A foot-based ludling and its implications for English footing

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1. Introduction

Language games or secret languages (*ludlings*, Bagemihl 1989) manipulate phonological constituents to disguise output forms of the source language. Among the most common processes used in ludlings are metathesis (Verlan, Lefkowitz 1989) and 'affixation' (Ubbi Dubbi, Yu 2008). The value of studying ludlings comes not only from understanding the exaggerated manner in which they mimic natural language, but from what they can tell us about the structure of those natural languages themselves.

Although most ludlings are used in running speech, implicating prosody above the word, Ubbi Dubbi [ʌ̀bɑɪtʌ́biːʧlʌ̀bɪŋgwʌ̀bɪstʌ́bɪks] 'I teach linguistics', most research limits itself to the lexical level [tʌ́biːʧ] 'teach'. We remedy this here with a study of a language game we call Ludika [lʌ́ɾɪkə], which is how the word *ludling* is pronounced in the game[1]. Our data comes from spontaneous telephone calls from within a jail, recorded legally by police and shared with the second author as part of a murder investigation in which the defendant was found guilty.[2]

Ludika is a previously undescribed ludling spoken by a small speech community in central California. Ludika forms consist of a series of trisyllabic words created by adding [ɪkə] to each foot in the English input to the game. By analyzing full utterances, we provide evidence for the foot structure of English in words and sentences. With data from Ludika, we challenge the use of recursive foot structure in English, the tradition of parsing aspirated stressless syllables while leaving unaspirated syllables in identical environments unfooted ((Lòlla)(pa)(lóoza) vs. (Tàta)ma(góuchee)), and all previous accounts of the footing of function words in phrases. We argue that all non-final trapped lights are parsed as degenerate stressless feet in content words and that all function words are parsed irrespective of stress or binarity.

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[1] According to this naming convention, Verlan would be LingLud, Ubbi Dubbi would be LubudLubing [lʌ́bədlʌbɪŋ], and Pig Latin would be Udlinglay [ʌ́dlɪŋleɪ].

[2] All data in this paper come from the convict, but our full corpus includes two of their relatives; all three are AAVE speakers, though this plays no special role in the data or analysis. Because of the second author's involvement in the investigation and the circumstances under which the data were obtained, we are unable to elicit more Ludika forms to fill gaps in the data.

The remainder of the paper proceeds as follows: §2 presents a theory-neutral description of the data and §3 presents a constraint-based account. §4 addresses the implications of the Ludika data for English foot structure at the word and sentence levels and §5 explores the possibility of a transderivational approach to Ludika and its consequences. §6 concludes.

2. Description of Ludika

In describing Ludika, we deviate from some of the conventional terminology used to discuss ludlings. The meaningless string inserted to disguise the input (e.g. [ʌb] in Ubbi Dubbi) is often referred to as a nonsense morpheme (Bagemihl 1995). The juxtaposition of 'nonsense' and 'morpheme' is contradictory because nonsense is inherently meaningless and morphemes are inherently meaningful. These strings universally lack meaning and their purpose is to impair non-speakers' ability to parse the meaning of an utterance; 'nonsense morphemes' cannot be morphemes. To divorce the status of morphemes from the meaningless gaming bits in some ludlings, we instead use the term *luds.*

2.1. The game

Each foot, including those bearing no stress (see sections 4 and 5 for a discussion of stressless feet in English), is promoted to a prosodic word ending in stressless –ɪkə with dactylic rhythm (σ́.ɪ.kə). When adding –ɪkə creates an output that contains a coda or deviates from the trisyllabic template, segments are deleted from the right edge of the offending foot.

(1)	(wɪt)	→	(wítɪ)kə	'with'
	(hóʊm)	→	(hóʊmɪ)kə	'home'
	(dífɹɪnt)	→	(dífɹɪ)kə	'different'
	(pɹə)(tɛ́k)tɪv	→	(pɹʌ́ɾɪ)kə (tɛ́ɾɪ)kə	'protective'
	(ɛ́ni)(bʌ̀di)	→	(ɛ́nɪ)kə (bʌ́dɪ)kə	'anybody'
	(ǽtɪ)(tùːd)	→	(ǽtɪ)kə (túːdɪ)kə	'attitude'

Deletion occurs in each of the above examples except for 'with' and 'home' to satisfy the basic conditions of the game. Simply adding –ɪkə to each foot in 'protective' yields *(pɹʌ́ɾɪ)kə (tɛ́ktɪ)kə, which violates the strong ban on codas. In the others, the rhyme of the second syllable of each disyllabic foot is deleted to adhere to the three syllable requirement.

Under hiatus, a flap is epenthesized to ensure that each syllable of the lud has an onset. Although both syllables of the lud always begins with a consonant, there is no word-initial epenthesis.

(2)	(mɑ)	→	(máɾɪ)kə	‘my’
	(ʃíː)	→	(ʃíːɾɪ)kə	‘she’
	(míː)	→	(míːɾɪ)kə	‘me
	(noʊ)	→	(noʊɾɪ)kə	‘no’
	(ɔ́n)	→	(ɔ́nɪ)kə	‘on’
	(áʊt)	→	(áʊtɪ)kə	‘out’

Although ‘out’ and ‘attitude’ phonetically contain flaps, we transcribe these in their underlying form to differentiate /t/ and /d/ in stems from the epenthetic flap generated by the need for luds to avoid hiatus. Note that in Ludika, /t/ and /d/ flap in the same environments as in American English generally; following Jensen (2000:208ff.), we take this to be much higher than the foot or the prosodic word; he suggests the utterance, since flapping can cross word– and even clause–boundaries: ‘Have a seat [ɾ], I'll be right back’.

