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Reconsidering the Constraint-based Analysis of Kyrgyz Manner Alternation

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1. Introduction

Kyrgyz is a Northwestern Turkic language that shows a manner alternation of /n/ and /l/ such that /n/ and /l/ alternate to obstruent /d/ or /t/ under certain environments. This alternation has received attention in several previous studies. Recently, Gouskova (2004) and Zhu (2018) have applied Optimality Theory (OT, Prince and Smolensky 1993/2004) to its analysis. OT analyzes phonological phenomena by violable constraints and their rankings. However, none of the rankings proposed in previous studies is sufficient to capture Kyrgyz manner alternation. Therefore, this paper proposes a new constraint ranking.

2. Outline of Kyrgyz phonology

2.1. Phoneme inventory

Kyrgyz has eight vowels (/e, a, ø, o, i, u, ü, u/), all of which show vowel harmony, and vowels in suffixes alternate according to the root final vowel. This paper uses /I, U, A/ to represent the underlying forms (i.e., inputs in OT) of vowels that alternate to /i, u, ü, u/, /ü, u/, and /e, a, ø, o/, respectively.

Not counting the consonants that appear only in loanwords, Kyrgyz has 17 consonants, as shown in (1). Here [\pm voiced] is abbreviated as [\pm voi], and affricates are put placed together with stops.

(1)

	Labial		Alveolar		Postalveolar		Dorsal	
	[-voi]	[+voi]	[-voi]	[+voi]	[-voi]	[+voi]	[-voi]	[+voi]
Stop	p	b	t	d	tʃ	dʒ	k	g
Nasal		m		n				ŋ
Lateral				l				
Trill				r				
Fricative			s	z	ʃ			
Glide						j		

2.2. /n/-alternation

/n/-alternation in Kyrgyz is observed in two positions: suffix-initial position and root-final position. First, /n/-alternation in suffix-initial position is seen in /n/-initial suffixes such as the accusative marker /-nI/ and the genitive marker /-nIŋ/. As shown in (2), /n/ in these suffixes alternates to /d/ after any consonant, and if the preceding consonant is voiceless, /d/ is devoiced and eventually becomes /t/ (see [at-tu] in (2)).

(2)¹

Preceding segment	Examples		
G (glide)	/aj/ “month”	/aj-nI/	→ [aj- du]
R (rhotic)	/kar/ “snow”	/kar-nI/	→ [kar- du]
L (lateral)	/rol/ “role”	/rol-nI/	→ [rol- du]
N (nasal)	/dan/ “piece”	/dan-nI/	→ [dan- du]
D (voiced obstruent)	/kuz/ “girl”	/kuz-nI/	→ [kuz- du]
T (voiceless obstruent)	/at/ “horse”	/at-nI/	→ [at- tu]
cf. V (vowel)	/bala/ “child”	/bala-nI/	→ [bala- nu] (No alternation)

It could be argued that the underlying form of suffix-initial /n/ is actually /d/, due to its wide distribution, and /d/ alternates to /n/ when it follows a vowel (e.g., /bala-dI/ → [bala-nu]). If this were correct, it would predict that the sequence [Vd] is not attested in Kyrgyz, as /d/ becomes /n/ after a vowel by the rule that $d \rightarrow n / V _$. However, this prediction is denied by the ablative and locative markers /-dAn/ and /-dA/. The initial consonant /d/ in these suffixes appear as /d/ after a vowel (e.g., /bala-dAn/ → [bala-dan], *[bala-nan] and /bala-dA/ → [bala-da], *[bala-na]). Therefore, the rule $d \rightarrow n / V _$ does not exist in Kyrgyz, and we must assume that the underlying forms of the accusative and genitive markers are /-nI/ and /-nIŋ/, not /-dI/ and /dIŋ/.

Interestingly, this alternation is only observed in /n/-initial suffixes, not in /m/-initial suffixes.² For example, /m/ of the desiderative suffix /-mAktʃI/ does not alternate in any environment.

- (3) /koj-/ “to put” [koj-**m**okʃu], *[koj-**b**okʃu]
 /bar-/ “to go” [bar-**m**aktʃu], *[bar-**b**aktʃu]
 /al-/ “to take” [al-**m**aktʃu], *[al-**b**aktʃu]
 /ajlan-/ “to roll” [ajlan-**m**aktʃu], *[ajlan-**b**aktʃu]
 /dʒaz-/ “to write” [dʒaz-**m**aktʃu], *[dʒaz-**b**aktʃu]
 /ajt-/ “to say” [ajt-**m**aktʃu], *[ajt-**p**aktʃu]

The reason for the difference between /n/ and /m/ is unknown, although Zhu (2018)

¹ This paper uses slashes to indicate phonemes and underlying forms, and morpheme boundaries are indicated not only in underlying forms but also in surface forms for clarity.

² Kyrgyz has another nasal, /ŋ/, but /ŋ/-initial suffix is not attested in Kyrgyz.

indicates that /m/ has a longer duration than /n/. This can be interpreted to mean that /m/ is more robust and /n/ is more tenuous. Thus, the difference in alternation may be connected to the difference in robustness. In any case, this mismatch should be kept in mind when proposing constraints and rankings.

Second, stem-final /n/ also shows alternation, but this alternation is irregular, in that it is found only in the /rn/ sequence. In Kyrgyz, two types of roots end in /C_[+son]n/: /(C)Vrn/ and /(C)Vjn/. This consonant cluster /C_[+son]n/ is preserved when it is followed by vowels; otherwise, it undergoes a high-vowel insertion (see column i. in (4)).³ As Zhu (2018: 469) describes, when the consonant cluster is preserved, /n/ alternates to /d/ in /rn/, but not in /jn/ (see column ii. in (4)).

(4)

Root	i. Citation form	ii. With the 3 rd person possessive suffix
/ern/ “lip”	erin	erd-i (alternates)
/murn/ “nose”	murun	mur <u>d</u> -u (alternates)
/mojn/ “neck”	mojun	moj <u>n</u> -u (not alternate)

Note: Shaded area denotes that no alternation occurs.

Thus, Kyrgyz /n/-alternation can be summarized by rule-based description, as follows.

