Rhythm is gradient: evidence from *–ative* and *-ization*[*]

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1 Introduction

- **Commonly assumed**: stress is the manifestation of linguistic rhythm (Liberman & Prince 1977).
- Rhythm implies *alternation*, or the timed succession of weak and strong beats.
  - In English, rhythmic alternation can be found at the phrase level.

(1) Rhythmic alternation within a phrase (Hayes 1995:28)

```
                x
x       x       x
x   x   x   x   x   x
x x x x x x x x x x x x
```
twenty-seven Mississippi legislators

  - Rhythmic alternation is also found at the word level.

(2) Rhythmic alternation within a word (Hayes 1995:29)

```
        x
x       x
x   x   x
x x x x x x
```
reconciliation

- Alternation implies *distance*: weak and strong beats are separated in time.
- **Question**: how do we measure rhythmic distance?
  - The way in which rhythmic distance is measured differs in foot-based and foot-free approaches to stress.
  - Distance, in recent foot-based approaches to stress (e.g. Kager 1999):
    - ⋗ Constraints like PARSESYL requires syllables to be parsed into feet.
    - ⋗ Constraints on foot form (e.g. IAMB, TROCHEE) and alignment (e.g. ALLFTLEFT) regulate distance between stresses.
  - Distance, in recent foot-free approaches to stress (e.g. Gordon 2002):
    - ⋗ Constraints like *LAPSE and *CLASH directly regulate the distance between stressed and stressless syllables.

(3) *LAPSE assign one violation for each sequence of two adjacent stressless syllables.

(4) *CLASH: assign one violation for each sequence of two adjacent stressed syllables.

    - ⋗ These constraints are often referred to as *rhythmic* constraints.
- These approaches are superficially different, but share something fundamental: they calculate distance over units of formal structure (syllables and feet).
- **This talk** explores an alternative: rhythm is calculated not over units of formal structure, but over duration, in a more direct way.

<u>Outline</u>

- The evidence for this alternative: suffixal stress in American English *-ative* (Stanton 2019) and *-ization*.
  - In both *-ative* and *-ization*, stress on the inner suffix is variable.
  - **Claim**: this variability is, at least in part, governed by rhythm.
- In both cases, inner suffix stress becomes more likely as its distance from the rightmost stem stress increases.
  - From *-ization*: words like *culturalization* (with a lapse) more likely to bear *-ize* stress than words like *realization* (without one).
  - From *-ative*: words like *legislative* (with a pre-*ate* cluster) more likely to bear *-ate* stress than words like *speculative* (with a pre-*ate* sonorant).
- **Main point**: the metric of distance speakers use references duration in a more direct way than is generally assumed by theories of stress.

[*] My thanks to A. Albright, D. Steriade, and NYU's PEP Lab for comments on this material.

2 Stress in *-ization*

- Our interest: words ending in *-ization* vary in whether or not *-ize* bears stress.

(5) Stress on *-ize-* is variable (Data source: OED)

a. Stressed *-ize-*: *solarization*, *lemmatization*
b. Stressless *-ize-*: *fascization*, *functionalization*
c. Variable: *relativization*, *serialization*

- Necessary to first review more general properties of stress in *-ization* to answer a few questions: what factors favor/disfavor stress on *-ize*?

2.1 Background

- It is useful to separate words that end in *-ization* into two domains: the stem (pre-*ization* material) and the suffixal domain (*-ization*).

(6) Division of *–ization* forms into stem and suffixal domains

$\underset{\textit{stem}}{\text{s o l a r}}\ –\ \underbrace{\text{i z e - a t e - i o n}}_{\textit{suffixal}}$ $\quad$ $\underset{\textit{stem}}{\text{f a s c}}\ –\ \underbrace{\text{i z e - a t e - i o n}}_{\textit{suffixal}}$

- We need just a few assumptions, for now, to illustrate why *-ization* stress varies.
  - Stress on *-ize* is compelled by a suffix-specific constraint, STRESS$_{\textit{-ize}}$.

(7) STRESS$_{\textit{-ize}}$: assign one * if the suffix *-ize* does not bear stress.

  - Stressing *-ize* and *-ate* violates *CLASH; *-ize* destressing can thus be seen as a clash-avoidance strategy.
    - ⋗ We'll assume that the relevant version of *CLASH is specific to *-ate*.
    - ⋗ Well-known that the verbal *-ate* repels stress; it's a *strong retractor*, in the sense of Liberman & Prince 1977.
  - Preference for *-izátion* (vs. *-ízation*) due to *LAPSER (Gordon 2002).

(8) *LAPSER: assign one * if neither of the final two syllables is stressed.

  - *LAPSER ≫ STRESS$_{\textit{-ize}}$ explains why it's *-ize* stress that varies.

(9)

sérial-ize-ate-ion	*LAPSER	*CLASH$_{\textit{-ate}}$	STRESS$_{\textit{–ize}}$
☞ a. sèrialìzátion		*	
☞ b. sèrializátion			*
c. sérialìzation	*!		

2.2 Rhythmic effects in *-ization* stress

- **The question**: can we predict when *-ize* is more or less likely to bear stress?
- Corpus study conducted to see if rhythmic factors are implicated in *-ization* stress (following Stanton 2019:7.2).[1]
  - Corpus: all relevant *-ization* forms in the OED as of 2/2019 (n=773).
  - Inner suffix counted as "stressed" if *-ize* transcribed as [aɪz].
  - Inner suffix counted as "stressless" if *-ize* transcribed as [ə] or [ɪ].
  - Variable cases are assigned to the "stressed" category (doesn't affect results).
- Results (10) demonstrate a rhythmic effect in *-ization* stress: *-ize* stress is more frequent when it resolves a lapse than when it creates a clash.[2]

(10)

Effect of *-ize* stress	Stressed *-ize*	Stressless *-ize*	% stressed
*CLASH violation	*còncrètìzátion* (n=59)	*mètronòmizátion* (n=33)	64.1% (59/92)
*LAPSE satisfaction	*chànnelìzátion* (n=529)	*dichòtimizátion* (n=32)	94.3% (529/561)
*EXTLAPSE satisfaction	*fèderalìzátion* (n=202)	*cùlturalizátion* (n=3)	98.5% (202/205)

- Available evidence suggests that speaker productions mirror the OED trends.
  - Productions are from `forvo.com`, a pronunciation dictionary.
  - Dictionary was searched (in 2/2019) for all *-ization* words in (10). Native speaker status and *-ize* stress were determined by ear.

