The Role of Contrast in Locality: Transparent Palatal Glides in Kyrghyz*

Andrew Nevins and Bert Vaux
Harvard University and University of Wisconsin-Milwaukee

This paper discusses the role of contrast in determining the locality of [back] harmony. Specifically, we argue that palatal glides, although they are phonetically [-back], are transparent to [+back] harmony across them, because harmony is relativized only to contrastive values of the feature [back]. We argue that the feature distinguishing high vowels and glides is [± consonantal], and that a relativized theory of locality provides a falsifiable and restrictive theory of variation in the class of harmony participants throughout Turkic.

1. Overview

Kyrghyz, like many other Turkic and Altaic languages, has harmony for the feature [back] operating throughout the prosodic word. In Kyrghyz, [back] harmony affects only the eight vowels in the language, and has no effect on or participation by any of the consonants. Turkish, in contrast, allows participation of three palatalized consonants in [back] harmony. Finally, Karaim (Nevins & Vaux 2003) allows participation of all consonants (except the glide) in [back] harmony. We thus address the following questions in this paper:

(1) a. What determines what will participate in harmony?
b. What is the featural representation of glides?

Glides are transparent to vowel harmony throughout Turkic: in Kyrghyz, Turkish, and Karaim. In this paper, we examine Kyrghyz as a concrete illustration of this phenomenon. Our central claim is that the phonological and phonetic transparency of the palatal glide *j* in Kyrghyz [back] harmony is due to:

(2) a. its representation as [+consonantal]

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b. an intervener-based theory of locality, in which contrastiveness plays a central role

Kyrghyz is a Northwest Altaic language, spoken in Kyrgyzstan by 2.5 million people. We draw on the following existing English-language descriptions of Kyrghyz Phonology: Poppe (1963) (henceforth HP); Wurm (1949) (henceforth W); Comrie (1981) (henceforth C), and Johnson (1980) (henceforth J). In addition, we conducted our own research in April-May, 2004 with Dr. Saltanat Mambaeva (henceforth SM), a resident of Bishkek who was visiting the University of Wisconsin-Milwaukee, with whom we elicited forms and made recordings.

The structure of this paper is as follows. In Section 2, we provide the central phonological and phonetic data on Kyrghyz vowel harmony. In Section 3, we compare the behavior of glides in Turkic harmony to the behavior of palatalized consonants, which do participate in harmony. In Section 4, we compare proposals for the feature representation of glides. In Section 5, we discuss the consequences of these phenomena and their analysis for theories of phonological locality.

2. Kyrghyz Vowels Harmony and Transparent /j/

Kyrghyz has an eight-vowel system, which can be perfectly described by the combination of the three binary features [± high], [± back], and [± round], as depicted in (3):

(3) Kyrghyz Vowel Inventory:

	[-back, -round]	[-back, +round]	[+back, -round]	[+back, +round]
[+high]	i	ü	ï	u
[-high]	e	ö	a	o

The operation of [back] harmony is completely systematic in Kyrghyz: it operates from left-to-right, being triggered by all vowels, and affecting all vowels, resulting in stem-internal harmony and suffixal alternations.

Kyrghyz also has a system of [round] harmony, which applies to *all* vowels, with the exception of the sequence *uCa*, in which it is allowed[1].

[1]Discussion of explanations of this latter fact would take us too far afield today, as there are two different dialects: one reported in Comrie (1981), in which *u* can spread [round] to *a*, and another cited by all of the authors mentioned above, and found in our own work, in which *u* does not spread [round] to *a*. Korn (1969) puts a tilde (∼) in this column, apparently indicating variability on this point, but grouping it with the other "Type 2" systems of labial

Suffixal alternations due to vowel harmony can be found in the following examples. In particular, note the agreement of all vowels as to the feature [± back], and the resulting alternations in suffixal vowels.

