Class 2: Structure above the segment II

To do
- ☐ Read Hayes 1995—brief study questions due ~~Monday~~ Wednesday
- ☐ First assignment to be posted soon—will be due a week from Friday (Jan. 19)

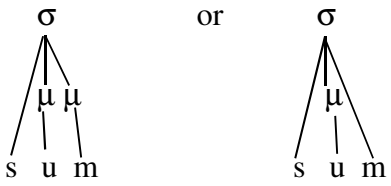
Overview
Moras, and a start on feet.

1 Moras

2 What are moras? Review

- A *mora* is an abstract unit of duration[1] that has been proposed for dealing with footing and stress assignment in so-called "quantity-sensitive" languages.
  - It's the difference between a light syllable and a heavy syllable.

- What gets a mora?
  - Onsets usually don't get any (but see (Topintzi 2006), (Ryan 2014), (Ryan to appear)
  - A nucleus vowel almost always gets one (though in some languages, schwa gets no mora).
  - A long vowel or diphthong (2 vowels in the same nucleus) usually gets two.
  - A coda consonant may get one, depending on the language—and it some languages, only certain coda consonants get one



depending on the language

Syllable weight
1 mora: light syllable
2 moras: heavy syllable
3 moras: superheavy syllable

? How could a syllable have 3 moras?

[1] or total acoustic energy, or total acoustic energy weighted with some frequencies counting more than others. See (Gordon 2002).

3 Reasons to add moras

3.1 Syllables with more moras often attract stress

- …leading to this constraint (Prince 1990)
  - **WSP** ("weight-to-stress principle"): a heavy syllable must be stressed

Italian
(Indo-European language from Italy and surroundings with 62 million speakers; I didn't write down where I first got these data and generalizations. A lot are from a dictionary, Melzi 1976)

- heavy penults must be stressed (unless final stress, and with a couple of exceptions)
- light penults can go either way

spa.gét.ti	'spaghetti'	ká.li.tʃe	'chalice'	di.ví.sa	'uniform'
a.rán.tʃo	'orange (color)'	mú.si.ka	'music'	tri.bú.na	'rostrum'
am.búr.go	'hamburger'	ál.be.ro	'poplar'	kom.prá.re	'buy'
in.tén.to	'intent'	fís.si.le	'fissionable'	kor.ní.tʃe	'cornice'

- There must be some difference between the underlying forms of [mú.si.ka] and [tri.bú.na], like underlying stress or (looking ahead) underlying footing, or something else

- Before moras you had rules like V → [+stress] / __ C{C,#}
  - Doesn't capture the typology (why not V → [+stress] / __ CV instead?)

3.2 Compensatory lengthening ((Hayes 1989))

Latin historical change		*kas.nus >	ka:.nus	'gray'
		*kos.mis >	ko:.mis	'courteous'
		*fi.des.li.a >	fi.de:.li.a	'pot'
Turkish free variation		sav.mak →$_{optionally}$	sa:.mak	'to get rid of'
	but	da.vul →$_{optionally}$	da.ul	'drum'

? Draw the moras and syllable structure for [sav.mak] and [da.vul]. Let's ponder why deletion leads to lengthening in one case but not the other.

Greek (East Ionic)	*woi.kos > oi.kos	‘house’
	*ne.wos > ne.os	‘new’
	*od.wos > oː.dos	‘threshold’

? Draw the moras and syllable structure for [woi.kos], [ne.wos], [od.wos], and ponder.

Middle English (originally from (Minkova 1982)*)*	ta.lə > taːl	‘tale’