(11)

Effect of *-ize* stress	Stressed *-ize*	Stressless *-ize*	% stressed
*CLASH violation	*rèalìzátion* (n=4)	*tàblòidizátion* (n=21)	19% (4/25)
*LAPSE satisfaction	*fòssilìzátion* (n=49)	*demòbilizátion* (n=151)	24.5% (49/200)
*EXTLAPSE satisfaction	*àctualìzátion* (n=21)	*lábializátion* (n=51)	29.2% (21/72)

[1] For the OED: a logistic regression finds a significant comparison between *LAPSE vs. *CLASH ($p < .001$) and *LAPSE vs. *EXTLAPSE ($p < .05$). For Forvo: a logistic regression finds a significant comparison between *LAPSE vs. *EXTLAPSE contexts ($p < .01$) but not *LAPSE vs. *CLASH. All models control for the frequency of the *-ization* form as well as the frequency of its *-ize* base.

[2] Numbers in (10) adds up to more than 773 because some stems have two stress patterns, e.g. *multimer-ization* can be 202-?10 or 020-?10. In such cases, variants are counted as separate stems.

- A more detailed look at the OED data shows that there is variance within some of these rhythmic categories.
  – Focusing on the cases where *-ize* stress results in a *CLASH violation (12), we see that the rate of *-ize* stress varies with the interstress material.[3]

(12)

Interstress seg(s).	Stressed *ize*	Stressless *ize*	% stressed
Sonorant (R)	*xè**n**ìzátion* (n=17)	*rèa**l**izátion* (n=15)	53.1% (17/32)
Obstruent (O)	*stỳlò**p**ìzátion* (n=17)	*fà**sc**izátion* (n=11)	60.7% (17/28)
Cluster (CC)	*bà**pt**ìzátion* (n=20)	*òbjè**ct**izátion* (n=6)	76.9% (20/26)

  – The rate of *-ize* stress does not vary noticeably within the *LAPSE and *EXTLAPSE resolution contexts; the numbers are close to ceiling.

2.3 Hypothesis

- **Hypothesis**: *-ize* stress is sensitive to duration. The longer the distance between the rightmost stem stress and *-ize*, the more likely *-ize* is to be stressed.
- Analytically: *-ize* stress is governed by a gradient version of *CLASH.
  – If this is correct: as the number of syllables between the rightmost stem stress and *-ize* increases, so should the duration (expected given (10-11)).

(13) Different interstress durations (in black) in *-ization* forms

a. V̀ C_0 -ìzátion (*fascization*) : shortest

V̀ $\boxed{C_0}$ ìzátion

b. V̀ C_0V C_0 -ìzátion (*cha**nnel**ization*): longer

V̀ $\boxed{C_0V \quad C_0}$ ìzátion

c. V̀ C_0V C_0V C_0 -ìzátion (***federal**ization*): longest

V̀ $\boxed{C_0V \quad C_0V \quad C_0}$ ìzátion

  > Seems obvious: more syllables should mean more duration.
  > However, Nespor & Vogel (1989:102) hint at the existence of lapse compression in English, so this prediction should be verified.

[3] A logistic regression finds that neither the R vs. O nor the O vs. CC comparisons are significant. In addition, there are 6 cases where a vowel-final stem takes *-ization* (e.g *Maoization*). In 5/6, *-ize* is reported to at least variably bear a stress. Because the number of such forms is small, and it is possible that there are additional constraints on V́V hiatus, I do not include these forms here.

  – Given (12), we might also expect for clashes with sonorants to be shorter than those with obstruents, which might be shorter than those with clusters.

(14) Different clash lengths in *-ization* forms (clash is in black)

a. V̀ ***R*** -ìzátion (*xe**n**ization*: shortest

V̀ $\boxed{R}$ ìzátion

b. V̀ ***O*** -ìzátion (*stylo**p**ization*): longer

V̀ $\boxed{O}$ ìzátion

c. V̀ ***CC*** -ìzátion (*ba**pt**ization*): longest

V̀ $\boxed{CC}$ ìzátion

- We need to know whether or not trends in the dictionary data correlate with trends in duration, and whether or not speakers' preferences match these trends.

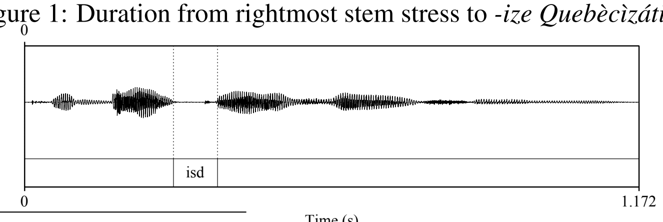
3 Experimental support

- To test the hypothesis, I ran a forced-choice task, asking participants to choose between *-izátion* and *-izátion* variants of the same form.
- **Result**: speakers are sensitive to duration! The longer the duration between the rightmost stem stress and *-ize*, the greater the preference for *-ize* stress.
- Analysis of the experimental items supports predictions in (13-14).

3.1 Items and acoustic analysis

- For the experiment, I recorded one speaker producing *-ìzátion* and *-izátion* variants of forms that ended in *-ization*, all placenames or demonyms (Table 1).
  – Ten items where *-ize* stress would violate *CLASH, and ten where *-ize* stress would satisfy *LAPSE, and ten where *-ize* stress would satisfy *EXTLAPSE.
  – Within categories, segmentals following the rightmost stem stress differed.
- Duration between the rightmost stem stress and *-ize* measured as in Fig. 1.[4]

Figure 1: Duration from rightmost stem stress to *-ize Quebècìzátion*



[4] All acoustic analysis was done in Praat (Boersma & Weenink 2017).