(4) LOCATIVE -tA (W 77):
turmuš-ta 'in the life'
el-de 'in the nation'
toɣoj-do 'in the forest'
üj-dö 'in the house'

(5) GENITIVE -dIn (W 77):
iš-tin 'of the work'
džïł-dïn 'of the year'
toɣoj-dun 'of the forest'
üj-dün 'of the house'

(6) ORDINAL -InçI (HP 7-8):
beš-inçi 'fifth'
altï-nçï 'sixth'
toguz-unçu 'ninth'
tört-ünçü 'fourth'

(7) DEFINITE PAST -dI (J 90):
ber-di 'gave'
al-dï 'took'
tut-tu 'held'
kör-dü 'saw'

Having observed the straightforward operation of [back] harmony among the Kyrghyz vowels, in which all vowels participate, we turn our attention to roots whose last consonant is the palatal glide /j/, which is phonetically and featurally [-back]. Importantly, the palatal glide is transparent to [+back] harmony across it (8). Thus, a [+back] vowel may spread [+back] to a suffix across the [-back] glide, as shown in the second of the following three forms.

(8) 1SG. POSSESSIVE -Im (SM):
üj-üm 'my house'
oj-um 'my idea'

harmony in which *uCa* is tolerated, namely Shor, Altai, and Kazan Tatar. Vaux (1993) offers an explanation for Type 2 systems, which are always found in 8-vowel systems, as follows: only *marked* values of [+round] are visible, which means only [-back,+round] and [+low,+round] vowels will trigger [round] harmony.

aj-ïm ‘my moon’

Importantly, the glide is fully *transparent*: it does not itself undergo harmony (9), nor does it block or initiate harmony across it (10):

(9) *üu̯üm, *ou̯um, *oi̯im

(10) *oj-üm, *aj-im

The reader is directed to the files at the website:
`http://www.fas.harvard.edu/~lingdept/locality/kyrghyz/` and asked to consult the JPG images there for discssion. The file `bijik.jpg` contains a spectrographic representation of the palatal glide in the [-back] harmonic word *bijik* ‘big’ (phonetically uttered as [bijic^{h}] in this recording. Notice that the F2 value of the palatal glide (the acoustic correlate of backness) is approximately 2675 Hz. The file `bIjIl.jpg` contains a spectrogram which includes an F2 value for the [+back] harmonic word [bɨjɨl] ‘this year’. Notice the tremendous transitions to and from the palatal glide to the surrounding [+back] vowels. Notice also that the F2 value for the glide is around 2475 Hz, very close to that of the glide in a [-back] harmonic span. Finally, the file `j-comparison.jpg` shows a comparison of these two values by superimposing their formant structures alongside the F2 value of the [+back,+high] vowel [ɨ], which has an F2 value of approximately 1400 Hz.

In short, there is little phonetic evidence to support the hypothesis that the palatal glide becomes phonologically [+back] within a [+back] harmony span. The slight lowering of the F2 of the glide in [bɨjɨl] is likely due to low-level, gradient coarticulation, and brings the backness value of the glide within an expected range of non-phonologically relevant variation[2]. We thus conclude that palatal glides are genuinely transparent in harmony; as the figure for [bɨjɨl] indicates, the tongue body seems to go out of its way to move back for the first root vowel [ɨ], forward for the constriction of the glide [j], and back again to a posterior target for the articulation of the vowel [ɨ]. This looks like a genuinely categorical move from [+back] to [-back] to [+back], and demonstrates that [back] harmony applies across the palatal glide, without its participation.

[2]See also Kim (2005) for evidence that phonologically-grammaticized transparency in harmony (in the case she examines, Finnish *i,e*) can be distinguished from low-level coarticulatory effects, which are unstable and non-categorical.

3. A Comparison with the Palatalized Consonants of Turkish

Unlike Kyrghyz, Turkish has [± back] k/k',g/g',l/l' (Clements and Sezer 1982; Kornfilt 1997; Levi 2004) that are *contrastive* (11) for the feature [back], and in fact, do participate in harmony. First, we provide minimal pairs that demonstrate the phonemic character of these oppositions.