- (5) a. The rule for suffix-initial /n/: n → d/ C-__
 b. The rule for root-final /n/: n → d/ r__]_{root}

2.3. /l/-alternation

/l/-alternation is observed in /l/-initial suffixes shown in (6).⁴ All suffixes other than /-lAr/ are derivational suffixes.

- (6) a. /-lAʃ/: Derives nouns denoting possessors of a shared attribute from nouns.
 b. /-lIk/: Derives nouns or adjectives from nouns.
 c. /-lIUU/: Derives adjectives from nouns.
 d. /-lA/: Derives verb stems from nouns.
 e. /-lAr/: Plural suffix

³ At first glance, one might assume that these roots already have a high vowel in their underlying form (/erin/), and the high vowel is deleted when a vowel follows the root. However, the Kyrgyz word /ʃirin/ ‘sweetheart’ retains a root-final high vowel in any context (e.g., [ʃirin-i], *[ʃirn-i], ʃird-i] ‘sweetheart.3_{RD.SG.POSS}’). Given the difference between [erd-i] and [ʃirin-i], an insertion analysis is more appropriate than a deletion analysis.

⁴ If there were a root ending in /C_[+son]l/, that root-final /l/ might show alternation as with the case of root-final /n/. However, a root ending in /C_[+son]l/ is not attested in Kyrgyz.

There have been many previous studies of /l/-alternation (Hebert and Poppe 1964: 18, Kasymova et al. 1991: 101, Gouskova 2004: 236-238, Landmann 2011: 5, Zhu 2018: 469-470 and so on). These previous studies agree that /l/ alternates to /d/ after lateral, nasal, and obstruent consonants. These alternations are also attested in my data (see (7a-d), note that /l/ becomes /t/ after voiceless obstruent). However, there are discrepancies among previous studies with regard to /l/-alternation in /jl/ and /rl/ sequences. For example, Hebert and Poppe (1964: 18), Kasymova et al. (1991: 101), and Landmann (2011: 5) described the alternation of /-lAr/, and the first two describe that /l/ alternates after any voiced consonants, including glide /j/ and rhotic /r/, but Landmann (2011: 5) asserts that it does not alternate after /j/ and /r/.

According to my data⁵, /l/ in all these suffixes does not alternate after /j/ and vowels (see (7e, f)), and whether /l/ alternates after /r/ depends on the suffix as described in Suganuma and Akmatalieva (2022). The inflectional suffix /-lAr/ does not alternate after /r/, but other derivational suffixes alternate optionally: both alternated and non-alternated forms are attested, and both forms are acceptable for native speakers (see (7g)).

(7)

Preceding segment	Examples
a. L	ajuul “village” → ajuul- da ʃ “fellow villager” el “nation” → el- di k “national” kural “weapon” → kural- duu “armed” tʃøɫ “desert” → tʃøɫ- dø “to be thirsty” rol “role” → rol- do r “roles”
b. N	zaman “time” → zaman- da ʃ “contemporary” akim “administrator” → akim- di k “administrative” kan “blood” → kan- duu “bloody” num “moisture” → num- da “to moisten” mugalim “teacher” → mugalim- de r “teachers”
c. D	sojuz “union” → sojuz- da ʃ “ally” tez “quickly” → tez- di k “speed” dʒuɫduz “star” → dʒuɫduz- duu “starry” tuz “salt” → tuz- da “to salt” køz “eye” → køz- de r “eyes”
d. T	kuuzmat “service” → kuuzmat- ta ʃ “coworker” bijik “high” → bijik- ti k “height” kubat “power” → kubat- tuu “powerful” ak “white” → ak- ta “to whiten” konok “guests” → konok- to r “guests”

⁵ My data were obtained from the following four native speakers. As for the controversial /l/-alternation in /jl/ and /rl/ sequences, the following steps were taken in the investigation: 27 stems ending in /j/ and 70 stems ending in /t/ were extracted from Krippes’s (1998) Kyrgyz-English dictionary, and native speakers were asked whether suffixes in (6) can be attached to those stems and, if so, whether or not /l/ alternates.

1. Female, born in 1978, from Naryn.
2. Male, born in 1986, from Naryn.
3. Male, born in 1981, from Naryn.
4. Female, born in 1949, from Bishkek.

e. V (No alternation)	sanaa “thought” ene “mother” baa “value” dʒaza “penalty” bala “child”	→ sanaa-laf “sympathizer” → ene-lik “motherhood” → baa-luu “valuable” → dʒaza-la “to punish” → bala-lar “children”
f. G (No alternation)	boj “height” gedej “poor people” maj “grease” suj “prize” aj “month”	→ boj-lof “of the same height” → gedej-lik “poverty” → maj-luu “greasy” → suj-la “to reward” → aj-lar “months”
g. R (Optional alternation in derivational suffixes and no alternation in the inflectional suffix /-lAr/.)	boor “liver” asker “army” zar “sobbing” kadur “respect” kar “snow”	→ boor-lof ~ boor-dof “relative” → asker-lik ~ asker-dik “military” → zar-luu ~ zar-duu “sorrowful” → kadur-la ~ kadur-da “to respect” → kar-lar, *kar-dar “a lot of snow”

Note: Shaded area denotes that no alternation occurs.

We can summarize Kyrgyz /l/-alternation as follows.

- (8) a. The rule for (7a-d) : $l \rightarrow d/ \{L, N, D, T\}_-$
 b. The rule for (7g) : $l \rightarrow d/ r_-$ (This rule is applied optionally iff /l/ belongs to a derivational suffix.)

In the next section, we see how these /n/- and /l/-alternation are analyzed in OT.

3. Previous OT analyses of Kyrgyz manner alternation and their problems

3.1. Basic assumptions of OT

Before delving into the problems of prior OT analyses of Kyrgyz manner alternation, we review the essential assumptions of OT and present how to see “tableaus” in OT. To analyze phonological phenomena, OT employs violable constraints and constraint rankings rather than phonological rules. The grammar is assumed to generate an infinite number of output candidates from a given input (i.e., underlying form), and these candidates are evaluated by a constraint ranking. This evaluation continues until the optimal output is chosen; here an optimal output is one that incurs the least serious violation of a set of constraints, and the optimal output must be identical to the actual surface form.