Stems ending with rhoticized vowels and postvocalic /ɹ/ also receive an epenthetic flap, suggesting that the rhotics here are parts of diphthongs rather than codas. We transcribe them with [ɚ] for this reason.

(3)	(híɚ)	→	(híɚɾɪ)kə	‘here’
	(kɑ́ɚ)	→	(kʰɑ́ɚɾɪ)kə	‘car’
	(mɔ́ɚ)	→	(mɔ́ɚɾɪ)kə	‘more’
	(hɚ)	→	(hɚ́ɾɪ)kə	‘her’
	(ðɛ́ɚ)	→	(ðɛ́ɚɾɪ)kə	‘there’

Final [ɚ] behaves like final diphthongs, and our transcription reflects this. A more complicated analysis with consonantal [ɹ] is no doubt possible, but we won’t pursue it here.

Stem-final consonants frequently change their place of articulation to surface as alveolar. ‘Stem-final’ here refers not only to English words with final codas, but any form where deletion described in (1) situates a consonant immediately before a lud. The most regular instance of this pattern is velars; to avoid adjacent stressless syllables with velar onsets (*ǵ.kɪ.kə, *ǵ.gɪ.kə, *ǵ.ŋɪ.kə), stem-final velars are usually fronted to alveolars:

(4)	(láɪ**k**)	→	(láɪɾɪ)kə	‘like’
	(ʧɹǽ**k**ɪŋ)	→	(ʧɹǽɾɪ)kə	‘tracking’
	(nɛ́**k**st)	→	(nɛ́ɾɪ)kə	‘next’
	(pí**g**)	→	(píɾɪ)kə	‘pig’

(níɡə)	→	(níɾɪ)kə	‘nigga’
(lɔ́ŋ)	→	(lɔ́nɪ)kə	‘long’
(líŋk)	→	(línɪ)kə	‘link’

Retaining the nasality of the input /ŋ/ in ‘long’ and ‘link’ provides evidence that these consonants are assigned a new place feature rather than deleted. However, there are five instances of unaltered velars that we cannot explain: éɾɪkə θíŋkə ‘everything’ (twice), méɪkɪkə ‘make’, tɔ́kɪkə ‘talk’, and íŋkə ‘in’ (once each).

Whether other stem-final consonants surface faithfully is less predictable. The realization of labials and coronals seems to vary arbitrarily.

(5)

(pí:pl̩)	→	(pʰí:pɪ)kə	‘people’
(èɪ)(sǽp)	→	(éɪɾɪ)kə (sǽɾɪ)kə	‘ASAP’
(ʌ́p)	→	(ʌ́pɪ)kə	‘up’
	→	(ʌ́ɾɪ)kə	
(pɹə)(skɹáb)	→	(pʌ́ɾɪ)kə (skɹáɾɪ)kə	‘prescribe’
(íf)	→	(ífɪ)kə	‘if’
	→	(íɾɪ)kə	
(óʊvɚ)	→	(óʊvɪ)kə	‘over’
(fáv)	→	(fáɾɪ)kə	‘five’
(ʌ́v)	→	(ʌ́vɪ)kə	‘of’
	→	(ʌ́ɾɪ)kə	
(mám)	→	(mámɪ)kə	‘mom’
(sʌ̀m)(bádi)	→	(sʌ́nɪ)kə (bádɪ)kə	‘somebody’
(tám)	→	(támɪ)kə	‘time’
	→	(tánɪ)kə	
(tʃɹúθ)	→	(tʃɹúɾɪ)kə	‘truth’
(háʊs)	→	(haʊɾɪ)kə	‘house’
(ʤʌ́st)	→	(ʤʌ́sɪ)kə	‘just’
	→	(ʤʌ́ɾɪ)kə	
(híz)	→	(híɾɪ)kə	‘his’
(júz)	→	(júzɪ)kə	‘use’
	→	(júɾɪ)kə	
(fóʊn)	→	(fóʊnɪ)kə	‘phone’
(pʌ́ntʃ)	→	(pʌ́ɾɪ)kə	‘punch’

(tél)	→	(télɪ)kə	‘tell’
(kúl)	→	(kúɾɪ)kə	‘cool’
(ɔ́l)	→	(ɔ́lɪ)kə	‘all’
	→	(ɔ́ɾɪ)kə	
(bítʃ)	→	(bíɾɪ)kə	‘bitch’

While some words always retain their final consonant (‘people’ is always [pípɪkə], and never *[pírɪkə]) and others always flap (‘house’ is [háʊɾɪkə], not *[háʊsɪkə]), there appears to be no generalization that adequately describes which consonants remain faithful and which do not.

