, the present study is capable of accounting for the facts of Kazakh suffixation as summarized in the following table of representative forms:

(5.1) *Suffix allomorphs by strength of stem-final consonants*

	1 [*V*]	2 [w y r]	3 [l]	4 [*N*]	5 [+vc *obs*]	6 [–vc *obs*]
a. adverb	–ša	–ša	–ša	–ša	–ša	–ša
b. dir. case	–ga	–ga	–ga	–ga	–ga	–ka
c. loc. case	–da	–da	–da	–da	–da	–ta
d. 1pers. pl.	–myz	–myz	–myz	–byz	–byz	–pyz
e. plural	–lar	–lar	–dar	–dar	–dar	–tar
f. nominal	–lyk	–lyk	–dyk	–dyk	–dyk	–tyk
g. yes/no ques.	–ma	–ma	–ma	–ba	–ba	–pa
h. acc. case	–ny	–dy	–dy	–dy	–dy	–ty
i. imper.	–syn	–syn	–syn	–syn	–syn	–syn
j. p. part.	–gan	–gan	–gan	–gan	–gan	–kan
k. instr. case	–men	–men	–men	–men	–ben	–pen
1. 1pers. sg.	–myn	–myn	–myn	–myn	–byn	–pyn
m. gen. case	–nyŋ	–dyŋ	–dyŋ	–nyŋ	–dyŋ	–tyŋ
n. abl. case	–dan	–dan	–dan	–nan	–dan	–tan

NOTES

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[1] This scale has also been called "sonority," with "stronger" segments being called "more sonorous." Since the direction of change dealt with in this paper is toward the stronger elements, since "strengthening" sounds better than "desonorizing," and since, as far as I can tell, *strength* is the original term used to describe this scale, I have chosen to speak of "strength." I understand sonority to be simply the inverse of strength. To avoid confusion, I have avoided speaking of "sonority" altogether.

[2] It should be emphasized that flow is not equivalent to strength (nor sonority; see note 1). Flow is a class of features, while strength is a rating system for segments *based on* their flow features. As I have pointed out, there are various ways of arranging sounds on a scale of strength based on their flow. It is possible that these arrangements could be language specific, as, e.g. Dobrovolsky 1986 argues. Furthermore, as I have pointed out, voicing, which is not a Flow feature, has been argued to be a factor in strength.

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