OT uses tableaus for analysis, as shown in (9). Input and output candidates are indicated on the left side of the tableau. In (9), the input is /X/, and [X, Y, Z] are output candidates generated from /X/, furthermore, we assume a constraint ranking $No X > No Y > No Z$ as an example here. Each of these constraints prohibits the emergence of X, Y, and Z in the output, respectively. Higher-ranked constraints are indicated on the left side of the tableau. In the case of (9), although output Z violates No Z, Z is chosen as the optimal output since the other candidates violate higher-level constraints (i.e., No X and No Y), and are

eliminated from the evaluation (i.e., these candidates are considered to be ineligible as outputs).

(9)

		Constraints		
		Higher-ranked ←		→ Lower-ranked
Input	Generated output candidates ⁶	No X	No Y	No Z
/X/	[X]	*!		
	[Y]		*!	
	☞ [Z]			*

Legends

- *: The candidate violates the constraint.
- *!: The crucial violation (The candidate is eliminated from the evaluation).
- ☞: The candidate is chosen as the optimal output.
- The shaded area is no longer relevant for evaluation either because the optimal output has already been chosen, or because the candidate in question has already been eliminated, having violated a higher constraint.

All candidates may occasionally violate the higher-level constraints. The evaluation is left to the lower-ranked constraints in this scenario. In (10), for example, both candidates violate No X. However, the output XY, which also violates the lower constraint No Y, is discarded from evaluation.

(10)

Input	Output candidates	No X	No Y
/XZ/	☞ [XZ]	*	
	[XY]	*	*!

Occasionally, multiple constraints may exist at the same position on the ranking. This can lead to multiple outputs being optimal. In (11), No Y and No Z are in the same position on the ranking, and both candidates Y and Z are chosen as the optimal outputs. Such cases are seen in optional alternation and/or free variation.

(11)

Input	Output candidates	No X	No Y, No Z
/X/	[X]	*!	
	☞ [Y]		*
	☞ [Z]		*

⁶ Since the grammar generates an infinite number of outputs, there can be other outputs than these three, such as [W]. OT assumes that outputs such as [W] are eliminated by the higher-ranked constraints, which are omitted in the tableau due to space limitations (e.g., NO W, etc.). Thus, in OT, constraints and candidates that are not closely involved in the discussion are often omitted from the tableau.

In the next section, we review Gouskova (2004).

3.2. Gouskova (2004)

We should first note that Gouskova's (2004) data are drawn from Hebert and Poppe (1964) and Kasymova et al. (1991), both of which state that suffix initial /n/ and /l/ alternate after any consonant including /j/ and /r/. Therefore, [kar-**dar**] and [aj-**dar**] are the outputs of /kar-lAr/ "a lot of snow" and /aj-lAr/ "months" in her OT analysis, which is not the case in my data (see (7f, g)). This section views her data as one of the variants of Kyrgyz and points out the problems that occur when her rankings are applied to my data.

Gouskova (2004) deals with not only Kyrgyz, but also Kazakh, Faroese, and several other languages, and her study is one of the studies of the Syllable Contact Law (SCL). SCL is a constraint that requires falling sonority to heterosyllabic coda and onset, and it can be formulated as in (12) below. This type of constraint has been assumed in many studies, as there is a cross-linguistic preference for falling sonority across a syllable boundary (e.g., Murray and Venneman 1983; Davis 1998; Baertsch and Davis 2004).

(12) Syllable Contact Law

A syllable contact A\$B is preferred more, the greater the sonority of the offset A and the less the sonority of the onset B. [Davis 1998: 182 (2)]

Let us illustrate how this constraint works by taking /kan.-lUU./ and its output [kan.-duu.] "bloody" as an example. There is a consonant sequence /n.l/ in this word, and /n/ and /l/ correspond to A and B in (12). /n.l/ has a rising sonority since the sonority of the nasal is less than that of the laterals according to the general sonority scale shown in (13). Therefore, the SCL requires /l/ to have less sonority than /n/ and motivates /l/ to alternate to /d/.

(13) Sonority scale

More sonorous ←—————
 V (vowels) > G (glides) > R (rhotics) > L (laterals) > N (nasals) > Z (voiced fricatives) > D (voiced stops) > S (voiceless fricatives) > T (voiceless stops)
 —————→ Less sonorous

[Based on Jespersen (1904:18)]

Gouskova (2004) assumes that SCL is behind Kyrgyz manner alternation. She proposes a fine-grained SCL constraint hierarchy that consists of many *DIS(TANCE) constraints shown in (14). *DIS 0 bans a flat sonority, where A and B in A\$B have the same sonority. *DIS +1 and *DIS -1 ban consonant sequences in which the sonority of B is one degree up or down from that of A, respectively (e.g., +1: LR, RG, -1: NZ, ST). Similarly, the

(15) Analysis of /n/-alternation based on Gouskova (2004)⁸

Inputs	Output candidates	*DIS +5 ~ +1	*DIS 0	*DIS -1	*DIS -2	*DIS -3	ID [F]	*DIS -4, -5
a. bala-nI child-ACC	☞ bala-nuu							
	☞ bala-duu						*! [+nas]	
b. aj-nI month-ACC	☞ aj-nuu					*!		
	☞ aj-duu						* [+nas]	* -5
c. kar-nI snow-ACC	☞ kar-nuu				*!			
	☞ kar-duu						* [+nas]	* -4
d. rol-nI role-ACC	☞ rol-nuu			*!				
	☞ rol-duu					*	* [+nas]	
e. dan-nI piece-ACC	☞ dan-nuu		*!					
	☞ dan-duu				*		* [+nas]	
f. kwuz-nI girl-ACC	☞ kwuz-nuu	*! +1						
	☞ kwuz-duu			*			* [+nas]	
g. at-nI horse-ACC	☞ at-nuu	*! +4						
	☞ at-tuu		*				* [+voi], [+nas]	

(16) Analysis of /l/-alternation based on Gouskova (2004)