The central role of the foot in Ludika can be seen by adding the lud after prosodic constituents *other* than feet. Assuming one lud per syllable, foot, or word makes the same predictions for monosyllables but overgenerate luds per syllable and undergenerates them per word. We begin with one lud per foot:

(6) One lud per φ

(hóʊm)	→	√ (hóʊmɪ)kə	‘home’
(íf)	→	√ (ífɪ)kə	‘if’
(pípl)	→	√ (pí:pɪ)kə	‘people’
(dífɹɪnt)	→	√ (dífɹɪ)kə	‘different’
(ə)(báʊt)	→	√ (ʌ́ɾɪ)kə (báʊtɪ)kə	‘about’
(bɪ)(kʌ́z)	→	√ (bí:ɾɪ)kə (kʌ́ɾɪ)kə	‘because’
(ætɪ)(tù:d)	→	√ (ætɪ)kə (tú:dɪ)kə	‘attitude’
(pɹə)(tɛ́k)tɪv	→	√ (pɹʌ́ɾɪ)kə (tɛ́ɾɪ)kə	‘protective’
(pɹə)(skɹáb)	→	√ (pʌ́ɾɪ)kə (skɹábɾɪ)kə	‘prescribe’
(ɛ́ni)(bʌ̀di)	→	√ (ɛ́nɪ)kə (bʌ́ɾɪ)kə	‘anybody’

One lud per foot gets the right results, as shown.

One lud per syllable gets the right number of luds only with monosyllables and with iambically shaped words like *about* and *because*; it gets too many ludlings with other polysyllables:

(7) One lud per σ

íf	→	í.fɪ.kə	'if'
hóʊm	→	hóʊ.mɪ.kə	'home'
pí.pl	→	* pí.ɾɪ.kə pʌ́.lɪ.kə	'people'
dí.fɹɪnt	→	* dí.ɾɪ.kə fɹí.nɪ.kə	'different'[3]
ə.báʊt	→	√ ʌ́.ɾɪ.kə báʊ.tɪ.kə	'about'
bɪ.kʌ́z	→	√ bí.ɾɪ.kə. kʌ́.zɪ.kə	'because'
ǽ.tɪ.tùːd	→	* æ̀.tɪ.kə tí.ɾɪ.kə tú.dɪ.kə	'attitude'
pɹə.tɛ́k.tɪv	→	* pɹʌ́.ɾɪ.kə tɛ́.ɾɪ.kə tí.vɪ.kə	'protective'
pɹə.skɹáb	→	√ pʌ́.ɾɪ.kə skɹá.ɾɪ.kə	'prescribe'
ɛ́.ni.bʌ̀.di	→	* ɛ́.ɾɪ.kə ní.ɾɪ.kə bʌ́.ɾɪ.kə dí.ɾɪ.kə	'anybody'

One lud per stressed syllable fares significantly better, but fails with words whose initial syllable is stressless. These cases begin with stressless degenerate feet, following Kiparsky 1979 and others (see Jensen 2000 for discussion), which explains the discrepancy between basing the game on feet and on stressed syllables.

(8) One lud per σ́

(hóʊm)	→	√ (hóʊmɪ)kə	'home'
(íf)	→	√ (ífɪ)kə	'if'
(pípl)	→	* píː.ɾɪ.kə	'people'
(dífɹɪnt)	→	* dí.ɾɪ.kə	'different'
(ə)(báʊt)	→	* ə.báʊ.tɪ.kə	'about'
(bɪ)(kʌ́z)	→	* bɪ.kʌ́.ɾɪ.kə	'because'
(ætɪ)(tùːd)	→	√ æ̀.tɪ.kə túː.dɪ.kə	'attitude'
(pɹə)(tɛ́k)tɪv	→	* pɹə.tɛ́.ɾɪ.kə	'protective'
(pɹə)(skɹáb)	→	* pə.skɹá.ɾɪ.kə	'prescribe'
(ɛ́ni)(bʌ̀di)	→	√ ɛ́.nɪ.kə bʌ́.ɾɪ.kə	'anybody'

Positing one lud per prosodic word undergenerates luds in all but monosyllabic and trochee-shaped words:

[3] For those who prefer a syllabification of 'different' like dɪf.ɹɪnt, the output is still mispredicted: *dífɪkə ɹínɪkə.

(9) One lud per ω

(hóʊm)	→	√ (hóʊmɪ)kə	‘home’
(íf)	→	√ (ífɪ)kə	‘if’
pípl	→	√ pí:pɪkə	‘people’
dífɹɪnt	→	√ dífɹɪkə	‘different’
əbáʊt	→	* əbáʊtɪkə	‘about’
bɪkʌ́z	→	* bɪkʌ́ɾɪkə	‘because’
ætɪtù:d	→	* ætɪtù:dɪkə	‘attitude’
pɹətéktɪv	→	* pɹə.ték.tɪ.vɪ.kə	‘protective’
pɹəskɹáb	→	* pə.skɹá.ɾɪ.kə	‘prescribe’
énibʌ̀di	→	* énibʌ̀dɪkə	‘anybody’

We conclude that Ludika requires one lud per foot, where initial stressless syllables are feet (Kiparsky 1979).

NB: our audio recordings sometimes report what we take to be a voiceless high vowel between voiceless consonants: ‘both’ is [boʊθi̥kə] or [boʊθkə] ‘listen’ is [lɪsi̥kə] or perhaps [lɪskə]. We assume the former, trisyllabic cases, but have too little data to test our assumptions properly.

A foot-based approach is the simplest analysis of Ludika. Only feet predict the correct number and placement of luds and accurately predict deletion and epenthesis effects.

2.2. Prosodic Restructuring

We now examine the structural changes that transpire in the phonology. In Ludika, each English foot becomes its own prosodic word. The resulting output is a series of dactyls each bearing a primary stress.

