Phonetic lapse in American English *–ative*[*]

Juliet Stanton
New York University

February 2019

Abstract

This article argues that constraints regulating the distribution of metrical prominence must be able to reference fine-grained durational information. Evidence comes from an apparent segmental effect on stress in American English *–ative*: stress on *–at-* is more likely when it is preceded by an obstruent or cluster (as in *irrigative*, *integrative*) than when it is preceded by a vowel or sonorant consonant (as in *palliative*, *speculative*; see Nanni 1977). I propose that this pattern should be understood as an effect of phonetically evaluated *LAPSE: longer lapses are penalized more severely than shorter ones. Results from two studies of speaker preferences for stress placement in nonce *–ative* forms support this proposal.

1 Introduction

The empirical focus of this article is on the Nanni effect, a segmental effect on stress in American English *–ative*. This effect is so-named after Nanni's (1977) claim that if *–ative* is preceded by a vowel or a sonorant consonant (hereafter just "a sonorant"), *–at-* is stressless; if an obstruent or a cluster precedes *–ative*, *–at-* bears a secondary stress (1).

(1)   Stress in *–ative*, as described by Nanni 1977

      a.   If preceded by a vowel or a sonorant consonant, *–at-* is stressless
            íterative, cúmulative, pálliative

      b.   If preceded by an obstruent or a cluster, *–at-* bears a secondary stress
            invéstigàtive, elúcidàtive, admínistràtive

Nanni's claim has been largely undiscussed in later work on English stress (though its relevance to the existence of onset-sensitive stress was first noted by Davis 1988, as discussed in Sec. 6). This is likely because the Nanni effect appears, at first glance, to be something of an anomaly: English stress is not generally sensitive to such detailed segmental information.

In this article I show that a version of the Nanni effect is attested in a large corpus of *–ative* forms and that the effect cannot be reduced to other considerations, like those of lexical frequency. I argue that the existence of the Nanni effect provides evidence that *LAPSE, one of the constraints that regulates stress placement in *–ative*, is sensitive to gradient phonetic distance: the longer the duration

---

of a stressless string, the harsher the penalty *LAPSE assigns. I present results from two experimental studies of nonce *–ative* forms that support this hypothesis and in addition pose a challenge for alternative analyses of the Nanni effect that appeal only to the identity of the pre-*at-* segments (e.g. Davis 1988). Finally, I briefly discuss the implications of this finding for our understanding of the constraints that regulate stress placement more generally.

1.1 Syllabic and phonetic *LAPSE

The theoretical interest of this article is that the Nanni effect lets us arbitrate between two possible definitions of the constraint *LAPSE. In grid-based theories of stress (e.g. Prince 1983, Gordon 2002), *LAPSE regulates the distribution of prominence by penalizing strings of stressless material. It is usually if not always assumed that *LAPSE is defined over stress-bearing units, which I will assume to be syllables (though cf. Steriade 2012, Garcia 2017 on intervals). A possible definition for *LAPSE (based on Gordon 2002:502) is in (2), and its use is illustrated with reference to the form *àbracadábra* (3). (For alternative formulations of *LAPSE, including some that make reference to foot boundaries, see Green & Kenstowicz 1995, Elenbaas & Kager 1999, Alber 2005, *a.o.*)

(2)   *LAPSE: Assign one * for each sequence of two stressless syllables.

(3)
à.	bra.	ca.	dá.	bra
$\grave{\sigma}_1$	σ_2	σ_3	$\acute{\sigma}_4$	σ_5

Syllabic *LAPSE assigns 1 violation to $\sigma_2\sigma_3$

I refer to this constraint as syllabic *LAPSE, as the number of assigned violations depends on the number of consecutive stressless syllables. This can be contrasted with a phonetic definition, where the number of assigned violations depends on duration: the longer the stressless string, the more violations it receives. The definition of phonetic *LAPSE adopted for now (in (4)) assumes that *LAPSE takes into account the raw phonetic duration of a stressless string, hypothesized to be the interval between the two stressed vowels, and assigns a violation for each millisecond (this definition will be revised in Sec. 5, where we will see evidence suggesting that phonetic *LAPSE in English only penalizes stressless strings that meet some minimum durational threshold).[1] As shown in (5), the version of phonetic *LAPSE in (4) would identify two stressless strings in *àbracadábra*, δ_1 (*bracad*) and δ_2 (*bra*), and assign more violations to δ_1.[2]

(4)   *LAPSE: For each span of stressless material δ, assign one * for each millisecond in δ.

(5)   à b r a c a d á b r a
          $\underbrace{}_{\delta_1}$ $\underbrace{}_{\delta_2}$

Phonetic lapse assigns *x* violations to δ_1, *x-y* to δ_2.

The syllabic and phonetic definitions of *LAPSE make different predictions about whether or not the content of a stressless string should play a role in lapse resolution phenomena. Under a syllabic definition of *LAPSE, the contents of the stressless string should not matter: all stressless strings

---

[1]The definitions of phonetic *LAPSE in this article are intended as null hypotheses and have not been fully tested against alternatives. One important question is whether phonetic *LAPSE references raw duration (as hypothesized here) or some abstract, generalized knowledge of duration. I leave the investigation of this question and others to future work.

[2]Left unchecked, this definition of phonetic *LAPSE would prefer that all stresses are adjacent to one another. For a case where such a preference appears to result in the deletion of all stressless vowels, see Payne 1990, McCarthy 2008 on Awajún (Aguaruna). An anonymous reviewer points out that this definition predicts languages in which all consonants in between stressed vowels are deleted as well; I am not aware of any that fit this description.

that comprise a given number of syllables are penalized equally. Under a phonetic definition of *Lapse, however, the contents of a stressless string should matter: the longer the stressless string, the greater penalty phonetic *Lapse assigns to it. This is illustrated below for *àbracadábra* and *àbraskladábra*. While both receive an equal number of syllabic *Lapse violations, the longer interstress interval in *àbraskladábra* is penalized more severely by phonetic *Lapse.

(6) Syllabic *Lapse: content of the stressless material should not matter

à.	bra.	ca.	dá.	bra		à.	bra.	skla.	dá.	bra
$\grave{\sigma}_1$	σ_2	σ_3	$\acute{\sigma}_4$	σ_5		$\grave{\sigma}_1$	σ_2	σ_3	$\acute{\sigma}_4$	σ_5

Both lapses are $\sigma_2\sigma_3$, so syllabic *Lapse assigns 1 violation to each.

(7) Phonetic *Lapse: content of the stressless material should matter

à $\underbrace{\text{b r a c a d}}_{\delta_1}$ á $\underbrace{\text{b r a}}_{\delta_2}$ à $\underbrace{\text{b r a s k l a d}}_{\delta_3}$ á $\underbrace{\text{b r a}}_{\delta_4}$

δ_3 is longer than δ_1, so phonetic *Lapse assigns more violations to δ_3 than it does to δ_1.

If it is correct to define *Lapse syllabically, we would not expect lapse resolution phenomena to be sensitive to the duration of a stressless string, as all lapses that comprise a given number of syllables are penalized equally. If it is correct to define *Lapse phonetically, however, we would expect lapse resolution phenomena to be sensitive to the duration of a stress lapse: under an appropriate model of constraint interaction, we might expect a language to exhibit a greater dispreference for words like *àbraskladábra* (with a longer interstress interval) than words like *àbracadábra* (with a shorter one). In this way, we will see that the Nanni effect arbitrates in favor of phonetic *Lapse.

1.2 Prior work, scope of the article

The proposal that gradient phonetic distance plays a role in rhythmic phenomena is not new. The most direct antecedent of this proposal is Hayes's (1984:70–73) *Phonetic Spacing Hypothesis*, under which "the spacing requirements of eurythmy are phonetic, either based on actual physical time, or perhaps some more abstract phonological timing measure." Hayes's discussion focuses mostly on the potential role of phonetic distance as it is applicable to English rhythm rule phenomena. For example, he claims that the propensity of the word *Korbél* to undergo stress retraction depends on the duration between *Korbél*'s final stress and the stress in the next word: retraction in *Korbél whískey* is more likely than retraction in *Korbél tequíla*, which is more likely than retraction in *Korbél champágne*. *Korbél tequíla* and *Korbél champágne* are alike in that one syllable separates the two stresses; the interstress distance in *Korbél champágne* is however longer than that in *Korbél tequíla*, which correlates with a reduced likelihood of retraction. Related observations on this point come from Nespor & Vogel (1989), who note that clashes can be ameliorated in Italian through "the lengthening of the first syllable [. . .] or the insertion of a pause between two stressed syllables" (p. 79; see also Marotta 1983 and Esposito & Truckenbrodt 1998 on this point). These options are also available in Catalan (Nespor & Vogel 1989:90), Greek (p. 92), and English (pp. 100–102; for a similar observation see also Liberman & Prince 1977:320). Nespor & Vogel also note that there is a tendency for lapses in English (p. 102) and Polish (p. 110) to be resolved not through the addition of stresses, but rather through an increase in speech rate: speakers "speed up a bit and maintain the string of weak syllables".

The finding that speech rate impacts the acceptability of a stress clash or lapse suggests that the factors governing rhythmic alternation reference physical time, not more abstract durational properties of segments or sequences of segments, independent of the rate at which they are produced. The results presented in this article, too, are consistent with this hypothesis: as discussed in Sec. 5, small, phonetically predictable differences in segmental duration affect the rate at which *–at-* bears stress. While effects of speech rate are not investigated in this article, further work in this area could help determine whether it is indeed correct to define phonetic *LAPSE in terms of raw duration (as hypothesized in this article) or if some abstract measure is more appropriate.

A distinct but related thread of work proposes that *LAPSE and *CLASH (Prince 1983, Kager 1994, Gordon 2002, *a.o.*) should be gradiently defined at the syllabic level. It is common to assume that what I have referred to as syllabic *LAPSE should be evaluated gradiently, with one violation assigned for each sequence of two stressless syllables (Steriade 1999, Gordon 2005, *a.o.*). Thus a word of the form $\acute{\sigma}_1\sigma_2\sigma_3\acute{\sigma}_4\sigma_5$ receives one violation of *LAPSE (for $\sigma_2\sigma_3$), while a word of the form $\acute{\sigma}_1\sigma_2\sigma_3\sigma_4\acute{\sigma}_5$ receives two (one for $\sigma_2\sigma_3$, and one for $\sigma_3\sigma_4$). Equivalent proposals for gradient, syllabically-defined *CLASH are rarer, but Gouskova & Roon (2013) show that the right definition for syllabic *CLASH as it applies to Russian compounds must be gradient: the more syllables that separate two stresses, the more well-formed the compound.

Whether or not the phenomena that have been analyzed with gradient, syllabically defined *LAPSE and *CLASH can be recast in terms of phonetically defined *LAPSE and *CLASH is not a question I address here. Similarly, for this article I assume that *LAPSE and *CLASH come in syllabic and phonetic versions; the question of whether this is correct, or if phonetic *LAPSE and *CLASH render syllabic *LAPSE and *CLASH unnecessary, is not one that I take up. Rather, the focus of this article is to demonstrate that phonetic *LAPSE provides us with one potential answer to the question of why stress in *–ative* appears to depend on the identity of the segments that directly precede *–at-*. While the proposed explanation has implications for our understanding of the constraints that regulate prominence and makes predictions regarding crosslinguistic patterns of stress assignment, these broader topics are left for future work.

2 Stress in *–ative*

The next few sections focus on the fact that words ending in *–ative* vary in whether or not *–at-* bears stress, to a greater degree than is discussed by Nanni (1977). This is immediately evident through consideration of the transcriptions in the Oxford English Dictionary (OED): *–at-* is transcribed as stressed in *deprecative* and *mutilative*, but as stressless in *speculative* and *adequative*. Before addressing this variability directly, it is first necessary to review some more general properties of stress in *–ative* to understand what the factors are that favor and disfavor stress on *–at-*.

For purposes of analysis, it is useful to separate words that end in *–ative* into two domains: the stem domain (containing all pre-*ative* material) and the suffixal domain (containing just *–ative*). Regarding the stress of words that end in *–ative*, I assume that the suffix *–ive* prefers to bear stress,[3]

---

[3]Does the assumption that *–ive* prefers to bear stress correspond with speaker judgments? A survey conducted in person and on Phonolist (https://blogs.umass.edu/phonolist/2017/07/10/flapping-in-english-derivatives-your-judgments-needed/) suggests variation. 10/20 speakers surveyed always flap /t/ before *–ive*, suggesting that *–ive* never bears stress. The rest flap /t/ before *–ive* in words like *législàtive* but aspirate /t/ in words like *affírmatìve*. If we assume that the presence of word-internal aspiration diagnoses stress on a following vowel, only this second group of speakers stresses *–ive*. I have chosen to model the speech of the second group here, but modeling the speech of the first group, if in fact they

but is prohibited from doing so when this would result in a stress clash. In other words: stress can fall on the penultimate syllable (as in *–àtive*) or on the final syllable (as in *–atìve*), but not on both (so *–àtìve*). I assume that the preference to stress *–ive* is implemented as the suffix-specific markedness constraint STRESS$_{-ive}$ (8) and that the dispreference for stress clashes is implemented as *CLASH (defined here in syllabic terms, (9)).

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

(9) *CLASH(syll): Assign one * for each sequence of adjacent stressed syllables.

Example (10) contains two *–ative* forms that have been subdivided into stem and suffixal domains, and illustrates the assumptions laid out above regarding stress placement within the suffixal domain. In *legislative*, *–at-* is stressed (and *–ive* isn't); in *affirmative*, *–ive* is stressed (and *–at-* isn't).