Inputs	Output candidates	*DIS +5 ~ +1	*DIS 0	*DIS -1	*DIS -2	*DIS -3	ID [F]	*DIS -4, -5
a. bala-lAr childe-PL	☞ bala-lar							
	☞ bala-dar						*! [+lat]	
b. aj-lAr month-PL	☞ aj-lar				*!			
	☞ aj-dar						* [+lat]	* -5
c. kar-lAr snow-PL	☞ kar-lar			*!				
	☞ kar-dar						* [+lat]	* -4
d. rol-lAr role-PL	☞ rol-lor		*!					
	☞ rol-dor					*	* [+lat]	
e. dan-lAr piece-PL	☞ dan-lar	*! +1						
	☞ dan-dar				*		* [+lat]	
f. kwuz-lAr girl-PL	☞ kwuz-lar	*! +2						
	☞ kwuz-dar			*			* [+lat]	
g. at-lAr horse-PL	☞ at-lar	*! +5						
	☞ at-tar		*				* [+voi], [+lat]	

Gouskova's (2004) constraint ranking successfully captures /n/- and /l/-alternation in her data. However, it does not consider no alternation of /m/-initial suffixes and root-final /n/-alternation, so her analysis is not completely sufficient. Moreover, applying her rankings to my data (i.e., other variants of Kyrgyz) raises at least two problems. First, this ranking requires all /r/ to alternate to /rd/ since *DIS -1 outranks ID [F]. Therefore, it cannot account for the fact that /-lAr/ does not show /l/-alternation in /r/ sequences, whereas /l/-initial suffixes other than /-lAr/ show optional alternation in /r/ sequences

⁸ Note that Gouskova (2004) provided only tableaux for /aj-lAr/, /kar-lAr/, and /aj-nI/ and did not provide detailed tableaux like (15) and (16). However, we can draw these tableaux by following her ranking.

shown in (7g).

Second, the ranking $*DIS -2 > *DIS -3 > ID [F]$ means that /jl/, /rn/, /jn/ and /jl/ are all prohibited since they have a -2 or -3 distance and violate $*DIS -2$ and $*DIS -3$. However, only /jl/ is allowed in my data (see (17b) below). For [aj-lar] to be selected as the optimal output, it is necessary to separate $*DIS -2$ for /jl/ and $*DIS -2$ for /rn/, placing the former below ID [F] ($*DIS -2$ for /rn/ $> *DIS -3 > ID [F] > *DIS -2$ for /jl/). However, if we do so, the constraint hierarchy in (14), which she states is cross-linguistic, will not hold in the Kyrgyz variant found in my data, as the reversal of $*DIS -2$ for /rl/ and $*DIS -3$ occurs (see (18) below).

(17) Evaluation of /aj-nI/, /aj-lAr/, and /kar-nI/

Inputs	Output candidates	*DIS -2	*DIS -3	ID [F]	*DIS -4, -5
a. aj-nI month-ACC	aj-nu		*!		
	☞ aj-du			* _[+nas]	* ₋₅
b. aj-lAr month-PL	☞ aj-dar			* _[+lat]	* ₋₅
	☞ aj-lar	*!			
c. kar-nI snow-ACC	kar-nu	*!			
	☞ kar-du			* _[+nas]	* ₋₄

Note: ☞ stands for an output that is wrongly chosen as the optimal one, and ☞ stands for the correct output.

(18) Reversal of $*DIS -2$ for /rl/ and $*DIS -3$

Inputs	Output candidates	*DIS -2 for /rn/	*DIS -3	ID [F]	*DIS -2 for /jl/	*DIS -4, -5
a. aj-nI month-ACC	aj-nu		*!			
	☞ aj-du			* _[+nas]		* ₋₅
b. aj-lAr month-PL	aj-dar			* _[+lat] !		* ₋₅
	☞ aj-lar				*	
c. kar-nI snow-ACC	kar-nu	*!				
	☞ kar-du			* _[+nas]		* ₋₄

3.3. Zhu (2018)

With respect to /n/-alternation, Zhu's (2018) data are consistent with my own. That is, the suffix-initial /n/ alternates after any consonant, and the root-final /n/ alternates only in /rn/ but not in /jn/. With respect to /l/-alternation, he deals with only /-lAr/ and /-lIk/, but his data are consistent with my own except for the case of /-lIk/ in the /rl/ sequence, for which he states that /-lIk/ always alternates after /r/, although it shows optional alternation in my data. In addition, he also notes in a footnote that the other /l/-initial suffix /-lA/ has both alternated and non-alternated forms. His brief discussion of /-lA/ seems to indicate that it shows an optional alternation, but he did not provide a specific analysis for it.

He proposes the constraints shown in (19) and analyzes /n/- and /l/-alternation as shown from (20) to (22).

- (19)⁹ a. *[n]/¬{V__}: Assign a violation mark for each [n] lacking a preceding vowel.
i.e., A consonant sequence [Cn] violates this constraint.
- b. *[n]/¬{[-cons]__}: Assign a violation mark for each [n] lacking a preceding segment with the feature [-consonantal].
i.e., A consonant sequence [Cn] other than [jn] violates this constraint.
- c. *[l]/¬{[-cons]__}: Assign a violation mark for each [l] lacking a preceding segment with the feature [-consonantal].
i.e., A consonant sequence [Cl] other than [jl] violates this constraint.
- d. *[l]/¬{[+s(on)], [-n(as)], [-l(at)]__}: Assign a violation mark for each [l] lacking a preceding segment with the feature [+son], [-nas], [-lat].
i.e., A consonant sequence [Cl] other than [jl] and [rl] violates this constraint.
- e. *[+LAT]: Assign a violation mark for each [l] in the outputs.
- f. ID(ENT)-NAS: The feature [±nasal] in the inputs must be preserved in its output correspondent.
- g. ID(ENT)-LAT: The feature [±lateral] in the inputs must be preserved in its output correspondent.
- h. ID(ENT)-NAS_{STEM}: The feature [±nasal] in the inputs of the stem (i.e., root) must be preserved in its output correspondent.
- i. ID(ENT)-LAT_{LAR}: The feature [±lateral] in the inputs of the suffix /-lAr/ must be preserved in its output correspondent.

