Vowel-consonant harmony in Uyghur

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1 Introduction

The present paper addresses a typologically rare pattern of harmonic vowel-consonant interactions in Uyghur, an Eastern Turkic language spoken in China (Engesæth et al. 2010: 5).

In addition to the commonly attested backness harmony in vowels, velar and uvular consonants in Uyghur participate in harmony, resulting in three types of harmonic processes: (i) vowel-vowel, (ii) consonant-consonant, and (iii) vowel-consonant interactions.[1] The three harmony types, which will be addressed in more detail in section 2, are illustrated below. Note that harmony between consonants is attested only when the harmony neutral vowels /i/ and/or /e/ are present, as in (2):

(1) Backness harmony between vowels
  a. *søz-lɛr* 'word-PL' (SU 48)
  b. *tʃatʃ-lar* 'hair-PL' (SU 48)

(2) Backness harmony between consonants
  a. *kim-lik* 'identity' (CIC 8)
  b. *qijintʃi-liq* 'difficulty' (GPC 10)

(3) Backness harmony between vowels and consonants
  a. *jygyr-mɛk* 'running' (GTB 301)
  b. *jaz-maq* 'writing' (GTB 310)

Pattillo (2013) addresses the consonant alternation in more detail and discusses the possibility of consonant harmony in Uyghur. The author concludes that the Uyghur pattern does not feature consonant harmony for alternating consonants being adjacent to vowels participating in backness harmony. However, considering neutral vowels and roots with vowels and/or consonants of different backness specification shows that there are two distinct but interacting harmony processes in the language. This will be discussed in section 2.4; for convenience, the three main points of the interaction are summarized here: (i) Affix vowels agree with the last harmonic root vowel in backness; (ii) harmonizing consonants agree with the closest harmonic/harmonizing segment which can be either a vowel or a consonant; (iii) if both a consonant and a vowel are adjacent segments to a harmonizing consonant, the latter agrees with the consonant.

This phenomenon is less common cross-linguistically for three reasons. Firstly, long-distance harmony processes between consonants and vowels are much rarer than local harmonic interactions (Rose & Walker 2011: 249). Secondly, reported alternations between velar and uvular consonants that interact with vowels involve the feature [±high], so that velars co-occur with [+high] vowels, whereas uvulars pattern with [–high] ones, as in, e.g. Sibe (Tungusic) (Rose & Walker 2011: 250), and Mongolic (Svantesson et al. 2005: 28; Beltzung et al. 2015: 230). Similar assimilations are attested in Misantla Totonac and Tepehua, where a high vowel is lowered in the context of uvulars (Hansson 2001: 70,73). In Uyghur, however, it is rather the feature [±back] that distinguishes between velars and uvulars and makes them co-occur with [–back] and [+back] vowels, respectively, whereas high vowels and uvulars are not restricted in their co-occurrence. Thirdly, Ní Chiosáin & Padgett (1993) and Padgett (2011) discuss cross-category interactions between vowels and consonants and note that consonant-to-vowel assimilations, in contrast

[1] A similar, though not identical, phenomenon is also attested in other Eastern Turkic languages: velar and uvular consonants occur adjacent to front and back vowels, respectively. In Turkmen, Tatar, or Bashkir, this is found on the phonetic level only. In Uyghur, on the other hand, velar and uvular consonants are not allophones but distinct phonemes, which take part in backness harmony.

to vowel-to-consonant assimilations, seem to be unattested, palatalizing mutations being "the only clear exception" (Padgett 2011: 1766). The Uyghur pattern could be another potential counter-example to this generalization, since consonant harmony depends on vowel harmony, but not vice versa.

Section 3 of the present paper proposes an Agreement by Correspondence approach to model the three types of harmonic interaction. ABC establishes correspondence relations between segments based on their similarity and imposes ID-constraints onto outputs of the corresponding segments, which results in the harmony pattern observed. As for the phenomenon in Uyghur, similarity requires segments to be [dorsal], which makes them agree in their feature specification for [±back].

ABC as theoretical framework has been chosen, since it deals with this kind of parasitic harmony in a very straight-forward way, i.e. all [dorsal] segments enter the correspondence relation, the harmonic feature being [±back]. In addition, the latter will be shown to be sensitive to contrast in order to account for the distribution of neutral segments that are [dorsal]. By doing so, there is no need to assume underspecification.

ABC having been developed to model consonant harmony driven by similarity (Rose & Walker 2004; Hansson 2001), it could also be applied to vowel harmony (Krämer 2003; Rhodes 2012) and consonant dissimilation processes (Bennett 2013). The present paper will show another type of application of the ABC framework, namely long-distance consonant-vowel interactions.

2 Data

This section gives an overview of the phoneme inventory of Uyghur, the basic functioning of backness harmony, and illustrates the distribution of velar and uvular consonants within roots and affixes. Finally, the relevant root types are introduced.

2.1 Uyghur phoneme inventory

In Uyghur, all high, mid, and low vowels can be divided into [±back] and [±round]. The vowel inventory, however, is not symmetric: the two [–back], unrounded vowels /i/ and /e/ do not have a [+back] counterpart. This can account for their neutral[2] behaviour (see section 3.3).

	–back		+back	
	–rd	+rd	–rd	+rd
+high	/i/	/y/		/u/
–high–low	/e/	/ø/		/o/
+low	/ɛ/		/a/	

Table 1: The vowel inventory of Uyghur (Hahn 1991*b*; Comrie 1997).

The consonant inventory is given in table 2 below. For the purpose of the present paper, especially the velar and palatal stops will be relevant, since these are the consonants participating in backness harmony.