Table 1: *-ization* items, by rhythmic profile and interstress C(s)

*CLASH (n=10) Interstress C(s)	*LAPSE (n=10) Interstress C(s)	*EXTLAPSE (n=10) Interstress C(s)
Pràgueizátion	*Ègyptizátion*	*Pròvidenceizátion*
[g]	[dʒ], [pt]	[v], [d], [ns]
Quebècizátion	*Wyòmingizátion*	*Sènegalizátion*
[k]	[m], [ŋ]	[n], [g], [l]
Chàdizátion	*Cùbanizátion*	*Ìndianàpolisizátion*
[d]	[b], [n]	[n], [p], [l]
Ròmeizátion	*Bròoklynizátion*	*Antàrcticanizátion*
[m]	[kl], [n]	[ɹ(k)t], [k], [n]
Japànizátion	*Àustinizátion*	*Blòomingtonizátion*
[n]	[st], [n]	[m], [ŋt], [n]
Brònxizátion	*Tèxasizátion*	*Mèxicanizátion*
[ŋks]	[ks], [s]	[ks], [k], [n]
Vermòntizátion	*Phòenixizátion*	*Mìchiganizátion*
[nt]	[n], [ks]	[ʃ], [g], [n]
Frànceizátion	*Alàskanizátion*	*Òberlinizátion*
[ns]	[sk], [n]	[b], [ɹl], [n]
Bàsqueizátion	*Rùssianizátion*	*Màdisonizátion*
[k]	[ʃ], [n]	[d], [s], [n]
Mìnskizátion	*Ìcelandizátion*	*Ròchesterizátion*
[nsk]	[sl], [nd]	[tʃ], [st], [ɹ]

- Durational properties of these forms are in line with the predictions above.
  - Distance from the rightmost stem stress is shortest in the *CLASH context, longer in *LAPSE, and longest in *EXTLAPSE (Fig. 2).[5]
  - Sonorants between two stresses are shorter than obstruents (though not by much), which are shorter than clusters (Fig. 3).
- First part of the hypothesis is plausible: broad trends discovered in the dictionary study correlate with properties of the productions.

3.2 Experiment 1

3.2.1 Design

- Stimuli were created from the forms in Table 1, differing only in suffixal stress (examples: *Quebècìzátion-Quebècizátion*, *Mèxicanìzátion-Mèxicanizátion*).
- Participants were told they were helping a travel company pronounce words in new slogans (*Prepare for the* ***Quebecization*** *of your vacation!*).

[5]Figure 3 and all other plots were produced with R's ggplot2 (Wickham 2016).

Figure 2: Interstress duration by the number of interstress syllables

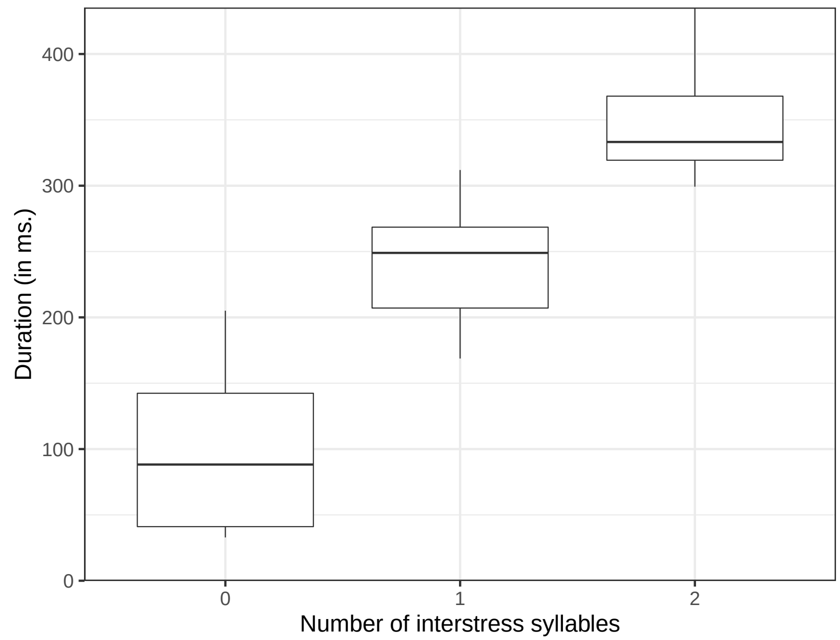
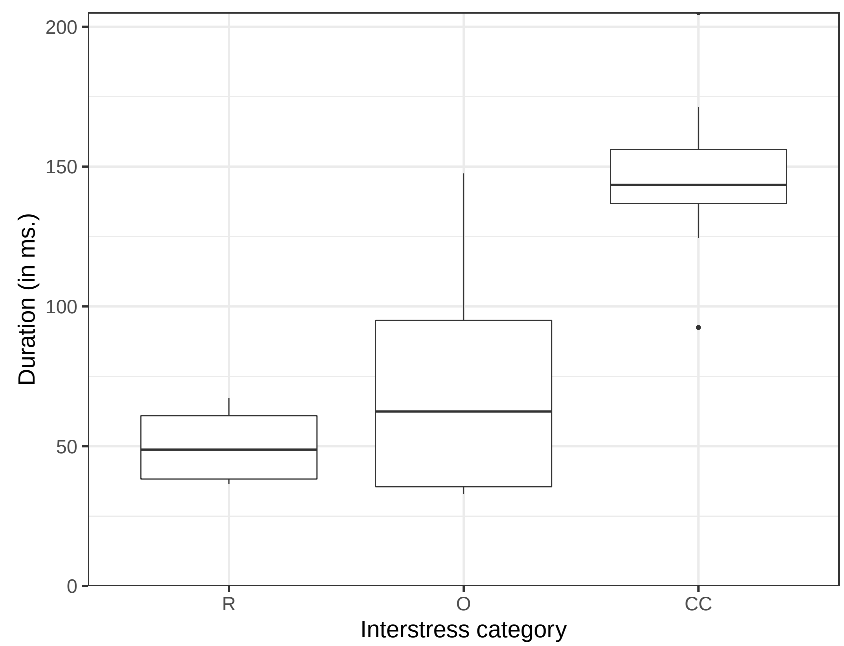


Figure 3: Interstress duration by the type of interstress consonant(s)



- They were asked to choose between two possible pronunciations of the bolded and italicized word, which they could listen to a maximum of twice.[6]

3.2.2 Participants

- Fifty participants recruited using Mechanical Turk. All indicated that they are native speakers of English from the U.S. None were excluded from the analysis.