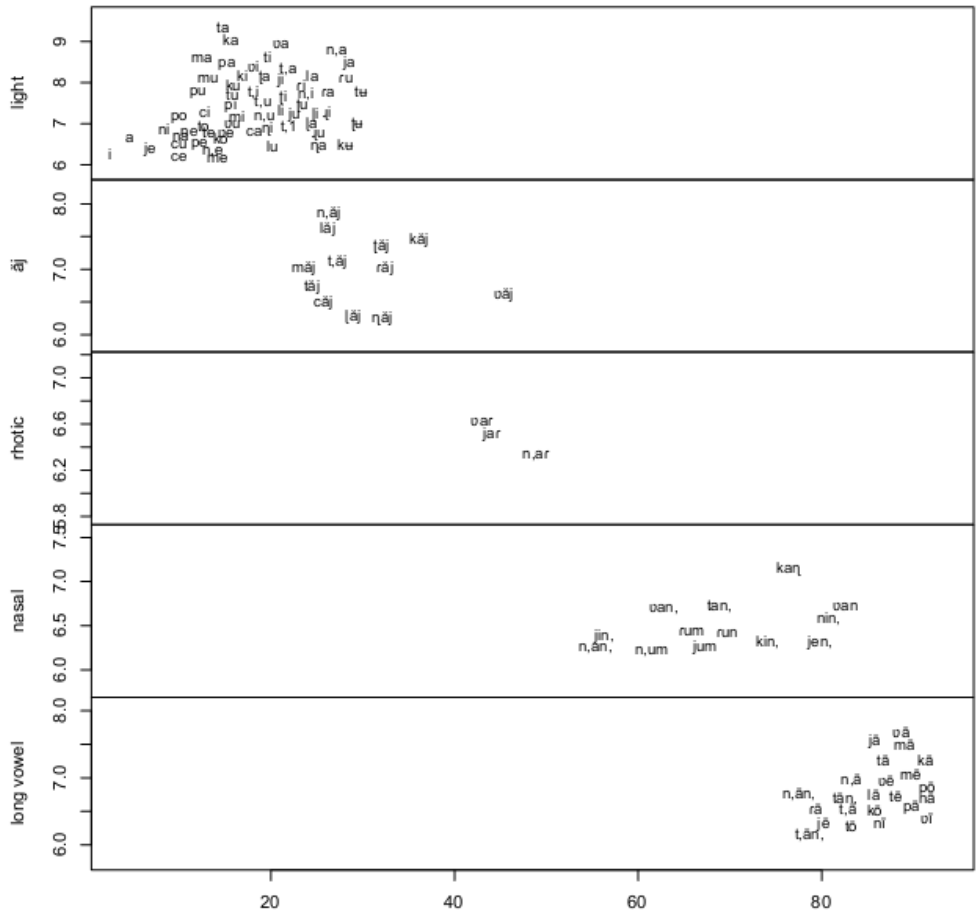
? We have to ignore several complications, but we can get the basic idea by drawing [ta.lə]

Unattested cases	sa → aː
	sla → saː

? Why don’t these occur?

3.3 Reining in our optimism about moras

- (Ryan 2011a; Ryan 2011b) shows that language can make many more than 2 or 3 weight distinctions
- Tamil: using sophisticated statistical measures over a huge verse corpus, Ryan finds 5 partly-overlapping weight classes



horizontal axis: percentage of the time each syllable type acts as though heavy in verse.

vertical axis within each slice: log frequency of each type (not important for our purposes).

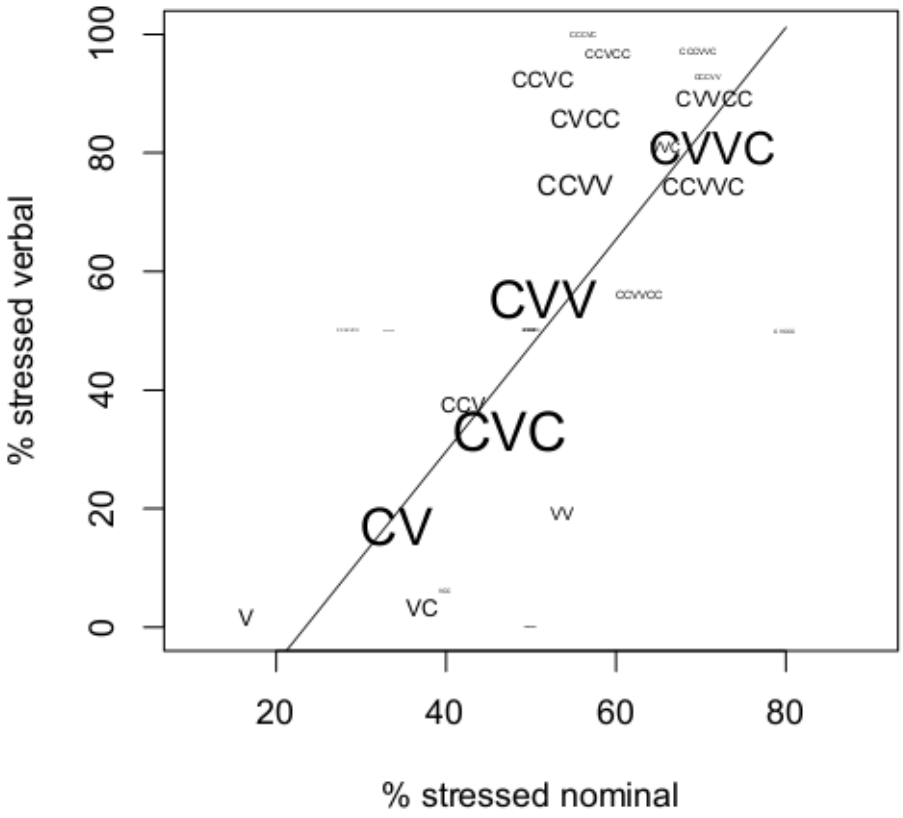
Figure 14: Figure 13 filtered into five phonological classes.

