Onset Weight Effects in Stress/Accent Systems Exhibiting Variation
UD Conference on Stress and Accent

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Can onsets contribute to syllable weight? (cf. e.g. Gordon 2005, Topintzi 2010)
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Onsets consistently and productively affect stress placement
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Onsets consistently and productively affect stress placement
P-center theory of weight
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   - Lexicon
   - Productivity
   - Analogy

3 Russian

4 Etc.

5 Analysis
English primary stress

- Predictable, but not fully deterministic
  - própane vs. cocáine
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  - ptomaine ("compound associated with putrefaction")
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  - Mélanie vs. Tennessée
English primary stress

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  - ptomaine ("compound associated with putrefaction")
  - Mélanie vs. Tennessee

- Generative accounts generally ignore onsets
  (though cf. Nanni 1977 on Eng. adjs. in -ative; also Kelly 2004, infra)
English stress: lexicon

- Simplex disyllables in CELEX (Baayen et al. 1993)
- Longer onset \(\Rightarrow\) greater incidence of primary stress (with Kelly 2004)

- 95% confidence intervals using Wilson scores (Wilson 1927, Newcombe 2000)
- * = sig. by Fisher’s exact test two-tailed with Holm correction for multiple comparisons
Consistent across independent subdivisions of the lexicon

- **noun**
- **adjective**
- **verb**

- **low frequency**
- **middle frequency**
- **high frequency**

- **V rime**
- **VC rime**
- **VV rime**

% initially stressed vs. consonants in initial onset
• Rimes aren’t covertly driving the effect (see last row)

• Even holding both rimes at their modes (_˘.C˘VC), \( \emptyset < C \) and \( C < CC \) persist (both Tukey’s HSD \( p < .05; n = 1,399 \))
Medial onsets

- Medial onset structure (unconsidered by Kelly 2004) behaves similarly
- Both contrasts persist when initial onset is held at C (Tukey’s $p < .0001$)
Logistic model

- **Data**
  
  Simplex English disyllables from CELEX

- **Dependent variable**
  
  Initial (1) or final (0) primary stress

- **Predictors**
  
  - Initial onset size (0 to 3)
  - Final onset size (1 to 3)
  - Initial coda size (0 to 2)
  - Final coda size (0 to 3)
  - Initial vowel identity (23 levels)
  - Final vowel identity (24 levels)
  - CELEX part of speech (9 levels)
  - log (frequency+1)
Logistic model: results

- **All eight main effects significant** \( (p < .0001 \text{ in an ANOVA}) \)

- **Initial onset**
  - \( \emptyset < C \) \( \text{(Tukey’s} \ p < .0001) \)
  - \( C < CC \) \( \text{(Tukey’s} \ p < .0001) \)
  - \( CC < CCC \) \( \text{(Tukey’s} \ p < .05) \)

- **Medial onset**
  - \( C >* CC \) \( \text{(Tukey’s} \ p < .0001) \)
  - \( CC >* CCC \) \( \text{(Tukey’s} \ p < .0001) \)

  *Since initial stress is being predicted, the coefficients are reversed

- **Even with fully specified rimes as crossed random factors, all but one of the above contrasts persists**
Summary: English lexicon

- Stress propensity $\sim$ onset size broadly supported
  - Robust across various divisions of the lexicon
  - Unconfounded by rime structure
  - Found independently in initial & medial syllables
  - Found independently in disyllables & trisyllables (not shown here)

- Monotonic
  - $\emptyset < C$ and $C < CC$ initially
  - $C < CC$ and $CC < CCC$ medially
Productivity: previous work

- Is *brontoon* more likely to be initially stressed than *bontoon*?