(10) Division of *–ative* forms into stem and suffixal domains

l é g i s l – à t i v e   a f f í r m – a t ì v e
    stem   *suffix*   *stem*   *suffix*

The location of stress within the stem domain is generally predictable from a combination of phonological and morphological factors (Nanni 1977, Stanton & Steriade in prep), but these considerations are not relevant here, and for the purposes of this article I assume that stem stress is specified in the input and cannot be changed. More relevant are the ways in which stem stress affects suffix stress. As noted by Nanni, if the pre-*ative* vowel carries stress, *–at-* generally does not (e.g. *affírmatìve*, but *affírmàtive*; if the pre-*ative* vowel does not carry stress, *–at-* can, but does not always carry stress (compare *législàtive*, where *–at-* is typically stressed, to *spéculatìve*, where it is not). For statistical confirmation of this rhythmic effect, see Sec. 3.1.

   Given the current analysis, we cannot explain why *–at-* variably bears stress: the confluence of STRESS$_{-ive}$ and *CLASH(syll) predicts that stress should always fall on *–ive*, never *–at-*. I assume that *–at-* stressing is a lapse resolution strategy: by stressing *–at-* in words like *législàtive*, a *LAPSE violation is avoided (see (11), where a syllable-based definition of *LAPSE is assumed). But the observed variability in *–at-* stress suggests that the ranking between *LAPSE(syll) and STRESS$_{-ive}$ is variable: the fact that *législàtive* (11a) is preferred to *législatìve* (11b) motivates *LAPSE(syll) ≫ STRESS$_{-ive}$, but the fact that *spéculatìve* (11e) is preferred to *spéculàtive* (11d) motivates the reverse. In the tableaux below, I use 1 for primary stress, 2 for secondary stress, and 0 for no stress.[4]

---

consistently do not stress *–ive*, only requires swapping out STRESS$_{-ive}$ for EXTENDEDNONFINALITY (= no stress on the final two syllables). For this second group, the variation between *spéculative* (1000) and *législàtive* (1020) diagnoses a conflict between *LAPSE and EXTENDEDNONFINALITY. Crucially, *–at-* stressing is still a lapse resolution strategy.

[4]An anonymous reviewer notes that, in their speech, *–at-* bears primary stress. To the best of my knowledge this variation has not been noted before, and in any case is not relevant to any points discussed below.

(11)   –*at-* stressing as lapse resolution

		législative		*CLASH(syll)	*LAPSE(syll)	STRESS$_{-ive}$
☞	a.	législàtive	1020			*
💣	b.	législatìve	1002		*	
	c.	législàtìve	1022	*!		
		spéculative				
💣	a.	spéculàtive	1020			*
☞	b.	spéculatìve	1002		*	
	c.	spéculàtìve	1022	*!		

The question, then, is if we can predict the circumstances under which –*at-* is more or less likely to bear stress. Are there certain forms or classes of forms for which it is more likely that *LAPSE(syll) ≫ STRESS$_{-ive}$, or are the preferences that individual words exhibit for stressed or stressless –*at-* random? The next section begins to address this question through a dictionary study.

3   Evidence for rhythmic and segmental influences on –*at-* stress

This section describes the results of a dictionary study intended to identify the factor or factors that govern stress within the suffixal domain of –*ative* forms. Broadly, the results of these studies support Nanni's claims. Sec. 3.1 confirms the existence of a rhythmic effect: –*at-* is more likely to bear stress when preceded by one or more stressless syllables than when preceded by a stressed syllable. Sec. 3.2 confirms the existence of a segmental effect: the identity of the pre-*at-* segment(s) has a significant effect on the rate of –*at-* stress, and this effect cannot be reduced to other factors, such as the frequency of the –*ative* form (cf. Kenyon & Knott 1944:31).

The discussion in this section focuses entirely on evidence from the Oxford English Dictionary (OED).[5] The corpus of –*ative* forms considered includes all non-obsolete forms in the dictionary as of July 2017 that have an IPA transcription and frequency information. 548 –*ative* forms satisfied these criteria. The suffix –*at-* is considered "stressed" if the vowel is transcribed as an [eɪ], variably or invariably; it is considered "stressless" if the vowel is always [ə]. (Transcriptions for the examples in (12) are from the OED; the OED is inconsistent in whether it transcribes –*ive* as [-dɪv] or [-tʰɪv].)

(12)   Categorization and frequency of "stressed" and "stressless" –*at-* forms

–*at-* stressless	–*at-* stressed	
–*at-* never stressed	–*at-* variably stressed	–*at-* consistently stressed
mollificative /məˈlɪfəkədɪv/	*communicative* /kəˈmjunəˌkeɪdɪv/, /kəˈmjunəkədɪv/	*motivative* /ˈmoʊdəˌveɪdɪv/

The choice to group variable and consistent –*at-* stress into one category, "–*at-* stressed", was essentially arbitrary but made to simplify the statistical analysis by allowing –*at-* stress to be treated as a binary response variable. The alternative assumption, that variable and no –*at-* stress should be grouped together under the "–*at-* stressless" category, would have been equivalent. The results of

---

[5]One reason to focus on the OED is that it contains the largest available corpus of transcribed –*ative* forms. Another is that, of the available dictionaries that provide transcriptions of large numbers of infrequent forms, the OED is likely the most reflective of native speaker judgments. For –*ative*-specific discussion on this point, see Stanton (to appear).

the statistical analyses in this article largely do not differ according to where the variable cases are grouped. The one case in which this decision makes a difference is discussed explicitly below.

3.1 Confirmation of a rhythmic effect

The data confirm Nanni's claim that *–at-* stress is rhythmically conditioned; the table in (13) contains two comparisons that show this. First, if *–at-* stress would cause a violation of syllabic *CLASH, as in *òrnátive* and *incùlpátive*, *–at-* is significantly less likely to bear stress (the asymmetry between (13a–b) is significant at $p < .001$, Fisher's Exact Test). Second, if we consider only those forms in which stressing *–at-* does not violate *CLASH, there is an additional rhythmic effect. Forms of this type can be subdivided into two classes: those in which *–at-* stress results in syllabic *LAPSE satisfaction (as in *législàtive*, where the alternative *législatìve* contains two stressless syllables), and those in which *–at-* stress results in syllabic *EXTLAPSE satisfaction (as in *amélioràtive*, where the alternative *amélioratìve* contains three stressless syllables). As is clear from (13a.i-ii), forms in the *EXTLAPSE category stress *–at-* at higher rates than those in the *LAPSE category. The statistical significance of this comparison depends on whether the variable *–at-* stress cases are grouped with the consistently stressed cases, as in (13) ($p > .1$), or the consistently stressless cases (*LAPSE = 180/334 stressed; *EXTLAPSE = 9/10 stressed; $p < .01$), but the asymmetry is in any case clear.[6]

(13)   Rates of *–at-* stressing by rhythmic context (all constraints are syllabically defined)

Result of stressing *–at-*	*–at- stressed*	*–at- stressless*	% stressed
a. *CLASH satisfied	238, e.g. *législàtive*	106, e.g. *spéculatìve*	69%
i. *LAPSE satisfied	229, e.g. *législàtive*	105, e.g. *spéculatìve*	69%
ii. *EXTLAPSE satisfied	9, e.g. *amélioràtive*	1, *détérioratìve*	90%
b. *CLASH violation	15, e.g. *órnàtive*	216, e.g. *quótatìve*	6%

Together, these facts support the general proposal that *–at-* stress is a lapse resolution strategy, which occurs with increasing frequency as the lapse lengthens.

3.2 Confirmation of a segmental effect

To investigate the contribution of the pre–*at-* segments to *–at-* stress, I focus only on those 334 words in the *LAPSE category in (13a.i), as there is too little data in the *EXTLAPSE category to investigate the factors that favor or disfavor *–at-* stress in that class of forms. (For brief discussion of segmental identity in the "*CLASH violated" subset (13b), see Sec. 5.6.)

As shown in (14), the OED data provide support for Nanni's (1977) claim that segmental identity is a predictor of *–at-* stress. They also reveal additional distinctions among segment types as well as quite a bit of variability. For words where *–ative* is preceded by a vowel (e.g. *palliative*), *–at-* is stressed in 50% (22/44) of the lexical items; for words where *–ative* is preceded by a sonorant (e.g. *speculative*), *–at-* is stressed in 58% (88/152); for words where *–ative* is preceded by an obstruent (e.g. *deprecative*), *–at-* is stressed in 84% (92/110); and for words where *–ative* is preceded by a consonant cluster (e.g. *legislative*), *–at-* is stressed in 96% (27/28).

---

[6]The number of forms in (13) sums to 574, a larger number than the 548 *–ative* forms in the OED. This discrepancy exists because a number of stems have variable stress or segmentals, e.g. the *i* in *palliative* can be glided (in which case *–at-* stress would result in a clash) or vocalized (in which case *–at-* stress would alleviate a lapse). In cases where this variation in stem shape leads to a different metrical consequence for *–at-* stress, the forms were counted separately.

(14)   Role of identity of preceding segment(s) in –at- stress

Segment(s)	Stressed –at-	Stressless –at-	% stressed	Total
Vowel	22, e.g. *annunciative* (010-20)	22, e.g. *enunciative* (210-02)	50%	44
Sonorant	88, e.g. *mutilative* (10-20)	64, e.g. *speculative* (10-02)	58%	152
Obstruent	92, e.g. *deprecative* (10-20)	18, e.g. *dubitative* (10-02)	84%	110
Cluster	27, e.g. *legislative* (10-20)	1, e.g. *adequative* (10-02)	96%	28

To ensure that this effect is not random and cannot be attributed to other factors, a logistic regression was fit to the data in (14). The dependent variable had a value of 0 if –at- was stressless, and a value of 1 if –at- was (variably or consistently) stressed. The role of segmental information, along with several other potentially relevant factors, were included as independent variables. All predictors included in the model are described below.

- ***Identity of pre-ative segments*** *(V/R/O/CC; continuous variable)*

  The segmental information represented in (14) was encoded as a continuous variable, where V=0, R=1, O=2, and CC=3. This predictor was included to verify the version of Nanni's (1977) claim apparent in (14): the identity of the pre-*ative* segment or segments affects the rate at which –at- bears stress. (Brief discussion of an alternative model in which V/R/O/CC is coded as a categorical four-level factor is provided below.)

- ***Frequency of the –ative form*** *(Freq$_{ative}$; continuous variable)*

  The frequency of the –*ative* form was encoded as a continuous variable, where higher numbers indicate higher frequency. The lexical frequency information was taken from the OED, which divides words into one of eight frequency "bands" (where extremely infrequent words are assigned to Frequency Band 1, and extremely frequent words are assigned to Frequency Band 8).[7] This information is included to evaluate Kenyon & Knott's (1944:31) claim that more frequent –*ative* derivatives are more likely to bear stress on –at-.

- ***Frequency of related –ate and –ation forms*** *(Freq$_{ate}$ and Freq$_{ation}$; continuous variables)*

  For many –*ative* derivatives, there is a similar –*ate* and/or –*ation* form. For example, *legislative* resembles *legislate* and *legislation*. It is possible that these –*ate* and –*ation* forms, in which –*at*- consistently bears stress, could influence speakers' pronunciations of the –*ative* form. Specifically, the more frequent the –*ate* or –*ation* form is, the more likely the speaker might be to stress –*at*- in the corresponding –*ative* form. Frequency information is from the OED; in the case that there was no related form, or the frequency was unavailable, it was marked as 0.

The logistic regression was fit using the glm function of R's lme4 package (Bates et al. 2015). Effects were considered significant if $p \leq .05$ (roughly, if the *z*-statistic's absolute value ≥ 2), as

---

[7]The OED's frequency data comes from the Google Books Ngrams corpus. It is "cross-checked against data from other corpora", "re-analyzed in order to handle homographs and other ambiguities", and log-scaled. For more information on the OED frequency bands, see http://public.oed.com/how-to-use-the-oed/key-to-frequency/.

assessed by the Wald test. A full model, including all four factors, indicated a significant effect of V/R/O/CC, but not any of the frequency-related factors (Freq$_{ative}$, Freq$_{ate}$, or Freq$_{ation}$). A likelihood ratio test (LRT) was then performed, comparing a model that included all four predictors to one that included only V/R/O/CC. The LRT indicated that the model including all predictors is not a significantly better fit to the data than the model including only V/R/O/CC (χ^2 (3) = 3.28, $p > .1$), and thus the simpler model is to be preferred. The output of this simpler model is summarized in (15). The positive coefficient indicates that as the pre-*ative* material changes from a vowel to a sonorant to an obstruent to a cluster, *–at-* becomes significantly more likely to bear stress.

(15)   Model results

	Estimate	z value	Significant?
Intercept	-0.42	–	–
V/R/O/CC	0.96	5.56	Yes ($p < .001$)

Because V/R/O/CC is a continuous factor, the model does not indicate which differences among these four categories, if any, are statistically significant. To address this point, I fit a second model to the data in (14), where V/R/O/CC was coded as a four-level factor (with 0, or V, as the reference level). Pairwise differences were assessed with Tukey's HSD post-hoc tests, using the glht function of R's multcomp package (Hothorn et al. 2008). All comparisons except vowel-sonorant and obstruent-cluster were found to be significant at $p < .05$ or lower thresholds. Note however that the vowel and cluster groups are fairly small (44 forms are in Vowel and 28 in Cluster, compared to 152 in Sonorant and 110 in Obstruent), so the lack of an effect for the vowel-sonorant and obstruent-cluster comparisons could be due to a lack of statistical power.

It is clear, then, that the identity of the pre-*ative* segments plays a significant role in determining whether or not *–at-* bears stress. Furthermore, the effect of segmental material cannot be reduced to more general considerations of lexical frequency.

