Stress and Vowel Harmony in Telugu

Introduction Telugu, a Dravidian language, has a pattern of regressive vowel harmony in nouns (table 1) in which the vowel /i/ in stems changes to /u/ when the plural morpheme -/lu/ is suffixed (Subbarao, 1971; Chekuri, 1976; Marantz, 1980; Pingali, 1985).

a.	giri	girulu	'hills'	d.	kolimi	kolumulu	'forges'	g.	gumiki:	gumiki:-lu	'punches'
b.	pilli	pillulu	'cats'	e.	atit^{h}i	atit^{h}ulu	'guests'	h.	wiwe:ki	wiwe:kulu	'wise persons'
c.	ni:ti	ni:tulu	'morals'	f.	tommidi	tommidulu	'nines'	i.	enimidi	enimidulu	'eights'

Table 1: /i/-/u/ alternation in nouns

Notice that harmony triggered by the /u/ in the plural suffix affects some (underlined) but not all instances of /i/ in stems. Previous accounts of stress in Telugu (Sitapati, 1936; Pingali, 1985) report primary stress on the longer of the vowels in the first two syllables and no secondary stress. Based on this generalization, Pingali (1985) ascribes the opacity of the initial vowel in (a) to stress but treats the alternation of non-initial stem vowels as unpredictable and sets up lexical classes with different degrees of under-specification to derive the harmony pattern in table 1. Kolachina (2016) proposes that all instances of vowels that resist harmony can be characterized precisely in terms of a cross-linguistically well-attested pattern of stress, the moraic trochee (or its foot-free equivalent). This pattern of stressed vowels resisting harmony is predicted using positional faithfulness- a vowel bearing stress in the plural must be identical to its counterpart in the singular. This analysis of nouns is extended to the harmony pattern in Telugu verbs as well. Example e. in table 1 is a novel datapoint which shows that onsets count towards weight. Glides /j, w/ are inserted before mid-vowels /e o/ in word-initial position in continuous speech and this is why the initial syllable in example i. is treated as CV. The analysis of Kolachina (2016) has been criticized as being circular- secondary stress is inferred based on the pattern of harmony and harmony is analysed as being stress-based. This study presents evidence for trochaic structure in Telugu that is independent of harmony.

Trochaic structure in Telugu Evidence for metrical structure discussed in the literature includes minimal word requirement (Hayes, 1995). In Telugu, the minimal word is bimoraic. There are a few content words and pronominal forms that consist of one long vowel, CVV. The frequency of different word types (up to 4 syllables) in the lexicon is shown in table 2. The most frequent types of stems in the lexicon of Telugu are CVCCV > CVCVCV > CVVCV > CVCCVCV > CVVCVCV > CVCVCVCV. The asymmetry between the frequency of CVXCV and CVCVV stems indicates a preference for trochees as opposed to iambs.

VV	4	CVCV	288	CVCCV	1133	CVCCVCV	613	CVCVVCV	213	CVCVCVC	189
CVV	25	CVVCV	768	CVCCVV	139	CVVCVCV	478	CVCCVCCV	282	CVCVCVV	66
CVC	0	CVCVV	39	CVCVCV	1076	CVCVCCV	187	CVVCVVCV	155	CVCVCVCV	415

Table 2: Frequency of word types in Telugu lexicon

Word minimality has been addressed in the comparative Dravidian literature. Krishnamurti (1955) claimed that Telugu verbal stems are of three types- CVCVCV, CVVCV and CVCCV. Manual inspection of verbal stems of other types from a dictionary corpus (Gwynn and Sastry, 1991) reveals them to be compounds. Thus, the shape of a Telugu verbal stem is a bimoraic trochee with an extrametrical final short /u/. The second syllable in monomorphemic Telugu verbal stems is light without exception. The weight of the second syllable in verbal stems in Telugu was lost through processes like nasal deletion, for example, correspondence of Tamil *kalaŋku* 'to be stirred up' to Malayalam *kalaŋŋuka*, Koḍava *kalaŋg-*, Tulu *kalaŋkuni*, Kannada *kalaŋku*, kalaku to Telugu *kalãgu*, *kalacu* (Krishnamurti, 2003, pp.172). Kobayashi (2004, pp.172) points out that this change in Telugu (and South-Central Dravidian/South Dravidian II) can be accounted for as a change in the foot type from iamb to moraic trochee in the development of Telugu. Evidence for this shift is also found in dialects of Koṇḍa (Krishnamurti, 2003, pp.161, footnote 16) that belongs to the same subgroup.

