Vowel harmony in Lhasa Tibetan — or how to deal with exceptions

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Abstract

The purpose of this paper is to provide an overview of vowel harmony in Lhasa Tibetan, in which vowels raise to become more similar. This process applies bidirectionally, i.e. high vowels cause preceding vowels to raise (*regression*) as well as following ones (*progression*). Vowel harmony is of interest to phonological theory because of the following asymmetry between the two directions: long low vowels appear resistant to progressive but not to regressive raising. A further nuance arises from the fact that one type of vowel laxing feeds the raising, but another counterfeeds it.

A rule–based account will be proposed, which, although somewhat unintuitive captures the essential facts. A constraint–based (OT) approach will also be shown to account for the raising pattern using alignment constraints. However, it will become clear that there is no straightforward way to implement the counterfeeding relation of the vowel laxing.

1 Corpus and Dawson's analysis

Our discussion will focus on the Lhasa dialect, which functions as a *lingua franca* in most of Tibet. Dawson (1980) provides the earliest known rule–based analysis of the vowel harmony phenomenon in this language. It is based on her work with native speakers as well as *A manual of spoken Tibetan*(Chang & Shefts, 1964). A subsequent analysis that will be discussed(Archangeli, 1999) attempts to account for the facts from within Optimality Theory.

1.1 General remarks on Lhasa Tibetan

Dawson (1980) reports that on the surface a total of twelve vowels appear, which are proposed to have the features illustrated in table 1.

Table 1: Vowels in Lhasa Tibetan. Features proposed by Dawson (1980).

		–back		+back	
		–round	+round	–round	+round
+high	–constricted	[i]	[ü]		[u]
	+constricted	[I]		[ə]	[U]
–high	–constricted	[e]	[ö]		[o]
	+constricted	[ɛ]		[a]	[ɔ]

Vowel length is contrastive and in this discussion I will for convenience assume that vowel length is a feature (i.e. ±long) of the vowel[1]. A syllable will be considered long if its vowel is long, and short otherwise.

Primary stress is assigned to the first long syllable in the word, if there is one, and otherwise on the first syllable. Secondary stress is assigned to syllables of the same length as the primarily stressed one, but Dawson (1980) notes that other syllables occasionally "take secondary stress as well"(p.21). For this reason I have chosen not to represent stress in the data, since Dawson (1980) does not provide stress transcriptions in her data[2] and hence my placement of stress would not be based on empirical grounds as it should be. Examples of this stress assignment are[3]: [qhapaa$^{(1)}$], [nu$^{(1)}$qu$^{(2)}$], [sɛɛ$^{(1)}$paa$^{(2)}$] (Dawson (1980), p. 20–21).

Furthermore vowels can occur nasalised, which for our present purposes will be ignored.

One of the first observations drawn from Tibetan is that there is something special about [a]. For example, it cannot occur before a final [p], and instead raises to [ə]. To this end, a rule DAWSON PRE–P LAX of pre–bilabial laxing is proposed(Dawson (1980) p.11). It is interesting to note that although Dawson (1980) refers to this process as "laxing," the effect on the segment [a] is the very same as raising, thus increasing confusability of the two processes.

- (DAWSON PRE–P LAX) a→ə/_____p#

Furthermore, [a] cannot occur unstressed, similarly "laxing" to [ə] by a rule that will be called LAXING, Dawson (1980), p.23). I will assume that the feature [–stress] matches any segment that bears neither primary nor secondary stress.