3.3   Local summary

The present results confirm Nanni's claims regarding rhythmic and segmental influences on *–at-* stress. They also suggest that *–at-* stress is more variable and sensitive to more distinctions among segment types than was previously known.

There are several possible questions about the dictionary study not addressed here. One is whether or not focusing on four segmental categories (V, R, O, and CC) has obscured finer distinctions within them: are clusters with three members, for example, associated with higher rates of *–at-* stress than clusters with two?[8] Another is the extent to which the OED data are representative of American English speech: given that the OED is a large dictionary with transcriptions for many varieties of English, might the results change if we take the potential diversity of transcription sources into account? The answers to both of these questions is no; for discussion on these points and for a partial extension of the investigation discussed here to other dictionaries, see Stanton (to appear).

---

[8]Along these lines, an anonymous reviewer asks about a potential role of the OCP in conditioning *–at-* stress. It is possible that *–at-* prefers to bear stress in words like *quantitative* in order to provide more temporal separation between the two /t/s, and that this inflates the rate of post-obstruent *–at-* stress. Of the 37 forms that end in *–tative*, 3 do not bear *–at-* stress while 34 do; this rate is not significantly different from that of the rest of the forms in the O category ($p > 0.1$, Fisher's Exact). To further confirm that this consideration is not responsible for the high rate of post-obstruent *–at-* stress, I redid the statistics in this section without the 37 forms that end in *–tative*. The resulting rate of *–at-* stress for obstruents (at 79% percent) is still between that of sonorants (58%) and clusters (96%), and results of the regressions do not change.

4 Hypothesis

Why should the rate of –at- stress depend on the identity of the preceding segment(s)? I hypothesize that the identity of these segments is relevant because –at- stress occurs more frequently as a potential lapse grows longer, and the identity of the pre-*at*- material can shorten or lengthen the duration of the lapsed string. Assuming that the dictionary facts summarized in (14) are representative of the average speaker's judgments: this hypothesis is equivalent to a claim that, all else equal, lapses containing a cluster (CC) are longer than those containing an obstruent (O), which are longer than those containing a sonorant (R), which are longer than those containing a vowel (V) (16).

(16)   Different lapse lengths in *–ative* forms (lapse is underlined)
   a. $\acute{V}$ C_0V –atìve   shortest lapse
   b. $\acute{V}$ C_0VR –atìve   shorter lapse
   c. $\acute{V}$ C_0VO –atìve   longer lapse
   d. $\acute{V}$ C_0VCC –atìve   longest lapse

The idea is that a form like *legislative* (for example) is more likely to bear –at- stress than a form like *meditative* because the lapse that would result in *législatìve*, were –at- stressless, would be longer than the lapse that would result in *méditatìve*. Under this hypothesis, the rhythmic and segmental effects in Sec. 3 have the same source: the longer the stressless string that precedes –*ive*, the more likely –at- is to bear stress. In other words, stress on –at- is entirely conditioned by rhythmic factors, and the apparent influence of segmental identity is an epiphenomenon.

   If this hypothesis is correct, it predicts that not only the pre-*ative* consonants, but also the post-stress consonants (C_0, in (16)) ought to play a role in governing –at- stress. (As the intervening vowel is a schwa in all cases, its length is assumed to be invariant across forms.) To see if such an effect is attested in the OED data, each –*ative* form under consideration was coded for the identity of its poststress consonants, using the same V/R/O/CC categories. As shown in (17), there is a recognizable trend, though the relative ordering of the R and O categories has reversed.

(17)   Role of post-stress segments in –*at*- stress (OED)

Segment(s)	Stressed –at-	Stressless –at-	% stressed	Total
Vowel	1, e.g. *violative*	1, e.g. *annihilative*	50%	2
Sonorant	57, e.g. *celebrative*	27, e.g. *denominative*	68%	84
Obstruent	80, e.g. *mediative*	48, e.g. *expatiative*	63%	128
Cluster	91, e.g. *segregative*	29, e.g. *expectorative*	77%	120

As we know that the identity of the pre–*at*- segments is a significant predictor of –*at*- stress, this must be take into account in any assessment of whether or not the identity of the poststress segments matters as well. To do this, I fit a logistic regression to the forms in (17), with continuous predictors for the identity of the pre-*at*- and poststress segments (with both coded as V=0, R=1, O=2, CC=3), as well as the three frequency-related measures introduced in Sec. 3.2. As before, a model including the frequency-related measures does not perform better than one that lacks them (χ^2 (3) = 3.27, *p*

> .1). The model results including the predictors for pre-*at-* and poststress segments is provided in (18). The predictor for the identity of the pre-*at-* segments is significant, and an LRT indicates that a model including this predictor is a better fit to the data than an otherwise equivalent model that does not (χ^2 (1) = 35.88, $p < .001$). The predictor for the identity of the poststress segments is not significant, and an LRT indicates that a model including this predictor is not a better fit to a model that does not (χ^2 (1) = 1.71, $p > .1$).

(18)   Role of pre-*at-* and post-stress consonants in –*at-* stress

	Estimate	*z* value	Significant?
Intercept	-0.84	–	–
Pre-*at-* (V/R/O/CC)	0.96	5.52	Yes ($p < .001$)
Poststress (V/R/O/CC)	0.21	1.31	No ($p > .1$)

These results suggest that the poststress segments do not have the same effect on –*at-* stress that the pre-*at-* segments do. There are however several possible interpretations of this finding that are consistent with the hypothesis advanced above. First, it could be that the facts for the poststress segments look different because the phonetic facts are different: perhaps, for example, lapses with a poststress sonorant are on average longer than lapses with a poststress obstruent. Second, it could be that the facts in (17) do not accurately represent the contribution of poststress segments to –*at-* stress, either because the dictionary data are not representative of native speakers' intuitions or there are sources of variance not accounted for by the predictors in (18). To preview, the experiment discussed in Sec. 5.4 suggests that the last of these hypotheses is correct.

The phonetic lapse hypothesis makes a number of further predictions; Sec. 5 focuses on two. First, if trends in the dictionary data are representative of native speaker judgments, we might expect the phonetic facts to resemble them. It should be the case, for example, that lapses with a pre-*at-* sonorant are on average shorter than lapses with a pre-*at-* obstruent. Second, speakers of American English must be sensitive to these potentially small differences in lapse duration, and they must exhibit a preference for phonetically shorter lapses over longer ones. Sec. 5 provides evidence from two forced-choice tasks that is consistent with these predictions, and in addition demonstrates that manipulating the duration of the pre-*at-* and post-stress segments has an equivalent effect on participants' likelihood to prefer –*at-* stress. This is perhaps unexpected given the dictionary results in (17–18), but is predicted by the current hypothesis: longer lapses are dispreferred relative to shorter lapses, regardless of where the extra length in the stressless string is located.

5   Experimental evidence

To probe the predictions outlined above, 320 nonce –*ative* forms were recorded by a native speaker of American English, and the majority of these forms were presented as part of two forced-choice tasks to 100 native American English speaking participants. The first forced-choice task probed the effects of manipulating the pre-*at-* segments (*badjalative* vs. *badjasklative*) on speaker preferences for –*at-* stress; the second task probed the effects of manipulating the poststress segments (*baladjative* vs. *baskladjative*). Stimuli and their acoustic properties are discussed in Sec. 5.1, task design and participant recruitment are discussed in Sec. 5.2, and results are presented in Secs. 5.3–5.4. Sec 5.5 presents a preliminary constraint-based analysis of the results, and Sec. 5.6 contains some brief discussion of the role of phonetic *Clash in these two studies.

5.1 Stimuli and their acoustic properties

Stimuli for the first task, which varied the identity of the pre-*at*- segments, were composed of one of four "stems" (19) and one of twenty "endings" (20). Three stems were trochaic and one was iambic. The twenty endings included –*ative*, –*ative* preceded by a sonorant (*r*, *l*, *n*, or *m*), –*ative* preceded by an obstruent (*b*, *d*, *g*, *p*, *k*, *f*, *s*, or *z*), and –*ative* preceded by a cluster (*kl*, *pr*, *skl*, *spr*, *dl*, *dm*, or *dn*). Each stem was combined with each ending to yield a total of 80 words.

(19) Nonce –*ative* "stems" for Task 1

Type	Stem (orthography)	Stem (IPA)
	badja, badji	[ˈbædʒə] (before a consonant), [ˈbædʒi] (before a vowel)
Trochaic	*kedja, kedji*	[ˈkɛdʒə] (before a consonant), [ˈkɛdʒi] (before a vowel)
	lidja, lidji	[ˈlɪdʒə] (before a consonant), [ˈlɪdʒi] (before a vowel)
Iambic	*sidjo*	[səˈdʒoʊ]

(20) Nonce –*ative* "endings" for Task 1

Type	Ending
None (V)	–*ative*
Sonorant (R)	–*rative*, –*lative*, –*native*, –*mative*
Obstruent (O)	–*bative*, –*dative*, –*gative*, –*pative*, –*kative*, –*fative*, –*sative*, –*zative*
Cluster (CC)	–*klative*, –*prative*, –*sklative*, –*sprative*, –*dlative*, –*dmative*, –*dnative*

Stimuli for the second task, which varied the identity of the post-stress segments, were also composed of one of four "stems" (21) and one of twenty "endings". As above, forms starting in *b*–, *k*–, and *l*– had trochaic stems; words beginning in *s*– had iambic stems. The twenty endings for the trochaic forms were similar to those employed in the first task and included bare –*adjative*, plus –*adjative* preceded by a sonorant (*r, l, n, m*), obstruent (*b, d, g, p, k, f, s, z*), or cluster (*kl, pr, skl, spr, dl, dm, dn*). Iambic forms differed only in the identity of the medial vowel, which was written as *o*; endings for the iambic stems included –*odjative*, –*rodjative*, –*godjative*, etc. As above, each stem was combined with each ending to yield a total of 80 words.

(21) Nonce –*ative* "stems" for Task 2

Type	Stem (orthography)	Stem (IPA)
	ba, bi	[ˈbæ] (before a consonant), [ˈbi] (before a vowel)
Trochaic	*ke, ki*	[ˈkɛ] (before a consonant), [ˈki] (before a vowel)
	li	[ˈlɪ] (before a consonant), [ˈli] (before a vowel)
Iambic	*si*	[sə] (stress falls on next syllable)

Two versions of each form, one –*at*-stressed ([eɪɾɪv]~[eɪɾəv]) and one –*ive*-stressed ([ətʰɪv]) were recorded by the author, a native speaker of American English. Each –*ative* form was produced in the frame phrase *X paper*. Recordings were made on a Marantz PMD661 MKIII recorder and an Shure SM35 head-mounted microphone in a soundproof booth at New York University. All recordings and text grids created for their analysis are available on the author's website.

Interstress duration was measured for each token (in Praat, Boersma & Weenink 2017) by summing the interval of time between the offset of the first stressed vowel and the onset of the second stressed vowel. For example, in *kédjamàtive*, the interstress duration comprises the total durations of /dʒ/ through /m/; in *kédjamàtive*, it comprises /dʒ/ through the end of /t/'s aspiration (Figs. 1–2).

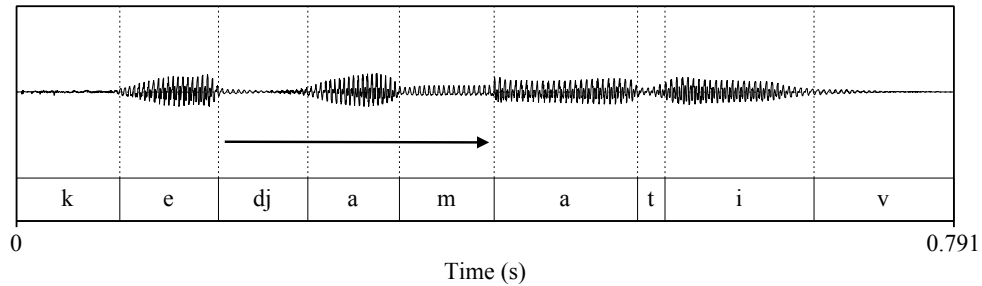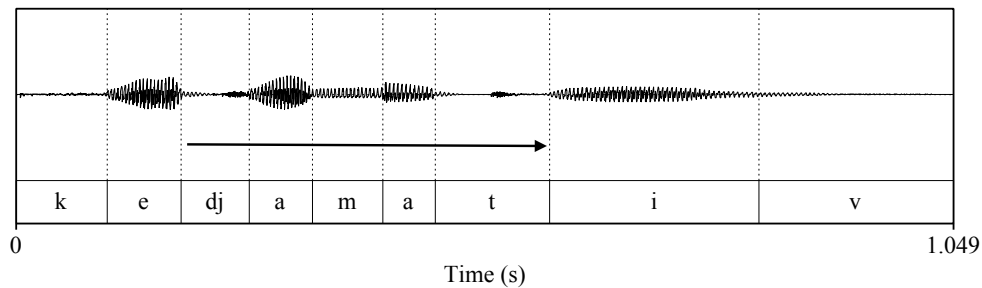Figure 1: Interstress interval in *kédjamàtive*

k	e	dj	a	m	a	t	i	v

0   0.791

Time (s)

Figure 2: Interstress interval in *kédjamatìve*

k	e	dj	a	m	a	t	i	v

0   1.049

Time (s)

Tokens in which the post-stress consonant was *r* or *l* were occasionally difficult to segment due to coarticulatory effects on the stressed vowel. In these cases, I inspected the waveform and spectrogram to find the earliest likely vowel-liquid boundary. This hypothesis was then tested auditorily by playing the recording starting from the sonorant and confirming that none of the preceding vowel was audible. In the event that it was, the boundary was moved to the next zero crossing and tested again; this process iterated as necessary. For example, in *keladjative*, the boundary was placed at the zero crossing indicated in Figure 3, where the spectrogram also showed a sharp decrease in amplitude. None of the preceding *e* is audible when playing the recording starting from this boundary.