(20) Tableau for the suffix-initial /n/-alternation

Inputs	Output candidates	ID-LAT, *[n]/¬{V__}	ID-NAS	*[+LAT]
aj-nI month-ACC	aj-nu	*[n]/¬{V__}!		
	aj-lu		*	*!
	☞aj-du		*	
bala-nI child-ACC	☞bala-nu			*
	bala-du		*!	*
	bada-nu	*ID-LAT!		

[Based on (5) and (6) in Zhu (2018)]

(21) Tableau for the root-final /n/-alternation

Inputs	Output candidates	*[n]/¬{[-cons]__}	ID-NAS _{STEM}	*[n]/¬{V__}
karn-I stomach-3.POSS	karn-u	*!		*
	☞kard-u		*	
mojn-I neck-3.POSS	☞mojn-u			*
	mojd-u		*!	

[Based on (7) in Zhu (2018)]

⁹ In addition to these constraints, Zhu (2018) proposes DEP-V (no insertion of vowels) and eliminates a vowel-inserted candidate (e.g., [aju-nu]). In tableau (20) to (22), DEP-V and vowel-inserted candidates are omitted.

duu]), this paper creates a ranking in which both the alternated form and the non-alternated form are chosen as the optimal output.

First, to limit the allophones of /n/ and /l/ to /d/ and /t/, this paper proposes the following distinctive feature and constraints.

(26) [\pm touch]¹¹

Consonants with [+touch] = Lateral, nasal, stops, affricates

Consonants with [-touch] = Fricatives, glides, trills

A segment is said to be [+touch] if it involves a non-instantaneous contact between the speech organs in the oral portion of the vocal tract.

- (27) a. ID_{PL(ACE)}: The place features in the inputs must be preserved in its output correspondent.
 b. ID_[+TOUCH]: The feature [+touch] in the inputs must be preserved in its output correspondent.

These constraints are at the top of the ranking and guarantee that /n/ and /l/ will alternate to only alveolar consonants with [+touch] (i.e., /l, n, d, t/), as shown in (28) below. We should note that [nar] and [li], which are not attested in Kyrgyz, are chosen as one of the optimal outputs in (28), but they are eliminated by other constraints proposed later.

(28)

Inputs	Output candidates	ID _{PL} , ID _[+TOUCH]
-lAr	☞ -lar, -dar, -tar, -nar	
	-rar, -zar	*! _[+TOUCH]
	-tʃar, -mar	*! _{PL}
-nI	☞ -ni, -di, -ti, -li	
	-ri, -zi	*! _[+TOUCH]
	-tʃi, -mi	*! _{PL}

In addition to these constraints, others that prohibit the alternation of root-internal segments other than /rn/ and yet another that prohibits the alternation of /m/-initial suffixes are also at the top of the ranking (e.g., ID_{ROOT [±VOI]}, ID-/M/, MAX, DEP, etc.).¹²

¹¹ Although [\pm touch] is proposed here for the first time, there are sound alternations in other Turkic languages that can be explained by introducing this feature. For example, /l/ alternates to fricative /ð/ after /w, j, r, ð/ in Bashkir (Berta 1998: 285). This can be regarded as the assimilation of [-touch].

¹² The definitions of these constraints are as shown below:

ID_{ROOT [±VOI]}: The feature [\pm voiced] in the inputs of the root must be preserved in its output correspondent.

ID-/M/: The segment /m/ must be preserved in its output correspondent.

These constraints prevent the root-internal alternation (e.g., /kuuz-lAr/ to [kuj-lar], [ku-lar], or [kuza-lar] etc.), and the alternation of /m/-initial suffixes. The remainder of the OT tableaux of this paper assume the existence of these constraints and omit them due to space limitations. Furthermore, only those candidates where the alternating consonant is realized as either [l], [n], [d], or [t] will be considered, since other candidates will be eliminated by these omitted constraints.

To explain the difference between root-final /rn/ and /jn/, this paper proposes the following constraint ranking.

- (29) Ranking: $*[C_{[LIQUID]N}] > ID_{ROOT[NAS]} > *[JN]$
- $*[C_{[LIQUID]N}]$: [rn] and [ln] are banned.
 - $ID_{ROOT[NAS]}$: The feature [\pm nasal] in the inputs of the root must be preserved in its output correspondent.
 - $*[JN]$: [jn] is banned.

This ranking eliminates the candidates [karn-u] and [mojd-u], as shown in (30).

(30) Tableau of $*[C_{[LIQUID]N}] > ID_{ROOT[NAS]} > *[JN]$

Inputs	Output candidates	$*[C_{[LIQUID]N}]$	$ID_{ROOT[NAS]}$	$*[JN]$
karn-I	karn-u	*!		
stomach-3.POSS	☞ kard-u		*	
mojn-I	☞ mojn-u			*
neck-3.POSS	mojd-u		*!	

$*[C_{[LIQUID]N}]$ and $*[JN]$ are also useful for explaining suffix-initial /n/-alternation. To explain the whole /n/-alternation, the following constraints and ranking are needed.

- (31) Ranking: $AGR-[\pm VOI], *RIS\ SON, *[C_{[LIQUID]N}] > ID_{ROOT[NAS]} > *FLAT, *[JN] > ID_{INFL\ SUF} > *[JL]$
- $AGR-[\pm VOI]$: A and B in A\$B must agree [\pm voi].
 - $*RIS(ING)\ SON$: B in A\$B must not have a higher sonority than A.
 - $*FLAT$: A and B in A\$B must not have the same sonority.
 - $ID_{INFL\ SUF}$: The specification of features of an input segment in the inflectional suffix must be preserved in its output correspondent.
 - $*[JL]$: [jl] is banned.

Here, the term inflectional suffix in (31d) includes the plural marker /-lAr/ and declensional suffixes, that is, the accusative and genitive markers /-nI/ and /-nIn/. ID_{INFL}

MAX: No deletion of segments.

DEP: No insertion of segments.