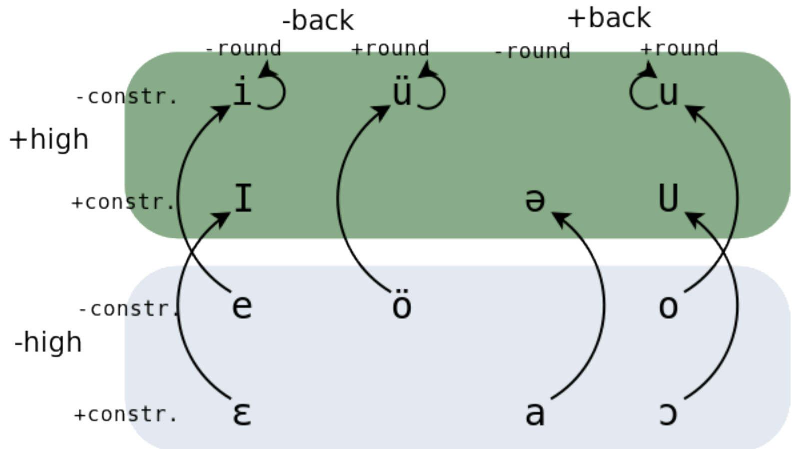
- (LAXING) $\underset{\text{[-stress]}}{\text{a}} \rightarrow \text{ə}$

[1]However, to ensure compatibility of Dawson (1980)'s notation, I will write a long vowel as two adjacent vowels, e.g. [aa] for long [a].

[2]In fact, very little data is given that the stress rules are correct in the first place. As I will show below, this stress assignment cannot be always as is described in these rules.

[3]The number following the vowel indicates the level of stress: 1 for primary, 2 for secondary or no number for no stress.

Table 2: The raising pattern. Arrows point from underlying vowels to the vowel they surface as in the environment of a high vowel. Adapted from Dawson (1980), p.140.



For example, the narrative past verbal suffix [–pə] is proposed to be underlyingly /–pa/. When suffixed to a verb stem, e.g. /sii$^{(1)}$+pa/ '(s)he looked, bought', LAXING will apply to form [siipə].

The proposed analysis is that [ə] is not present in the underlying form. The only ways in which it can appear on the surface is through the laxing rules presented above, or, as we will see, through vowel harmony.

What will be encountered peripherally in our analysis is the fact that Lhasa Tibetan does not allow consonant geminates, deleting one of them instead.

- (C–DEGEM) $C_i \rightarrow \emptyset / C_i$_____

1.2 Vowel harmony

1.2.1 Bidirectional Raising

Dawson (1980) notes that stem vowels alternate depending on the suffix, depicted in table 3, as well as in compound formation. Investigating all combinations of vowel height, we find the raising pattern that is schematically represented in table 2.

On the basis of these and more data, it is proposed that vowels raise progressively and regressively in Tibetan, roughly as resulting from the following rule.

- (DAWSON–RAISE) $V \rightarrow \left[+\text{high}\right] / \left\{ \begin{matrix} \underline{\quad\quad} C_1^2 \begin{matrix} V \\ \left[+\text{high}\right] \end{matrix} \\ \begin{matrix} V \\ \left[+\text{high}\right] \end{matrix} C_1^2 \underline{\quad\quad} \end{matrix} \right\}$

Given the data explored so far, the rule provides the correct results if we order it after the laxing. The reason is that if laxing would apply first, the past suffix [-pa] would have "laxed" (but for all practical purposes "raised") and subsequently raise the vowel in the stem. If we invert that order, it yields the correct result, i.e. this is a counterfeeding relationship.

But we soon run into an ordering paradox. The negative verbal prefix /ma-/ with /lap/ 'teach' and past /-pa/ surfaces as [mələpə] (p.71).

To note the problem, first one can observe that the negative verbal prefix does in other forms surface not as [ə], e.g. [malɔɔpə] (p.71). According to our existing stress rules, the stress should not fall on the prefix, /malɔɔ$^{(1)}$pa/. But then it should reduce to [ə] via LAXING to *[məlɔɔpə]. So we need to assume that sporadic secondary stress applied to yield /ma$^{(2)}$lɔɔ$^{(1)}$pa/.

It then seems that in /ma$^{(2)}$+lap$^{(1)}$+pa/ the laxed versions of the underlying [a] in the negative prefix *did* feed the (regressive) raising[4]. From examples such as /kap+pɛɛ/ surfacing as [kəpII] we can conclude this laxing also feeds progressive raising.

Notice also that we have to assume that the final /-pa/ is unstressed, for it to be able to lax to [ə]. Since according to our rules it should receive at least secondary stress, we need to assume that it is somehow extrametrical, or that stress is assigned before suffixing. Similarly for /kap/ 'do', we find /ma+kap+pa/ surfaces as [məkəpə].