Figure 3: Placement of boundary within [ɛl] in *keladjative*
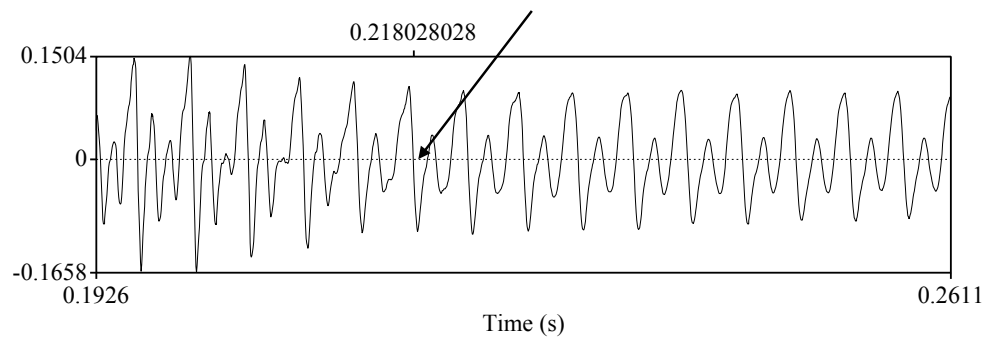
Inspection of the resulting interstress durations reveals several generalizations. First, the identity of the pre-*at*- material has the expected effect on overall lapse duration in the *ive*-stressed forms: the V/R/O/CC cline observed in the dictionary data is present in the acoustic data (Fig. 4). This finding correlates with the dictionary data in the way predicted by the hypothesis. It is thus plausible that –CC*ative* forms bear stress at higher rates than –O*ative* forms, and –O*ative* forms at higher rates

13

than –R*ative* forms, and –R*ative* forms at higher rates than –*ative* forms, because the length of the potential lapse decreases across these categories. While Fig. 4 suggests that there is considerable variability in the durations of the various members of these categories – voiced stops, for example, are shorter than nasals – the fact that the rough categories of V/R/O/CC arrange themselves in the cline familiar from the dictionary data is of interest.

Figure 4: Duration of lapse in *ive*-stressed form by pre-*at*- segment category; task 1 stimuli
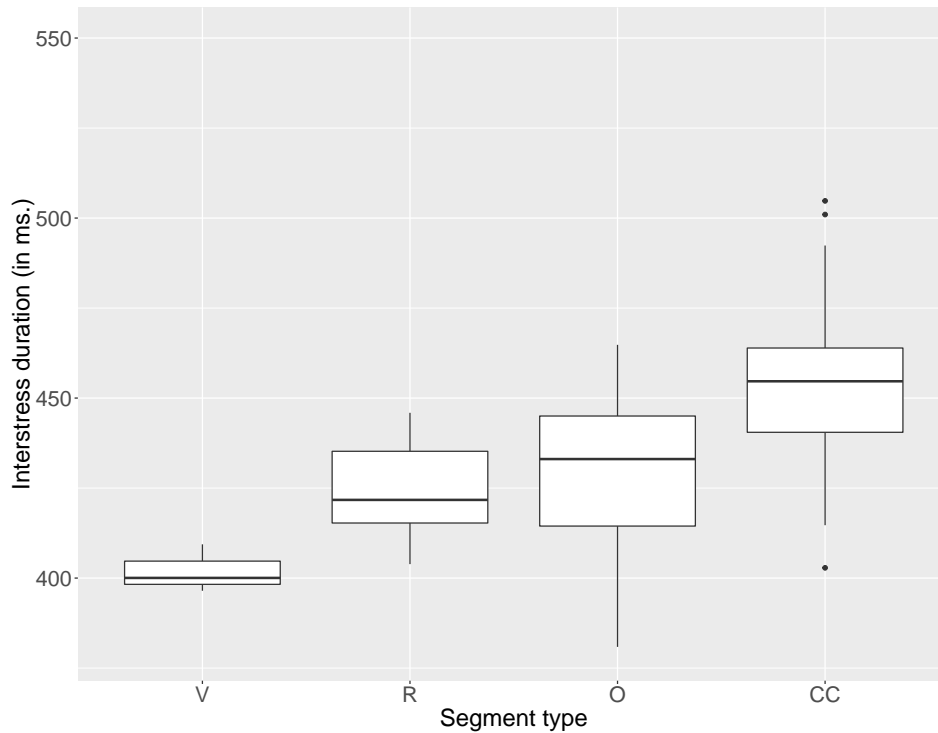
The second generalization of interest is that the contribution of the segment types is the same in pre-*at*- position as it is in poststress position: across contexts, as the material changes from V to R to O to CC, interstress duration of the *ive*-stressed form rises. This is evident from comparing the durations plotted in Fig. 5 with those in Fig. 4. This is not exactly what was expected – in the dictionary data, forms with a poststress sonorant (e.g. *celebrative*) bore –*at*- stress at higher rates than forms with a poststress obstruent (e.g. *mediative*) – but the general shape of the data (V is associated with shorter lapses than CC, and R/O fall somewhere in the middle) is familiar.[9]

Finally, the third generalization of interest has to do with the relationship between the interstress durations of forms that differ only in the location of suffix stress (e.g. *kédjamàtive* vs. *kédjamatìve*). The average interstress duration of the –*ive* items (at 401 ms.) is longer than the average interstress duration of the –*at*- items (at 223 ms.), and this comparison holds for each item: the *àt-to-ìve* ratio for interstress duration is fairly constant across forms (.59 on average; see also Sec. 5.3 on this). It is thus plausible to hypothesize that a speaker would prefer an –*at*-stressed form to an *ive*-stressed

---

[9]Linear regressions fit separately to the acoustic data summarized in Figs. 4–5 find significant correlations between segment type and interstress duration ($p < .001$ for both).

Figure 5: Duration of lapse in *ive*-stressed form by pre-*at-* segment category; task 2 stimuli
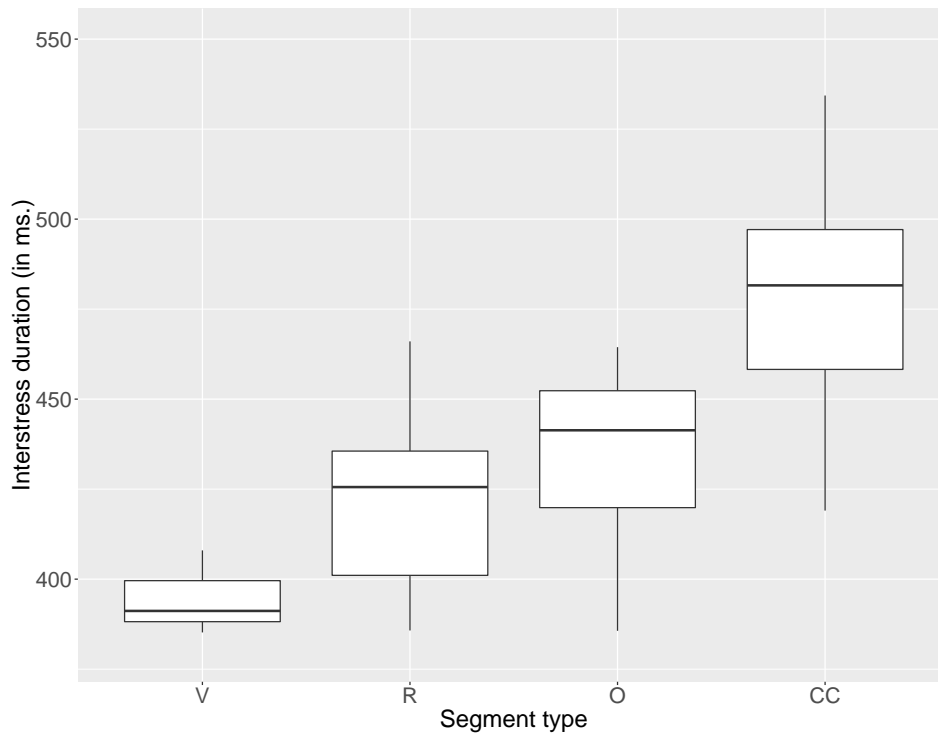
form on account of the –*at*-stressed form's shorter interstress duration.

In sum, acoustic analysis of these nonce –*ative* forms reveals that the trends discovered in the dictionary study are largely reflected in properties of the stimuli. This is the first step in showing that the current hypothesis regarding the source of the Nanni effect is plausible.

5.2 Methods

The nonce words discussed in Sec. 5.1 were normalized for amplitude and pitch-smoothed by 50% (using Praat Vocal Toolkit, Corretge 2012); this was done to lessen differences in amplitude and intonation. The experimental items were constructed by pairing forms that differed in suffixal stress but were otherwise identical. Task 1 had 80 items: 60 trochaic test items (*bádjamàtive* vs. *bádjamatìve*) and 20 iambic fillers (*sidjómàtive* vs. *sidjómatìve*). Task 2 had 79 items: 60 trochaic test items (*bámadjàtive* vs. *bámadjatìve*) and 19 iambic fillers (*simódjàtive* vs. *simódjatìve*; one iambic item was excluded due to speaker error). As the OED suggests that the rate of –*at-* stress in trochaic forms is generally high, the hope was that including iambic items – where –*ive* stress is necessary to avoid a clash – would encourage some variety in response strategy.

For both tasks, participants were presented with an item's orthographic representation (*lidjaka-tive*) and instructed to choose which of the two possible pronunciation options they preferred (*líd-jakàtive* vs. *lídjakatìve*). The stimuli were presented only auditorily, and recordings were played by pressing a radio button (see Figure 6 for an example of how the items were presented). To ensure that participants listened to the recordings in the desired order, the radio button linked to the second

recording ('Option 2') was only available after the first ('Option 1') had been pressed. In addition, participants were not able to indicate their preferred choice until both 'Option 1' and 'Option 2' had been pressed. Order of items was randomized by participant, and order of the *–at-* and *–ive-*stressed recordings was randomized by item and by participant.

Figure 6: Example trial for *lidjakative*

Here are the possible pronunciations for **lidjakative**.

Option 1

Option 2

Which of these options do you prefer?

Option 1   Option 2

The tasks were constructed with Experigen (Becker & Levine 2013) and 100 participants – 50 per task – were recruited using Amazon's Mechanical Turk. To be eligible to participate, participants had to have a US IP address, 500 previously accepted tasks, and an approval rating of 97% or above. Participants were compensated $2.00 for their time. When deciding whether or not to include the responses from each participant, I checked that they were a native speaker of American English and that they were attending to the stimuli, in the ways discussed below.

- **Was the participant a native speaker of American English?**

  The survey included two demographic questions, following the presentation of all stimuli: "What would you consider your first (native) language?" and "Where do you live?". If a participant indicated that they were not a native speaker of English or that they did not currently reside in the US, their results were excluded.

- **Was the participant attending the stimuli?**

  Participants employed a number of different response strategies for the task. One strategy was consistent selection of the first or second pronunciation option for each item. Since this response strategy does not make it clear that this participant's decisions were influenced by the recordings, their responses were excluded.

One Task 1 participant selected the first pronunciation option for all 80 items, so their results were excluded. The analysis of Task 1 that follows takes into account the responses of the remaining 49 participants, while the analysis of Task 2 takes into account the responses of all 50 of its participants.

5.3   Results and statistical analysis for Task 1

Responses for Task 1 indicate a positive correlation between interstress duration of the *ive*-stressed form and the likelihood of a preference for *–at-* stress. This result is visualized in Figure 7. Figure

7's *x* axis represents interstress duration of the *ive*-stressed form; the raw results are represented as point ranges, where the point represents the percentage of *at*-stress responses and the line represents the 95% binomial proportion confidence interval. To aid readability, data were binned into 10ms intervals. The absence of a point range at 470 ms. reflects an absence of items for which the *ive*-stressed form's interstress duration falls between 470 and 480 ms.

Figure 7: Interstress duration of *ive*-stressed form is positively correlated with *at*-stress (Task 1)
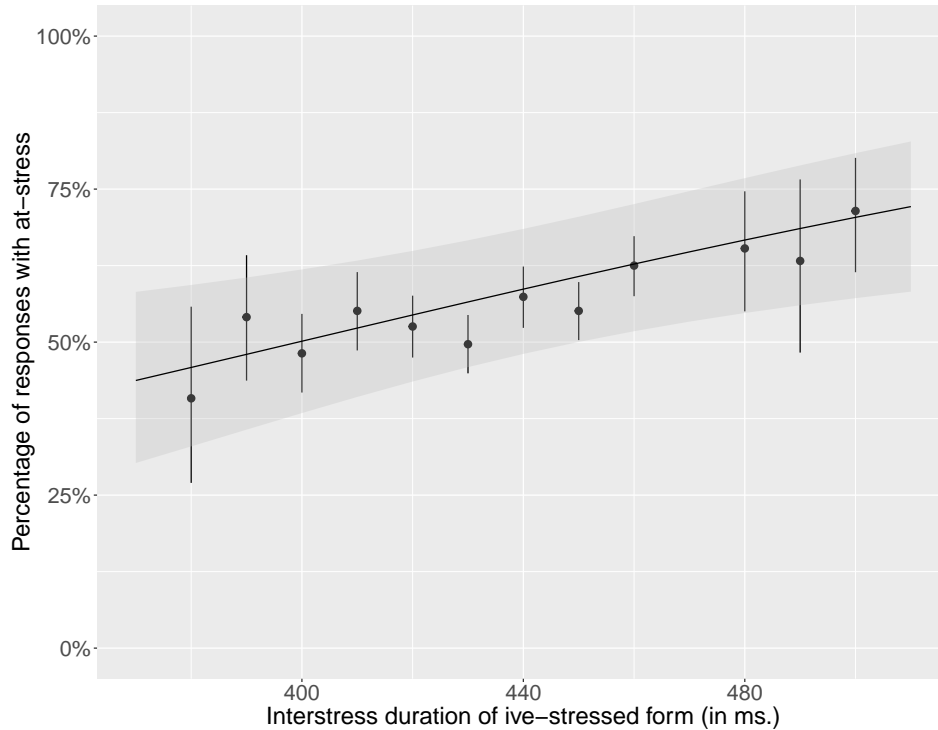
The best fit line in Figure 7 was obtained from a mixed effects logistic regression model, using the Effect function of R's effects package (Fox 2003, Fox & Weisberg 2018). The dependent variable for the model was the preferred pronunciation (a 1 for *–at-* stress, and a 0 for *–ive* stress). Independent variables included interstress duration (a continuous predictor) and the identity of the pre–*at-* material (a categorical predictor, sum-coded, with "vowel" as the reference level); this second variable was included so as to account for the possibility that *–at-* stress might be preferred or dispreferred in certain segmental contexts (i.e. *–skative* or *–lative*) for reasons independent of interstress duration.[10] Random effects included a random intercept for item (1|Item) and a by-participant random slope and intercept for interstress duration (1+Interstress|Participant). The model was fit using the glmer function of R's lme4 package (Bates et al. 2015) and *p*-values were obtained with R's lmerTest package (Kuznetsova et al. 2017).