[2]Uyghur features phonological processes that derive /i/ from /a/ and /ɛ/ in non-initial open syllables and /e/ from the same vowels in short initial syllables of a word with /i/ in the following syllable. Those derived vowels are not neutral in all cases. This will not be of concern in the present paper, for a detailed account these two processes see Vaux (2000) or Hahn (1991*b*: 51).

	labial		alveo-dental		alveo-palatal		velar		uvular		laryngeal
stops	/p/	/b/	/t/	/d/			/k/	/g/	/q/	/ɢ/	ʔ
affricates			/ts/		/tʃ/	/dʒ/					
fricatives	/f/	/v/	/s/	/z/	/ʃ/	/ʒ/			/χ/		/h/
nasals		/m/		/n/				/ŋ/			
liquids			/l/	/r/							
glides		/w/			/j/						

Table 2: The consonant inventory of Uyghur (Hahn 1991*b*: 59).

Only the velars and uvulars shaded in the table above participate in harmony; /ŋ/ and /χ/ do not participate (see section 3.3 on neutral segments).

2.2 Backness harmony of vowels

Similar to most other Turkic languages, Uyghur has backness harmony, i.e. any suffix vowel must agree with the vowel of the preceding morpheme in backness until a word boundary is encountered (Hahn 1991*b*: 46).

However, two other processes seem to blur harmony: vowel raising and umlauting. Raising derives /i/ from /a/ and /ɛ/ in non-initial open syllables and umlauting results in /e/ from underlying /i/ or /ɛ/ in short initial syllables of a word with /i/ in the following syllable (Vaux 2000). Also the vowels /i/ and /e/ being transparent, the number of participating vowels is reduced in Uyghur, compared to, e.g. Turkish. Nevertheless, all suffixes that feature harmonizing vowels participate in harmony and surface with the respective vowel selected according to the harmonic properties of the root.[3]

The following examples show the harmonic restrictions on affix vowels. As can be seen in the basic examples in (4) and (5), roots with [αback] vowels trigger [αback] vowels in affixes:

(4) The plural suffix *-lar*

bɛl-lɛr	'waist-PL' (SU 48)[4]	*tʃatʃ-lar*	'hair-PL' (SU 48)
kyn-lɛr	'day-PL' (SU 48)	*toj-lar*	'feast-PL' (SU 48)
søz-lɛr	'word-PL' (SU 48)	*quʃ-lar*	'bird-PL' (SU 48)

(5) The negative suffix *-ma*

kɛt-mɛ-	'go-NEG' (SU 48)	*qat-ma-*	'harden-NEG' (SU 48)
kyt-mɛ-	'wait-NEG' (SU 48)	*qoj-ma-*	'put-NEG' (SU 48)
køj-mɛ-	'singe-NEG' (SU 48)	*qur-ma-*	'dry-NEG' (SU 48)

In addition, most native roots are harmonic, i.e. all vowels are specified for [±back]. Nevertheless, vowels of different backness specification are tolerated within roots, mostly occurring in loan words. In case roots feature vowels of different backness specifications, the surface form of the harmonizing suffix vowel(s) is determined by the harmonic vowel that is closest to it:

[3]Uyghur additionally exhibits labial harmony with non-low vowels. Since this is not relevant for the discussion of the present paper, it will not be addressed in the following sections. For a description of labial harmony in Uyghur, see Hahn (1991*b*), Comrie (1997) or De Jong (2007).

[4]SU refers to Hahn (1991*b*).

(6) V-inconsistent roots

saʔɛt-lɛr	'hour-PL' (GTB 6)[5]
universitet-lar	'university-PL' (GTB 6)
adɛm-lɛr	'man-PL' (WP 61)

As has already been mentioned, the vowels /e/ and /i/ are neutral to harmony due to their lack of a harmonic partner (/ɪ/ and /ɤ/, respectively) specified for [±back]. Both vowels are transparent, i.e. both can co-occur with other front and back vowels in the root and neither of them participates in backness harmony:

(7) /i/ and /e/ with [–back] vowels

nɛrsi-lɛr	'thing-PL' (WP 15)
kerɛklik	'need' (CRA 6)

(8) /i/ and /e/ with [+back] vowels

jelindʒa-ʃ-qa	'burn-GER-DAT' (WP 483)
qiz-lar	'girl-PL' (GTB 153)

Since the vowel /e/ only surfaces in native words due to umlauting (cf. Hahn (1991*b*: 51)), there are no suffixes that contain /e/. The vowel /i/ on the other hand, occurs in affixes with both front and back roots. The following examples show how the genitive and ablative suffixes contain the surface vowel /i/ with front and back vocalic roots equally:

(9) Genitive *-niŋ*

turmuʃ-niŋ	'life-GEN' (TS 10)
belɛt-niŋ	'ticket-GEN' (TS 52)

(10) Ablative *-tin*[6]

ari-din	'middle-ABL' (WP 273)
kynklyk-tin	'day-ABL (WP 268)

2.3 Backness harmony of consonants

As is quite common in Turkic languages, velar consonants co-occur with front vowels, while uvular consonants surface adjacent to back vowels. The vowels /i/ and /e/ being neutral to backness harmony, we find roots in Uyghur that do not contain any harmonic vowel, but harmonic consonants only. Example of such V-neutral roots[7] selecting the nominalizing/adjectivizing suffix *-liq* are given below:

(11) V-neutral roots with velars

tegiz-lik	'tall' (WP 253)
kiʃi-lik	'human' (CRA 12)
tegiʃi-lik	'essential' (GPC 21, WP 143)
kim-lik	'identity' (CIC 8)

(12) V-neutral roots with uvulars

qeri-liq	'old' (WP 18)
jeqim-liq	'gracious' (WP 236)
qetim-liq	'time' (TS 20)
qijintʃi-liq	'difficulty' (GPC 10)

The examples in (11) and (12) show that V-neutral roots with harmonic consonants (velars or uvulars) consistently select a suffix consonant with the same place of articulation (velar or uvular, respectively). Considering that the only vowels present are neutral to backness harmony, the consonants arguably are in a long-distance harmony relation.