SUF is needed to explain that /n/ does not alternate after a vowel. This constraint must be lower than *FLAT for [dan-du] “piece_{.ACC}” to be selected as optimal outputs (see (32)). For [snarjad-du] “missile_{.ACC}” and [at-tu] “horse_{.ACC}” to be selected as optimal outputs, AGR-[±VOI] and *RIS SON must be higher than *FLAT (see (33)).¹³ Furthermore, *[JN] and *[JL] are needed to eliminate the candidate [aj-nu] and [aj-lu] for [aj-du] to be selected as the optimal output (see (34)). To explain /n/-alternation, the position of *[JL] in the ranking can be anywhere. However, its position must be lower than ID_{INFL SUF} to explain the /l/-alternation.

(32)

Inputs	Output candidates	*FLAT	ID _{INFL SUF}
dan-nI piece-ACC	dan-nu	*!	
	☞ dan-du		*

(33)

Inputs	Output candidates	AGR-[±VOI], *RIS SON	*FLAT
snarjad-nI missile-ACC	snarjad-nu	*!*RIS	
	☞ snarjad-du		*
	snarjad-tu	*! _{AGR}	
at-nI horse-ACC	at-nu	**! _{AGR, *RIS}	
	☞ at-tu		*

(34)

Inputs	Output candidates	*[JN]	ID _{INFL SUF}	*[JL]
aj-nI month-ACC	aj-nu	*!		
	aj-lu		*	*!
	☞ aj-du		*	

Regarding /l/-alternation, we saw that the inflectional suffix /-lAr/ does not alternate after /r/, whereas that of the derivational suffixes show optional alternation. To capture this difference, this paper proposes additional constraints shown in (35a, b) and add them between ID_{INFL SUF} and *[JL] in the ranking.

¹³ To show the necessity of a ranking AGR-[±VOI] > *FLAT, here, a loanword [snarjad-du] is taken as an example since it has a flat sonority [d-d]. Strictly speaking, however, the pronunciation [snarjad-du] is found only when the spelling “снаряд-ды” is pronounced correctly, and in most cases, it is pronounced [snarjat-tu]. The ranking here is retained as far as we consider the pronunciation of [snarjad-du]. If we do not consider [snarjad-du], then there is no need to assume AGR-[±VOI] > *FLAT. We only must assume that AGR-[±VOI] is higher than ID_{INFL SUF} and ID_{DER SUF}, which prevent voicing assimilation. The reason why this loanword is taken as an example is that Kyrgyz native words can end in voiced fricatives (e.g., [kuz-du] ‘girl_{.ACC}’) but not voiced stops, and the consonant sequence [z-d] has falling sonority. Thus, [z-d] will not have a violation mark on *FLAT and cannot show the necessity of AGR-[±VOI] > *FLAT.

(35) Ranking: AGR-[±VOI], *RIS SON, *C_{[LIQUID]N}] > ID_{ROOT_[NAS]} > *FLAT, *[JN] > ID_{INFL SUF} > ID_{DER SUF}, *RL] > *[JL]

- a. ID_{DER SUF}: The specification of features of an input segment in the derivational suffix must be preserved in its output correspondent.
- b. *RL]: [rɫ] is banned.

The ranking ID_{INFL SUF} > ID_{DER SUF} > *[JL] successfully explains that /l/ of all suffixes does not alternate after /j/ (see (36)). In the same way, ID_{INFL SUF} > *RL] captures the fact that /l/ of the inflectional suffix /-lAr/ does not alternate after /r/ (see (37)).

As for ID_{DER SUF} and *RL], there is no order between them. This means that both the alternated and non-alternated forms receive a violation mark at the same location, and because other candidates violate the higher-level constraints, both the alternated and non-alternated forms are chosen as the optimal outputs (see (38)). This ranking captures the optional /l/-alternation in (7g).

(36)

Inputs	Output candidates	ID _{INFL SUF}	ID _{DER SUF}	*[JL]
aj-lAr _{INFL} month-PL	aj-dar	*!		
	↗aj-lar			*
maj-lUU _{DER} grease-LUU	maj-duu		*!	
	↗maj-luu			*

(37)

Inputs	Output candidates	ID _{INFL SUF}	* <u>RL</u>]
kar-lAr _{INFL} snow-PL	kar-dar	*!	
	↗kar-lar		*

(38)

Inputs	Output candidates	AGR-[±VOI], * <u>C_{[LIQUID]N}</u>]	ID _{DER SUF} , * <u>RL</u>]
zar-lUU _{DER} sorrow-LUU	zar-tuu	*! AGR	* ID _{DER}
	zar-nuu	*! * <u>C_{[LIQUID]N}</u>]	* ID _{DER}
	↗zar-duu		* ID _{DER}
	↗zar-luu		* <u>RL</u>]

To provide an overall confirmation, the tableaux from (39) to (42) include the candidates where the alternating consonant is realized as either [l], [n], [d], or [t], and indicate that the ranking in (35) selects the correct output. From (39) to (42), the relevant constraints are underlined, and only those are shown in the tableau.

(39) The root-final /n/-alternation: $\text{AGR-}[\pm\text{VOI}], *RIS\text{ SON}, *C_{[\text{LIQUID}]N} > \text{ID}_{\text{ROOT}[\text{NAS}]}$
 $> *FLAT, *[JN] > \text{ID}_{\text{INFL SUF}} > \text{ID}_{\text{DER SUF}}, *RL > *[JL]$

Inputs	Output candidates	$\text{AGR-}[\pm\text{VOI}], *C_{[\text{LIQUID}]N}$	$\text{ID}_{\text{ROOT}[\text{NAS}]}$	$*[JN]$	$*[RL]$
karn-I stomach-3.POSS	karn-u	*! $*C_{[\text{LIQUID}]N}$			
	☞kard-u		*		
	karl-u		*		*!
	kart-u	*! $_{\text{AGR}}^{14}$	*		
mojn-I neck-3.POSS	☞mojn-u			*	
	mojd-u		*!		
	mojl-u		*!		
	mojt-u	*! $_{\text{AGR}}$	*		