It then also becomes clear that it is desirable for future research to provide a solid account of stress in Lhasa Tibetan, which is beyond the scope of the current paper due to lack of access to a Tibetan speaker.

1.2.2 Exception to progressive raising

An issue that is more prominent, however, is reported but not captured in rules. Dawson (1980) notes that "regressive raising has greater strength [than progressive raising]" (p.83). The crucial observation is that long low back vowel ([aa]) does not undergo raising from preceding high vowels (*progression*) but does from following high vowels (*regression*). Some relevant facts are in table 4, which contrast with regressive raising, e.g. [məəmi] in table 3.

We can observe at this point that more needs to be said than DAWSON–RAISE, though it is a good beginning.

2 Rule–based account

An account of these data should hence include a progressive and regressive raising rule, which (i) makes sure that progression is blocked for [aa], and (ii) resolves the ordering paradox with respect to laxing.

To make sure our progression rule does not apply to [aa], one could adapt it in the following, admittedly rather ad–hoc way. The idea is that [aa] is characterized by the features [+long,+constricted,–round,+back]. So the following rule will on each pass apply progressively to all segments that have at least one of those features set differently, e.g. it will progressively raise [a] since it matches [–long], [ɔ] since it is [+round], and to [e] it will apply

[4] Dawson (1980) does not mention this issue, so the analysis presented here is merely hypothetical on the basis of the data provided in that study.

Table 3: Vowel raising data points (Dawson (1980) p.64–74)

Regressive

stem		[pə] (past)	[qi] (future)
/tee/	'to get'	[teepə]	[tiiqi]
/nεε/	'sleep'	[nεεpə]	[nIIqi]
/qho/	'hear'	[qhopə]	[qhuqi]
/tsoo/	'sell'	[tsoopə]	[tsuqi]
/lɔɔ/	'roead'	[lɔɔpə]	[lUUqi]

				compound	
[me]	'fire'	[šiŋ]	'wood'	[mišii]	'firewood'
[to]	'stone'	[puu]	'pile'	[tupuu]	'pile of stones'
[lɔɔ]	'electricity'	[rii]	'price'	[lUUrii]	'price of electicity'
[phöö]	'Tibet'	[luu]	'sheep'	[phüüluu]	'Tibetan sheep'
[maa]	'war'	[mi]	'person'	[məəmi]	'soldier'

Progressive

[-pεε] vs. [-pII] (2p. past interr.)				
	[naapεε]	'do'	[siipII]	'look'
	[sεεpεε]	'eat'	[luupII]	'pour'
	[lɔɔpεε]	'read'	[tsüüpII]	'enter'
	[sööpεε]	'make'	[kəpII]	'do, make'

[-po] vs. [-pu] (nom/adj suffix)				
	[qapo]	'happy'	[sipu]	'tasty'
	[seepo]	'yellow'	[thupu]	'thick'

				compound	
[ri]	'mountain'	[tse]	'peak'	[ritsi]	'mountain peak'
[qu]	'body'	[tshe]	'life'	[qutsi]	'life (H)'
[chu]	'water'	[qo]	'head'	[chuqu]	'water source'
[tu]	'barley'	[söö]	'seed'	[tusüü]	'barley seed'

Table 4: Exceptions to progressive raising (Dawson (1980) p.81)

[pikaa]	'relative'
[ripaa]	'wild boar'
[ŋüüqaa]	'bank'
[thüsaa]	'next year'

twice, once for its being [–back] and another time for its being [–constricted]. In other words, we have an elaborate way of saying “not [aa]”.

- (PROGR) $\overset{\text{V}}{\left[\begin{Bmatrix}\text{-long}\\ \text{-constricted}\\ \text{+round}\\ \text{-back}\end{Bmatrix}\right]} \rightarrow [\text{+high}] \;/\; \overset{\text{V}}{[\text{+high}]}\; C_0\underline{\qquad}$

The regressive counterpart of this rule is straightforward.