(Ryan 2011a p. 21)

- Later he finds more and more categories (here and for other languages)
- The categories also don't behave as though evenly spaced

→ In versification and lexically-variable stress (English real and fake words), it seems more like you can attach a real number to each syllable, like "0.81".

- Here's Ryan's English real-word data:



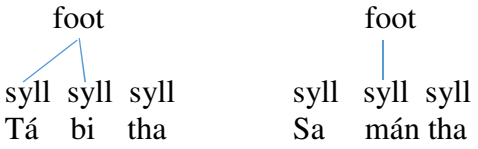
Size of font indicates frequency.

Notice that more-complex onset leads to more stress.

(Ryan 2011a, p. 179)

3.4 Looking very slightly ahead, foot inventory

- Short version: a *foot* is a constituent that groups syllables (usually one or two)



- Different languages require different types of feet:

	trochees (stress on first syll)	*iambs (stress on second syll)*
quantity-insensitive	**attested**	maybe unattested?
quantity-sensitive	**attested: moraic (LL), (H)**	**attested: "uneven" (LH), (H), (LL)**

  - At least for trochaic languages, we want feet to be able to count moras

4 Preparatory concept for exercise: the "perfect grid"

- Prince proposes that the four basic stress types of Hayes 1980 can be achieved through setting two parameters for lining up syllables with a *perfect grid*:

```
     x   x   x
… x x x x x x x …
```

(a) where to start on the grid: peak or trough
(b) where to start in the word: beginning or end

? What are the parameter settings for each of the following four languages (don't worry about primary vs. secondary stress)? [taken from Hayes]

Maranungku (aka Maranunggu, Australian lang. from Australia, highly endangered; data orig. from Tryon 1970)

tí.ralk	'saliva'
mé.re.pèt	'beard'
yán.gar.mà.ta	'the Pleiades'
láng.ka.rà.te.tì	'prawn'
wé.le.pè.ne.màn.ta	'kind of duck'

A: peak, beginning
B: peak, end
C: trough, beginning
D: trough, end

Weri (Trans-New Guinea, PNG, 4,000 speakers; data orig. H. Boxwell & M. Boxwell 1966)

ŋin.típ	'bee'
kù.li.pú	'hair of arm'
u.lù.a.mít	'mist'
à.ku.nè.te.pál	'times'

A: peak, beginning
B: peak, end
C: trough, beginning
D: trough, end

Warao (Language isolate, Venezuela, 28,000 speakers; data orig. from Osborn 1966)

yi.wà.ra.ná.e	'he finished it'
yà.pu.rù.ki.tà.ne.há.se	'verily to climb'
e.nà.ho.rò.a.hà.ku.tá.i	'the one who caused him to eat'

A: peak, beginning
B: peak, end
C: trough, beginning
D: trough, end

Araucanian (data originally from Echeverria & Contreras 1965)
Family consisting of Mapudungun (Chile & Argentina, 300,000 speakers) & Huilliche (Chile, 2000 speakers).

wu.lé	'tomorrow'
t̪i.pán.to	'year'
e.lú.mu.yù	'give us'
e.lú.a.è.new	'he will give me'
ki.mú.ba.lù.wu.làу	'he pretended not to know'

A: peak, beginning
B: peak, end
C: trough, beginning
D: trough, end

- Additional parameter: add a grid mark on the top level at either the beginning or the end of the word.

? Which setting does each of the four languages above have?

? Consider Araucanian *elúmuyù*: how does the extra grid mark end up in the right place?