- Kelly (2004)
  - Orthographic stimuli pronounced aloud, stresses logged

- Ryan (2011)
  - Self-reported judgments of orthographic stimuli
  - Screening based on performance on real words

- Both: initial C < CC in disyllables
Perception experiment

- Auditory wug-test

- Addresses possible problems with orthographic stimuli
  (e.g. “visual syllable” confound)
### Stimuli

- **Critical items:** 8 wugs in 3 nested conditions (crossed by participant)

<table>
<thead>
<tr>
<th></th>
<th>Ø-</th>
<th>C-</th>
<th>CC-</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ummorm</td>
<td>lummorm</td>
<td>flummorm</td>
</tr>
<tr>
<td>2</td>
<td>izzoof</td>
<td>rizzoof</td>
<td>grizzoof</td>
</tr>
<tr>
<td>3</td>
<td>irgeen</td>
<td>lirgeen</td>
<td>flirgeen</td>
</tr>
<tr>
<td>4</td>
<td>illawm</td>
<td>willawm</td>
<td>swillawm</td>
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<tr>
<td>5</td>
<td>izzool</td>
<td>bizzool</td>
<td>brizzool</td>
</tr>
<tr>
<td>6</td>
<td>ordoot</td>
<td>mordoot</td>
<td>smordoot</td>
</tr>
<tr>
<td>7</td>
<td>evvain</td>
<td>devvain</td>
<td>drevvain</td>
</tr>
<tr>
<td>8</td>
<td>istrow</td>
<td>listrow</td>
<td>slistrow</td>
</tr>
</tbody>
</table>

- **Fillers:** 8 real disyllables with C onsets, 50% trochaic

- **Critical items and fillers randomized**
  (except first two items fillers and then no two adjacent fillers)
Stimuli

- All items recorded and processed in Praat (Boersma and Weenink 2011)
  - Pitch → 150 Hz
  - Intensity → 65 dB
  - Onsets spliced onto same completion across conditions
    (a fixed portion of the vowel was also replaced for natural-sounding transitions)

  istrow ⏺; listrow ⏺; slistrow ⏺
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    istrow ♩; listrow ♩; slistrow ♩

- Amazon’s Mechanical Turk
  - Analyzed iff US location, native speaker, and 7+/8 on fillers
    38 usable participants (from 166)
Results

- $\emptyset$ - 43% trochaic, C - 63%, CC - 79%
  
  (ANOVA $F(2) = 9.8, p < .0001$)

- $\emptyset < C$ and $\emptyset < CC$ both significant in a mixed model
  
  (Tukey’s $p < .05$)
Analogy?

iambic neighbors (total mass=53)

trochaic neighbors (total mass=34)

- Neighbors of pseudoword *plizzooft*
• **Analogical Modeling** (e.g. Skousen 1989, 1992, 2009)

• **TiMBL** (Daelemans et al. 2010) shows best of 72 tested parameterizations
  (cf. Hayes et al. 2009:855) <overlap, information gain, 7, inverse linear>

• Both significantly underperform superset model with onset factor
  
  \[ F(1) = 17.5, p < .001 \]
Russian stress/accent

- Like English, not fully predictable in roots
  - 100+ minimal pairs (e.g. múka ‘torment’ vs. muká ‘flour’) (Cubberley 2002)
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- But non-deterministic ≠ unpredictable (e.g. Zuraw 2010)
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- Corpus
  - 32,616-lemma frequency list (Sharoff 2002)
  - Excluded monosyllables & compounds
  - Accents supplied from online dictionary (starling.rinet.ru)
  - Excluded items with mobile stress
  - Result: 11,757 nouns; 5,258 adjectives; 7,399 verbs
Russian initial onset size & accent

- In trisyllabic lemmata (modal word length):

![Graph showing the percentage of initially stressed consonants in the initial onset over different counts of consonants.]
<table>
<thead>
<tr>
<th></th>
<th>noun</th>
<th>adjective</th>
<th>verb</th>
</tr>
</thead>
<tbody>
<tr>
<td>% initially stressed</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