[5]GTB refers to Engesæth et al. (2010); all other sources of examples refer to texts from the corpus listed on p. 14.

[6]Uyghur has a restriction on consonant clusters; adjacent obstruents have to be either both voiced or voiceless (Comrie 1997: 920). This causes suffix initial obstruents to assimilate to the last root/stem-segment, which is the reason for the different realizations of /t/ in the ablative suffix.

[7]Note that there are also V-C-neutral roots with neither harmonic vowels nor consonants, e.g. *biz* 'we' (TS 56), *bil* 'know' (TS 5), *teŋ* 'bind' (WP 406), *ejt* 'tell, speak' (WP 323, GTB 305), *χizmit* 'job' (EY 27). A more detailed discussion of the harmonic behaviour of such roots would go beyond the scope o this paper; one would probably have to assume an ideosyncratic value for backness, perhaps as a floating feature.

2.4 Interaction of vowel and consonant harmony

The distribution of velar and uvular consonants broadly corresponds to the distribution of front and back vowels in native roots. Non-native roots, on the other hand, do not show that restriction, so that roots of all combinations can be found in Uyghur. [8]

(13) /g/ adjacent to front vowels
gyzɛl ‘beautiful’ (WP 220)
sɛgɛk ‘caution’ (WP 248)

(14) /g/ adjacent to back vowels:
gaŋgira ‘hesitate’ (WP 82)
gogul ‘Google’ (TS 22)

(15) /k/ adjacent to front vowels
høkymit ‘government’ (CIC 6)
bɛk ‘very’ (WP 336)

(16) /k/ adjacent to back vowels
makan ‘place, land’ (WP 237)
tʃoka ‘chopstick’ (TS 78)

(17) /ɢ/ adjacent to front vowels
ɢɛrb ‘West’ (CRA 1)
mɛblɛɢ ‘capital, funds’ (CIC 7)

(18) /ɢ/ adjacent to back vowels
ujɢur ‘uyghur’ (ATM 5)
tʃaɢ ‘time’ (WP 378)

(19) /q/ adjacent to front vowels
wɛqɛ ‘event’ (GPC 16)
mɛqsid ‘aim’ (WP 447)

(20) /q/ adjacent to back vowels
hoquq ‘rights’ (CRA 12)
mundaq ‘this’ (GPC 23)

As for harmonizing affixes, the co-occurrence of front/back vowels and velar/uvular consonants is more restricted. A velar affix consonant occurs only with a front affix vowel, while a uvular consonant surfaces with a back vowel in affixes. Examples of this are provided in (21)-(28) for the infinitive (*-maq*), the dative (*-qa*), the past participle (*-qan*), and the causative (*-quz*):[9]

(21) Infinitive [–back]
kør-mɛk ‘seeing’ (GTB 302)
jygyr-mɛk ‘running’ (GTB 301)

(22) Infinitive [+back]
jaz-maq ‘writing’ (GTB 310)
ju-maq ‘washing’ (GTB 308)

(23) Dative [–back]
jɛr-gɛ ‘place-DAT’ (WP 12)
kytʃ-kɛ ‘power-DAT’ (SU 616)

(24) Dative [+back]
dunja-ɢa ‘world-DAT’ (WP 129)
mɛbus-qa ‘prisoner-DAT’ (WP 463)

(25) Past participle [–back]
kɛl-gɛn ‘having come’ (WP 45)
øt-kɛn ‘having passed’ (WP 241)

(26) Past participle [+back]
tol-ɢan ‘having filled’ (WP 368)
aχilaʃ-qan ‘having finished’ (TS 98)

[8] The difference between Uyghur and e.g. Turkmen (Schönig 1998: 261), Tatar or Bashkir (Berta 1998: 283) is that in the latter three languages, it is a process of phonetic assimilation, with no impact on the phonological level. Velars and uvulars are allophones and not distinctive, which is also assumed for Proto-Turkic (Johanson 1998: 88). In Uyghur, on the other hand, the uvular obstruents /ɢ and /q/ are not phonetic variants of velar /g/ and /k/ anymore, but have developed into distinct phonemes. It has been suggested that this happened as a consequence of the loss of phonemic /ɪ/ and neutralization of /i/ (Hahn 1991*b*: 83). In the course of /i/ losing its back counterpart, the velar and uvular allophones became phonemic due to minimal-pair contexts.

[9] As has been remarked in section 2.2 (see footnote 6 on p. 3), affix initial consonants assimilate to the [voice] specification of the last root/stem segment, so that the consonants in the affixes of dative, the past participle, and the causative have four distinct variants.

(27) Causative [–back]

jyr-gyz	'make go'	(ATM 6)
jɛt-kyz	'make reach'	(CIC 5)

(28) Causative [+back]

tur-ʁuz	'develop (tr)'	(APT 31)
aq-quz	'make flow'	(WP 473)

The examples presented so far served as illustration for the functioning of vowel and consonant harmony. However, it does not directly follow from them to what extent the two processes of consonant and vowel harmony interact. For that reason, it is necessary to look at roots with "mismatches" of harmonic segments, i.e. vowels of different specification for [±back] and/or velar and uvular consonants co-occurring in a root. Although such inconsistent roots appear to occur rather marginally, they represent a better diagnostic to shed more light upon the harmonic feature realization in harmonizing segments.