5 Exercise: fragment of Cairene Classical Arabic

= the variety of Classical Arabic spoken in Cairo. Data taken from Hayes 1995, Kenstowicz 1994, orig. from Mitchell 1960, Kenstowicz 1980—probably resulting in contradictions.

- Let's see how far we can get with just moras and a grid
- To start, let's try building a grid on **moras** and see where we run into problems.

? Make a guess about the two basic "perfect-grid" parameters. You can assume for now that secondary stress gets assigned and then wiped out by a later rule (i.e., you have to guess where it was).

a	ká.ta.ba	'he wrote'	*you might need a special rule for the final syllable*
b	ka.ta.bí.tu	'she wrote it'	(not Classical, but apparently words of this shape are stressed the same in Classical and Colloquial Cairene)
c	ša.ja.rá.tu.hu	'his tree'	

? Still working for these data?

d	ʔad.wi.ya.tú.hu	'his drugs (nom.)'	
e	ʔin.ká.sa.ra	'it got broken'	
f	qat.tá.la	'he killed'	
g	haa.ðáa.ni	'these (m. dual)'	
h	ša.ja.ra.tu.hú.maa	'their (dual) tree (nom.)'	
i	ša.ja.rá.tun	'tree (nom.)'	
j	haj.jáat	'pilgrimages'	
k	fí.him	'he understood'	(not Classical)

? These data should be problematic: for now let's just identify the problem

l	ka.táb.ta	'you (m.sg.) wrote'	
m	mu.dár.ris	'teacher'	(not Classical)
n	mu.dar.rí.sit	'teacher (f. construct)'	(not Classical)

6 Moving on to feet: more about what they are

- Concept originally from poetic metrics, where a foot is a grouping of stressed and unstressed syllables (or "long" and "short", terms used more properly for Latin verse than for English).

Trochee trips from long to short;	**[x .]**
From long to long in solemn sort.	" "
Slow Spondee stalks, strong foot!, yet ill-able	[x x]
Ever to keep up with Dactyl's trisyllable.	[x . .]
Iambics march from short to long.	**[. x]**
With a leap and a bound the swift Anapests throng.	[. . x]
One syllable long, with one short at each side,	[. x .]
Amphibrachys hastes with a stately stride; --	" "
First and last being long, middle short, Amphimacer	[x . x]
Strikes his thundering hoofs like a proud high-bred Racer.	" " (Coleridge 2001)

- Linguistic feet seem to be **trochees** and **iambs** only.
- A language <u>usually</u> has all trochees or all iambs.

- English is said to have trochaic *phonological* feet, regardless of poetic meter:

```
                 x                                  x
 x               x                       x          x
 x      x        x                      (x  . )(x  . )(x  . )
(x  x) (x  x) (x  x)                     A pa  la chi co la
 A pa   la chi co la
```

or, equivalently, (right-hand grid above)

[(Tró)(chèe)] [(tríps) from] [(lóng) to] (shórt);
From [(lóng) to] [(lóng) in] [(sólemn)] (sórt).
[(Slów) (Spón)] [(dèe) (stálks)], [(stróng) (fóot)!], [(yèt) (ìll)] -(áble)
[(éver) to] [(kéep) (ùp) with] [(Dáctyl)'s (trì)] [(sýlla)ble.]
[I(ám] [bics) (márch)] [from (shórt)] [to (lóng).]
[With a (léap)] [and a (bóund)] [the (swìft) (Á] [na)(pèsts) (thróng)].
[(Òne) (sýlla)] [ble (lóng), with] [(òne) (shórt) at] (èach) (síde),
[(Àm)(phíbra)] [chys (hástes) with] [a (státely)] (stríde);
[(Fírst) and (lást)] [(béing) (lóng),] [(míddle) (shórt),] [(Ámphi)(mà]cer)
[(Stríkes) his (thún] [der)ing (hóofs)] [(lìke) a (próud)] [(hígh)-(brèd) (Rá]cer).

Here's the poem again, with [ ] for poetic feet and ( ) for phonological feet

- Crucially, **feet group syllables**, not segments or moras directly:

```
foot
 / \
σ   σ
```

7 Back to Cairene Arabic

? Do the feet seem to be trochaic or iambic?