(11)				
	bol	abundant	bol'	cocktail
	kalp	counterfeit	kal'p	heart
	kar	snow	k'ar	profit
	gaz	gas	g'avur	infidel

We notate k',g',l' as k^y,g^y,l^y respectively. In the following examples, it is shown that the [-back] liquid l^y *intercepts* a [+back] span of vowel harmony, triggering a [-back] value on the following vowel.

(12)			
	usul^y	usul^y-ü	system-acc.sg
	sual^y	sual^y-i	question-acc.sg
	okul	okul-u	school-acc.sg
	karakol	karakol-u	police station-acc.sg
	petrol^y	petrol^y-de	petrol-loc.sg
	meʃgul^y	meʃgul^y-dü-m	busy-past-1.sg

Importantly, we can see in the last two examples of (12) that the vowel undergoing valuation and the palatalized liquid need not be strictly adjacent for [-back] valuation to "unexpectedly" occur.

The intuition to be captured in these Turkish cases is that there are *two sources* of valuation for the underspecified affix in *meʃgul^y-düm*. However, rather than writing (or positing) two distinct Spreading rules, one spreading [back] from vowels, and one spreading [back] from contrastively palatalized consonants, the Turkish affixal alternations may be governed by a single statement:

(13) Immediately upon affixation of a [-low] suffix, copy the values of [round] and [back] from the *closest* **contrastive** source

Clearly, in *meʃgul^y-düm*, the l^y is a closer potential source for [back] valuation than the preceding *u*. Hence, in a leftward search for a valuation source, once l^y is encountered, [-back] is copied to the suffix, and the search for [back] is terminated. However, the search for [round] continues, until *u* is encountered.

When inflectional suffixes are added in Turkish, they take their specification for [back] from, indeed, the **closest** source of valuation, which is, in these cases, a consonant. But perhaps we can assimilate Kyrghyz vowel harmony under this same behavior. Recall that Kyrghyz palatal glides (as well as Turkish palatal glides) do not participate in harmony, while Turkish palatalized /lʸ/ does. But of course a crucial difference between [-back] /lʸ/ and [-back] /j/ is that there *is* a segment /l/ in the inventory, there is no segment /i̱/ in the inventory of Kyrghyz nor Turkish nor Karaim.

(14) a. *Central puzzle*: [-back] liquids participate in harmony, but the [-back] glide doesn't!
b. *The intuition*: There is no [+back] counterpart to the glide

Existing analyses (e.g. Clements & Sezer 1982) of Turkic consonantal participation extrinsically designate l^j as an Opaque P-bearing segment (meaning it will block [back] harmony) and *j* as a transparent, non-P-bearing segment. This intuition has been translated into various vocabularies. Our aim, however, is to *predict* what participates in [back] harmony for all of Turkic, simply by inspecting the inventory.

(15) The rule of [back] harmony for all of Turkic: All segments that are contrastive for [back] will trigger harmony.

(16) A segment S with specification αF is *contrastive* for F if there is another segment F' in the inventory that is featurally identical to S, except that it is $-\alpha$F[3].

In order to test the applicability of (15) and (16) to the Kyrghyz palatal glide, however, we must examine in further detail the featural representation of /j/, and in particular, how it differs from the vowel /i/.