We will now turn to the different types of inconsistent roots in Uyghur. Two different types of mismatches with respect to the harmonic feature are attested. A root can have vowels of both [αback] and [βback] specification (V-inconsistent root) and / or [αback] vowels and [βback] consonants (CV-inconsistent root). The theoretically possible third option of both [αback] and [βback] consonants does not seem to occur.

The behaviour of V-inconsistent and CV-inconsistent roots with respect to affix selection is illustrated below.

(29) **V-inconsistent roots**

with V-suffixes	
saʔɛt-lɛr	'hour-PL' (GTB 6)
adɛm-lɛr	'man-PL' (WP 61)
universitet-lar	'university-PL' (GTB 6)
with C-suffixes	
qudrɛt-lik	'powerful' (WP 19)
dɛhqantʃi-liq	'farming' (APT 30)
hɛjran-liq	'surprise (N)' (WP 49)
with CV-suffixes	
mɛhbus-qa	'slave-DAT' (WP 22)
halɛt-kɛ	'situation-DAT' (WP 67, 448)
ɛwlad-qa	'generation-DAT' (WP 94)

(30) **CV-inconsistent roots**

with V-suffixes	
qɛpiz-im-dɛ	'cage-POSS.1SG-LOC' (WP 106)
qɛdɛh-lɛr-ni	'cupPL-ACC' (TS 79)
hɛqq-i-dɛ	'concern-POSS3-LOC' (GPC 3)
with C-suffixes	
qɛtij-lik	'resolution' (WP 475)
ɛχmɛq-liq	'fool' (WP 339)
hɛq-liq	'right (ADJ)' (WP 115)
with CV-suffixes	
tekrarli-maq	'practice-INF' (GTB 79)
qɛpɛz-gɛ	'cage-DAT' (WP 197)
kawak-ka	'pit-DAT' (Hahn 1991*a*: 82)

Considering the examples in (29) and (30) above, the interaction of harmonic vowels and consonants can be generalized in the form of three main observations:

(i) Affix vowels agree with the last harmonic root vowel in backness, irrespective of the value of a closer harmonic consonant.
(e.g. *hɛqq-i-dɛ*, *χɛlq-qɛ*)

(ii) Harmonizing consonants agree with the closest harmonic/harmonizing segment which can be either a vowel or a consonant.
(e.g *qudrɛt-lik*, *hɛq-liq*)

(iii) If both a consonant and a vowel are adjacent segments to a harmonizing consonant, the latter agrees with the consonant.
(e.g. *kawak-ka*)

3 Analysis

This section proposes an ABC-analysis to capture both vowel and consonant harmony, as well as their interaction in Uyghur. The first part introduces the general properties of the ABC framework, after which the correspondence and the harmonic features (section 3.2), and neutral segments (3.3) are addressed in more detail. Section 3.4 provides the constraints necessary for the analysis, which is then elaborated.

3.1 Agreement by Correspondence

The theoretical framework employed here is Agreement by Correspondence (e.g. Rose & Walker 2004; Hansson 2001), which establishes agreement between segments via output-output-correspondence relations based on similarity. An abstract correspondence relation of two non-adjacent segments to illustrate the correspondence is given in figure 1 below.

The similar segments in figure 1 are consonants (sharing the feature [+cons]), which enter a correspondence relation indicated by the index. Segments that have received the same index are required to have the same specification for the harmonic feature F.

$$\begin{array}{cccc} C_x & V & C_x & V \\ | & & | & \\ [\alpha F] & & [\alpha F] & \end{array}$$

Figure 1: ABC configuration.

Similarity between segments in ABC is defined by constraints of the CORR-SS family. Sharing a given (set of) feature(s), segments enter a correspondence relation. In order to model harmony, an additional type of constraints is needed. Harmony is regulated by the IDENT-SS constraints, which determine the feature specification that the corresponding segments have to agree for.

The advantage of such an approach is that it inherently keeps apart the two features responsible for correspondence and harmony, which is a very straight-forward way to model parasitic harmony (harmony depending on another feature). The fact that Uyghur exhibits harmonic long-distance interaction between vowels and consonants naturally follows if [dorsal] is the feature that establishes correspondence and [±back] the one responsible for harmony.

ABC was designed to label non-local consonant interactions and has been assumed unsuitable to model vowel harmony, since the latter often involves intervention effects or transparency. Nevertheless, Rhodes (2012) and Hansson (2001) showed that ABC can be used to account for harmonic vowel interactions as well. The Uyghur pattern analysed here is of theoretical relevance, as it represents yet another type of harmony, namely long-distance vowel-consonant interaction. Apart from the goal of this paper to account for Uyghur data, it shows the applicability of ABC to this type of harmonic interaction.

3.2 The features [dorsal] and [±back]

Since ABC is implemented in an Optimality Theoretic model, the feature specification of segments and their interaction can be achieved by the interaction of constraints; a detailed feature-geometric structure will not be developed in this paper. Rather, the two features [dorsal] and [±back] relevant to the harmony processes found in Uyghur will be addressed in detail in this section.