? How can they help with our problematic data? (repeated here)

l	ka.táb.ta	'you (m.sg.) wrote'	
m	mu.dár.ris	'teacher'	(not Classical)
n	mu.dar.rí.sit	'teacher (f. construct)'	(not Classical)

I don't think we'll get this far, but just in case we do… let's try an OT analysis of Cairene! First, we'll need some constraints for feet.

8 Generalized Alignment (McCarthy & Prince 1993) (18)

ALIGN(*Cat1*, *Side1*; *Cat2*, *Side2*)

where *Cat1* and *Cat2* ∈ {PhonoWord, LexicalWord, Foot, Syllable, Morpheme...}
Side1, *Side2* ∈ {Left, Right}

∀*Cat1*, ∃*Cat2* s.t. coincide(*Side1*(*Cat1*), *Side2*(*Cat2*))

i.e., "for every instance of *Cat1* in the candidate, there must exist some instance of *Cat2* such that the *Side1* edge of *Cat1* coincides with the *Side2* edge of *Cat2*"

Sample constraints of this format, with commonly used nicknames

"**EDGEMOST-L**" = ALIGN(PWord,L; Foot,L) good: (Ca.na)da, (but.ter)
bad: ba(na.na), a(lu.mi)num

EDGEMOST-R good: ba(na.na), (but.ter)
bad: (Ca.na)da, a(lu.mi)num

- How do you count violations?
  - Though there's no slot for a "counting-type" argument in the ALIGN(*Cat1*, *Side1*; *Cat2*, *Side2*) template, it's an additional part of the definition that must be precised.

    - binary: either they coincide (no *s) or they don't (one * per non-aligned *Cat1*).
    - count syllables that intervene [typical for a foot-aligning constraint]: *ba(na.na)*: *, hypothetical *a.ba(na.na):* **
    - count segments that intervene: *ba(na.na)*: **, *a(lu.mi)num:* *
    - count feet that intervene (not applicable for EDGEMOST)

ALLFEETLEFT = ALIGN(Foot,L,PWord,L) [usu. counts intervening syllables]
ALLFEETRIGHT

LEFTMOST = ALIGN(HeadFoot,L,PWord,L) [usu. counts intervening feet]
RIGHTMOST

? Let's take some English words with straightforward footing and check how many times each violates each of these constraints.

9 A few more OT constraints for stress

Some from Prince & Smolensky 1993/2004, some from McCarthy & Prince 1993, others in general use but whose origin I didn't track down.

- TROCHAIC/IAMBIC: the first/last element of each foot is more prominent than any other element of that foot (if the foot's just one syllable, no violations).
- WEIGHTTOSTRESSPRINCIPLE: a heavy syllable must be stressed (pre-OT work by Prince)
- FOOTBINARITY-moraic/syllabic: a foot must consist of exactly two moras/syllables
- FOOTBINARITY-general: a foot must consist of exactly two moras or exactly two syllables
- NONFINALITY-mora/syll-stress/footing: the last mora/syllable of a word must not be stressed/footed
- PARSE-σ: every syllable must be in a foot
- NOCLASH/NOLAPSE: don't have two stressed/unstressed sylls in a row
- or, NOCLASH-grid: * x x / x x
- and NOLAPSE-grid: * x / x x x , * x / x x x

Why NONFINALITY but not NONINITIALITY?

Just because that's what the typology indicates.

See Lunden 2006 on extrametricality for a perceptual explanation of much but not all non-finality.

- CULMINATIVITY: every content word has exactly one main stress (or, combined effect of one constraint requiring a content word to project a phonological word and another requiring every phonological word to contain at least one foot).

Possible redundancies, debate ongoing: if we have feet, do we need constraints against clash and lapse? If we have constraints against clash and lapse, do we need feet?

10 OT analysis of Classical Cairene (assume secondary stresses are deleted post-lexically)

- Go for it—here are the crucial candidates (next page). Assume the obvious moraifications—except /ʔadwiyatuhuma(a)/, where Hayes, citing (Harrell 1960), says that final supposedly-long vowels are not pronounced differently from short.

  - Tip: start by finding constraints that are violated by some losing candidates given here but by no winning candidates (and can therefore be top-ranked).

