Iambicity without stress in Kera

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The Chadic language Kera (Ebert 1979; Pearce 1998, 2003) exhibits iambicity without stress. This paper argues that feet are constructed over a combination of light and heavy syllables, and that deletion and lengthening of vowels takes place as necessary to form the iambic feet (–) and (–). We will consider inputs of the form /CVCV/, where in phrase-medial position, the final vowel is deleted, giving a monosyllabic, heavy foot (CVC). In phrase-final position, the second vowel undergoes iambic lengthening, giving (CVCV-). As well as lengthening and deletion, other clues to the iambic nature of Kera are found in the system of vowel allophony and the domains of vowel harmony and tonal/voice spreading. We will conclude that the foot structure is a central part of Kera phonology, and that Kera adds to the list of languages with foot structure in the absence of overt stress.

1 INTRODUCTION

Kera is a Chadic language, spoken in southern Chad and parts of Cameroon, with 50,000 speakers. Previous literature on the language (Ebert 1979; Pearce 1998, 2003) includes nothing on the foot structure of Kera. Although previous work on Chadic refers to quantity sensitivity, there are few references to any metrical structure (Newman 1972; Roberts 2001; Wolff 2001; Jagger and Wolff 2002).

Kera is one of a set of iambic languages with only two types of feet: light-heavy (L–) and heavy (–). Strategies are in place to avoid light-light (L L) feet. Iambs can force not only lengthening but also vowel deletion.

(1) For an input of /CVCV/:

<table>
<thead>
<tr>
<th>Phrase medial</th>
<th>final vowel deletion: (CVC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phrase final</td>
<td>2nd vowel lengthened: (CVCV-)</td>
</tr>
<tr>
<td>With definite article, -ŋ → no change: (CVCVŋ)</td>
<td></td>
</tr>
</tbody>
</table>

In disyllabic feet, the contrast between the vowels is maximized, as is common in iambs, so non-head vowels are shortened, while head vowels are lengthened. Other clues to iambicity include vowel allophony, vowel harmony domains, and tonal spreading. Kera is a tone language and as is the case in many tone languages, there is no overt stress. For this reason, the evidence for the parsing of feet is not based on stress placement.

In the following section, we will see in more detail how the strategies of deletion and lengthening are employed in Kera to avoid the (L L) foot. But to understand the Kera foot, we must first consider the allowable structures in Kera syllables.

(2) Kera syllable structure

<table>
<thead>
<tr>
<th>Light syllables (L):</th>
<th>(C)V</th>
<th>[baŋa]</th>
<th>‘elephant’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy syllables (H):</td>
<td>(C)V: (vowel lengthened) /cawa/ → [cәwa:] ‘fire’</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(C)VV (lexically long vowel) [baŋa] ‘elephant’</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(C)VC [kan] ‘water’</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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CamLing 2004: 100-107.
2 Kera Iambic Feet

Kera has iambic feet which are constructed over light and heavy syllables: (♀ –) or (–). A foot which is constructed over two light syllables is inadmissible in Kera: *(♀♀). Combining these facts with the acceptable syllable structure, we get the following:

(3) **Possible foot structures**

<table>
<thead>
<tr>
<th></th>
<th>monosyllabic foot</th>
<th>disyllabic foot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(CVV)</td>
<td>(Cv.CVV)</td>
</tr>
<tr>
<td></td>
<td>(CVC)</td>
<td>(Cv.CVC)</td>
</tr>
</tbody>
</table>

Before looking at examples of Kera deletion and lengthening, we will look briefly at the strategies employed by other languages which wish to avoid the (♀♀) foot.

Choctaw (Lombardi and McCarthy 1991), Chickasaw (Hayes1995), Hixkaryana (Derbyshire 1979) and Yupic (Baković 1996) are all iambic languages that avoid (♀♀) feet by lengthening the second vowel to form a (♀ –) foot. On the other hand, Palauan (Gouskova 2005), avoids (♀♀) feet by deleting the final syllable.

Several trochaic languages employ a similar strategy (Gouskova 2005). Panare and Tonkawa avoid (♀♀) feet by deletion of the final vowel. Itelmen prefers consonant gemination, so that /CVCV/ \( \rightarrow \) CVC.CV. Ilokano, Icelandic, Italian and Tagalog lengthen the first syllable vowel as do Woleaian and Kiribati, but the related languages Ponapean and Mokilese delete the final vowel (Spaelti 2005).