Following Sagey (1986), all vowels as well as velar and uvular consonants are assumed to be [dorsal], i.e. they involve the tongue body as an active articulator. Segments specified for [dorsal] can further be

[±back] and [±high]. It has been mentioned in the introductory chapter that in certain languages, the velar-uvular alternation interacting with high and non-high vowels can be accounted for by the feature [±high]. The data from sections 2.2 to 2.4 showed that this cannot be the case in Uyghur: vowel height neither affects nor is affected by velar-uvular alternations. On the other hand, it follows from the data that back vowels pattern with uvulars as well as front ones with velars. Therefore, the harmonic feature is assumed to be [±back]. Within representational model, front vowels are specified for [–back] in contrast to [+back] vowels. Sagey (1986: 146) argues that vowel harmony is generally not blocked by [dorsal] consonants, because they are not specified for [±back], but [dorsal] only. By showing some examples of interactions between palatal and velar consonants and vowels from Turkish, Kinyarwanda, and Shona (Sagey 1986: 148), the author argues that [dorsal] consonants can be "distinctively" specified for [±back]. This will be assumed to hold for Uyghur as well: velar /g/ and /k/ are specified for [–back], while uvular /ɢ/, /q/, and /χ/ are [–back.][10]

It has to be noted here that (especially) the [dorsal] specification for vowels has not stayed unchallenged (e.g. Pulleyblank 1989; Lahiri & Evers 1991; Hume 1992; van de Weijer 1996), e.g. interactions of front vowels and coronal consonants are a problem for this account. For this reason, the present paper does not claim a universal [dorsal] specifications for vowels, but language-specifically for Uyghur, where this is supported by the data. Complying with Mielke (2008, 2011) and Mohanan et al. (2010), distinctive features do not have to be universally defined but emerge (to a certain extent) in a given language system. The assumption made here is restricted to Uyghur, since the data supports a shared feature for all vowels as well as velar and uvular consonants. Moreover, there is no language internal motivation for a [coronal] specification of front vowels, e.g. labial consonants do not interact with them.

By analogy, the same argumentation applies to uvulars. As for Uyghur, data suggests that they pattern with velars rather than forming a natural class with the laryngeals /ʔ/ and /h/ (for a discussion of post-velars see Shahin 2003), which motivates their specification as [dorsal].

3.3 Neutral segments

It was shown in the data from the previous sections that not all [dorsal] segments, i.e. all vowels as well as alveo-palatal, velar, and uvular consonants participate in the harmony. As for the consonants, only velar /g/, /k/ and uvular /ɢ/,/q/ participate, while velar /ŋ/ and uvular /χ are neutral to harmony (cf. table 2 on page 3). In addition, the two vowels /i/ and /e/ are transparent to harmony.

Contrast in phonology has been widely discussed in previous works (e.g. Dresher et al. 1994; Calabrese 1995; Baković 2002; Dresher 2003; Hall 2007; Avery et al. 2008; Nevins 2010; Dresher 2012). As for vowel harmony, it has been argued that neutral vowels do not participate in harmony because they are not contrastively specified for the harmonic feature, which can also account for the data found in Uyghur. In the present paper, contrast shall be understood in the sense of Nevins (2010: 70):

(31) *Definition of* contrastive:
A segment S with specification αF in position P is *contrastive* for F if there is another segment S′ in the inventory that can occur in P and is featurally identical to S, except that it is –αF.

Contrast being relevant to harmony neutral segments, however, does not entail the Contrastivist Hypothesis (Hall 2007), stating that only contrastively specified features are computed by the phonology. Here, it is assumed that feature specification can also be non-contrastive (which avoids the problem of underspecification in an OT system), while, crucially, the harmony process can only access contrastively specified

[10]More evidence for shared features between vowels and consonants is discussed in Padgett (2011: 5), e.g. interaction of vowel rounding and labial consonants, dorsal and pharyngeal consonants that trigger backing/lowering of vowels.

features (Nevins 2010: 71).

Returning to the Uyghur data, the lack of contrast in feature specification correctly predicts the neutral segments. The vowel inventory of Uyghur presented in section 3.6 (p. 2) indicates that both [–back] /i/ and /e/ lack a phoneme with the same features but a [+back] specification, i.e. /ɪ/ and /ɤ/. Data from the previous sections showed that it is /i/ and /e/ that are neutral to harmony. As for [dorsal] consonants, velar /ŋ/ and uvular /χ/ neither have a uvular/velar counterpart. As predicted, they do not participate in any harmony process. The same holds for the alveo-palatals /ʃ/, /tʃ/, /ʒ/, /dʒ/, and /j/, which would require [+back] (velar) counterparts, which are not attested in Uyghur.

We are now turning to the question of contrast in ABC. Rhodes (2012: 154), in order to model transparent vowels in ABC, adds feature strength to the segmental representation, so that in addition to the [αF] specification, each feature obtains a strength level. Strength is determined by contrast: strong features are contrastively, weak features are non-contrastively specified. Strength being implemented into the CORR-SS constraint, the latter restricts correspondence (and ultimately, harmony) to segments with a strong [αF] specification and excludes weakly specified segments. The present paper will adopt this approach in a slightly modified way. Since there is no evidence for or against the implementation of contrast into the CORR-SS constraint instead of the ID-SS constraint, the present paper relocates the contrast requirement to the latter. At the theoretical level, this has the advantage of a clear division between the feature of correspondence [dorsal], being insensitive to contrast, and the harmonic feature, requiring a contrastive specification for [$\pm$back]. This means that all segments specified for [dorsal] enter the correspondence relation. Only at the level of the ID-SS constraints, contrast is relevant in that it makes the ID-SS constraints apply to those segments with a contrastive specification for [$\pm$back].