- (REGR) $\text{V}\rightarrow[\text{+high}] \;/\underline{\qquad}C_0\; \overset{\text{V}}{[\text{+high}]}$

2.1 Rules for exceptions

My proposal to deal with the ordering paradox around laxing is to generalise the pre–bilabial laxing rule, since the environment in the problematic /ma+lap+pa/ seems suspiciously similar to that of /lap/ in isolation. The new version of the rule would not apply only at word–final [p], but at any morpheme–final [p]. We furthermore add the requirement that [a] be short.

- (P–LAX) $\overset{\text{a}}{[\text{–long}]}\rightarrow\text{ə}/\underline{\qquad}\text{p+}$

Now the solution lies in ordering this rule P–LAX before both REGR and PROGR, so that it can feed them. On the other hand, the LAXING rule that will reduce unstressed [a] not followed by [p], should be ordered after them, so that it counterfeeds them.

Using these rules, it seems one obtains the correct results, as becomes clear from table 5.

It is difficult to say whether these rules are indeed valid, since we do not know whether examples like [mələpə] (where the underlying /a/ undergoes laxing early enough to raise the prefix /ma–/) all have the short vowel /a/, enabling us to solve the ordering paradox by splitting up the regression rule.

At any rate this might feel very unsatisfying. To start with, we now have separate regression– and progression rules for a phenomenon that seems like one and the same thing.

However, it should be noted that even if we could have collapsed the rules into a schema such as DAWSON–RAISE, then we might object that there too we should really understand them as two rules. The reason is that we could have written using the same notation, a rule like the following, where in D no slot occurs at all.

- (HYPO) $\text{A} \rightarrow \text{B}/\begin{Bmatrix}\underline{\qquad}\text{C}\\ \text{D}\end{Bmatrix}$

In other words, our notation does not require us to include the slot in every option in curly brackets, thus yielding after expansion a rule that does nothing at all: A→B/D. The

Table 5: Some derivations demonstrating the proposed rule–based account.

	/saa+pa/	/saa+qi/	/kap+pεε/
P–LAX			[kəppεε]
REGR		[səəqi]	
PROGR			[kəppII]
LAXING	[saapə]		
C–DEGEM			[kəpII]

	/ma+lap+pa/	/pi+kaa/	/ma+tee+pa/
P–LAX	[maləppa]		
REGR	[mələppa]		
PROGR	[mələppə]		
LAXING	[mələppə]		[mateepə]
C–DEGEM	[mələpə]		

argument here is that even if we could have collapsed the rules as in DAWSON–RAISE, that does not say much, for we could also collapse rules that we certainly do not want to count as being one and the same thing. So our notation not enabling us to collapse PROGR and REGR should not, I argue, be held as a great shortcoming of their formulation.

Secondly, there is other evidence that regression and progression are really two separate processes. Dawson (1980) cites cross–linguistic evidence, but even seems to forget to mention that in the very Lhasa Tibetan under consideration, it appears that nasality spreads from one vowel to another regressively but not progressively.

3 Account in Optimality Theory

Archangeli (1999) proposes an account of these data in Optimality Theory. Since the motivation of the study is purely to illustrate how Optimality Theory works, she can hardly be blamed for not dealing with the two problematic phenomena mentioned above.

The proposal is that there are two markedness constraints (AlHiL and AlHiR) that are violated if the right edge of the [+high] feature is not aligned with the word boundary on the right, and on the left, respectively. The winning candidate violates the faithfulness constraint Ident(high).

To make sure that [aa] is not affected by progression, Archangeli (1999) proposes that this is due to a fourth constraint, Max(low). It is violated every time an input segment has the feature [+low] but its correspondent in the output does not. Crucially ordering it between the alignment constraints makes sure that it allows the [+high] feature to regress but not progress.

The proposal starts from a different way to assign features to the sounds than Dawson (1980) has used. As a result, it makes sense to talk about [aa] as *the* long, low, vowel, since there is only one. However, in the featureset that Dawson (1980) proposed, low simply means [–high] and as a result there are six possible long, low vowels.