Now turning to Kera, the strategies are as follows:

(4) **/LL/ input undergoes deletion or lengthening to make a well-formed foot:**

/\textit{bege}/ phrase-medial: [\textit{beg} nu\textit{tu}] \textit{animal} his \textit{his animals}'

phrase-final: [\textit{bege:}] \textit{animal} 'animals'

definite article: [\textit{bege\textendash}] \textit{animal-DEF} 'the animals'

The input for /\textit{bege}/ must be /CVCV/ because /CVC/ would not need to be lengthened and /CVCV:/ would not need to be shortened with vowel deletion. Only /CVCV/ explains both the shortening and lengthening processes.

There is also a third strategy where light syllables attach to the following word:

(5) **Syllable attaches to following word to avoid (LL) feet**

(H)L# (H) \( \rightarrow \) (H)(LH) /\textit{saama nim\textendash ti/} rope yours 'your rope'

word level: \( \text{saam\textendash a} \) (nim\textendash ti) phrase level: \( \text{saam\textendash a} \) (m\textendash a\textendash nim\textendash ti)

These lengthening and deletion strategies support the case for the Kera iambic foot.

3 Other Evidence For Iambs

3.1 Vowel Allophones

Kera has 6 vowel phonemes and the three non-high vowels have allophones as follows:

(6) **Allophones in Kera vowels**

<table>
<thead>
<tr>
<th>phonemes:</th>
<th>/\textit{a}/</th>
<th>/\textit{e}/</th>
<th>/\textit{u}/</th>
<th>/\textit{e}/</th>
<th>/\textit{e}/</th>
<th>/\textit{a}/</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head (-ATR)</td>
<td>[i]</td>
<td>[i]</td>
<td>[u]</td>
<td>[e]</td>
<td>[a]</td>
<td>[\textsc{a}]</td>
</tr>
<tr>
<td>Non-head (+ATR)</td>
<td>[i]</td>
<td>[i]</td>
<td>[u]</td>
<td>[e]</td>
<td>[\textsc{a}]</td>
<td>[\textsc{a}]</td>
</tr>
</tbody>
</table>
Lexical monosyllabic words always select vowels from the top set: [i] [u] [ə] [a] [ɔ]. As monosyllabic words must be feet, it follows that they are also heads. This implies that these vowels are head vowels. On the other hand, the vowels [e] [ə] and [o] are non-head vowels. They are of short duration and never appear in heads. Allophony and duration both indicate the difference between a head and a non-head vowel.

(7) **Comparison of head and non-head vowels**

- [e] [ə] [o], always of short duration (approx. 30ms), found in non-head position.
  - e.g. [pep:] 'god’, [gol:] ‘to look’ (phrase-final)
- [e] [a] [ə], always of longer duration (greater than 50ms), found in head position.
  - e.g. [pep] 'god’ [gol] ‘to look’ (not phrase-final)
  - [pep:] 'god’, [gol] ‘looked’ (phrase-final)

(8) **Possible Kera structures with vowel quality differences in head and non-head**

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
<th>Heads are underlined</th>
</tr>
</thead>
<tbody>
<tr>
<td>LH</td>
<td>/ka.бан\j/</td>
<td>(LH) (kaban) 'tree'</td>
</tr>
<tr>
<td>LL</td>
<td>/pe.pe/</td>
<td>(H) (LH) (pep) (pepe:) 'god’</td>
</tr>
<tr>
<td>HH</td>
<td>/гг.нг/</td>
<td>(H)(H) (g gor)(g) 'hyena'</td>
</tr>
<tr>
<td>H#LH</td>
<td>/те фан/</td>
<td>(H)(LH) (ten) ‘rat’</td>
</tr>
<tr>
<td>H#LL</td>
<td>/те гол/</td>
<td>(H)(H) (ten) ‘I found’</td>
</tr>
<tr>
<td>HL</td>
<td>/баа.г/</td>
<td>(H)(L) (pepe:) 'elephant'</td>
</tr>
</tbody>
</table>

Kera is not the only language with vowel quality differences linked to a difference in duration. English has phonemic length differences with +ATR vowels almost double the duration of -ATR vowels (Wells 1962). There are also smaller phonetic differences between vowel heights, high vowels being shorter. Cantonese (Yip 1996) has length differences between +/- ATR vowels. Similarly, the Chadic languages Sokoro (Gordon Martin p.c.) and Goemai (Birgit Hellwig p.c.) show length differences between e/e and o/o. Like in Kera, [e] is shorter than [e]. Hausa also has a difference in vowel quality corresponding to length, but unlike Kera, a short vowel is found in both CV and CVC syllables (Carnochan 1988). In Kera, the shorter vowels are restricted to non-head position.