A note on the distinction between vowel and consonant harmony and neutral segments has to be made here. ABC has been developed for consonant harmony processes, as it has been assumed to function differently from vowel harmony. One major difference being the lack of blocking segments in most consonant harmony systems (Rhodes 2010: 1), Hansson (2001: 237) argues that it should not be possible to account for vowel harmony with blocking. On the other hand, Rose & Walker (2004) are rather confident about cases of parasitic harmony (e.g. labial harmony restricted to vowel height) being modelled in ABC. The present paper provides new data to support this second view; vowel and consonant harmony in Uyghur both show transparent segments suggesting that they should be treated in the same way.

3.4 Constraints

This section introduces the constraints that are needed in order to model the Uyghur consonant-vowel interactions as Agreement by Correspondence. The correspondence relation is established between vowels and consonants by the following constraint:

(32) **CORR-EG↔AQ** Assign a violation for the pair of segments X and Y for which holds that
- X and Y are specified for [dorsal];
- X and Y are closest neighbouring segments (not necessarily adjacent);
- and X and Y are not in a correspondence relation.

This constraint is violated if front/back vowels or velar/uvular consonants are not in a correspondence relation with another consonant or vowel of that type on the word level. The number of violations equals the number of pairs of adjacent segments specified for [dorsal]. The schematic example in 2 shows a string of segments, some of which being specified for [dorsal]. Those segments can enter a correspondence relation; corresponding segments are marked by the index. As two segments, although being specified for [dorsal], are not corresponding, three violations (marked by ! in figure (32)) are counted in, since these two segments affect three pairs of segments.

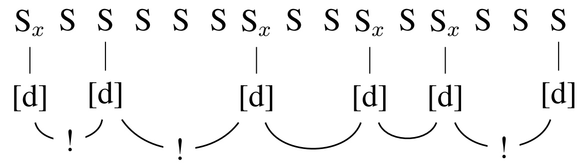

Figure 2: Violation of the CORR-EG↔AQ constraint.

The identity between corresponding segments is guaranteed by ID-SS constraints. Since it is important to distinguish between vowel-vowel, consonant-consonant, and vowel-consonant interactions, three different ID-SS constraints for each of these interactions are needed:

(33) **ID-VV(bk)** Assign a violation for the pair of segments X and Y for which holds that
- X and Y are contrastively specified for [±back] in the output;
- X and Y are closest corresponding vowels;
- and X is [αback] and Y is [βback].

(34) **ID-CC(bk)** Assign a violation for the pair of segments X and Y for which holds that
- X and Y are contrastively specified for [±back] in the output;
- X and Y are closest corresponding consonants;
- and X is [αback] and Y is [βback].

(35) **ID-VC(bk)** Assign a violation for the pair of segments X and Y for which holds that
- X and Y are contrastively specified for [±back] in the output;
- X and Y are closest corresponding vowels, consonants, or vowel and consonant;
- and X is [αback] and Y is [βback].

The ID constraints are modelled in a way that they have the identity of corresponding segments be evaluated pair-wise, by analogy to the CORR-EG↔AQ constraint. This means that a violation of ID-VV(bk), ID-CC(bk), and ID-VC(bk) will only be assigned if two neighbouring correspondents with a contrastive specification for [±back] have a different backness specification.

The restriction to contrastively specified segments is needed here, since the two un-paired vowels /i/ and /e/ are neutral to backness harmony; in addition, the Uyghur phoneme inventory features other velar consonants which do not participate in these harmony processes either.

Finally, in addition to the the constraints above which apply to output-output relations, the more general input-output faithfulness constraints have to be considered:

(36) **ID-IO(bk)** Assign a violation for the pair of segments X and Y for which holds that
- X is a segment in the input and Y its correspondent segment in the output;
- and X is [αback] and Y is [βback].

(37) **ID-IO$_{\text{root}}$(bk)** Assign a violation for the pair of segments X and Y for which holds that
- X is a root segment in the input and Y its correspondent root segment in the output;
- and X is [αback] and Y is [βback].

The distinction between ID-IO(bk) in roots and affixes follows from the data presented in section 2 above: disharmony between root segments is allowed, while harmonizing affix segments must agree to harmonic root segments in their backness specification.

The following sections 3.5 and 3.6 will derive the ranking of these constraints, given in (38) below:

(38) ID-IO$_{\text{root}}$(bk), CORR-EG↔AQ $\gg$ID-VV(bk) $\gg$ID-VC(bk) $\gg$ID-CC(bk) $\gg$ID-IO(bk)

3.5 Vowel harmony and consonant harmony

We now turn to the analysis of vowel (backness) harmony on the basis of words which do not contain harmonic consonants.

Tableau (39) features a basic example of a root with a neutral vowel and a vowel specified [–back]. This example illustrates the functioning and ranking of the CORR-EG↔AQ, the ID-VV(bk), and the ID-IO(bk) constraints.

(39) *birlɛʃ-tyr-yp* ‘combine-CAUS-CONV’ (APT 11)

I: birlɛʃ-tur-up	CORR-EG↔AQ	ID-VV(bk)	ID-IO(bk)
☞ **a$_1$** bi$_i$rlɛ$_i$ʃ-ty$_i$r-y$_i$p			**
a$_2$ birlɛ$_i$ʃ-ty$_i$r-y$_i$p	*!		**
a$_3$ birlɛʃ-ty$_i$r-y$_i$p	*!*		**
a$_4$ birlɛʃ-tyr-yp	*!**		**
b bi$_i$rlɛ$_i$ʃ-ty$_i$r-u$_i$p		*!	*
c bi$_i$rlɛ$_i$ʃ-tu$_i$r-y$_i$p		*!*	*
d bi$_i$rlɛ$_i$ʃ-tu$_i$r-u$_i$p		*!	