3.2.3 Results

- Patterns in the data suggest that the hypothesis is correct.
  - Distinctions among rhythmic categories are what we would expect, given the dictionary data and acoustic results.
    - ⋗ For the *CLASH context (*xè**n**izàtion*), 34.9% prefer *-ize* stress.
    - ⋗ For the *LAPSE context (*chà**nnel**izátion*), 39.4% prefer *-ize* stress.
    - ⋗ For the *EXTLAPSE context (*fè**deral**izátion*), 40.2% prefer *-ize* stress.
  - The positive correlation between *-ize* stress and interstress duration is also expected: the worse the clash, the more likely *-ize* destressing (Figure 4).
- Interestingly, the statistics indicate that only duration (and *not* rhythmic category) played a role in participants' responses.
  - A mixed-effects logistic regression finds a significant effect for duration.[7]

(15) Model with duration as fixed effect

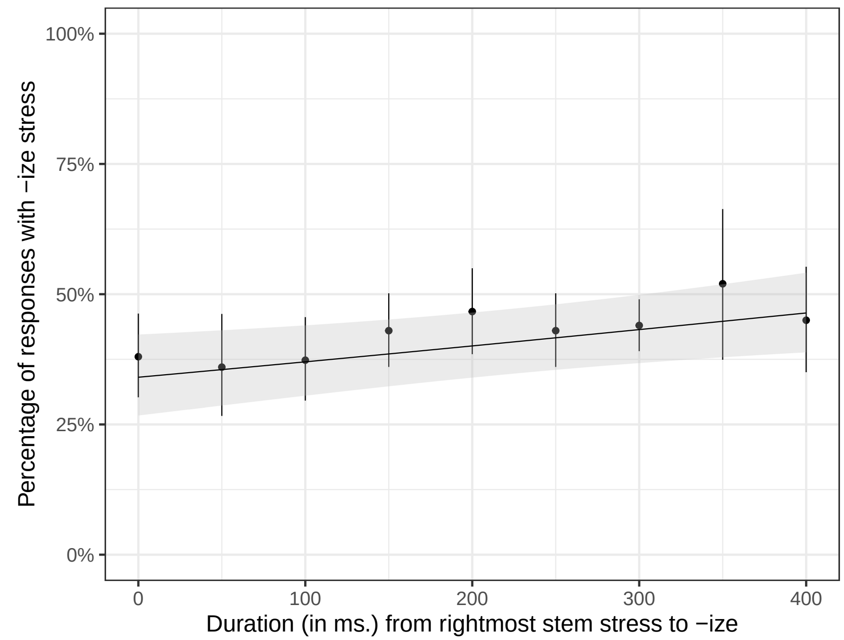
Factor	Coefficient	z value	Significant?
(Intercept)	-0.66	–	
Duration	1.29	2.52	Yes ($p < .05$)

  - Adding a predictor for rhythmic category does not improve the fit of the model (χ^2 (2) = 1.25, p = .53), nor does adding an interaction.
- What we can take away from these results:
  - Gradient rhythmic information plays a role in speakers' judgments about whether or not to destress *-ize* in *-ization*.
  - It's the *duration* between the last stem stress and *-ize* that matters. The rhythmic category the form belongs to (*CLASH, *LAPSE, *EXTLAPSE) only matters insofar as these categories are shorthand for duration.

[6]The order of stressed and stressless *-ization* was randomized by item and participant; item order was randomized by participant. Experiments were made with Experigen (Becker & Levine 2013).

[7]All models were fitted using the glmer function of R's lme4 (Bates & Maechler 2011) and include a random intercept for participant,. Significance values are from lmerTest (Kuznetsova et al. 2016).

Figure 4: Preference for *-ize* stress by interstress duration



4 Towards an analysis

- Results from Experiment 1 support the hypothesis. The longer the distance between the rightmost stem stress and *-ize*, the more likely *-ize* is to be stressed.
- Analytically speaking: these results support the addition of a gradient *CLASH constraint, defined over duration, to CON.
- But a few things aren't clear, given the available evidence: how this constraint should be defined, and what kinds of representations it evaluates.
  - Constraint could be defined in terms of milliseconds (as in Stanton 2019): predicts sensitivity to speech rate, length of intervening segments.
  - Constraint could be defined in more abstract terms; predicts no sensitivity to speech rate, length of intervening segments, etc.
- Results from a second judgment task suggest that an abstract definition is more appropriate; I sketch a possible one, based on these results, in Section 4.2.

4.1 Experiment 2

- Experiment 2 used half of the *-ization* items from Experiment 1 (Table 2). It was in all other ways identical to Experiment 1.

Table 2: Experiment 1 items, by rhythmic profile and interstress C(s)

*CLASH (n=5) Interstress C(s)	*LAPSE (n=5) Interstress C(s)	*EXTLAPSE (n=5) Interstress C(s)
Quebècizátion [k]	*Ègyptizátion* [dʒ], [pt]	*Ròchesterizátion* [tʃ], [st], [ɹ]
Chàdizátion [d]	*Cùbanizátion* [b], [n]	*Sènegalizátion* [n], [g], [l]
Ròmeizátion [m]	*Àustinizátion* [st], [n]	*Ìndianàpolisizátion* [n], [p], [l]
Brònxizátion [ŋks]	*Tèxasizátion* [ks], [s]	*Antàrcticanizátion* [ɹ(k)t], [k], [n]
Bàsqueizátion [sk]	*Phòenixizátion* [n], [ks]	*Mèxicanizátion* [ks], [k], [n]

- For this experiment, two versions of each item were used.
  - The first version: both forms were presented at the normal speech rate.
  - The second version: both forms were artificially slowed by 20%, using Praat Vocal Toolkit (Corretge 2012).
- **The prediction:** if phonetic *CLASH is defined in terms of milliseconds, we should find a stronger preference for *-ize* stress in the slowed items.
- The results are clear, and do not support this prediction.
  - First, a sanity check: does the result from Experiment 1 replicate?
    - ⋗ Yes: duration is a significant predictor of *-ize* stress (16). Trend is visible in both the normal and slowed forms (Fig. 5).