In sum, the length and quality distribution of the vowels is exactly what is expected if the word is parsed into iambic feet, and the head/non-head position controls length and ATR.

### 3.2 Vowel harmony domains

Other evidence for the foot is found in vowel harmony domains. Kera has total harmony on roots and height harmony between roots and suffixes, but it also has fronting and rounding on central vowels. Front suffixes cause central vowels in the same foot to front (9a). But between feet, the fronting does not take place (9b). If Kera does not have a foot structure, these harmony facts are hard to explain.
3.3 Tone spreading

A third piece of evidence for the foot comes from the tone spreading facts. In three syllable words with two tones, the domain of the first tone is a foot.

Kera is not the only language with tone and foot interaction. Creek (Zec 1999), Seneca (Zec 1999) and Winnebago (Hayes 1995) have alternating stress and tone on the head of the foot. Shanghai (Duanmu 1993) allows tone spread from the head. In Llasa Tibetan (Duanmu 1992) the head keeps its tone, but the tone on non-heads is lost. Three Chadic languages, Bole, Kanakuru and Hausa (Newman 1972), show interaction between the tone and syllable weight, possibly involving foot structure. The tone patterns in Kera are similar to those seen in these languages and give supporting evidence for the Kera foot.

3.4 Slow speech pause breaks

A final piece of evidence comes from pauses in slow speech. A Kera speaker was asked to say certain phrases slowly and instead of lengthening each segment, he introduced pauses between each foot. This shows he is treating each foot as a minimal word and that the foot is psychologically real to the Kera speaker.

Having established the foot structure, we now consider the evidence for the absence of feet.

4 Evidence that there are no CVCV feet

4.1 Words with underlying form /CVCV/

The phonetic lengthening and shortening provide strong evidence for the foot. Syllables in the order CV.CVC shorten and lengthen respectively because they form one iambic foot, while syllables in the order CVC.CV have no change in the expected duration. If

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1 These examples also contain height harmony -e→i, which is not restricted by foot structure.

2 Bisyllabic feet with a single high tone are actually realized with the high tone on the non-head first syllable lowered to mid. This implies that high tone does not spread.
there was no iambic foot, we would not expect a contrast in these two patterns. We will look first at /CVCV/ feet. The following facts are repeated from Section 1.

(12) **Changes in /CVCV/ input**
(a) In non-phrase-final position, /CVCV/ becomes (CVC).
(b) In phrase-final position, /CVCV/ becomes (CVCV:)
(c) The first vowel is shortened as non-head vowel
(d) The second vowel is lengthened as head vowel.

The graph below shows these facts in the vowels of the /CVCV/ words in two folk tales.

![Graph showing vowel duration](image)

**Fig 1**

First and second vowel duration in 55 /CVCV/ words from 2 folk tales

The ratio of the first syllable to the second in /CVCV/ words at the right edge of the phonological phrase is on average 1 to 2.7. This is similar to other languages such as Ciyao with a ratio of 1:2.2 and Luganda 1:3.2 (Hubbard 1995a and 1995b). The graph below shows the ratio for phrase final /CVCV/ words. Although the spread of results is quite large, the graph shows that very few words have a ratio of less than 1:2.

![Graph showing ratio of vowel duration](image)

**Fig 2**

Ratio of duration of vowels in /CVCV/ at right edge of phrase

There are no /CVCV/ words which give an output close to being [CVCV]. But in order to discard the possibility of a (CVCV) foot, we must also consider longer words which might contain a (CVCV) foot.

### 4.2 Words with underlying form /CVC.CVC/

/CVC.CVC/ words include a transition between the two middle consonants. If the transition were shown to be a vowel, this would imply that a word-initial (CVCV) foot must exist. For this reason, the transitions in 85 /CVC.CVC/ words were measured.