The CORR-EG↔AQ constraint requires all vowels to be corresponding, including the neutral one. For reasons of brevity, not all possible combinations of corresponding and non-corresponding vowels are listed as output candidates; the ones given for candidate a in (39) shall suffice to show that all [dorsal] segments have to be indexed, otherwise, the highest ranked constraint CORR-EG↔AQ is violated. Apart from that, we see that ID-VV(bk) does not apply to neutral vowels, even though they are indexed and in correspondence. As for the underlying specification of the harmonizing segments, a remark has to be made here. Considering all patterns discussed in the present paper, there is no good evidence for either of [±back] specifications in the input of affixes, since ID-IO(bk) will be shown to be the lowest ranked constraint. For reasons of brevity, harmonizing input segments are marked as [+back] in this paper. As the harmonizing segments have a [–back] specification in the output, ID-IO(bk) is ranked lowest in tableau (39) above.

Tableau (40)[11] features another example of vowel harmony, now with two root vowels specified [+back] and [–back], respectively. The example illustrates the necessity of a more specific ID-IO$_{root}$(bk)-constraint: we see that input-output faithfulness on the root level is maintained at the expense of harmony, so that candidate c is not optimal. Neither is candidate b, due to the pairwise evaluation of the ID-VV(bk) constraint. Although not being crucial to the present analysis, the ranking of the ID-IO$_{root}$(bk) and CORR-EG↔AQ constraints, therefore, the two are marked by a dashed line.

(40) *adɛm-lɛr* ‘man-PL’ (WP 203)

I: adɛm-lar	ID-IO$_{root}$(bk)	CORR-EG↔AQ	ID-VV(bk)	ID-IO(bk)
a. a$_i$dɛ$_i$m-la$_i$r			**!	
☞ b. a$_i$dɛ$_i$m-lɛ$_i$r			*	*
c. a$_i$da$_i$m-la$_i$r	*!			*

We now turn to consonant harmony. Tableau (41) exemplifies how the present approach captures consonants being in a harmonic non-local relation without participating vowels. This happens with V-neutral roots and an affix with a harmonizing consonant only. Candidate a in tableaux (41), although violating ID-IO(bk), wins over candidate b, which violates the ID-CC(bk) constraint:

[11] Henceforth, only those output candidates with all [dorsal] segments in correspondence are listed in the tableaux.

(41) *kiʃi-lik* 'human-ADJ' (CRA 12)

I: kiʃi-liq	ID-IO$_{root}$(bk)	CORR-EG↔AQ	ID-CC(bk)	ID-IO(bk)
☞ a. $k_i i ʃ_i i_i$-$li_i k_i$				*
b. $k_i i_i ʃ_i i_i$-$li_i q_i$			*!	

3.6 Interaction of vowel and consonant harmony

The mechanisms to derive vowel harmony and consonant harmony being established, we can now turn to the question how those two processes interact. As has been shown in section 2.4, vowels do not depend on consonants, unless they are the only trigger; consonants agree with the closest corresponding segment, irrespective of whether vowel or consonant. Therefore, the ranking of the three ID-SS(bk) constraints is the following:

(42) ID-VV(bk) ≫ID-VC(bk) ≫ID-CC(bk)

We will first look at the ranking of ID-VC(bk) and ID-CC(bk). Consider example (43) below.

(43) *qudrɛt-lik* 'powerful' (WP 19)

I: qudrɛt-liq	ID-IO$_{root}$(bk)	CORR-EG↔AQ	ID-VV(bk)	ID-VC(bk)	ID-CC(bk)	ID-IO(bk)
a. $q_i u_i$drɛ$_i$t-$li_i q_i$			*	**!		
☞ b. $q_i u_i$drɛ$_i$t-$li_i k_i$			*	*	*	*

Since the disharmony between vowels occurs within the root, both candidates are assigned a violation. As for the output specification of the harmonizing affix consonant, this example shows that the more general constraint considering both vowels and consonants must be higher ranked than the one that requires consonants to have the same feature specification. Candidate b is more optimal than candidate a at the expense of consonant harmony; showing harmony between the closest correspondent and the consonant in question.

This ordering of constraints would predict that, in a counterpart to (43) having vowels of [αback] and a consonant with [βback] as last corresponding segment in the root, the harmonizing consonant agrees with the consonant. Example (44) shows that, indeed, this is the case.

(44) *ɛχmɛq-liq* 'fool' (WP 339)

I: ɛχmɛq-liq	ID-IO$_{root}$(bk)	CORR-EG↔AQ	ID-VV(bk)	ID-VC(bk)	ID-CC(bk)	ID-IO(bk)
☞ a. ɛ$_i$χ$_i$mɛ$_i$q$_i$-$li_i q_i$				*		
b. ɛ$_i$χ$_i$mɛ$_i$q$_i$-$li_i k_i$				**!	*	*

Having shown that the more general constraint ID-VC(bk) must be higher ranked than ID-CC(bk), we will now derive the ranking between ID-VV(bk) and ID-VC(bk). Example (45) illustrates that the case, in which a harmonizing vowel is closer to a harmonic consonant being [+back] than to the harmonic vowel with [–back] specification. Since the harmonizing vowel agrees with the more distant harmonic vowel instead of the closer harmonic consonant, ID-VV(bk) must be ranked over ID-VC(bk).