(16) Model with duration as a fixed effect

Factor	Coefficient	z value	Significant?
(Intercept)	-0.66	–	
Duration	0.99	2.26	Yes ($p < .05$)

    - ⋗ Adding a rhythmic context factor does not improve fit ($\chi^2(2)$=4.58, p=.1).
  - Item type (slowed vs. not slowed) is not a significant predictor; adding it to the model also does not improve fit (χ^2 (1) = .72).
- **The takeaway**: gradient *CLASH likely assesses violations at a more abstract level than milliseconds, though more systematic investigation is necessary.

Figure 5: Preference for *-ize* stress by duration (faceted by speech rate)

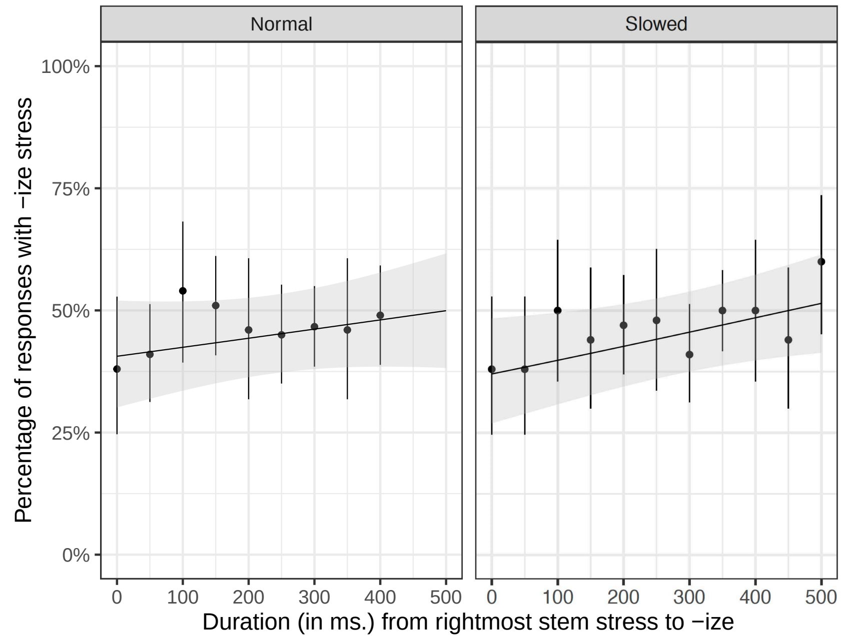
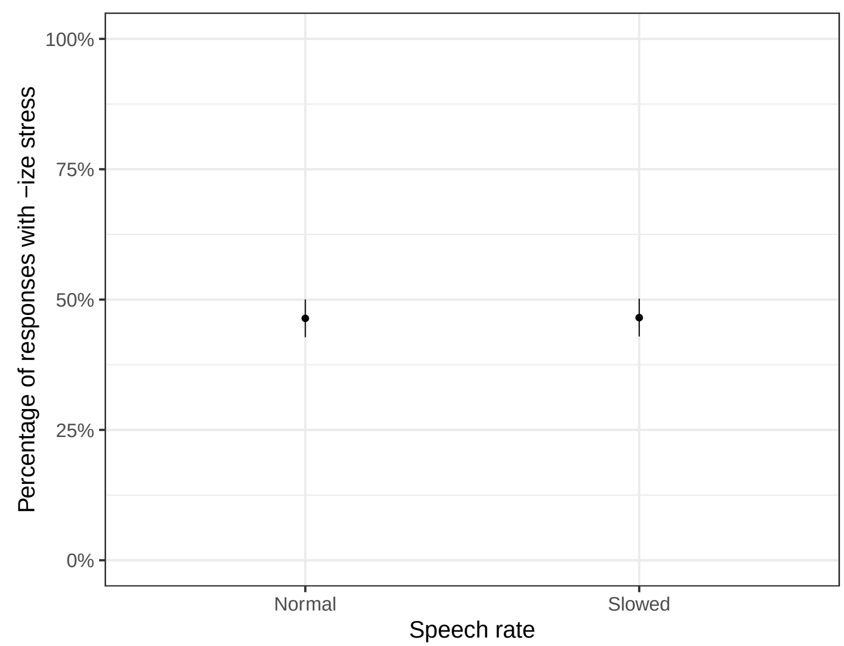


Figure 6: Preference for *-ize* stress by speech rate



4.2 Defining gradient rhythmic constraints

- Results of the above experiment limit the hypothesis space as to how gradient *Clash is defined, but the hypothesis space is still large.
  - A possibility: each segment is associated with an idealized duration, stored as milliseconds. Rhythmic constraints reference idealized duration.
  - Another possibility: segments are split up into durational categories. Rhythmic constraints reference durational categories.
- Further work is required to further narrow down this hypothesis space!
- For the purposes of this talk, I'll define gradient *Clash as the following.

(17) *Clash: for each pair of stressed vowels $\acute{V}_1$ and $\acute{V}_2$, assign a base violation score of 1. For each segment between $\acute{V}_1$ and $\acute{V}_2$, multiply the violation score by $1/x$, where x is valued according to (a-b).
  a. Sonorant consonants = 2
  b. Obstruent consonants = 3

  - For *Quebècìzátion*, violation score is 1/3; for *Tèxasìzátion*, it's 1/27.

- In addition to gradient *Clash, we should also consider the possibility that gradient *Lapse plays a role in speakers' judgments.
  - Argued in Stanton (2019) that phonetic *Lapse is active in English.
  - For *Tèxasizátion* vs. *Mèxicanizátion*, possible that the preference for more *-ize* stress on the latter is due to gradient *Lapse.