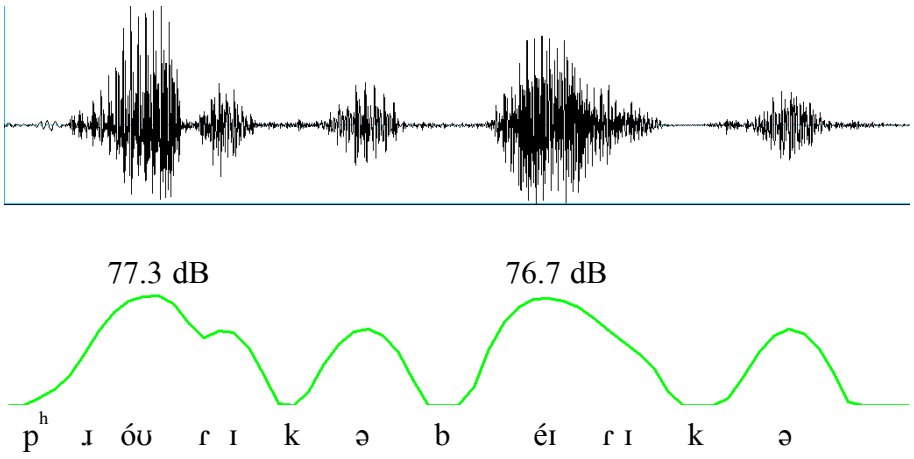
In English, each foot in multi-stress words is assigned varying degrees of prominence, as is each member of a compound. This is reflected by the phonetic correlates of stress: duration, amplitude, and pitch (see Gordon 2011), where a primary stress is longer and louder with more extreme pitch than a secondary stress. English words with multiple stresses (and thus multiple feet), create polydactylic Ludika forms:

(10) (pɹʊ̀ʊ)(béɪ)ʃn → (pɹóʊɾɪ)kə (béɪɾɪ)kə ‘probation’

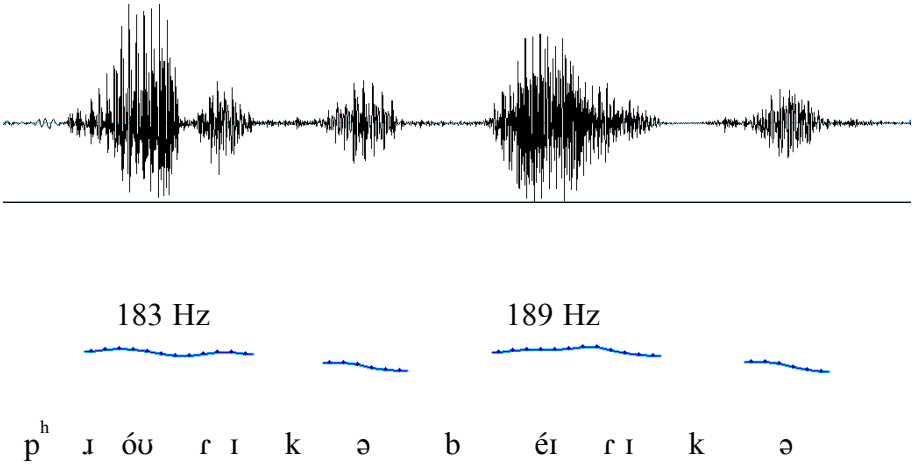
Measuring the phonetic correlates of stress on the initial syllable of each dactyl allows us to determine whether there is secondary stress in Ludika. Despite the presence of secondary stress

in English, amplitude and pitch on the stressed syllables of polydactyls do not differ significantly, indicating that the stresses on each are equal.

(11) Amplitude of (pʰɹóʊɾɪ)kə (béɪɾɪ)kə ‘probabtion’



(12) Pitch of (pʰɹóʊɾɪ)kə (béɪɾɪ)kə ‘probabtion’



Independent sample t-tests of polydactylic outputs shows that the phonetic cues on the stressed syllable of the first dactyl are not routinely higher than the second, and vice versa.[4]

[4] Duration is excluded from the statistical analysis because further subcategorizing polydactyls into CV́Cɪkə and CV́VCɪkə groups to achieve fair comparisons of vowel duration would create samples too small to report reliable results.

(13) Overall comparison of mean amplitude and pitch

Mean Amplitude $\acute{\sigma}_1$	Mean Amplitude $\acute{\sigma}_2$	*p*-value	N
72.5 dB	73.1 dB	0.502	29
Mean Pitch $\acute{\sigma}_1$	Mean Pitch $\acute{\sigma}_2$	*p*-value	N
189.7 Hz	189.5 Hz	0.994	29

Nor is there a correlation between English stress assignment and the relative prominence of Ludika outputs. The phonetic differences between primary/secondary stress (‘pròbátion’) and stressed/stressless syllables (‘protéctive’) found in English do not translate to Ludika. In cases where primary stress falls on the first of two feet, as in *hóme-bòy* and *áttitùde*, we might expect greater amplitude and pitch on the stressed syllable of the first dactyl. This does not happen in Ludika.

(14) Comparison of mean amplitude and pitch: head foot first

Mean Amplitude $\acute{\sigma}_1$	Mean Amplitude $\acute{\sigma}_2$	*p*-value	N
73.2 dB	72.1 dB	0.497	11
Mean Pitch $\acute{\sigma}_1$	Mean Pitch $\acute{\sigma}_2$	*p*-value	N
172.2 Hz	193.8 Hz	0.141	11

Although mean amplitude of the first dactyl is slightly higher than the second, the difference is not significant. Strangely, the mean pitch difference is closer to obtaining a statistically significant result, but the higher pitch falls on a different syllable than is predicted by English stress.