As in other Dravidian languages (Bright, 1972), words in Telugu must obligatorily end in a vowel unless ending in nasal /m/ (optional in this case). In loanwords from English, the enunciative vowel /u/ is added word-finally such as /ṭippu/ 'tip', /bɛḍḍu/ 'bed', /raggu/ 'rug', etc. Notice that the final consonant in monosyllabic loanwords is geminated before adding the enunciative /u/. Telugu, like Italian (Passino, 2008) as opposed to Finnish (Kroll, 2014) and Hungarian (Magyar, 2017) allows all geminates attested in the native vocabulary in loanwords. This unexceptional gemination suggests that the enunciative /u/ is non-moraic. The final consonant needs to be geminated to meet the minimal word requirement of bimoraic trochee. This also shows that contra Gordon (2002), coda consonants count as moraic, so CVX > CV > V. Languages without a minimal word requirement (Hungarian) or a different minimal word (Finnish CVV) place restrictions on which consonants are geminated based on geminate markedness in the lexicon (Magyar, 2017).

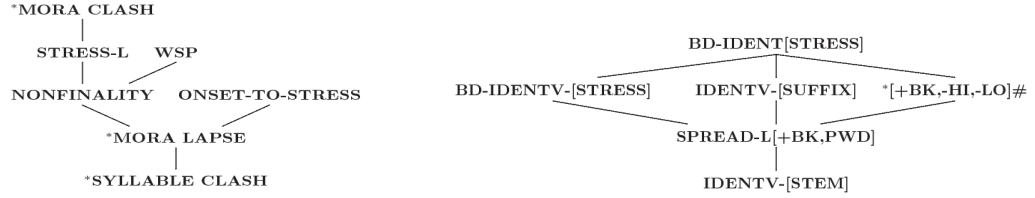
Analysis The stress pattern of different stems predicted by left-to-right moraic trochee (End Rule Left (Hayes, 1995, pp.69) with ban on degenerate feet) is shown in table 3. There is resistance to harmony in all contexts where moraic trochee predicts secondary stress.

stem	Stress	Plural	stem	Stress	Plural	stem	Stress	Plural
CV.C$\underline{i}$	ĹL	CV.C$\underline{u}$lu	V.Ci.C$\underline{i}$	LĹL	CV.Ci.C$\underline{u}$lu	CV.CV.Ci:	ĹLH̀	CV.CV.Ci:lu
CVX.C$\underline{i}$	ĤL	CVX.C$\underline{u}$lu	CVX.Ci.C$\underline{i}$	ĤL̀L	CVX.Ci.C$\underline{u}$lu	CVX.CVX.C$\underline{i}$	ĤH̀L	CVX.CVX.C$\underline{u}$lu
CV.C$\underline{i}$.C$\underline{i}$	ĹLL	CV.C$\underline{u}$.C$\underline{u}$lu	CV.CVX.C$\underline{i}$	LĤL	CV.CVX.C$\underline{u}$lu	CV.Ci.Ci.C$\underline{i}$	ĹL̀L	CV.Ci.Ci.C$\underline{u}$lu

Table 3: Rhythmic word types and vowel alternations in nouns

These trochaic stress patterns can be derived using Optimality theory (OT) constraints such as- STRESS-L: stress the syllable at the left edge of the word, *MORA LAPSE: no adjacent unstressed moras, *SYLL CLASH: no adjacent stressed syllables, NONFINALITY: final syllable is unstressed, *MORA CLASH: no adjacent stressed moras, WSP: Heavy (bimoraic) syllables must be stressed and ONSET-TO-STRESS: Syllables with onset must be stressed. Also, primary stress goes on the heavier of the initial two syllables and not on the longer of the vowels in them as hypothesized in previous work. The constraint ranking is shown in figure 1a. Non-high vowels such as /a/ and /e/ do not alternate in plural forms. The non-alternation of /a/ shows that harmony is with respect to the backness feature. The non-alternation of /e/ is due to a ban on distribution of the back mid-vowel /o/ in the stem final position in the lexicon, captured using a markedness constraint- *[+BK,-HI,-LO]#: no back mid-vowel in the stem-final position. The other relevant constraints are- BD-IDENT[STRESS]: Assign a * for each pair of correspondent syllables differing in stress, BD-IDENTV-[STRESS]: A stressed vowel in base must match its correspondent in derivative in all features, IDENTV-[SUFFIX]: A vowel in suffix must match its correpondent in output in all features, SPREAD-L[+BK,PWD]: Let f be a variable ranging over occurrences of the feature [+BK] in a prosodic word P. For all vowels in P, if there is a feature f associated with a vowel v_i, assign a * to every vowel to the left of v_i which is not associated with the feature f, following (Walker, 1998, pp.51). In addition, an undominated markedness *GAP constraint that bans gapping configurations such as 

, which violate segmental adjacency in feature linking on the vowel tier is required. The ranking of constraints to derive the alternation of /i/ in unstressed syllables is shown in figure 1b.



(a) Stress assignment (b) Alternations

Figure 1: OT constraint hierarchy