4. The Representation of Glides:/i/ vs. /j/

4.1. Reference to Syllabic Position

Many researchers have claimed that *syllabic position alone* differentiates /i/ and /j/ (Clements and Keyser 1983; Rosenthall 1994). Under this view, /i/ and /j/ have identical feature specifications, but when this segment is syllab-

[3]See Nevins (2004) for discussion. This formulation departs from Calabrese (1995), who defines contrastiveness in terms of filter deactivation.

ified as a nucleus, it arises as /i/, whereas when it is syllabified outside of a nucleus, it manifests as /j/. An immediate problem for this view arises when we consider configurations in which *both* /i/ and /j /can occur in a postnuclear position, yielding minimal pairs, as shown by the following example from Central Alaskan Yupik Eskimo (Woodbury 1987, p.687; Hayes 1989):

(17) áŋyalíiyulúúní boats-excellent-make-3sg.ind.
"He was excellent at making boats"

(18) áŋyalíyyulúúní boats-EXCELLENT-make-3sg.ind.
"He was excellent-EXPRESSIVE at making boats"

Clearly, syllabic position alone cannot differentiate the glide vs. the vowel in (17) vs. (18). It seems that some featural (i.e. subsegmental) difference must underlie the two as well. Further Problems for the "/j/ = Non-Nuclear /i/" hypothesis arise when the same surface glide has two distinct underlying sources. In other words, if we see the same surface phoneme behaving differently, depending on whether it comes from a lexical glide or a lexical vowel, again, we must distinguish underlying glide from vowel representationally. A relevant example comes from from Karuk (Bright 1957; Herman 1994; Levi 2004), which has two sources for glides, resulting in phonologically) minimal pairs:

(19) a. *θaw*$_v$ 'to knock down acorns'
b. *θaw*$_c$ 'to float' (where w_v indicates the glide derived from a vocalic source, and w_c indicates the glide derived from a consonantal source).

This underlying difference arises in the conditioning of phonological rules, as well. For example, Karuk has a process of intervocalic deletion of w$_v$ only, so that /ikriw+išrih/ → [ikri:šrih] 'to sit down', but the consonantal glide resists this deletion: /ikyiw+išrih/ → [ikyiwišrih] 'to fall down'. Turning to a further difference, there is a process of preconsonantal nasalization, which applies only to the consonantally-derived glide; thus /ʔiw$_c$+kara/ → [ʔi:**m**kara]; but /θiw$_v$+taku/ → [θi:wtaku]. It is thus clear from the Yupik and Karuk data that if there are two distinct underlying sources for surface glides, they cannot be differing only in syllabic position[4]. Finally, we note a typological parallel with Kyrghyz glides and their (non-)participation in

[4]See also Fula alternations which result from distinct underlying representations (Paradis 1992; Halle 1995):
/w$_c$,y$_c$/ → [b,tʃ], /w$_v$, y$_v$/ → [g,g] .

harmony: in Ainu, glides are opaque to harmony, and they are derived from an underlying vowel, whereby in contrast, in Efik, glides are transparent to harmony, precisely when they are underlyingly consonantal (Herman 1994).

4.2. Feature-Geometric Proposals

A second class of proposals as to the representational difference between vowels and glides comes from Revised Articulator Theory (Halle, Vaux, and Wolfe 2000), which proposes that the two differ in their *place* of articulation: /i/ has the [Designated Articulator: Dorsal] and /j/ has the [Designated Articulator: Coronal]. On this view, there is no difference in whether /j/ is consonantal or not; there is rather the postulation that /j/ differs from /i/ in its designated articulator. There may be some apparent drawbacks to this approach however; as it predicts the non-existence of Velar Glides, (but cf. Axininca Campa, Black 1993; Spring 1993. It also makes it difficult to explain why Semitic roots may contain /j/ (with designated articular: Coronal) and /k/ (with designated articulator: Dorsal), but do not contain /a/ (which is designated articulator: Dorsal); with a consonantal-based approach, one may say instead that Semitic roots are only composed of *consonants*.