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<tr>
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<table>
<thead>
<tr>
<th></th>
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<th>CC interlude</th>
<th>CCC interlude</th>
</tr>
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<tr>
<td>% initially stressed</td>
<td>*</td>
<td>*</td>
<td>*</td>
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consonants in initial onset

0 1 2 3+
Russian: logistic regression

- Model set up as for English

- Trisyllables (all Tukey’s $p < .0001$)
  - $\emptyset < C$
  - $C < CC$
  - $CC < CCC+$

- Disyllables (plot not shown) (both Tukey’s $p < .0001$)
  - $\emptyset < C$
  - $C < CC$

- As in English, onset structure & stress propensity covary significantly & systematically
Hayes (2012, handout):

<table>
<thead>
<tr>
<th>Constraint</th>
<th>Penult/Antep in corpus</th>
<th>Weight$^6$</th>
</tr>
</thead>
<tbody>
<tr>
<td>STRESS PENULT WHEN ITS VOWEL IS LOW.</td>
<td>7335/699</td>
<td>3.16</td>
</tr>
<tr>
<td>STRESS PENULT WHEN IT HAS A TRIPLE ONSET (CCC)</td>
<td>18/0</td>
<td>0.92</td>
</tr>
<tr>
<td>STRESS PENULT WHEN IT HAS (AT LEAST) A DOUBLE ONSET (CC)</td>
<td>2596/178</td>
<td>0.84</td>
</tr>
</tbody>
</table>
Convergent evidence from poetic meter, e.g. Sanskrit

- All else equal, syllables with longer onsets are more skewed towards strong positions
- Why are longer onsets more stress-attracting?
- English again (disyllabic nouns & adjectives only):
Proposal: P-center theory of weight

- The domain over which weight percept is assessed begins not with the rime, but with the perceptual center of the syllable (on p-centers, e.g. Patel et al. 1999, Villing et al. 2003, Soraghan et al. 2005, Barbosa et al. 2005, Tilsen 2006, Port 2007, Wright 2008, Villing 2010)

- Near beginning of rime, but perturbed by onset structure
First speaker in Harvard-Haskins Database of Regularly Timed Speech (Patel et al. 1999)
As onset size increases, p-centers increasingly anticipate the rime, but only by a small fraction of the duration of the onset
Proposal: P-center theory of weight

- Onset/coda asymmetry
  - The p-center parses only a fraction of the onset into the domain (while rime segments are parsed in their entirety)
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- P-centers predict each onset C to contribute avg. 35% as much as each coda C to the weight percept in English
  - English stress: onset coefficient is 46% of coda coefficient
Proposal: P-center theory of weight

- Stress & meter are rhythmic phenomena  

- Timing/isochrony studies (e.g. op. cit.) suggest linguistic rhythm is not anchored to (sub)syllabic structure per se
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- Stress & meter are rhythmic phenomena

- Timing/isochrony studies (e.g. op. cit.) suggest linguistic rhythm is not anchored to (sub)syllabic structure *per se*

- Auditory recovery (Gordon 2005) unlikely to be the whole story
  - Ceiling $\sim 40$ ms (Delgutte 1982:135), whereas events well outside of this window affect stress attraction (e.g. slide 27)
  - Null onset problem (Gordon 2005)
  - Geminate onset problem (Topintzi 2010:243)
Conclusion

- Onsets contribute to syllable weight
  - Their influence is clearest in, but not exclusive to, non-deterministic systems
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- But they contribute *less* than codas
  - Less likely to be invoked by categorical criteria
  - Smaller coefficient in non-deterministic systems
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- Smaller coefficient in non-deterministic systems

The p-center hypothesis can explain this asymmetry

- Onsets parsed only partially into weight domain
- Assuming categorization optimizes both perceptual dispersion & formal simplicity *(Gordon 2002)*, criteria are expected to favor codas
Acknowledgments

Bruce Hayes, Donca Steriade, Kie Zuraw
References I