As is evident from the summary in Table 1, the effect of interstress duration is significant: the observed correlation between longer interstress duration of the *–ive*-stressed form and greater likelihood of *–at-* stress is unlikely to be due to chance. In addition, significant effects of ending identity

---

[10]Stem identity, or *ba–* vs. *ke–* vs. *li–*, is not included here; it did not play a role in participant responses in either task.

indicate that the segmental composition of the items played a role in participant judgments. –*at*-stress was preferred less than expected (given interstress duration) for forms ending in –*dmative*, –*dnative*, –*fative*, –*native*, and –*rative*; –*at*- stress was preferred more than expected (given interstress duration) for forms ending in –*skative*. An LRT indicates that a model including the predictor for interstress duration is a significantly better fit to the data than an otherwise equivalent model that does not (χ^2 (1) = 7.57, $p < .01$).

Table 1: Summary of fixed effects for stressless –*at*- model (significant effects only)

| Factor	Coefficient	z value	Significant?
Intercept	-3.20	–	–
Interstress duration	8.60	2.79	Yes ($p < .01$)
Ending: *dm*	-0.73	-2.54	Yes ($p < .05$)
Ending: *dn*	-0.63	-2.14	Yes ($p < .05$)
Ending: *f*	-0.81	-2.71	Yes ($p < .01$)
Ending: *n*	-0.66	-2.43	Yes ($p < .05$)
Ending: *r*	-0.63	-2.22	Yes ($p < .05$)
Ending: *sk*	0.72	2.02	Yes ($p < .05$)

An anonymous reviewer expresses surprise that the results in this section are modeled as a function of the interstress duration of the *ive*-stressed form, rather than the *àt*-to-*ìve* ratio for interstress duration. The reason for this is reflected in Figure 8, which plots for each item the interstress duration of the –*ive*-stressed form against that of the –*at*-stressed form (e.g. *lídjakatìve*–*lídjakàtive*). The ratio of *àt*-to-*ìve* interstress duration is roughly constant across forms of all lengths (as discussed briefly in Sec. 5.1); the best-fit line has a slope of 0.97 ($p < .001$, linear regression).

Given this, differences in the *àt*-to-*ìve* ratio do not seem a likely predictor of participant responses, as it is largely invariant. This was confirmed by fitting another mixed effects logistic regression to the data, similar to the one reported in Table 1, but with the –*at*-to-*ive* ratio replacing interstress duration of the *ive*-stressed form in the fixed and random effect components. The effect of the –*àt*-to-*ìve* ratio was not significant in this model (z = -0.67, $p > .1$), and goodness of fit measures indicate that it is a poorer fit to the data than is the model reported in Table 1.[11]

This result is interesting because it indicates that participants' dispreference for an *ive*-stressed form is likely linked to the interstress duration of that form in isolation, and does not take into account the relationship between that longer interstress duration and the shorter one that could be obtained by stressing –*at*-. In other words, participants appeared to make their decisions about whether –*at*-stress or *ive*-stress was preferable on the basis of the *ive*-stressed form alone; there is no evidence that the properties of the –*at*-stressed form, alone or in comparison to those of the *ive*-stressed form, were taken into account. It is possible to imagine a different response strategy to this task, where a preference for –*ive* stress would increase proportional to the difference between the –*at*- and –*ive*-stressed forms' interstress durations. This, however, is not what was observed.

---

[11] For the model reported in Table 1, the AIC is 3315.8 and the BIC is 3465.4. For the model that includes the –*àt*-to-*ìve* ratio, the AIC is 3320.5 and the BIC is 3470.2. A lower AIC/BIC indicates a better fit to the data.

Figure 8: Interstress duration for the *–at*-stressed and *ive*-stressed forms, by item
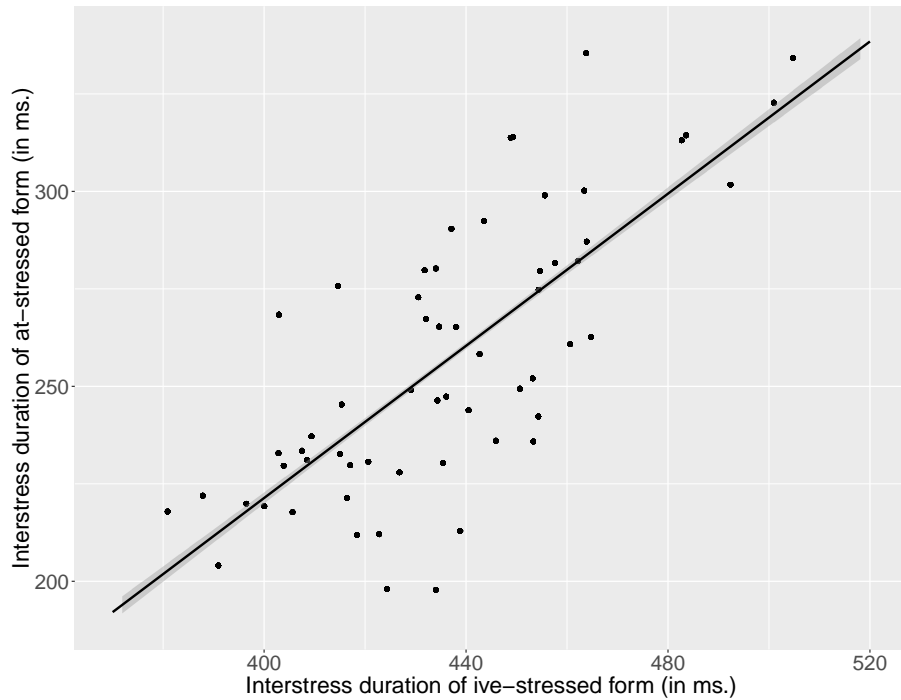
5.4   Results and statistical analysis for Task 2

Participant responses for Task 2, which manipulated the identity of of the post-stress material (e.g. *baladjative* vs. *baskladjative*) also indicate a positive correlation between interstress duration of the *ive*-stressed form and the likelihood of a preference for *–at-* stress (Fig. 9). The best fit line was again obtained from a mixed effects logistic regression model with the Effect function of R's effects package. The dependent variable for the model was the preferred pronunciation (1 for *–at-* stress, 0 for *–ive* stress). Independent variables included interstress duration (a continuous predictor) and the identity of the post-stress material (a categorical predictor, sum-coded, with "vowel" as the reference level). Random effects included a random intercept for Item (1|Item) and a by-participant random slope and intercept for interstress duration (1+Interstress|Participant). In this way, the model fit to the Task 2 data was identical to that fit to the Task 1 data (and as before, the model was fit using the glmer function of R's lme4 package, with *p* values obtained with R's lmerTest package).

Model results (Table 2) indicate that interstress duration plays a significant role in particpant responses: the longer the interstress duration of the *ive*-stressed form, the more likely participants are to prefer *–at-* stress. An LRT confirms that a model including this fixed effect is a better fit to the data than an otherwise equivalent model that does not (χ^2 (1) = 5.94, $p < .05$). The coefficient of this effect (8.36) is close to the coefficient of the equivalent effect in Task 1 (8.6), indicating that the magnitude of the effect was fairly consistent across the two tasks. In addition, the results indicate that forms with a post-stress consonant of *d* (e.g. *kedadjative*) are more likely to bear *–at-* stress than is predicted based on their interstress duration alone.[12]

---

[12] An alternative model that substitutes the *–àt*-to-*ìve* ratio for interstress duration, in both the fixed and random effects

Figure 9: Correlation between interstress duration of *ive*-stressed form and preference for *at*-stress
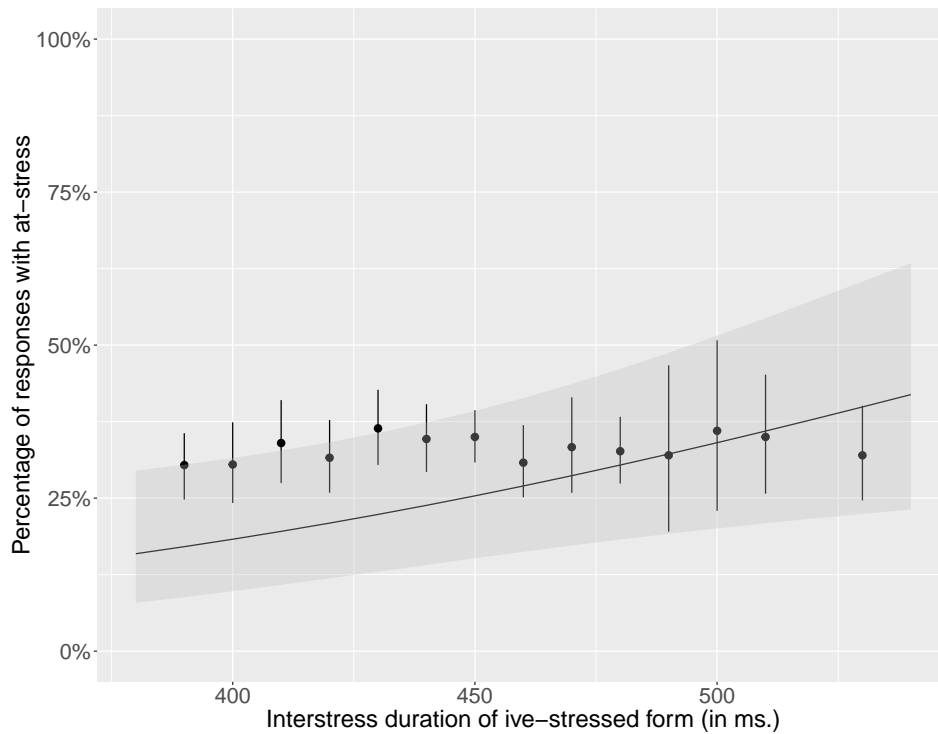

Table 2: Summary of fixed effects for stressless –*at*- model (significant effects only)

Factor	Coefficient	z value	Significant?
Intercept	-4.99	–	–
Interstress duration	8.36	2.48	Yes ($p < .05$)
Ending: d	0.69	2.12	Yes ($p < .05$)

Why is there an apparent discrepancy between the raw results plotted in Figure 9 and the mixed effect model's best fit line? Because the best fit line takes other sources of variance into account. In particular, the identity of the post-stress segment(s) often influences participants' judgments in opposite direction than what is expected from interstress duration. For example, participants were less likely to prefer –*at*-stress on forms with post-stress *skl* than is expected given their interstress duration ($p = .1$), and more likely to prefer –*at*-stress on forms with post-stress *l* than is expected given their interstress duration ($p > .1$). For complete information along these lines, see the appendix, which contains a summary of the statistical models fit to both sets of experimental data.

Two other differences between the tasks should be addressed before moving on. First, the effects of interstress duration are visually apparent in the raw data from Task 1 but not Task 2. While I do not have an explanation for this finding, this difference between the Task 1 and Task 2 raw results

---

components, did not find a significant effect for the –*àt*-to-*ìve* ratio. In addition, this model was a worse fit to the data than the one summarized in Table 2: compare its AIC/BIC of 2595.2/2745.4 to Table 2's 2589.0/2739.1.

results mirrors differences observed in the dictionary data: the effect of V/R/O/CC comes through clearly when one categorizes the forms by their pre-*at-* segments, though not their poststress ones. Perhaps the segmental factors responsible for the appearance of the raw data in Fig. 9 are responsible for the shape of the dictionary data as well. Second, the mean rate of *–at-* stress differs across the two tasks. Task 1 participants preferred *–at-*stress for 55.4% of the items, while Task 2 participants preferred it for 33.2%. One possible explanation for this observation is that *–at-* stress is preferred when the pre–*at-* consonant is [dʒ] (as was the case for all Task 2 items) due to a potential OCP effect: if *–at-* were stressless, the result would be words in which obstruents sharing the same major place of articulation are separated only by a schwa ([–dʒətʰɪv]). Whether or not this is plausible would need to be confirmed by running variants of Task 2 with different pre–*at-* segments.

In any case, the result of interest here is that interstress duration is a significant predictor of participant preference for *–at-*stress. Furthermore, the magnitude of this effect does not appear to depend on whether the manipulated segments are in pre-*at-* position (as in *badja**l**ative-badja**skl**ative*, Task 1) or poststress position (as in *ba**l**adjative-ba**skl**adjative*, Task 2). This result – that segments distal to *–at-* should matter, just as proximal ones do – is predicted by the current hypothesis.