The same is true of instances where English stress anticipates that the second dactyl is more prominent than the first, such as ‘pròbátion’ and ‘protéctive’.

(15) Comparison of mean amplitude and pitch: head foot second

Mean Amplitude $\acute{\sigma}_1$	Mean Amplitude $\acute{\sigma}_2$	*p*-value	N
72 dB	73.6 dB	0.174	18
Mean Pitch $\acute{\sigma}_1$	Mean Pitch $\acute{\sigma}_2$	*p*-value	N
200.3 Hz	186.9 Hz	0.613	18

These results mirror those in (15). Mean amplitude is greater where it reflects primary stress in the input, and mean pitch is higher where it reflects secondary stress in the input. Again, neither test returns significant results, showing no relationship between English stress and relative prominence in Ludika. Because different degrees of stress are neither assigned to polydactyls

systematically by the grammar of Ludika nor transferred from input stresses, we conclude that each dactyl belongs to its own prosodic word. As polydactyls are not composed of multiple feet in a single word or structured recursively as compounds, the input must be altered by promoting feet to prosodic words.

3. Ludika in OT

The core of Ludika is creating a dactyl that ends in the lud [ǐkə], with both syllables stressless, but other issues come up as well, including the emergence of unmarked syllables and the absence of [...kǐkə], [...gǐkə], and [...ŋǐkə]. We address these in the following sections, beginning with the core.

3.1 Lexical data

We treat the addition of [ǐkə] as epenthesis caused by an ad-hoc alignment constraint (McCarthy & Prince 1993), one that is part of Ludika but not part of English:

(16) ALIGNR(ω, ǐkə$_{LUD}$): Every word ends with the lud [ǐkə].

ALIGNR requires that each word end in the string [ǐkə]; words ending otherwise, including words ending with stress on either syllable of the lud are illicit. Combined with ALLFEETLEFT, this yields a dactylic shape (σ́.ɪ.kə) that gives the game its feel. A one-syllable word like [hóʊm] 'home' surfaces in the game with [ɪkə] attached:

(17) (hóʊm) → (hóʊ)mɪkə 'home'

	(hóʊm)	ALIGNR
a.	(hóʊm)	*!
b.	(hóʊ.mə)	*!
c.	(hóʊm.kə)	*!
d.	(hóʊ)(mìkə)	*!
e.	☞ (hóʊ.mɪ)kə	

Candidates (a-d) don't end in [ɪkə], (d) ending in stressed [ìkə] rather than stressless [ɪkə] as required. This leaves (e) as the output for the game.

Note that [ɪkə] is *not* an affix in the game, *sensu stricto*. Affixes are morphemes and mean something; [ɪkə] has no meaning, it's just filler to throw the listener off and conceal the intended

message. Referring to a lud as a 'meaningless morpheme' is senseless, we think, a contradiction in terms, and one with empirical consequences we'll spell out shortly. The lud [ǐkə] is introduced as part of ALIGNR, not as part of the underlying input: it's *just part of the game, not part of the input message.* To surface, it must violate low-ranked DEP, by inserting a lud that isn't part of the input; [ǐkə] is only supplied to satisfy ALIGNR.

Beyond this core constraint, we see NOCODA (Prince & Smolensky 1993/2004) and NOHIATUS (Green 2000) giving the game relatively unmarked prosody. NOHIATUS mandates epenthesis of [ɾ] when vowel-final stems abut [ɪkə]:

(18) NOHIATUS: A V.V sequence is prohibited.

(19) (ɑ́) → (ɑ́ɾɪkə) 'I'

	(ɑ́)	ALIGNR	NOHIATUS	MAX
a.	(ɑ́)	*!		
b.	(ɑ́ɪ.kə)	*!		
c.	(ɑ́.ɪ).kə		*!	
d.	☞(ɑ́.ɾɪ).kə			

NOCODA forces loss of stem-final consonants that can't be syllabified into onsets:

(20) NOCODA: Every syllable ends in a vowel.

(21) (wʌ́nt) → (wʌ́nɪ)kə 'want'

	(wʌ́nt)	ALIGNR	NOCODA	MAX
a.	(wʌ́nt)	*!	*	
b.	(wʌ́n)tɪ.kə		*!	
c.	☞ (wʌ́.nɪ)kə			*

Stem-final [t] is deleted to allow [n] into the onset of the penultimate syllable. We assume that [n] is retained rather than [t] to avoid a violation of CONTIGUITY (McCarthy & Prince 1995).

Respecting the rarity of velar onsets in successive stressless syllables (25)[5], words such as ‘like’ or ‘brick’ surface with the stem-final velar as a flap:

(22) OCP_{VEL}: No velar onset follows another.

(23) (bɹík) → (bɹíɾɪ)kə ‘brick’

	(bɹík)	ALIGNR	OCP_{VEL}	IDENT
a.	(bɹíkɪ)ɾə	*!		*
b.	(bɹíkɪ)kə		*!	
c.	☞ (bɹíɾɪ)kə			*

Candidate (b) fails because of the successive velar onsets in stressless syllables. (a) shows that how the lud sounds is more important than how the root sounds, leaving (c) as the winner.

We derive stem-final consonant variation with variable ranking of markedness and faithfulness constraints (Anttila & Cho 1998). Recall that with the exception of nasals, consonant alternations are either entirely faithful or they change to [ɾ]. Labial fricatives, for instance, never become coronal fricatives. This indicates that the ranking of markedness constraints is variable with respect to faithfulness but the ranking of markedness constraints amongst each other is consistent; specifically, they are all tied. We further add a high-ranked anchoring constraint to restrict the environment of alternations to stem-final consonants.