(18) *Lapse: for each pair of stressed vowels $\acute{V}_1$ and $\acute{V}_2$, assign a base violation score of 1. For each segment between $\acute{V}_1$ and $\acute{V}_2$, multiply the violation score by x, where x is valued according to (a-b).
  a. Sonorant consonants = 2
  b. Obstruent consonants = 3

  - For *Quebècìzátion*, violation score is 3; for *Tèxasìzátion*, it's 27.

- Where is the evidence that we need to define these constraints with reference to the identity of segments, rather than just the number of segments?
  - Sporadic evidence that R vs. O matters: in the *Lapse context, for example, *Texasization* has a higher rate of *-ize* stress (48%) than *Austinization* (40%).
  - Evidence is more consistent for *-ative*, where the segmentals of experimental stimuli were more tightly controlled. We'll come back to this.

- What's important here is the idea: the strength of violation is correlated with the distance between two stresses. These precise formulations can be revised.

4.3 Analysis

- To demonstrate how an analysis of these data might work, I consider four items: *Quebècizátion*, *Frànceizátion*, *Tèxasizátion*, and *Mex̀icanizátion*.
- For an analysis of these results, I include the following constraints:

(19) *Clash$_{\text{-}ate}$: assign one * for each sequence of two adjacent stressed syllables that includes the verbal suffix *-ate*.

(20) Stress$_{\text{-}ize}$: assign one * if the suffix *-ize* doesn't bear stress.

(21) *Lapse, *Clash: as in (17, 18).

- I used the Maxent grammar tool (Hayes et al. 2009) to find weights for the above constraints, given the candidates and violation scores in Table 3.

Table 3: Candidates and violations fed to the Maxent grammar tool

	Stress-*ize*	*Clash$_{\text{-}ate}$	*Clash	*Lapse
a. *Quebècìzátion*		1	1/3	3
b. *Quebècizátion*	1		1/9	9
c. *Frànceìzátion*		1	1/6	6
d. *Frànceizátion*	1		1/18	18
e. *Tèxasìzátion*		1	1/27	27
f. *Tèxasizátion*	1		1/81	81
g. *Mèxicanìzátion*		1	1/54	54
h. *Mèxicanizátion*	1		1/162	162

- The tool finds the weights in (22), and makes the predictions in (23).

(22)

Constraint	Weight
*Clash	2.553
*Clash$_{\text{-}ate}$	0.280
*Lapse	0.006
Stress$_{\text{-}ize}$	0.000

(23)

Form	Rate of *-ize* stress	
	Predicted	Observed
Quebècìzátion	30%	30%
Frànceìzátion	38%	40%
Tèxasìzátion	50%	48%
Mèxicanìzátion	59%	60%

- **The main takeaway**: phonetic, gradient versions of *Clash and *Lapse play a role in judgments of *-ize* stress. Rhythm drives variation.

5 A parallel from *-ative*

- The suffix *-ative* behaves like *-ization*, in that stress on the inner suffix varies.
  - The OED lists *-ate* as stressed in *motivative* and stressless in *communicative*
  - It also lists some *-ative* forms as having variable stress, like *mollificative*.
- **Crucial:** I assume that the morphological composition of these forms is *X-ate-ive*, and that the *-ate* in *-ative* is the same verbal *-ate* that is in *-ization*.

5.1 Background

- Unlike *-ization*, there are rhythmic limitations on *-ate* stress. As shown in (24), *-ate* stress is dispreferred under clash (data in this section from Stanton 2019).

(24)

Effect of *-ate* stress	Stressed *-ate*	Stressless *-ate*	% stressed
*CLASH violation	*òrnàtíve* (n=15)	*quótatìve* (n=216)	6.4% (15/231)
*LAPSE satisfaction	*législàtive* (n=229)	*spéculatìve* (n=105)	68.6% (229/334)
*EXTLAPSE satisfaction	*amélioràtive* (n=9)	*detérioratìve* (n=1)	90.0% (9/10)

- To understand why this is, it's useful to assume that *CLASH$_{\text{-}ate}$ is active.
- To analyze the fact that stress varies within the suffixal domain, I assume for now that the suffix *-ive* prefers to bear stress when possible (25).[8]

(25) STRESS$_{-ive}$: assign one * if the suffix *-ive* does not bear stress.

- Variation: STRESS$_{\text{-}ive}$ conflicts with *LAPSE (evaluated syllabically, for now).

(26) *-ate* stressing as *LAPSE resolution

investigative	*CLASH$_{\text{-}ate}$	*LAPSE	STRESS$_{-ive}$
☞ a. invéstigàtive			*
☞ b. invéstigatìve		*	
c. invéstigàtìve	*!		
quotative			
d. quótàtive	*!		*
☞ e. quótatìve			
f. quótàtìve	*!*		

[8] It's possible that *-ive* is not stressed in your dialect. With some modification, the analysis proposed here works for dialects where *-ive* is stressless. See Stanton (2019) for more.

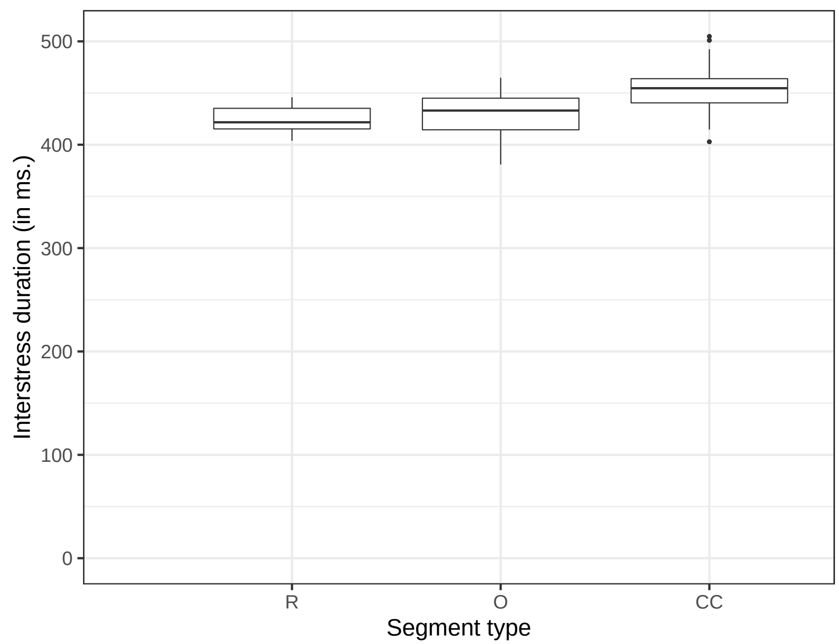
- **Question**: can we predict when *-ate* is more or less likely to bear stress?
- **Answer** (Stanton 2019): The longer the lapse that would result were *-ate* not stressed, the higher the likelihood that *-ate* will bear stress.
  - Observation (due to Nanni 1977): *-ate* stress depends on content of the lapse.