5.5 Preliminary constraint-based analysis

For a preliminary constraint-based analysis of these results, I focus on participant responses to four of the Task 1 items: *badjasprative*, *badjapative*, *badjalative*, and *badjanative*. As is evident from (22), the shorter the duration of the *ive*-stressed form, the more likely participants are to choose the *ive*-stressed form. Unsurprisingly given the above discussion, the participant responses were not correlated with the *–àt*-to-*ìve* ratio or the raw difference in their interstress durations.

(22)   Results and interstress durations for *badjasklative* and *badjalative*

Item	Form	Interstress duration of *ive*-stressed form	*–àt*-to-*ìve* diff. *–àt*-to-*ìve* ratio	Preferred
badjasklative	*bádjaspràtive* *bádjaspratìve*	464 ms.	177 ms. 0.62	69% 31%
badjapative	*bádjapàtive* *bádjapatìve*	435 ms.	170 ms. 0.61	61% 39%
badjalative	*bádjalàtive* *bádjalatìve*	423 ms.	211 ms. 0.50	51% 49%
badjanative	*bádjanàtive* *bádjanatìve*	406 ms.	188 ms. 0.54	41% 59%

For an analysis I assume two constraints. The first is a phonetic *Lᴀᴘsᴇ. To capture the observation that participants' responses only took into account the interstress duration of the *ive*-stressed form, I assume that phonetic *Lᴀᴘsᴇ only penalizes stressless strings that exceed a certain durational threshold. For the purposes of this preliminary analysis I assume, somewhat arbitrarily, that this threshold is 381 ms.: this is both the longest interstress duration of an *–at-*stressed form (Task 2, *lispradjative*) and the shortest interstress duration of an *ive*-stressed form (Task 1, *badjabative*). As a result, the version of phonetic *Lᴀᴘsᴇ in (23) penalizes only lapses in *ive*-stressed forms. This allows the grammar to take into account only the interstress duration of the *ive*-stressed form.[13]

---

[13]An anonymous reviewer asks about an alternative definition of this constraint that appeals to a relational measure, such as the proportion of the lapse's duration to the entire word's. Such a measure does not appear to be relevant here.

(23)   *LAPSE: For each span of stressless material δ that exceeds 381 ms., assign one * for each millisecond above 381.

The second necessary constraint is STRESS$_{-ive}$, repeated from (4) as (24). This constraint prefers *ive*-stressed forms, and acts as a counterbalance to phonetic *LAPSE.

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

Weights for these constraints were computed with the Maxent Grammar Tool (Hayes et al. 2009), using the input-output pairs and violations summarized in (25). The tool found a weight of 0.02 for *LAPSE and 0.79 for STRESS$_{-ive}$. When the *ive*-stressed form has a relatively short lapse, as in (25d), the penalty assigned by *LAPSE is relatively minimal, and the *–ive*-stressed form is preferred. When the *ive*-stressed form has a relatively longer lapse, as in (25a), the penalty assigned by *LAPSE is much greater, and the *–at*-stressed form is preferred. The close resemblance of the predicted probabilities to the attested responses (22) indicates that this model provides a relatively good fit to participants' preferences regarding stress in these four items.

(25)   Violations and predicted frequencies for four experimental items

		*LAPSE 0.02	STRESS$_{-ive}$ 0.79	Harmony	Prob.
a. bádjasklative	bádjasklàtive		1*	0.79	71%
	bádjasklatìve	84*		1.68	29%
b. bádjapative	bádjapàtive		1*	0.79	57%
	bádjapatìve	54*		1.08	43%
c. bádjalative	bádjalàtive		1*	0.79	51%
	bádjalatìve	42*		0.84	49%
d. bádjanative	bádjanàtive		1*	0.79	43%
	bádjanatìve	25*		0.50	57%

In a full analysis, segment-specific effects like the preference for *–at-* stress in *–skative* forms could be captured by incorporating further markedness constraints, like *skə.

An anonymous reviewer asks how to reconcile the probabilistic behavior exhibited by participants in the nonce word experiments with the observation that many existing *–ative* words have a fixed stress. It is however unclear exactly how many *–ative* words actually have a fixed stress: while the OED records only 75/344 of the trochee-final *–ative* forms as carrying variable stress, judgments from native speakers suggest that variability is more pervasive. To give one example: *fabricative* is transcribed as bearing *ive*-stress, but the speakers I have consulted consider *–at-* stress possible as well. Among the relatively few forms for which speakers do have consistent judgments, there are two possible explanations for where this consistency comes from. The first is that the penalty assessed by *LAPSE is so severe that the probability of producing the *ive*-stressed form approaches zero. This could be the case for *rémonstràtive*, with consistent *–at-* stress and a preceding four-consonant cluster. The second possibility is that speakers have memorized the *–ative* form, together with its stress, and the consistent stress placement reflects faithfulness to the lexical item's input

A model of the Task 1 results that replaces interstress duration of the *ive*-stressed form with the lapse-to-word ratio does not find a significant effect of the lapse-to-word ratio. In addition, goodness of fit measures indicate that this model is a worse fit to the data than is the model reported in Table 1. Identical results hold for Task 2.

stresses (see Zuraw 2000 for a proposal that can distinguish real and nonce words in this way). This could be the case for *légslàtive*, a frequent form with invariant stress.

5.6 Iambic fillers and phonetic *CLASH

Recall from the discussion in Sec. 3.1 that stress in *–ative* is rhythmically conditioned. *–at-* stress is possible in a context where it does not result in clash: in 69% of the relevant forms in the OED, *–at-* is variably or consistently transcribed as bearing stress (as in e.g. *législàtive*). *–at-* stress is however much less frequent in a context where it results in a stress clash: only 6% of the relevant forms in the OED bear *–at-* stress in this context (e.g. *órnàtive*). We would thus expect participants' preferences to reflect this. Concretely, *–at-* stress should be more frequent with trochaic forms like *bádjasprative* (where it does not result in a clash) than in iambic forms like *sidjósprative* (where it does). As shown in Figure 10, this prediction is borne out: across both tasks, the rate of *–at-* stress is higher for forms with trochaic stems ($p < .001$ for both tasks, logistic regressions).

Figure 10: Preference for *–at-* stress by rhythmic profile of stem (Tasks 1 and 2)
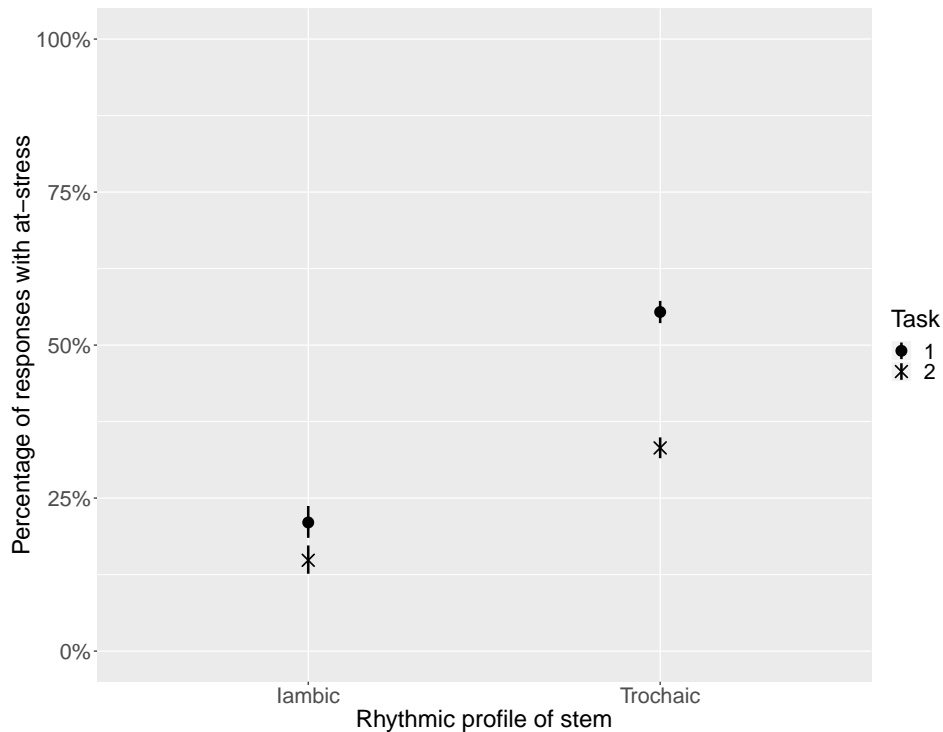
I assume that the dispreference for *–at-* stress in iambic forms is due to *CLASH, a constraint that penalizes adjacent stressed syllables. An alternative interpretation under which the relevant constraint is really phonetic *CLASH, which would assign violations for interstress durations that fall below a certain threshold, is not supported by consideration of further results. This is demonstrated in Figs. 11–12, where participant responses to the iambic items are plotted by the interstress duration of the *–at-*stressed form. In the case of the Task 1 iambic forms (Fig. 11), the best-fit line has a slight negative slope, which would be unexpected were phonetic *CLASH active (though $p > .1$).

Figure 11: Preference for –at- stress by rhythmic profile of stem (Task 1)
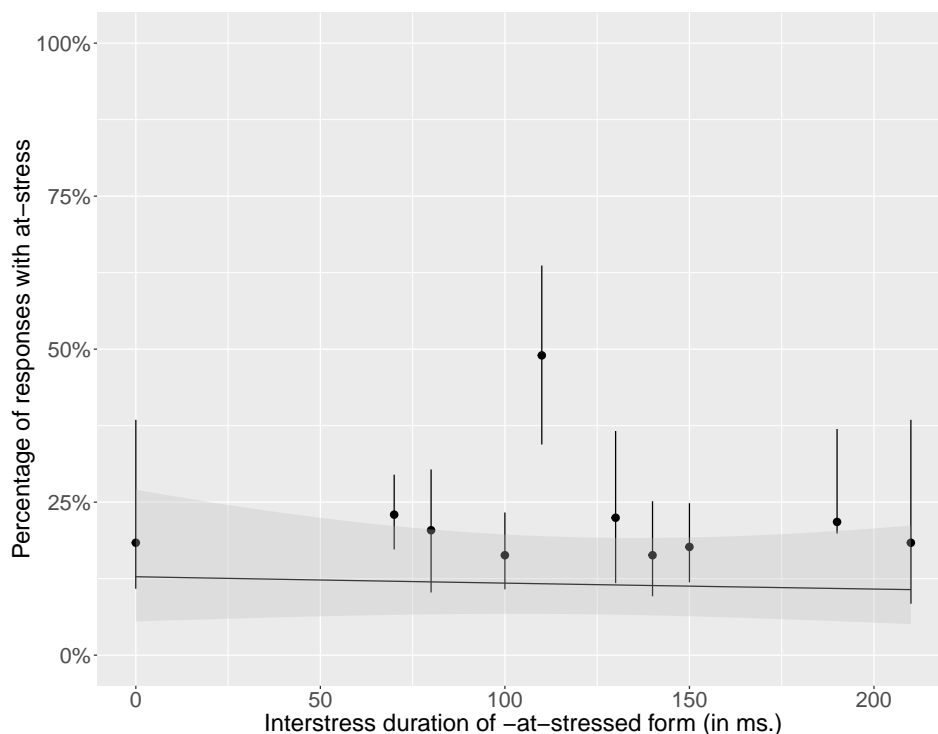
In the case of the Task 2 iambic forms (Fig. 12), the best-fit line has a positive slope, as would be expected if phonetic *CLASH were active (though $p > .1$). (For both sets of data, the dependent variable was the participants' stress judgment; independent variables included a continuous predictor for interstress duration of the –at-stressed form and random intercepts for item and participant.[14])

The dictionary data are largely consistent with this picture: clash in –ative is dispreferred, but there are no clear further subdivisions within that class. Of the 41 cases where –at- stress would involve a clash across a sonorant (e.g. *compéllative*), 3 (7%) stress –at-; of the 75 cases where –at-stress would involve clash across an obstruent (e.g. *légative*), 5 (6%) stress –at-; and of the 115 cases where –at- stress would involve clash across a cluster (e.g. *cálmative*), 7 (or 6%) stress –at-.

It is worth noting however that these investigations into *CLASH in –ative are based on relatively little data, and as such should not be taken as evidence against the possibility that phonetic *CLASH is active in English. The experimental results summarized in Figs. 11–12 are based on responses to a small number of items: since there was only one iambic 'stem', each pre-*at*- or poststress value (e.g. *b*, *spr*) was found in only one item. This means that any effect of interstress duration in these forms cannot be dissociated from an item effect (perhaps certain recordings sounded unnatural) or a segmental effect (perhaps clash is better across *pr* than *kl*, for independent reasons). An experiment with a larger and more varied set of stimuli would be necessary to further investigate the effect of interstress duration in iambic –ative forms. In the case of the dictionary data, only 15 words

---

[14]Further fixed effects or a more complicated random effects structure were not possible due to the limited number of iambic items; see also discussion below.