(40) Suffix-initial /n/-alternation: $\text{AGR-}[\pm\text{VOI}], *RIS\text{ SON}, *C_{[\text{LIQUID}]N} > \text{ID}_{\text{ROOT}[\text{NAS}]}$
 $> *FLAT, *[JN] > \text{ID}_{\text{INFL SUF}} > \text{ID}_{\text{DER SUF}}, *RL > *[JL]$

Inputs	Output candidates	$\text{AGR-}[\pm\text{VOI}], *RIS\text{ SON}, *C_{[\text{LIQUID}]N}$	$*FLAT, *[JN]$	$\text{ID}_{\text{INFL SUF}}$	$*[RL]$	$*[JL]$
bala-nI child-ACC	☞bala-nuu					
	bala-duu			*!		
	bala-luu			*!		
	bala-tuu			*!		
aj-nI month-ACC	aj-nuu		*! $*[JN]$			
	☞aj-duu			*		
	aj-luu			*		*!
	aj-tuu	*! $_{\text{AGR}}$		*		
kar-nI snow-ACC	kar-nuu	*! $*C_{[\text{LIQUID}]N}$				
	☞kar-duu			*		
	kar-luu			*	*!	
	kar-tuu	*! $_{\text{AGR}}$		*		
rol-nI role-ACC	rol-nuu	*! $*C_{[\text{LIQUID}]N}$				
	rol-luu		*! $*FLAT$	*		
	☞rol-duu			*		
	rol-tuu	*! $_{\text{AGR}}$		*		
dan-nI piece-ACC	dan-nuu		*! $*FLAT$			
	☞dan-duu			*		
	dan-luu	*! $*RIS$		*		
	dan-tuu	*! $_{\text{AGR}}$		*		
snarjad-nI missile-ACC	snarjad-nuu	*! $*RIS$				
	☞snarjad-duu		* $*FLAT$	*		
	snarjad-luu	*! $*RIS$		*		
	snarjad-tuu	*! $_{\text{AGR}}$		*		
at-nI horse-ACC	at-nuu	**! $_{\text{AGR}, *RIS}$				
	at-duu	**! $_{\text{AGR}, *RIS}$		*		
	at-luu	**! $_{\text{AGR}, *RIS}$		*		
	☞at-tuu		* $*FLAT$	*		

¹⁴ Since the root-final consonant sequences like /rt/ and /jt/ are allowed in Kyrgyz (e.g., /tart-/ “to pull”, and /ajt-/ “to say”), we may consider that [kart-u] and [mojt-u] are excluded not because they violate $\text{AGR-}[\pm\text{VOI}]$, but because they violate $\text{ID}_{\text{ROOT}[\pm\text{VOI}]}$, which requires the outputs to preserve root internal $[\pm\text{voiced}]$.

(41) Suffix-initial /l/-alternation (in the case of inflectional suffix /-lAr/):

$\text{AGR-}[\pm\text{VOI}], *RIS\text{ SON}, *[C_{\text{LIQUID}}]N > \text{ID}_{\text{ROOT}}[\text{NAS}] > *FLAT, *[JN] > \text{ID}_{\text{INFL}}\text{SUF} > \text{ID}_{\text{DER}}\text{SUF}, *[RL] > *[JL]$

Inputs	Output candidates	AGR-[±VOI], *RIS SON *[C _{LIQUID}]N	*FLAT *[JN]	ID _{INFL} SUF	*[RL]	*[JL]
bala-lAr child-PL	☞ bala-lar					
	bala-dar			*!		
	bala-nar			*!		
	bala-tar			*!		
aj-lAr month-PL	☞ aj-lar					*
	aj-dar			*!		
	aj-nar		*!*[JN]	*		
	aj-tar	*! AGR		*		
kar-lAr snow-PL	☞ kar-lar				*	
	kar-dar			*!		
	kar-nar	*!*[C _{LIQUID}]N		*		
	kar-tar	*! AGR		*		
rol-lAr role-PL	rol-lor		*! *FLAT			
	☞ rol-dor			*		
	rol-nor	*!*[C _{LIQUID}]N		*		
	rol-tor	*! AGR		*		
dan-lAr piece-PL	dan-lar	*! *RIS				
	☞ dan-dar			*		
	dan-nar		*! *FLAT	*		
	dan-tar	*! AGR		*		
snarjad-lAr missile-PL	snarjad-lar	*! *RIS				
	☞ snarjad-dar		* *FLAT	*		
	snarjad-nar	*! *RIS		*		
	snarjad-tar	*! AGR		*		
at-lAr horse-PL	at-lar	**! AGR, *RIS				
	at-dar	**! AGR, *RIS		*		
	at-nar	**! AGR, *RIS		*		
	☞ at-tar		* *FLAT	*		

(42) Suffix-initial /l/-alternation (in the case of derivational suffixes e.g., /-llk/):

$$\text{AGR-}[\pm\text{VOI}], *RIS\text{ SON}, *[C_{[LIQUID]N}] > ID_{\text{ROOT} [NAS]} > *FLAT, *[JN] > \\ ID_{\text{INFL SUF}} > ID_{\text{DER SUF}}, *[RL] > *[JL]$$

Inputs	Output candidates	AGR- $[\pm\text{VOI}]$, *RIS SON *[C _{[LIQUID]N}]	*FLAT *[JN]	ID _{DER SUF} , *[RL]	*[JL]
ene-llk mother-LIK	☞ ene-lik				
	ene-dik			*! ID _{DER}	
	ene-nik			*! ID _{DER}	
	ene-tik			*! ID _{DER}	
gedej-llk poor people-LIK	☞ gedej-lik				*
	gedej-dik			*! ID _{DER}	
	gedej-nik		*!*[JN]	* ID _{DER}	
	gedej-tik	*! AGR		* ID _{DER}	
asker-llk army-LIK	☞ asker-lik			**[RL]	
	☞ asker-dik			* ID _{DER}	
	asker-nik	*!*[C _{[LIQUID]N}]		* ID _{DER}	
	asker-tik	*! AGR		* ID _{DER}	
el-llk nation-LIK	el-lik		*! *FLAT		
	☞ el-dik			* ID _{DER}	
	el-nik	*!*[C _{[LIQUID]N}]		* ID _{DER}	
	el-tik	*! AGR		* ID _{DER}	
akim-llk administrator-LIK	akim-lik	*! *RIS			
	☞ akim-dik			* ID _{DER}	
	akim-nik		*! *FLAT	* ID _{DER}	
	akim-tik	*! AGR		* ID _{DER}	
tez-llk quickly-LIK	tez-lik	*! *RIS			
	☞ tez-dik			* ID _{DER}	
	tez-nik	*! *RIS		* ID _{DER}	
	tez-tik	*! AGR		* ID _{DER}	
bijik-llk high-LIK	bijik-lik	**! AGR,*RIS			
	bijik-dik	**! AGR,*RIS		* ID _{DER}	
	bijik-nik	**! AGR,*RIS		* ID _{DER}	
	☞ bijik-tik		* *FLAT	* ID _{DER}	