(25) *[LAB] No labials
*[FRIC] No fricatives
ANCHORL-BA(φ) The left edge of each foot in the argot must correspond to the left edge of each foot in the base

[5] There are exceptions, but they are rare or archaic: e.g., anarchical, (hier)archical, autarkical, bacchical, psychical. See https://lotsofwords.com.

(26) (fáv) → (fávɪ)kə ‘five’

(fáv)	ANCHORLφ	IDENT	*[LAB]	*[FRIC]
a. ☞ (fávɪ)kə			**	**
b. (fázɪ)kə		*!	*	**
c. (fáɾɪ)kə		*!	*	*
d. (ɾáɾɪ)kə	*!	**		

The inverse ranking of IDENT and markedness constraints results in a [ɾ].

(27) (fáv) → (fáɾɪ)kə ‘five’

(fáv)	ANCHORLφ	*[LAB]	*[FRIC]	IDENT
a. (fávɪ)kə		**	*!*	
b. (fázɪ)kə		*	**!	*
c. ☞ (fáɾɪ)kə		*	*	*
d. (ɾáɾɪ)kə	*!			**

Even when markedness is reranked above IDENT, these constraints are still dominated by ANCHORLφ, containing alternations to stem-final consonants.

Nasals are more resilient, retaining their nasality while changing their place feature. This suggests faithfulness to [nas] is high-ranked.

(28) MAX[NAS] Don’t delete a nasal feature

(29) (tám) → (támɪ)kə/(tánɪ)kə ‘time’

(tám)	MAX[NAS]	*[LAB]	IDENT
a. ☞ (támɪ)kə		*	
b. ☞ (tánɪ)kə			*
c. (táɾɪ)kə	*!		*

The selection of (a) or (b) again depends on the ranking of markedness constraints with respect

to IDENT. Crucially, under either ranking of the variably ranked constraints, MAX[NAS] ensures that unfaithful stem-final consonants remain nasal.

Trochaically shaped words like 'different' surface with the final syllable lost, to avoid unnecessary violation of NOLAPSE, as we see below.

(24) NOLAPSE No stressless syllable follows another.

(25) (dí.fɹɪnt) → (dí.fɹɪ)kə 'different'

	(dífɹɪnt)	ALIGNR	NOLAPSE	MAX
a.	(dí.fɹɪnt)	*!		
b.	(dí.fɹɪ)nɪ.kə		**!	*
c.	☞ (dí.fɹɪ)kə		*	***
d.	(dí.fɪ)kə		*	***!*

ALIGNR always forces some violation of NOLAPSE, by introducing the lapsey string [ĭkə], as (c) shows. But any additional stress lapse (b) is as fatal as gratuitous violation of MAX (d).

As we've seen, English words with multiple feet retain the number of feet in the ludling. Thus two-foot 'attitude' surfaces with two feet in the ludling to respect FAITHFOOT, but undominated ALLFEETLEFT forces those feet into distinct prosodic words, each ending in [ɪkə]:

(26) FAITHFOOT: Every input foot has an output foot and vice versa.

(27) ALLFEETLEFT:Every foot is word-initial.

(28) (ætɪ)(tù:d) → (ætɪ)kə (tú:dɪ)kə 'attitude'

	(ætɪ)(tù:d)	ALIGNR	FAITHFT	ALLFTL
a.	(ætɪ)(tù:d)	*!		*
b.	(ætɪ)kə(tù:dɪ)kə			*!
c.	☞ (ætɪ)kə (tú:dɪ)kə			
d.	(ætɪ)kə		*!	
e.	(ærɪ)kə (tíɾɪ)kə (tú:dɪ)kə		*!	

Candidate (b) fails because the output word contains a non-initial foot, leaving (c) with two prosodic words, each of which has all its feet initial. The number of input and output feet must be the same, neither less (d) nor more (e). Again, this straightforwardly shows the role of feet in Ludika.

FAITHFOOT allows us to probe directly into what constitutes a foot in English. As we've said, words like *potato, today,* and *calypso* have been argued to begin with a stressless foot, based on the aspiration in the initial stops (Kiparsky 1979). Ludika data is consistent with this, since stressless pre-tonic syllables are promoted to their own prosodic words with [ɪkə]:

(29) (ə)(gɛ́n) → (ʌ́ɾɪ)kə (gɛ́nɪ)kə 'again'

	(ə)(gɛ́n)	ALIGNR	FAITHFT	ALLFTL
a.	(ə)(gɛ́n)	*!		*
b.	ə(gɛ́nɪ)kə		*!	*
c. ☞	(ʌ́ɾɪ)kə (gɛ́nɪ)kə			

We'll look at consequences of this for theories of English foot structure below. For now, it's important to see that all words in our corpus with stressless initial syllables behave like *again.*

(30) (ə)(báʊt) → (ʌ́ɾɪ)kə (báʊtɪ)kə 'about'
(bɪ)(kʌ́z) → (bíːɾɪ)kə (kʌ́ɾɪ)kə 'because'
(pɹə)(tɛ́k)tɪv → (pɹʌ́ɾɪ)kə (tɛ́ɾɪ)kə 'protective'