(27)

Interstress seg(s).	Stressed *-ate*	Stressless *-ate*	% stressed
Sonorant (R)	*muti**l**ative* (n=85)	*specu**l**ative* (n=65)	57% (85/150)
Obstruent (O)	*depre**c**ative* (n=91)	*dubi**t**ative* (n=19)	83% (91/110)
Cluster (CC)	*legi**sl**ative* (n=27)	*ade**qu**ative* (n=1)	96% (27/28)

  - Note a similarity to how clash works in the *-ization* corpus: the rate of *-ate* stress increases as we go from sonorant to obstruent to cluster.
  - A small production study suggests that this cline reflects duration: categories associated with higher rates of *-ate* stress are associated with longer lapses.

Figure 7: Lapse length by category of the pre-*ate* consonant(s) (Stanton 2019)



5.2 Experimental evidence

- Evidence that speakers are sensitive to lapse duration: there is a positive correlation between lapse duration and a preference for *-ate* stress (Stanton 2019[9]).

- Unlike *-ization*: for *-ative*, *CLASH has a categorical effect. This may be due to differences in morphological composition between the two classes of forms.

5.2.1 Design and participants

- Stimuli: 80 pairs of nonce *–ative* forms, differing only in suffixal stress (examples: *bádjaspàtive-bádjaspatìve, sidjólatìve-sidjólàtive*).
  - Forms varied in two ways: the pre-*ative* material (e.g. *r* vs. *s* vs. *sp*) and the rhythmic profile of the stem (iambic, *bádja-* or trochaic, *sidjó-*).
  - There were three times as many trochaic as iambic stems; my interest in this task was on forms with lapses, or the trochaic forms.

- Design and presentation was identical to the *-ization* tasks in all relevant ways; recruitment was also identical, though one participant's data was excluded.

5.2.2 Results

- Results demonstrate a clear distinction between the iambic and trochaic stems.
  - For iambic forms (*sidjólatìve-sidjólàtive*), 20.6% preferred *-ate* stress.
  - For trochaic forms (*bádjaspàtive-bádjaspatìve*), 54.3% preferred *-ate* stress.

- Interstress duration has a clear effect for the trochaic stems (Figure 8), but not for the iambic stems (Figure 9).

- A mixed-effects logistic regression (with random intercepts for item, participant) confirms an interaction between stem type and interstress duration.[10]

(28)

Factor	Coefficient	*z* value	Significant?
(Intercept)	-1.58	–	–
RhType (Trochee)	-0.11	-0.40	No (p = .69)
Interstress dur.	2.68	1.86	Almost (p = .06)
RhType*Interstress dur.	-3.83	-2.65	Yes ($p < .01$)

[9]Stanton (2019) actually reports two judgment studies; I focus on the first (the study described in that paper's Section 5.3). The two tasks have equivalent results for the present purposes.

[10]The RhType factor is sum-coded. The model is a better fit to the data than one that does not include an interaction (χ^2 (1) = 6.74, $p < .01$).

Figure 8: Preference for *-ate* stress by lapse duration (trochaic subset)

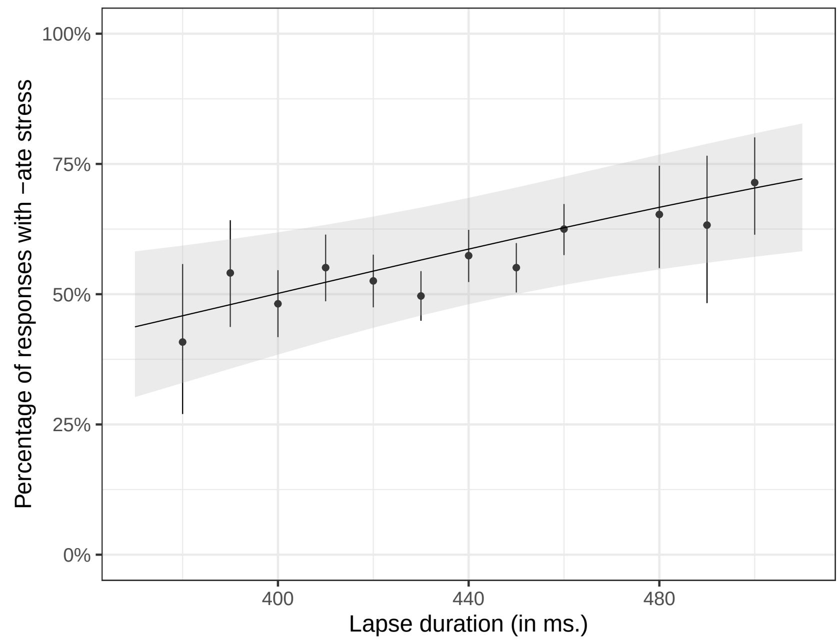
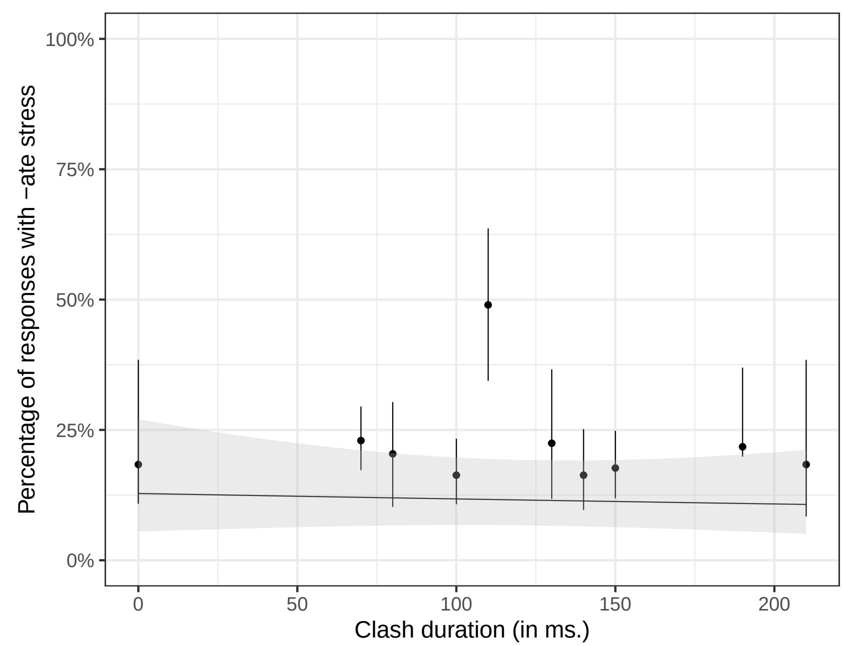