There is a solution, however, which we adopt here, that encounters none of the above pitfalls, and also predicts that /j/ and /i/ will differ in their transparency in contrastive-value harmony: to posit that these segments differ in value for the feature [consonantal]. There is suggestive evidence that glides and vowels differ in "consonantality". Maddieson and Emmorey (1985) examined [iji] and [uwu] in Amharic, Yoruba, and Zuni, and found that glides were produced with (a) a lower F1 than the corresponding vowel, (b) a lower F2 for [w] than for [u], and (c) a higher F3 for [j] than for [i]. A reasonable conclusion is that glides (at least in these languages) are produced with greater *constriction* than vowels. The feature [$\pm$ consonantal] is a good candidate for representing this constriction difference. Additional evidence comes from Straka (1964), who found that, when segments were produced under *increased effort*, vowels have *less constriction*, while consonants (and glides) have *greater constriction*. We are led to (20):

(20) Featural representation of constriction difference between /i/ and /j/: [$\pm$ consonantal] (see especially Hyman (1985))

Before proceeding, however, we must consider phonological evidence that Turkic glides are consonantal in their behavior, external to the facts of harmony. We will review here convincing evidence for Turkish from Levi

(2004: Chap. 4), who shows three sources of evidence.

First, there is a general process of epenthesis between the first pair of consonants when three in a row are concatenated via affixation, as can be seen in *bur.nu∼bur**u**nlar* 'nose'. This same process applies when C1 is a glide, e.g. *boj.nu∼boj**u**nlar* 'neck'. We can tell that this is epenthesis between an underlying cluster created in the plural (and not due to syncope in singular) based on *kojunu∼kojunlar* 'sheep'). In fact, *kojun* is ambiguous between the nominative singular of either 'sheep' or 'bosom', but these differ in their genitive forms (*kojunum* 'my sheep' vs. *kojnum* 'my bosom'), precisely because 'sheep' has an underlying vowel in the second syllable (Charette 2004). A similar minimal pair involving epenthetic vs. underlying high vowels is *geniz∼genzim* 'nasal passage' vs. *deniz∼denizim* 'sea'.[5] Returning to *boj.nu∼boj**u**nlar*, the fact that /j/ is patterning with the consonants here in triggering epenthesis is, by hypothesis, because it is [+consonantal]/.

In addition, there is evidence from a rule of quantity-sensitive stress, found mostly in place names, which are sometimes called 'Sezer stems' due to their initial discovery by Sezer (1981). The productivity of this pattern for novel place names is further discussed in Inkelas and Orgun (1998) and Inkelas (1999). The general pattern is the following: if the penultimate syllable is heavy, it attracts stress in these words (e.g. *Is.tán.bul, Va.šínk.ton*). Otherwise, if the antepenultimate syllable is heavy and the penultimate syllable is light, stress falls on the antepenult, e.g., *Án.ka.ra*. Importantly, there is penultimate stress in the Sezer stem *An.tál.**ja***, demonstrating that the glide is a consonantal onset to the final syllable, and syllabified separately from the preceding liquid.

A final source of evidence for the consonantal status of glides in Turkish to be considered here is allomorph selection for consonant-final stems. Thus, the genitive affix varies in form for C-final *jɨlan-**ɨ*** 'his snake' vs. V-final *boru-**su*** 'his pipe'. Importantly, it takes the C-final form when

[5] In the analysis of Charette (2004), this is not a difference between epenthetic and underlying vowels, since Government Phonology (GP) does not recognize epenthesis as an operation. Thus, working within the templatic proposal for Turkish originally suggested by Denwood (1998), Charette proposes that the stem-final vowels in both 'sheep' and 'bosom' are the realization of an empty nucleus, which must be realized when the following nucleus fails to be p-licensed. The difference is that the vowel of 'sheep' is followed by an empty onset which dominates a skeletal point, while the vowel of 'bosom' is followed by an empty onset which is *pointless* (a representational distinction made in GP). Pointless onsets are subject to *reduction* (Gussmann and Kaye 1993), which subsequently allows p-licensing, which subsequently allows the underlying stem vowel to be phonetically unrealized in *burnu, bojnu,* and *kojnum*. Adopting this different approach to the representational distinction between alternating and non-alternating vowels does not affect the point made in the text about /j/ being consonantal in similarly creating the environment in which the vowel must surface in alternating contexts.