There is however a independent problem with the proposed approach. When [a] raises under the influence of a nearby high vowel, it does not so much become [+high], but rather ceases to be [+low]. So to capture the facts with a spreading of the high–feature seems to fall short of the facts in this feature set.

3.1 Adapting the proposal to features

In what follows I will adapt Archangeli (1999)'s proposal to work with the feature set we have used before.

First of all there is a number of undominated constraints, corresponding to processes that are never observed in Lhasa Tibetan. These are the identity constraints ID(α) for any feature α other than [±high]. This includes also MAX–V that is violated when we delete a vowel, and DEP–V, violated when we insert a vowel. Finally we add a constraint ID(+HIGH) that is violated every time we change a feature's value from +high into –high. This is to prevent harmony clashes from being resolved by lowering one element rather than raising the other. For the sake of clarity, these constraints will be referred to as UNDOM for undominated.

From Archangeli (1999) we take over the alignment constraints ALHIL and ALHIR. ALHIL is violated once for every vocalic segment that separates the left edge of the feature high and the left word boundary, and similarly ALHIR for the right edges. In the spirit of his approach, we order in between them a constraint ID(−HIGH)$_{\text{/A/}}$, which is violated once for every segment that is underlyingly /aa/ and whose [±high] value is changed in the candidate output.

Low enough for it to not dominate anything we order a further constraint ID(−HIGH) that is violated once for every time we change a [–high] segment in the underlying form to [+high].

Table 6 illustrates that these constraints result in the correct facts for as far as plain harmony is concerned, spreading [+high] regressively and progressively unless, in the latter case, the affected vowel is [aa].

Then we observed that consonant clusters do not occur, so we add a constraint $*C_iC_i$ that is violated once for every two same adjacent consonants. Then MAX–C$_{\text{-+}}$ is defined to be violated once for every consonant that we delete that is followed underlyingly by a morpheme boundary (this makes sure we delete the second consonant of a geminate so that the P–LAX environment is not taken away), and it will be ordered after $*C_iC_i$ to achieve consonant degemination.

To incorporate pre–bilabial laxing itself, I propose the constraint *[ap+] is violated once for every sequence [ap+] in the candidate output. Similarly, $\begin{matrix}\text{a}\\ \text{[-stress]}\end{matrix}$ is violated once for every unstressed [a] in the output.

Table 7 shows that these constraints yield the correct raising of the /a/ as well as deletion of one of the geminate /pp/s.

A very direct problem, however, is that we cannot straightforwardly capture the counterfeeding relation between laxing and raising, as illustrated in table 8, where the laxed /a/

Table 6: Illustration of the OT account of the plain vowel harmony (without interference from other rules).

/[qhaa+ri]/			UNDOM	ALHIL	ID(−HIGH)/A/	ALHIR	ID(−HIGH)
1a.		[qhaari]		∗!			
1b.	☞	[qhəəri]			∗		∗
1c.		[qhaare]	∗!				∗
/[ri+paa]/							
2a.		[ripəə]			∗!		
2b.	☞	[ripaa]				∗	
2c.		[repaa]	∗!				∗

Table 7: Laxing and degemination: OT yields the correct output.

/lap+pa/			∗[AP+]	$*C_iC_i$	MAX–C_+	ALHIL	ID(−HIGH)/A/	ALHIR	ID(−HIGH)
a.		lap+pa	∗!	∗					
b.		ləp+pa		∗!				∗	∗
c.		la+pa			∗!				
d.		lap+a	∗!						
e.		ləp+a						∗!	∗
f.		lə+pa			∗!			∗	∗
g.	☞	ləp+ə							∗∗

Table 8: Counterfeeding is not captured by the OT account, yielding the incorrect surface candidate.

/saa+pa/			$\overset{\text{A}}{[\text{-STRESS}]}$	ALHIL	ID(−HIGH)/ə/	ALHIR	ID(−HIGH)
a.		saapa	*!				
b.	☹	saapə		*!			*
c.	✷	səəpə			*		**
d.		səəpa	*!		*	*	*

incorrectly raises the preceding vowel. If we would order the $\overset{\text{a}}{[\text{-stress}]}$ constraint after the alignment constraint, this would not help since then the maximally faithful candidate [saapa] would incorrectly win. In sum, we run into a direct ordering paradox of our constraints.