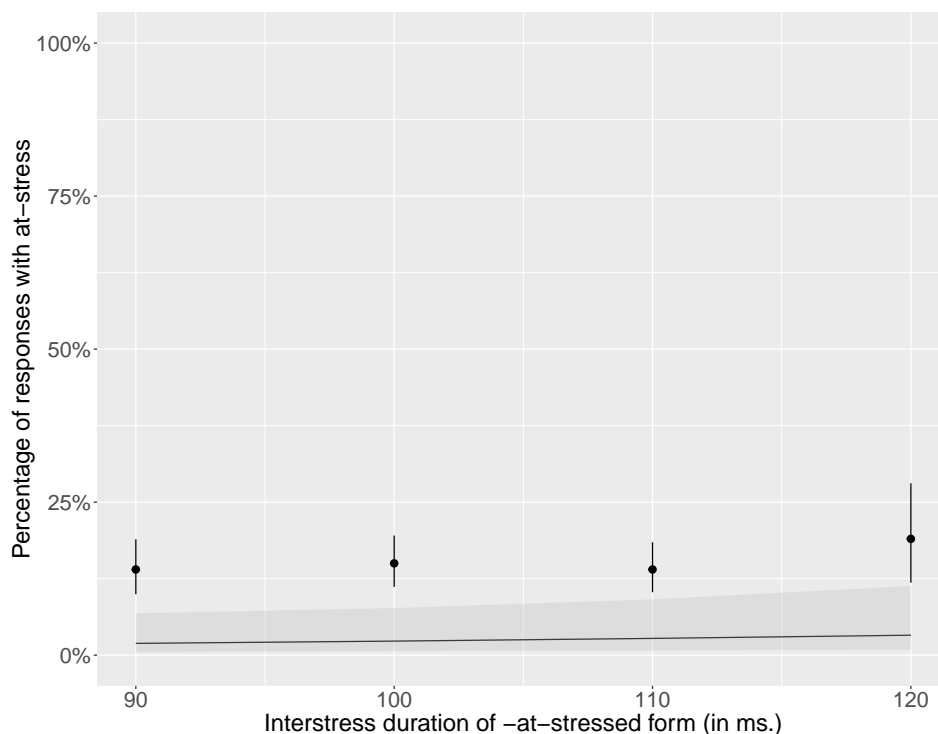Figure 12: Preference for –*at*- stress by rhythmic profile of stem (Task 2)

exhibit clash with –*at*-, meaning that the numbers are too small to reliably investigate any differences according to segment type. Thus any dictionary study attempting to locate potential evidence for phonetic *CLASH would need to focus on a class of words where clash is more common; for a potential example of this sort see Sec. 7.2 on –*ization*.

6 Against an onset-sensitive alternative

Results discussed above suggest that interstress duration of the *ive*-stressed form is positively correlated with participants' preference for –*at*- stress. This section compares the present proposal to that of Davis (1988), where the rate of –*at*- stress depends on the identity of the penultimate onset: –*at*- is more likely to bear stress if the penultimate onset is an obstruent or cluster (*investigative*, *administrative*) than if the onset is null or a sonorant (*palliative*, *speculative*). Assuming that an obstruent onset (*investigative*) attracts stress more readily than a sonorant onset (*speculative*), and that a cluster onset (*administrative*) attracts stress more readily than an obstruent onset (*investigative*), a probabilistic version of Davis's claim could be adapted to the variable dictionary data in the following way: the heavier the penultimate syllable's onset, the more likely it is to bear stress (see Ryan 2014 for corpus and experimental evidence that a similar pattern holds in English more generally).[15]

---

[15]The claim that less sonorous onsets are heavier than more sonorous onsets is consistent with what is known about the typology of onset-sensitive stress (see Gordon 2005). The observation that clusters act heavier than obstruents could be explained if what governs onset heaviness is not the onset's sonority but rather its duration (see Ryan 2014).

As is clear from (26), the familiar trend holds when the forms are categorized in this way.

Note that in (26), each cell contains two numbers. It is not clear to me how *s*-consonant clusters divide across a syllable boundary – *legis.lative* or *legi.slative*? – so I entertain two parses. The first number in the cell is the count if an *s*-consonant cluster is split across the syllable boundary, as in *legis.lative*; the second number is the count if the entire cluster belong to the onset, as in *legi.slative*. (I ignore here the fact that not even single intervocalic consonants are consistently treated as onsets in English; for experimental evidence on this point see Treiman & Danis 1988, *a.o.*)

(26)   Onset-sensitive reinterpretation of the OED data

Onset type	Stressed *–at-*	Stressless *–at-*	% stressed	Total
None	22/22, e.g. *annunciative*	22/22, e.g. *enunciative*	50%/50%	44/44
Sonorant	91/90, e.g. *mutilative*	64/64, e.g. *speculative*	59%/58%	155/154
Obstruent	100/99, e.g. *deprecative*	18/18 e.g. *dubitative*	85%/85%	118/117
Cluster	16/18, e.g. *registrative*	1/1, e.g. *adequative*	94%/95%	17/19

With respect to the results of Task 1 (Sec. 5.3), the onset-sensitive and phonetic lapse hypotheses are difficult to tease apart. It was demonstrated in Task 1 that interstress duration is significantly correlated with the weight of the pre–*at-* material and with participant preferences for *–at-* stress (Figures 4, 7). Unsurprisingly, the weight of the pre–*at-* material is significantly correlated with participant preferences for *–at-* stress as well ($p < .05$, mixed effects logistic regression[16]). Thus for Task 1, it is possible to understand participant preferences for *–at-* stress as a function of interstress duration or weight of the pre-*at-* material. Task 2 acts to dissociate the predictions of these two hypotheses. Under an analysis in which *–at-*'s stress-bearing potential depends entirely on the identity of the pre-*at-* material, there is no possible explanation for why the identity of the poststress segments should affect participant preferences for *–at-* stress. The phonetic lapse hypothesis alone predicts this effect and allows the results from Tasks 1 and 2 to be understood in a unified way.

A further way to dissociate the predictions of the phonetic lapse and onset-sensitive hypotheses is to split each group in (26) into two subcategories, according to whether or not the antepenultimate syllable has a coda. For example: among the forms for which the onset of the penultimate syllable is an sonorant, some have an antepenultimate coda (as in *desig.native*) and others do not (as in *halluci.native*). The phonetic lapse hypothesis predicts that forms like *designative* might stress *–at-* at higher rates than forms like *hallucinative*, due to the extra consonant in the lapsed string. The onset-sensitive hypothesis, however, predicts that there should be no difference in the rates of *–at-* stress between these two types of form, as both classes have the same kind of onset.

In (27), forms from each onset type are subdivided into two subgroups: (i) forms without an antepenultimate coda, and (ii) forms with an antepenultimate coda. (Forms in which the penultimate syllable lacks an onset are excluded, as there necessarily is no antepenultimate coda.) An invariant generalization in (27) is that if a form has an antepenultimate coda, it stresses *–at-*; among the forms

---

[16]This model included a continuous predictor for segment type (V=0, R=1, O=2, CC=3), a by-participant random slope for segment type, and a random intercept for item. It was not possible to include an additional fixed effect for segment identity (i.e. *d*, *dm*, *dn*) as the resulting model is rank-deficient and drops the predictor for segment type.

where there is no antepenultimate coda, the rate of *–at-* stress is somewhat lower. But the numbers in the (ii) categories are too small for within-type comparisons to be meaningful, and Fisher's Exact Tests find no evidence for a significant asymmetry, within any onset type or on either syllable parse.

(27)   Contribution of antepenultimate codas to stress on *–at-*

Onset type	Condition	Stressed *–at-*	Stressless *–at-*
Sonorant	(i) R	88/88 (e.g. *lace.rative*)	64/64 (e.g. *halluci.native*)
	(ii) C.R	3/2 (e.g. *desig.native*)	0/0
Obstruent	(i) O	92/92 (e.g. *predi.cative*)	18/18 (e.g. *eradi.cative*)
	(ii) C.O	8/7 (e.g. *alter.cative*)[17]	0/0
Cluster	(i) CC	10/15 (e.g. *dese.crative*)	1/1 (e.g. *ade.quative*)
	(ii) C.CC	6/3 (e.g. *concen.trative*)	0/0

Evidence consistent with the asymmetry in (27) comes from the results of Task 1. Within the R onset type, there were six types of item that differed only in the presence vs. absence of an antepenultimate coda: *–l/m/native* (R) vs. *–dl/dm/dnative* (C.R). In these forms, the penultimate onsets are matched; only the antepenultimate coda in the C.R forms differentiates them (e.g. *badjalative–badjadlative*).[18] As shown in Fig. 13, the presence of an antepenultimate coda leads to longer interstress duration of the *ive*-stressed form ($p < .001$, linear regression). And as shown in Fig. 14, participants exhibited a greater preference for *–at-* stress in the C.R context than they did in the R context, though this difference was small (47.6% *–at-* stress for R and 49.2% *–at-* stress for C.R) and not significant ($p > .1$, mixed effects logistic regression).[19]

   Thus with respect to the role of antepenultimate codas, the dictionary and behavioral data trend in the same direction, though further work is necessary to determine if these trends are reliable. To the extent that they are, such a correlation is unexpected if a preference for *–at-* stress depends only on the penultimate syllable's onset. The difference is however predicted if the preference for *–at-* stress depends on interstress duration: stressless strings that include C.R are longer than those including only R. In sum, then, the available data suggest that the duration-based hypothesis correctly predicts that the presence of an antepenultimate coda encourages *–at-* stress. This, together with the influence of poststress consonants on *–at-* stress, points towards phonetic *Lapse as the source of the Nanni effect.

---

[17]An anonymous reviewer notes that orthographic <er> could be [ɚ]. I do not know how to distinguish [ɚ] (which has no coda) from [ɔɹ] (which presumably does), and assume for now that these sequences are transcribed as [ɔɹ].

[18]An anonymous reviewer raises a concern that singleton /n/ is flapped before a stressless syllable (as in *bádjanatìve*), and that this might put it in a different weight category than /dn/, where /n/ is not flapped. It is not clear from these data however that this concern is valid: in the experimental items, [n] was longer on average in the singleton context than in the cluster context (51 vs. 33 ms.). Increased duration is not what would be expected from a flapped allophone.

[19]This model included a sum-coded binary predictor for sequence type (0 = R, 1 = C.R) and random intercepts for item and participant. It was not possible to include a predictor for sequence identity (i.e., *dl* vs. *dm* vs. *m*, etc.) because the resulting model was rank deficient, and necessarily dropped a coefficient. In order to include this predictor, a further experiment with more types of items differing only in the presence of an antepenultimate coda would be necessary.

Figure 13: Interstress durations of R (*–l/m/native*) and C.R (*–dl/dm/dnative*) forms
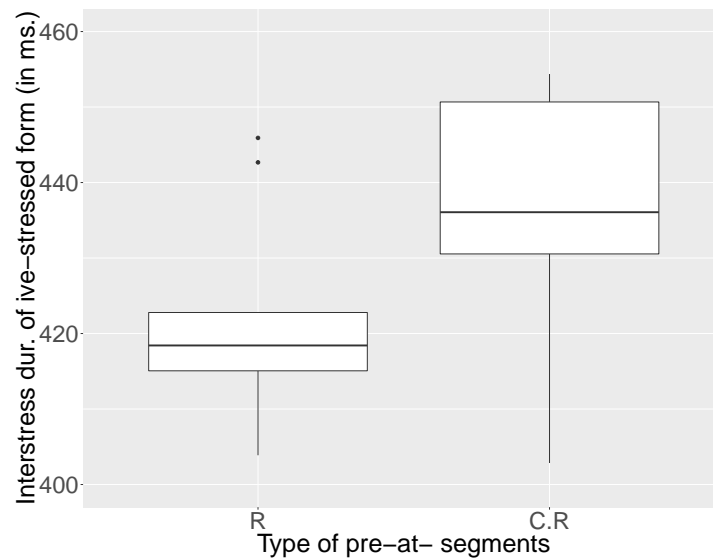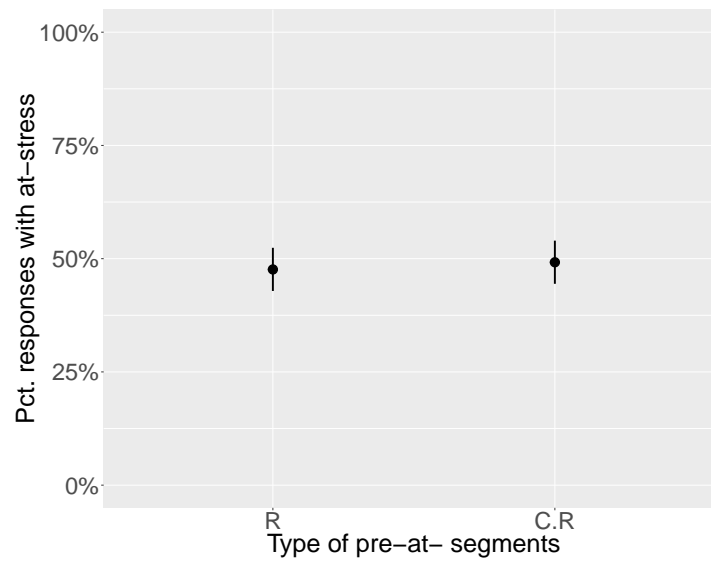

Figure 14: No significant differences between participant responses to R and C.R items

7 Discussion and conclusion

This article has tested two predictions of the hypothesis that *LAPSE is phonetically defined, within the domain of *–ative* forms. First, acoustic properties of forms ending in *–ative* should parallel the existing dictionary data, such that higher rates of *–at-* stress reported in the dictionary correlate with longer potential lapses; second, speakers should exhibit a preference for phonetically shorter lapses over phonetically longer ones. Results from the acoustic analysis of the stimuli, together with

statistically significant trends in the results of two nonce word forced-choice tasks, provide support for both predictions. This, in turn, concludes the argument that the Nanni effect is a symptom of a more general dispreference for phonetically longer lapses relative to shorter ones.

In this final section, I first discuss why the relatively obscure class of words ending in *–ative* is an ideal empirical basis for a study on phonetic *LAPSE. Following this, I show that most of the accentual and segmental trends in *–ative* are mirrored in *–ization*; this discovery provides further support for the claim that the constraints responsible for the Nanni effect are entirely general. Finally, I briefly discuss some implications of these findings for theories of stress.