5. Conclusion

This paper identified certain shortcomings of previous studies and proposed the following constraint ranking which accounts for Kyrgyz manner alternation.

$$(43)=(35) \text{ AGR-}[\pm\text{VOI}], *RIS\text{ SON}, *[C_{[LIQUID]N}] > ID_{\text{ROOT} [NAS]} > *FLAT, *[JN] > \\ ID_{\text{INFL SUF}} > ID_{\text{DER SUF}}, *[RL] > *[JL]$$

However, we have assumed seemingly ad-hoc four constraints: *[C_{[LIQUID]N}], *[JN], *[RL] and *[JL]. Perhaps these four constraints should be interpreted as the following three constraints in (44) and/or as composites of them (see (45)).

- (44) a. $*C_{[+son(orant)]}C_{[+son(onorant)]}$: Both A and B in A\$B must not be sonorant.
 b. $*C_{[+alve(olar)]}C_{[+alve(olar)]}$: Both A and B in A\$B must not be alveolar.
 c. AGR- $[\pm NAS(AL)]$: A and B in A\$B must agree $[\pm NAS]$.

(45) Internal organization of $*[C_{[LIQUID]N}]$, $*[JN]$, $*[RL]$ and $*[JL]$ ¹⁵

- a. $*[C_{[LIQUID]N}]$: $*C_{[+son]}C_{[+son]}$, $*C_{[+alve]}C_{[+alve]}$ and AGR- $[\pm NAS]$
 b. $*[JN]$: $*C_{[+son]}C_{[+son]}$ and AGR- $[\pm NAS]$
 c. $*[RL]$: $*C_{[+son]}C_{[+son]}$ and $*C_{[+alve]}C_{[+alve]}$
 d. $*[JL]$: $*C_{[+son]}C_{[+son]}$

Composite constraints (45a–c) assign a violation mark for each structure that violates all the internal constraints. For example, $*[C_{[LIQUID]N}]$ assigns a violation mark for [ln] but not for [nn]; both [ln] and [nn] violate $*C_{[+son]}C_{[+son]}$ and $*C_{[+alve]}C_{[+alve]}$, but [ln] also violates AGR- $[\pm NAS]$, while [nn] does not.¹⁶

(44a, b) and (44c) require the dissimilation and assimilation of certain features, respectively. Given that dissimilation and assimilation are found cross-linguistically, we can say that constraints in (44) and (45) succeed in reducing the ad-hocness of the four constraints. In Kyrgyz, these dissimilation and assimilation constraints work alongside SCL, resulting in the consonant alternations examined in this paper. Note that at this time, we consider constraints in (44) and (45) as independent of the SCL, but since $*C_{[+son]}C_{[+son]}$ involves consonant sonority as in the SCL, it may be associated with the SCL. Future studies are needed to clarify the relationship between the SCL and $*C_{[+son]}C_{[+son]}$.

Besides this task, we must determine whether the constraints proposed in this paper can account for manner alternations in other Turkic languages. The advantage of OT over rule-based analysis is that it can account for phonological variations among languages by rearrangement of the same constraint set. This makes it easier to understand the phonological differences among languages. Clarifying the set of constraints necessary to explain manner alternations across the Turkic languages and identifying what motivates such alternation could provide a better understanding of Turkic languages and their phonology.

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¹⁵ The reviewer asked why [jn] is less preferred than [jl] despite the greater sonority difference observed between [j] and [n] than between [j] and [l]. Based on the composition assumption in (45), we can state that this is because [jn] violates more constraints than [jl].

¹⁶ However, [nn] is eventually eliminated from evaluation by *FLAT.

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Summary

Kyrgyz shows manner alternation of /n/ and /l/; that is, /n/ and /l/ alternate to obstruent /d/ or /t/ under certain environments. /n/-alternation in Kyrgyz is observed in two positions: suffix-initial position and root-final position: the suffix-initial /n/ alternates after any consonant ($n \rightarrow d/ C_ _$), while the root-final /n/ alternates after /r/ ($n \rightarrow d/ r_ _$]_{root}). /l/-alternation occurs in /l/-initial suffixes; /l/ alternates after any consonant other than /j/ and /r/ ($l \rightarrow d/ \{C_{[+lateral]}, C_{[+nasal]}, C_{[-sonorant]}\} - _ _$) and /l/ optionally alternates after /r/ only if /l/ belongs to a derivational suffix ($l \rightarrow d/ r - _ _$).

Recently, Gouskova (2004) and Zhu (2018) have applied Optimality Theory (OT, Prince and Smolensky 1993/2004) to the analysis of these alternations. OT analyzes phonological phenomena by violable constraints and their rankings. However, none of the rankings proposed in previous studies is sufficient to capture Kyrgyz manner alternation. For example, Gouskova's (2004) ranking predicts that /l/ alternates after /j/, and Zhu's (2018) ranking cannot explain the optional /l/-alternation after /r/. Therefore, this paper proposes the following new constraint ranking that accounts for Kyrgyz manner alternation.

Ranking: AGR-[±VOI], *RIS SON, *[C_[LIQUID]N] > ID_{ROOT [NAS]} > *FLAT, *[JN] > ID_{INFL SUF}
> ID_{DER SUF}, *[RL] > *[JL]

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