Transitions play no part in the phonological structure of the word (Levin 1986, 1987). The duration of the transition is dependent on the nature of the surrounding consonants (Byrd 1996). In English, transitions can be up to 30 ms long (Hoole et al 2003) and transitions generally follow [-son] consonants (Matteson 1965). Dell and
Elmedlaoui (2002) note that transitions in Berber are always consonantal releases. These facts are also true for Kera, as seen below in a comparison of the vowel or transition with the following vowel. Transitions are measured in CVC_CVC words. Vowels are measured in (CVCVC) feet in the words: (CVCVC)CV or (CVC)(CVCVC).

\[
\text{Vowel ratio} = \frac{\text{vowel length}}{\text{final vowel length}} \quad \text{Transition ration} = \frac{\text{transition length}}{\text{final vowel length}}
\]

(Range: 0.4-0.8) (Range: 0-0.4)

(a) Sonorant ___C

(b) Obstruent ___ Sonorant

(c) Obstruent___Obstruent

All of these results are highly significant with results of p<0.001

Fig 3

Comparison of transitions and vowels (using ratio compared with following vowel)

These measurements show that /CVC.CVC/ words have transitions and not vowels between the two middle consonants. In fact, there are no [CVCVCVC] words in Kera.

**4.3 Relative vowel lengths**

In Kera there are various categories of vowels and also a transition. Each of these is characterized by a different duration. Below, the tables show average durations for each and the ratio between them. Firstly we compare transitions with short and long vowels.

<table>
<thead>
<tr>
<th>vowel</th>
<th>duration (ms)</th>
<th>number of tokens</th>
<th>ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>transition</td>
<td>...C-C...</td>
<td>(62)</td>
<td>1</td>
</tr>
<tr>
<td>short vowel</td>
<td>(CVC)</td>
<td>(56)</td>
<td>6</td>
</tr>
<tr>
<td>long vowel</td>
<td>(CVV)</td>
<td>(20)</td>
<td>9</td>
</tr>
</tbody>
</table>

The three categories above are clearly distinct from each other. In addition, short vowels differ considerably depending on whether they are heads and the nature of the foot. The
changes in duration take place in disyllabic feet as the non-head vowel shortens and the head vowel lengthens to maximize the contrast between them.

(15)

<table>
<thead>
<tr>
<th>vowel</th>
<th>duration (ms)</th>
<th>number of tokens</th>
<th>ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>non-head, open syllable</td>
<td>(CVCVC)</td>
<td>28</td>
<td>(32)</td>
</tr>
<tr>
<td>head, closed syllable</td>
<td>(CVC)</td>
<td>57</td>
<td>(56)</td>
</tr>
<tr>
<td>head, disyllabic foot, closed</td>
<td>(CVCVC)</td>
<td>70</td>
<td>(34)</td>
</tr>
<tr>
<td>head, long vowel</td>
<td>(CVCV:;)</td>
<td>86</td>
<td>(20)</td>
</tr>
</tbody>
</table>

In none of the examples above have we found any evidence for a /CVCV/ foot. It is in fact the case that no such foot exists in Kera. This explains the need for the strategies of deletion and lengthening as described in the first section of this paper.

5 CONCLUSION

A more theoretical explanation for the presence of (−) and (−) feet, and absence of (○ ○), can be found in the Iambic/Trochaic Law (Hayes 1985) with further developments from Kager (1993, 1995), Mellander (2004), Revithiadou and van de Vijver (1997) and van de Vijver (1998). For reasons of space, the reader is referred to the literature.

For many languages, foot structure is assigned with reference to stress patterns. But we have seen that Kera like Hausa (Leben 1997), Hedè (Vaibra p.c.; Roberts p.c.), Creek, Shingazidja (Kim 1999), Kirundi (Hayes 1995), and Choctaw (Lombardi and McCarthy 1991) has foot structure in the absence of overt stress. Kera shows that iambics can be the domain of tone and vowel harmony. It can also have a bearing on the allophony of vowels. Kera is one of a number of iambic languages that allow only (○ −) and (−) iambics with strategies in place to avoid the (○ ○) foot. Iambics can force lengthening or vowel deletion in many languages, but in Kera, both strategies are employed.

REFERENCES


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