the stem ends in a glide, resulting in *saraj-ɪ* 'his palace'. This fact, as with all of the others above, may be captured by proposing that consonants and glides share the feature [+consonantal].We thus propose that the Turkish and Kyrghyz palatal glide is represented as follows:

(21) Featural composition: [**+consonantal**, +sonorant, +high, -back, -round]

5. Consequences for Theories of Locality

We have adopted here an *intervener-based* theory of locality, in which Turkic [back] harmony can skip any segments (be they consonants or vowels) that are not contrastive for the feature. We thus follow the general value-parametrized approach to whether or not intervening segments will be transparent that was developed by Calabrese (1995). Calabrese posited that a phonological process may be relativized to *all* values of a feature, only the *contrastive* values of a feature, or only the *marked* values of a feature. Turkic palatal harmony falls into the second category.

What is most important about the contrastiveness-based approach to the transparency of segments in harmony is that it makes the participants in this syntagmatic process fully predictable based on the paradigmatic structure of the inventory. Thus, Kyrghyz/Turkish/Karaim glides are transparent to harmony, because they are non-contrastive for [back], Turkish palatalized liquids and velars do participate in harmony, because they *are* contrastive for [back], and Karaim non-initial vowels are transparent to harmony, because they are not contrastive in non-initial positions (see Nevins and Vaux (2003)). None of these systems need be described as "vowel harmony", "vowel harmony interrupted by consonants", or "consonant harmony non-interrupted by vowels": all that is needed is reference to the contrastiveness of the feature [back] in the inventory of that language.

We may briefly note that the class of locality proposals that fall under Vowel-Place theory (Clements and Hume 1995) are not likely to be successful in modeling Turkic [back] harmony, as V-Place theory is specifically designed to rule out consonant harmony, which does in fact occur in Karaim. It is also unclear why [-back] glides would have a difference V-Place representation than [-back] liquids under V-Place theory. Recall that in the model we are adopting here, both segments are specified as [-back], and it is only the structure of the inventory as a whole that determines their different behavior in the process of harmony.

Finally, we may note that the non-affectedness of the intervening

palatal glide in Kyrghyz, as further evidenced by our spectrographic analysis, reveals an incompatibility with Strict Locality Theory (NíChiosáin and Padgett 2001), which hypothesizes that intervening segments are always phonologically affected in harmony.

In short, the relativized theory of locality, in which all segments are fully specified for [±back], but in which Turkic harmony is always relativized to the contrastive values of [back] in a given language, correctly avoids the undergeneration of Strict Locality Theory and avoids the overgeneration of an arbitrary designation scheme in which some segments are P-bearing-Opaque or V-Place-bearing and others are not.

6. Conclusions

We have attempted to examine Kyrghyz as a case study of the transparency of a phonologically and phonetically [-back] consonant within a span of [+back] harmony. The core of our proposal is that palatal glides are [+consonantal, +high, -back, -round], and that since there is no [+consonant, +high, +back, -round] segment in the language, the value of [back] on /j/ is not contrastive. We proposed that palatal harmony throughout Turkic is relativized only to contrastive values of [back], thus excluding the Kyrghyz palatal glide from the class of participants in harmony, while correctly including the contrastively palatalized consonants of Turkish.

Kyrghyz *j* helps demonstrate that *contrast plays a central role in determining phonological locality*, and that *harmony may be relativized, rather than operating strictly locally*.

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317 Boylston Hall
Department of Linguistics
Harvard University
Cambridge, MA 02139
USA

Department of Foreign Languages and Linguistics
University of Wisconsin-Milwaukee
893 Curtin Hall
Milwaukee, WI 53211
USA

nevins@fas.harvard.edu
vaux@csd.uwm.edu