3.2 Phrasal data

As we mentioned, it's important in studying ludlings to take into account phrasal data as well as individual words. This is especially important as there is a longstanding tradition of using the source language's output as input to the ludling (see Frazier & Kirchner 2011:6 and references therein). We'll show here that postlexical surface feet provide an accurate predictor of lud assignment in Ludika and that Ludika therefore casts light on how feet are assigned postlexically to phrasal units. Consider the following, which contains a number of pronouns in various syntactic environments: matrix subject (*I*) and object (*it*), the spec position of an embedded clause (*what*), and embedded subject (*they*) and object (*you*):

(31) áɾɪkə sɛ́dɪkə ítɪkə dónɪkə mǽtɪkə wʌ́tɪkə déɪɾɪkə tɛ́lɪkə júːɾɪkə
I said it don't matter what they tell you

All of the pronouns are promoted to prosodic words ending in [ɪkə], suggesting that they enter the Ludika game either as feet or as prosodic words. The fact that they generally surface as stressless in English make it unlikely that they enter Ludika as prosodic words; we conclude that they enter as feet.

Evidence that nonlexical heads like complementizers (*that*), auxiliary verbs (*was*), and prepositions (*on, with*) also feet postlexically comes from output like the following:

(32)	árɪkə	sédɪkə	ðǽtɪkə	árɪkə	nóʊrɪkə	wʌ́tɪkə	wʌ́rɪkə	góʊnɪkə	ánɪkə	wítɪkə	hɚ́rɪkə
	I	said	that	I	know	what	was	going	on	with	her

Determiners (*the*) and prepositional complementizers (*to*) behave in the same way:

(33)	(dáʊnɪ)kə (ðʌ́rɪ)kə (mídɪ)kə	'down the middle'
	(ámɪ)kə (ʧɹáɪrɪ)kə (túːrɪ)kə (gítɪ)kə (áʊtɪ)kə	'I'ma try to get out'

This phrasal data strongly suggests that stressless function words form feet generally in English, since they behave exactly like word-internal feet in Ludika.

Note that contractions like *don't* and *that's* below (and *outa* in 36) are allowable inputs to Ludika and that contraction is visible on the surface:

(34)	ítɪkə dóʊnɪkə mǽtɪkə	'it don't matter'
	dǽsɪkə ɔ́lɪkə áɪrɪkə kǽnɪkə dúːrɪkə	'that's all I can do'

Psycholinguistic research suggests that high-frequency words are stored as they appear on the surface (e.g., Monaghan et al. 2017). Other reductions are less likely to be stored and surface with their own luds. We find this to be true generally for object pronouns (*her*) and for the infinitive marker (to), which are promoted to full [ɪkə] words in cases like the following:

(35)	déɪdɪkə tóʊlɪkə hɚ́rɪkə	'they told her'
	níːdɪkə túːrɪkə gétɪkə ðʌ́rɪkə fʌ́rɪkə áʊrɪkə híɚrɪkə	'need to get the fuck outa here'

We conclude that Ludika provides evidence that function words generally have the status of a foot in English, accounting for their normal promotion to full [ɪkə] words in the game.

4. Consequences for English Foot Structure

The merit of studying ludlings is not restricted to the intrinsic value of understanding the rules that govern them. They also present a unique perspective from which to interpret the grammar of its source language. Our knowledge of feet in English is informed primarily by stress assignment (moraic trochees, Kager 1989) and by the distribution of aspiration (foot-initial) and preglottalization (foot-final, Iverson & Salmons 1995). The Ludika data afford the opportunity to draw conclusions about more opaque cases which cannot be easily resolved by these cues.

4.1. Feet within Words

A highly debated topic is the foot structure of initial stressless syllables in words like 'potato'; arguments have been made for degenerate feet (Kiparsky 1979, Hayes 1987, Iverson & Salmons 1995), stray syllables (Itô & Mester 2009), and syllables adjoined to feet in recursive (Jensen 2000; Davis & Cho 2003; Kager 2012) or internally layered feet (Martínez-Paricio & Kager 2015). Ludika provides evidence for analyses using degenerate feet. Examples such as *protective* get two luds in Ludika, (pɹʌ́ɾɪ)kə (téɾɪ)kə, indicating the presence of two input feet:

(36) degenerate φ (pɹə)(ték)tɪv → (pɹʌ́ɾɪ)kə (téɾɪ)kə

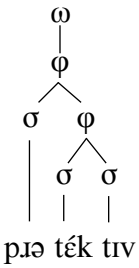
If stressless initial syllables are just stray syllables not dominated by feet, we expect them not to receive a lud; but this prediction is wrong (38). The prediction should be the same whether the initial syllable is dominated directly by a prosodic word or directly by a phonological phrase:

(37) stray in ω ($_{ω}$ pɹə (ték) tɪv) → *($_{ω}$ pɹə(téɾɪ)kə)
stray in Φ (Φ pɹə (ték) tɪv) → *(Φ pɹə(téɾɪ)kə)

Recursive and internally layered feet don't seem to provide the right input either, as far as we can tell, though the metaphysics of recursive feet don't necessarily make for clear predictions, especially for the promotion of feet to prosodic words.

Assuming the recursive foot below (see Jensen 2000, Davis & Cho 2003, Kager 2012, Martinez-Parício & Kager 2015), there are two right foot-boundaries, both of them following [tɪv]:

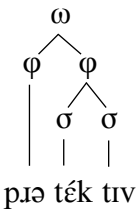
(38) recursive foot ‘protective’



If [ĭkə] is added at the right boundaries (*protective-ika-ika*), we should get something like *pɹətékɪkə íkə with both luds at the end of the word, where the recursive boundaries fall. Adding [ĭkə] at the left boundaries fares worse; we leave this to the interested reader. In short, we don’t see any way of using recursive feet to account for Ludika. There is no set of left or right boundaries to get the lud after [pɹə] and after [ték].