(45) *hɛqq-i-dɛ* 'concern-POSS3-LOC' (GPC 3)

I: hɛqq-i-da	ID-IO$_{root}$(bk)	CORR-EG↔AQ	ID-VV(bk)	ID-VC(bk)	ID-CC(bk)	ID-IO(bk)
a. $hɛ_iq_iq_i$-i_i-da_i			*!	*		
☞ b. $hɛ_iq_iq_i$-i_i-$dɛ_i$				**		

Nevertheless, yet another case of harmonizing segments found with inconsistent roots needs to be addressed, as its surface specification does not seem to immediately follow from this ranking of constraints. If a harmonizing consonant in the affix is adjacent to both a vowel and consonant participating in harmony, example (46) illustrates that the consonant agrees with the consonant and not with the vowel. This seems to be different from what is predicted, given that ID-VC(bk) is ranked higher than ID-CC(bk).

(46) *kawak-ka* 'pit-DAT' (Hahn 1991*a*: 82)

I: kawak-qa	ID-IO$_{root}$(bk)	CORR-EG↔AQ	ID-VV(bk)	ID-VC(bk)	ID-CC(bk)	ID-IO(bk)
a. $k_ia_iwa_ik_i$-q_ia_i				***	*!	
☞ b. $k_ia_iwa_ik_i$-k_ia_i				***		*
c. $k_ia_iwa_ik_i$-$k_iɛ_i$			*!	**		**

However, the tableau above shows that the candidates a and b equally violate the higher ranked ID-VC(bk) constraint, so that the lower ranked constraint responsible for agreement between consonants becomes relevant as well. Since only candidate a violates the latter constraint, the attested candidate b is also the optimal output candidate predicted by this account.

4 Conclusion

The present paper addressed a typologically rather unusual pattern of non-local vowel-consonant harmony in Uyghur. It was shown that velar and uvular consonants participate in backness harmony and agree at long-distance. Three general patterns of harmony are involved: (i) harmonizing affix vowels always agree with the last vowel of the root in its backness specification; (ii) harmonizing consonants always agree with the closest harmonic or harmonizing segment, irrespective of whether it is vocalic or consonantal; (iii) if the consonant is adjacent to both a harmonic/harmonizing vowel and consonant, it agrees with the consonant.

In contrast to velar/uvular alternations found in other languages, Uyghur could be argued to involve the feature [±back] and not [±high]. This can be viewed as support to emergent features rather than universal ones.

In addition, the dependency of consonant on vowel harmony in Uyghur provides new evidence for the typologically rare type of consonant-to-vowel place assimilations.

As theoretical framework to model these processes, Agreement by Correspondence was chosen, as it inherently distinguishes the feature of similarity that makes segments enter a correspondence and the harmonic feature itself. The data from Uyghur could be shown to be predictable with such a system, [dorsal] being the feature of correspondence and [±back] the harmonic feature. Both consonantal and vocalic transparent segments were shown to be predictable by restrictions on contrast. Hence, this paper shows that besides being applicable to consonant and vowel harmony seperately, ABC can successfully be used to model long-distance vowel-consonant interactions.

The Uyghur corpus

The corpus used consists of several texts that are accessible online as part of the "Uyghur Light Verbs Project" (University of Kansas, 2010-2014, directed by Prof. Arienne M. Dwyer).

Contemporary Uyghur texts
Nurmuhemmet Yasin Orkishi. 2004. *Yawa Kepter*. [Wild Pigeon]. **(WP)**
URL: `https://uyghur.ittc.ku.edu/2013/texts/uig/uig20040324_mr_YawaKepter.xml`
Abduqadir Jalalidin. 2005. *Özini izdesh bosughisida*. [Looking for the threshold of the self], ch. 3. **(TS)**
URL: `https://uyghur.ittc.ku.edu/2013/texts/uig/uig200503_ur1_ch3.xml`
Contemporary broadcast texts from Radio Free Asia
Eqide. *Xitay Amérikidin Güentanamodiki Uyghurlarni qayturup bérishni yene telep qilmaqta*. [China again requests of America to return the Guantanamo Uyghurs]. (13/01/2010). **(CRA)**
URL: `https://uyghur.ittc.ku.edu/2013/texts/uig/uig20100113_wshRFA1.xml`
Shohret Hoshur. *Gogul Xitaydin chiqip ketmekchi*. [Google plans to leave China]. (14/01/2010). **(GPC)**
URL: `https://uyghur.ittc.ku.edu/2013/texts/uig/uig20100114_wshRFA1.xml`
Irade. *Béyjingdiki térrorluqqa qarshi yighin*. [Anti-terrorism meeting in Beijing]. (28/08/2013). **(ATM)**
URL: `https://uyghur.ittc.ku.edu/2013/texts/uig/uig20130828_wsh_RFA1.xml`
Irade. *Xitay hökümiti ichkiri ölkidiki Xinjiang sinipini köpeytmekte*. [Chinese government increases Xinjiang classrooms in Inner China]. (28/08/2013). **(CIC)**
URL: `https://uyghur.ittc.ku.edu/2013/texts/uig/uig20130828_wsh_RFA2.xml`
Contemporary broadcast texts from Chinese National Radio
Abduqadir Hashim. *Shizangdiki partiyining ammiwiy lushen terbiyisi pa'aliyiti*. [Mass transit activities by the Party in Tibet]. (28/08/2013). **(APT)**
URL: `https://uyghur.ittc.ku.edu/2013/texts/uig/uig20130828_bj_CNR1.xml`
Dildar Muhemmedréhim. *Yünnande besh pütün ondin bir bal yer tewridi*. [5.1-magnitude earthquake shakes Yunnan]. (28/08/2013). **(EY)**
URL: `https://uyghur.ittc.ku.edu/2013/texts/uig/uig20130828_bj_CNR2.xml`
"Frog, where are you?"-story
Anonymous speaker. Version 1. (16/07/2010). **(F1)**
URL: `https://uyghur.ittc.ku.edu/2013/texts/uig/uig20100716_il_Frog1.xml`

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