šajaratuhu	
☞ *a* (šà.ja)(rá.tu)hu	
b (šá.ja)(rà.tu)hu	
c (šà.ja)ra(tú.hu)	
d ša(jà.ra)(tú.hu)	
e (šá.ja)ra.tu.hu	
f (šà.ja)(rà.tu)(hú)	

ʔadwiyatuhu	
☞ *a* (ʔàd)(wì.ya)(túhu)	
b (ʔàd.wi)(yá.tu)hu	

ʔadwiyatuhumaa	
☞ *a* (ʔàd)(wì.ya)(tú.hu)maa \ / µ	
b (ʔàd)(wì.ya)tu.(hú.maa) \ / µ	
c (ʔàd)(wì.ya)(tù.hu)(máa) \ / µ	

? If you finish before the rest of us: try these items

i	bée.tak	'your (m.sg. house)'	(not Classical)
m	ka.tábt	'I wrote'	(not Classical)

To sum up

- We've seen reasons to add moras and feet to our representations, again with some cautions and skepticisms

Next time

- Arguments for feet
- Practice doing analyses with feet

References

Boxwell, H. & M. Boxwell. 1966. Weri phonemes. In S. A Wurm & S. A Wurm (eds.), *Papers in New Guinea Linguistics*, vol. 5. Canberra: Australian National University.

Coleridge, Samuel Taylor. 2001. *The collected works of Samuel Taylor Coleridge*. Princeton University Press.

Echeverria, Max S & Heles Contreras. 1965. Araucanian phonemics. *International Journal of American Linguistics* 31. 132–135.

Gordon, Matthew. 2002. A Phonetically Driven Account of Syllable Weight. *Language* 78(1). 51–80.

Harrell, Richard S. 1960. A linguistic analysis of Egyptian Radio Arabic. In Charles A Ferguson (ed.), *Contributions to Arabic linguistics*, 3–77. Cambridge: Harvard University Press.

Hayes, Bruce. 1980. A Metrical Theory of Stress Rules. MIT.

Hayes, Bruce. 1989. Compensatory Lengthening in moraic phonology. *Linguistic Inquiry* 20. 253–306.

Hayes, Bruce. 1995. *Metrical Stress Theory: principles and case studies*. The University of Chicago Press.

Kenstowicz, Michael. 1980. Notes on Cairene Arabic syncope. *Studies in the Linguistic Sciences* 10. 39–54.

Kenstowicz, Michael. 1994. *Phonology in Generative Grammar*. 1st ed. Blackwell Publishing.

Lunden, S.L. Anya. 2006. Weight, final lengthening and stress: a phonetic and phonological case study of Norwegian. University of California, Santa Cruz dissertation.

McCarthy, John J & Alan Prince. 1993. Generalized Alignment. In Geert E Booij & Jaap van Marle (eds.), *Yearbook of Morphology*, 79–153. Dordrecht: Kluwer.

Melzi, Robert C. 1976. *The Bantam new college Italian and English dictionary*. New York: Bantam Books.

Minkova, Donka. 1982. The environment for open syllable lengthening in Middle English. *Folia Linguistica Historica* 3(1). 29–58.

Mitchell, T. F. 1960. Prominence and syllabication in Arabic. *Bulletin of the School of Oriental and African Studies* 23. 369–89.

Osborn, Henry. 1966. Warao I: Phonology and morphophonemics. *International Journal of American Linguistics* 32. 108–123.

Prince, Alan. 1990. Quantitative consequences of rhythmic organization. In Michael Ziolkowski, Manuela Noske & Karen Deaton (eds.), *Parasession on the Syllable in Phonetics and Phonology*, 355–398. Chicago: Chicago Linguistic Society.

Prince, Alan & Paul Smolensky. 2004. *Optimality Theory: Constraint interaction in generative grammar*. Malden, Mass., and Oxford, UK: Blackwell.

Ryan, Kevin. to appear. *Prosodic weight: categories and continua*. Oxford University Press.

Ryan, Kevin M. 2011a. Gradient weight in phonology. University of California, Los Angeles Ph.D. dissertation.

Ryan, Kevin M. 2011b. Gradient Syllable Weight and Weight Universals in Quantitative Metrics. *Phonology* 28(03). 413–454.

Ryan, Kevin M. 2014. Onsets contribute to syllable weight: Statistical evidence from stress and meter. *Language* 90(2). 309–341. doi:10.1353/lan.2014.0029.

Topintzi, Nina. 2006. Moraic onsets. University College London.

Tryon, D. T. 1970. *An Introduction to Maranungku (Northern Australia)*. Canberra: Australian National University.