Compare those outcomes with those of non-recursive feet, as we argued for above, where it’s much easier to see how the game is played: each foot turns into an ɪkə word:

(39) non-recursive foot ‘protective’



Adding [ɪkə] to the end of each surface foot above and promoting the output to a prosodic word straightforwardly models the desired outcome. We submit that Ludika offers a novel test of recursive feet, one which they appear to fail.

The Ludika data further enable us to extend the application of degenerate stressless feet in English. In the literature, trapped lights in English are often treated as parsed syllables when there’s aspiration (leftmost examples) and strays when there is not (rightmost).

(40)	**(pʰə)**(tʰéɪɾo)	‘potato’	**sə**(pʰɹáɪz)	‘surprise’
	(lùlə)**(pʰə)**(lúːzə)	‘Lollapalooza’	(tʰèɾə)**mə**(gúːʧi)	‘Tatamagouchee’

While there are no explicit claims that the footing of *Lollapalooza* contrasts with *Tatamagouchee*, trapped light syllables in identical environments can still be parsed differently on the basis of aspiration. Ludika provides concrete evidence to correct these inconsistencies.

(41)	(ə)(gɛ́n)	→	(ʌ́ɾɪ)kə (gɛ́nɪ)kə	'again'
	(ə)(báʊt)	→	(ʌ́ɾɪ)kə (báʊtɪ)kə	'about'
	(bɪ)(kʰʌ́z)	→	(bíːɾɪ)kə (kʰʌ́ɾɪ)kə	'because'

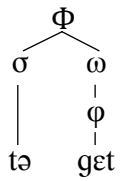
If the initial syllables of *again, about,* and *because* were strays, they would be skipped by lud assignment in Ludika, producing *ə(gɛ́nɪ)kə, *ə(báʊtɪ)kə, and *bɪ(kʰʌ́ɾɪ)kə. This shows that unaspirated trapped lights must be parsed as degenerate feet. Although Ludika offers direct evidence only that all initial trapped lights are degenerate feet in English, we hypothesize that this is true of all non-final trapped lights since the underlying principle on which we base our argument for parsing initial trapped lights applies to non-initial positions as well.

Note that the words in (43) give us the same problem for recursive feet that we saw with *protective:* recursive feet like (ə(gɛ́n)) don't have a set of (left or) right foot boundaries that can position the lud. If we add the lud to the right of each foot we get *əgɛ́nɪkəɪkə. If we add it to the left of each foot we get * ɪkəɾərɪkəgɛ́n.

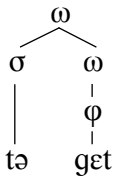
4.2 Feet within Phrases

How English function words are phrased phonologically has been an important area of research since Selkirk 1984 at least. We won't review all of that literature here, but merely note two recent proposals: stressless function words are stray syllables dominated by a phonologial phrase Φ (Selkirk 1996) or stray syllables dominated by a (recursive) prosodic word ω (Itô & Mester 2009).

(42) σ dominated by φ 'to get'



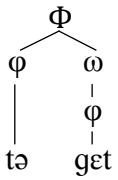
(43) σ dominated by ω ‘to get’



Recall now that function words like *to* surface in Ludika as prosodic words ending in [ɪkə]: [tʌ́ɾɪkə gétɪkə]. It’s difficult to derive this from (46) or (47) since each has a single foot and the number of [ɪkə] corresponds exactly to the number of phonological feet elsewhere in Ludika.

But if stressless function words are degenerate feet, as we have argued, they should pattern with the initial syllables of *again, about,* and *because*, as indeed they do:

(44) φ dominated by Φ ‘to get’



(We assume that *to* isn’t a prosodic word because it is stressless.) Treating stressless function words as stressless degenerate feet is a sort of compromise between Selkrik’s (1996) treatment of reduced function words (stray syllables) vs. focused and phrase-final function words (stressed feet). In *Ludika* we see function words surfacing as stressless feet that are sometimes monomoraic and reduced (ðə, ə, fɚ, kn̩, tə...) and sometimes bimoraic and full (ði:, eɪ, fɔɹ, kæn, tu:...).

5. Conclusion

We’ve provided here a description of a language game new to the literature, as far as we know, and provided a formal analysis of it using an ad hoc alignment constraint plus a number of familiar constraints from the phonology of English. Briefly, every phonological foot in English is promoted to a prosodic word ending in [ɪkə].

We’ve also argued that the game sheds light on footing in English generally, outside of the game. Specifically, it suggests that Kiparsky 1979 and others were right in treating initial stressless sylalbles as *stressless feet*, because we see them promoted to prosodic words in the game, [ʌ́ɾɪkə báʊtɪkə] ‘about’, rather than deleted like unfooted syllables are word-finally. Ludika

also provides evidence for footing the third syllable of (Tàta)(ma)(góuchee), where there is no aspiration, just as we foot the third syllable of (Mèdi)(ter)(ránean), where there is. Similarly for stressless function words, which are likewise promoted to prosodic words in the game, [tʎ́rɪkə gɛ́tɪkə] 'to get', suggesting that they too are stressless feet in the surface phonology of English.

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