Figure 9: Preference for *-ate* stress by clash duration (iambic subset)



- **Takeaway**: gradient *LAPSE influences speakers' judgments about *-ate* stress. Gradient *CLASH does not; this may be because clash with *-ate* is dispreferred.

5.3 Analysis

- To demonstrate how an analysis of these data might work, I consider four items: *sidjópative*, *sidjósprative*, *bádjapative*, and *bádjasprative*.
- For an analysis of these results, I include the following constraints: STRESS$_{\text{-}ive}$, *CLASH$_{\text{-}ate}$, *LAPSE, and *CLASH.
- As before, I used the Maxent grammar tool (Hayes et al. 2009) to find weights for these constraints, given the candidates and violation scores in Table 4.

Table 4: Candidates and violations fed to the Maxent grammar tool

	STRESS$_{\text{-}ive}$	*CLASH$_{\text{-}ate}$	*LAPSE	*CLASH
a. *sidjópàtive*	1	1	3	1/3
b. *sidjópatìve*			9	1/9
c. *sidjósklàtive*	1	1	18	1/18
d. *sidjósklatìve*			54	1/54
e. *bádjapàtive*	1		9	1/9
f. *bádjapatìve*			27	1/27
g. *bádjaspràtive*	1		108	1/108
h. *bádjaspratìve*			324	1/324

- The tool finds the weights in (29), and makes the predictions in (30).

(29)

Constraint	Weight
*CLASH$_{\text{-}ate}$	1.443
*LAPSE	0.004
STRESS$_{\text{-}ive}$	0.000
*CLASH	0.000

(30)

Form	Rate of *-ate* stress	
	Predicted	Observed
sidjósàtive	19%	24%
sidjóspràtive	21%	18%
bádjapàtive	52%	61%
bádjaspràtive	70%	69%

- Picking up on a loose thread: there's evidence that talking about segment identity, and not just segment count, is necessary to accurately model these results.
  - Participants preferred *-ate* stress on -R*ative* items 47.6% of the time.
  - By comparison: *-ate* stress on -O*ative* items preferred 56.9% of the time.
  - Any proposed definition of *LAPSE that counts segments, ignoring their quality, would entirely miss this distinction.
- **Takeaway**: phonetic *LAPSE plays a role in *-ative* stress. Categorical *CLASH prevents us from seeing any effects of phonetic *CLASH.

6 Discussion

- **In short**: gradient, phonetically informed versions of *LAPSE and *CLASH are necessary to account for the full range of rhythmic effects in English.
  - Supporting evidence: stress in English words ending in *-ative* and *-ization*.
  - Why have we focused on this small slice of the lexicon?
    - ⋗ Words ending in *-ative* and *-ization* are perhaps the two corners of the English lexicon where evidence for gradient rhythm is most easily available.
    - ⋗ Clashes and lapses are in principle allowed in these forms: *-ative* and *-ization* are largely stress-preserving (Stanton & Steriade in prep).
    - ⋗ Both of the inner suffixes, *-ate* and *-ize*, have stressed and stressless forms. Their realization can depend on rhythmic context.
- Words in *-ative* and *-ization* are infrequent; must be the case that evidence for gradient rhythm is more widespread in English than we've seen here.
  - One likely corner: the rhythm rule (Hayes 1984, Beames 2020).
  - Another likely corner: English post-tonic syncopation (Hooper 1978).
    - ⋗ Small pilot in 2015: does syncopation depend on rhythmic context?
    - ⋗ Participants presented with related pairs of items like *delíberàte-delíbràte*, *delíberate-delíbrate*, *delíberateness-delíbrateness*.
    - ⋗ Rhythmic context matters; the best-fit statistical model is one that references duration, not rhythmic context per se (just as we saw for *-ization*).
- These results add to a growing base of evidence that rhythmic constraints pay greater attention to duration than is commonly assumed. A couple of examples:
  - Secondary stress in Russian compounds
    - ⋗ Gouskova & Roon (2013): the further away the secondary stress from the primary stress (counting by syllables), the more acceptable the compound.
    - ⋗ Additional work (done by me in 2018) found that replacing the number of syllables with the duration of the interstress interval improves model fit.
  - Secondary stress in Finnish
    - ⋗ Karvonen (2008): for long odd-parity words, secondary stress on antepenult if words ends in *-ia* (*érgonòmia*), penult otherwise (*kólesteròli*).
    - ⋗ Potentially understandable as an effect of gradient *LAPSER: maybe stress wants to be a consistent distance from the edge, and *-ia* is short.
- All work discussed here is consistent with a broader view in which stress placement is directly informed by phonetics (e.g. Lunden 2013, 2014; Ryan 2014).

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