3.2 Possible solution: multiple–level OT

In Stratal OT(Kiparsky, 2000) this counterfeeding phenomenon can be accounted for, even with just two levels, lexical and postlexical. The lexical level then represents what Kiparsky (2000) would call the Word Level in the sense that all affixing is done. At this level the constraints are ranked as before except for that it $\overset{\text{a}}{[\text{-stress}]}$ is below ID(−HIGH) so that unstressed [a] do not lax to [ə]. At the postlexical level, then, the constraint $\overset{\text{a}}{[\text{-stress}]}$ is undominated, and we rank ID(−HIGH) below it, which in turn dominates ALHIL and ALHIR. In this way, at the postlexical level [a] will lax to [ə] but then this /ə/ will not in turn raise other vowels.

As an illustration, clearly /saa+pa/ would run through the lexical level as the optimal candidate, and in the postlexical level be turned into [saapə], yielding the counterfeeding result. Table 9 shows the more complex example of [mələpə].

One can then also note that we have not made use of the freedom in lexical phonology to have the affixes enter at different stages in the derivation: all affixing is done on one and the same lexical level. The only reason why Stratal OT is solving the counterfeeding issue is that it enables us to have word forms be confronted in two times with differently ranked constraints.

So one might argue that since all affixes enter on one level, there is no theoretic justification for the second level. The only possible justification that seems reasonable on the basis of these data is that stress is assigned after the harmony process is done, happening in between the OT strata (i.e. in between what has been called the Lexical and Postlexical levels).

Table 9: Example of the Stratal OT account

Lexical level

/ma+lap+pa/		*[AP+]	$*C_iC_i$	MAX–C_×	ALHIL	ID(−HIGH)/A/	ALHIR	ID(−HIGH)
a.	ma+lap+pa	*!	*					
b.	ma+ləp+pa		*!		*		*	*
c.	ma+la+pa			*!				
d.	ma+lap+a	*!						
e.	ma+ləp+a				*!		*	*
f.	ma+lə+pa			*!	*		*	*
g.	ma+ləp+ə				*!			**
h. ☞	mə+ləp+ə							***

Postlexical level

/mələpə/		UNDOM	A [-STRESS]	ID(−HIGH)	ALHIL	ID(−HIGH)/A/	ALHIR
a. ☞	mələpə						
b.	maləpə	*!			*		
c.	mələpa	*!	*				*

One would further specify that the constraint $\underset{[\text{-stress}]}{\text{a}}$ is “voidly satisfied” before stress assignment and after the lexical level, stress is assigned to the winning candidate which in turn serves as input for a second level of constraint ranking along the lines described before.

3.3 Further research

In the future, it would be interesting to note to what extent the output of the two laxing processes of /a/ are actually the same phonetically, since if, for instance, the output of LAXING is lower than that of P–LAX, this could immediately explain why the latter causes raising on other vowels and the former not. In this case, there would not even be counterfeeding and hence Classic OT could completely account for the phenomenon.

As mentioned before, a detailed account of the stress pattern in Lhasa Tibetan is also called for.

4 Conclusion

Lhasa Tibetan exhibits raising of vowels caused by preceding high vowels (progression) or following ones (regression). There seems to be a difference between the two processes, however. Regression is stronger because it also applies to [aa], which is an exception to progression.

In a rule–based approach this phenomenon can be captured somewhat ad–hocly but remaining within the formal framework of SPE. The fact that two different vowel laxing processes feed and counterfeed this raising, respectively, is captured straightforwardly by the rules.

In optimality theory left and right alignment constraints can yield the correct surface forms when an identity constraint corresponding to the exception [aa] is ordered in between them. The counterfeeding phenomenon, however, is not captured in any straightforward manner in Classic OT. Stratal OT yields the correct result with only two levels at which constraints are applied to the output forms.

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