7.1   Why *–ative*?

If phonetic *LAPSE is active in American English, why is it necessary to look at *–ative* forms to find evidence for it? In this section I first show that *–ative* is one of the few corners of English where phonetic and syllabic definitions of *LAPSE can be differentiated, as *–ative* forms are one of the only classes of forms in English in which lapses are both allowed and can be variably resolved. In addition, I argue that the relative infrequency of forms in *–ative* provides support for the notion that the factors regulating their stress are entirely general.

To review and expand on points from Sec. 2: in forms in *–ative*, two preferences conspire to create lapses. The first is a dispreference for shifting stress in the stem domain, such that *législative* must be produced as *législàtive* or *législatìve* (*legíslatìve*). I assume that this dispreference for shifted stress is due to a requirement for the stem of an *–ative* derivative to resemble the stem of its morphological base: thus the stem of *législative* must resemble that of *législation* and *législate*, while stress in the suffixal domain is governed by other constraints.[20] I formalize this dispreference against shifting stem stress as BASE-DERIVATIVE(stress)$_{stem}$ (abbreviated as BD-IDENT(stress)$_{stem}$); see Benua (1997) on transderivational correspondence constraints. To simplify the presentation, in (28) I assume a syllabic definition of *LAPSE.

(28)   Possible *LAPSE violation in *speculative*

legisl-ative Base: lègisl-át(ion) 20-1(0)		BD-IDENT(stress)$_{stem}$	STRESS$_{-ive}$	*LAPSE(syll)
☞ a. législ-àtive	10-20		*	
☸ b. législ-atìve	10-02			*
c. legísl-atìve	01-02	*!*		

Candidate (28c), with shifted stress relative to *lègislát(ion)*, is ruled out by BD-IDENT(stress)$_{stem}$: the initial stress of *législàt(ion)* has been removed, and a peninitial stress has been added. Candidate (28a), which violates STRESS$_{-ive}$, ties with candidate (28b), which violates *LAPSE(syll); the ultimate preference for *législàtive* is due to the fact that the stressless string preceding *–at-* is long.

Forms in *–ative* are not alone in allowing large numbers of lapses. Stanton & Steriade (in prep) show that, for those forms in *–able* that end in trochaic or dactylic bases (e.g. *challenge-able*, from *chállenge*), a large majority (375/393) permit *LAPSE violation in order to satisfy BD-IDENT(stress)$_{stem}$. *chállengeable*, for example, must resemble the related *chállenge* and in doing so violates *LAPSE twice. This indicates that BD-IDENT(stress)$_{stem}$ ≫ *LAPSE, as above.

---

[20]It is irrelevant here whether the morphological base of *legislative* is *legislate* or *legislation*, so I do not take a stand.

(29)   Possible *LAPSE violation in *speculative*

challenge-able Base: chállenge 10	BD-IDENT(stress)*stem*	*LAPSE(syll)
☞ a. chállenge-able 10-00		**
b. challénge-able 01-00	*!*	*

Forms ending in *–able* differs from those ending in *–ative* in that they typically does not resolve *LAPSE violations except under specific morphophonological circumstances. Take, for example, the case of *remédiable*, which takes its stress not from its likely morphological base *rémedy* but from the co-derivative *remédial* (Steriade 1999, Stanton & Steriade in prep). Here, the stress shift of *remédiable* relative to its base *rémedy* is plausibly licensed by the form *remédial*, and thus has no bearing on whether or not *LAPSE should be defined in phonetic or syllabic terms: the stress of *remédial* is preferable by either. Further support that the shift in *remédiable* is licensed by the related form *remédial* comes from the fact that stress shift in *–able* only arises when such a related form is available. *Medícinable*, for example, resembles not *médicine* but its co-derivative *medícinal*; *compániable* resembles not *cómpany* but its co-derivative *compánion*. For justification of assumptions regarding the identity of morphological bases and for analysis of this phenomenon, see Steriade (1999) and Stanton & Steriade (in prep). What matters here is that the circumstances under which *–able* allows lapses to be avoided are restricted, and in this sense, *–able* is very different from *–ative*.

The question arises as to why *–ative* and *–able* are different in this way: why can lapses be avoided in *–ative* (by stressing *–at-*, as in possible *spéculàtive*) but not in *–able*, as the impossible **chállengeàble* makes clear? I am not sure that there is a more insightful answer than the observation that *–able*, when word-final, never bears stress on either of its syllables (and thus whatever constraint requires *–able* to be stressless must dominate *LAPSE). Thus *–ative* is special in three ways. First, base-derivative faithfulness to stem stress is high-ranked, meaning that the conditions for lapse licensing (e.g. a trochee-final stem, like *législ–*) can be met. Second, STRESS*–ive* works to pull stress off *–at-*, creating a context where lapses are preferred. And third, *LAPSE can be resolved in these forms by stressing a suffix. These three factors work together to create a large class of forms in which lapses are sometimes licensed and sometimes resolved. This combination of factors is attested in only one other type of form that I am aware of (*–ization* forms, discussed in Sec. 7.2), making *–ative* one of the only corners of English in which the phonological conditions that make lapse licensing or resolution more likely can be investigated in a quantitatively robust way.

It is worth emphasizing that the relative obscurity of forms ending in *–ative* provides support for the hypothesis that the Nanni effect reveals something very general about the phonology of American English, and against an additional alternative hypothesis that the effect reflects a grammatical principle peculiar to *–ative*. Of the 548 *–ative* forms considered in this study, the mean OED frequency band is 2.8. As noted by the OED, forms in band 2 "occur fewer than 0.01 times per million words in typical modern English usage", and are "almost exclusively terms which are not part of normal discourse and would be unknown to most people". The rarity of *–ative* forms makes it unlikely that a typical English-acquiring child would be exposed to many of them (if any at all), a hypothesis that is supported by the complete absence of all *–ative* forms from the CHILDES Parental Corpus (MacWhinney 2000, Li & Shirai 2000). Given the probable lack of *–ative* forms from the typical child's input, the fact that we find the Nanni effect robustly attested in dictionary and behavioral data suggests that the factors governing stress on *–at-* must be general: the learner must be able to acquire the Nanni effect even with little or no information from *–ative*.

7.2 Beyond –*ative*: potential evidence from –*ization*

This section presents potential evidence for phonetic *LAPSE and *CLASH in –*ization* forms. As is true for –*at*- in –*ative*, stress on –*ize*- in –*ization* is variable: the OED transcribes *ruggedization* with and without –*ize*- stress (*rùggedìzátion* and *rùggedizátion*), *dogmatization* with –*ize*- stress (*dògmatìzátion*), and *migmatization* without it (*mìgmatizátion*). I show here that the rhythmic and segmental factors implicated in –*at(ive)* stress are implicated in –*iz(ation)* stress as well.

For this small study, I extracted 759 –*ization* forms from the OED. These include all –*ization* forms associated with a transcription, and a number of duplicates: in some cases there were multiple possibilities for stem stress in a given word (e.g. *notarization* can have trochaic [ˈnoʊdər–], or monosyllabic [ˈnoʊdr–]), so these instances were counted separately. In line with the counts that were done for –*ative*, –*ize*- is counted as "stressed" if it is consistently or variably stressed, and "stressless" if it is never stressed. Examples follow in (30), with transcriptions from the OED.

(30)   Categorization of forms into "stressed" and "stressless" –*ize*-

–*ize*- stressless	–*at*- stressed	
–*ize*- never stressed	–*ize*- variably stressed	–*ize*- consistently stressed
migmatization /ˌmɪgmədəˈzeɪʃ(ə)n/	*ruggedization* /ˌrəgəˌdaɪˈzeɪʃən/, /ˌrəgədəˈzeɪʃən/	*dogmatization* /ˌdɑgməˌtaɪˈzeɪʃən/

There is an overall preference for –*ize*- stress: it is stressed in 705/759 cases. I assume that this is due to the activity of some markedness constraint, which prefers stress to fall on –*ize*- (e.g. STRESS$_{-ize}$). The question investigated below is whether or not the distribution of the 54 forms in which –*ize*- does not bear stress can be predicted given rhythmic or segmental factors. The discussion in this section is largely speculative, as it does not include statistical models that take factors like lexical frequency into account, or any investigation into the phonetic properties of –*ization* forms.

7.2.1 Rhythmic factors

The suffix –*ation* invariably bears primary stress, so when –*ize*- is stressed in –*ization* forms, a violation of *CLASH always occurs. This discussion abstracts away from this instance of suffixal clash, as is it consistent across stress contexts, and focuses on the stress pattern of the stem.

The table in (31) subdivides –*ization* forms into two larger categories: those in which stressing –*ize*- would result in a clash with the stem (e.g. *Màoìzátion*, (31b)), and those in which it would not (e.g. *mòrphinìzátion*, (31a)). A comparison between these groups shows that –*ize*- stress is less likely if it would result in a stress clash with the stem ($p < .001$, Fisher's Exact Test). Among the forms in which –*ize*- stress does not result in a clash with the stem, there is another possible subdivision: those in which –*ize*- stress would avoid a violation of syllabic *LAPSE (as in *stìgmatìzátion*, (31a.i), where failure to stress –*ize*- would result in two adjacent stressless syllables), and those in which –*ize*- stress would avoid a violation of syllabic *EXTLAPSE (as in *kèratinìzátion*, (31a.ii), where there would be three). A comparison between these groups indicates that –*ize*- stress is significantly more likely if it results in *EXTLAPSE satisfaction ($p < .05$).

31

(31)   Rates of –ize- stressing by rhythmic context (all constraints are syllabically defined)

Result of stressing –ize-	–ize- stressed	–ize- stressless	% stressed
a. No clash with stem	651 (*mòrphinìzátion*)	25 (*vìrilizátion*)	96%
i. *LAPSE satisfied	461 (*stìgmatìzátion*)	23 (*macàdamizátion*)	95%
ii. *EXTLAPSE satisfied	190 (*kèratinìzátion*)	2 (*cùlturalizátion*)	99%
b. Clash with stem	54 (*Màoìzátion*)	29 (*fàscizátion*)	65%

Stress in *–ization* thus appears to be rhythmically conditioned in the same way as stress in *–ative*: the longer the potential lapse, the more likely the inner suffix is to bear stress. What differentiates the two cases is that in *–ization*, the outer suffix must bear stress as well.

7.2.2   Segmental factors

For an investigation of segmental factors, I focus first on those forms in which stressing *–ize-* would resolve a lapse (e.g. *mòrphinìzátion*). As is evident from (32), the identity of the pre-*ize-* consonants (i.e. the *n* in *mòrphinìzátion*) does not appear to play a role in the distribution of *–ize-* stress, as the rate of *–ize-* stress does not vary by segmental category (Fisher's Exact Test, $p > .1$).

(32)   Role of pre-stress segments in *–ize-* stress (OED)

Segment	Stressed –ize-	Stressless –ize-	% stressed	Total
Vowel	2, e.g. *Sàudiìzátion*	–	100%	2
Sonorant	319, e.g. *pìcturìzátion*	17, e.g. *perìpherizátion*	95%	336
Obstruent	123, e.g. *dràmatìzátion*	5, e.g. *pỳritizátion*	96%	128
Cluster	17, e.g. *sòuthern**ì**zátion*	1, e.g. *psychìatrizátion*	94%	18

The identity of the poststress consonants does, however, appear to play a role in *–ize-* stress. As shown in (33), the rate of *–ize-* stress varies by category ($p < .05$, Fisher's Exact Test), in roughly the direction we would expect given the phonetic lapse hypothesis: if the primary stress is followed by a cluster, for example (e.g. *nùclearìzátion*), *–ize-* is more likely to bear stress than if it is preceded by a sonorant (e.g. *màmmonizátion*). While further statistical modeling would be necessary to ensure that this apparent effect cannot be attributed to some other factor, this trend constitutes preliminary support that phonetic *LAPSE is also active in *–ization* forms.

(33)   Role of poststress segments in *–ize-* stress (OED)

Segment	Stressed –ize-	Stressless –ize-	% stressed	Total
Vowel	18, e.g. *ionìzátion*	3, e.g. *psychìatrizátion*	86%	21
Sonorant	116, e.g. *Hèllenìzátion*	10, e.g. *màmmonizátion*	92%	126
Obstruent	168, e.g. *àtomìzátion*	7, e.g. *macàdamizátion*	96%	175
Cluster	159, e.g. *nùclearìzátion*	3, e.g. *mìgmatizátion*	98%	162

Finally, I consider the role of the interstress consonants in forms where stressing *–ize-* would result in a clash with the stem (e.g. the *r* in *Màgyàrizátion*, or the *rx* in *Màrxízátion*). There appears to be a link between segmental identity and rate of *–ize-* stress: clash across a cluster, for example, is more frequent than clash across a sonorant. This trend is predicted by a phonetic definition of *CLASH: the longer the duration between the two stresses, the more acceptable the clash. The trend is not significant (*p* = .08, Fisher's Exact Test) however, likely due to the low number of forms overall.

(34) Role of interstress segments in *–ize-* stress (OED)

Segment	Stressed *–ize-*	Stressless *–ize-*	% stressed	Total
None	5, e.g. *Màoìzátion*	1, e.g. *Jùdàization*	83%	6
Sonorant	14, e.g. *Màgyàrizátion*	15, e.g. *pàrallèlizátion*	48%	29
Obstruent	18, e.g. *stàtizátion*	9, e.g. *fàscizátion*	67%	27
Cluster	17, e.g. *Màrxìzátion*	4, e.g. *sòlmizátion*	81%	21

In sum, evidence for segmental effects on stress in *–ization* is limited, but what evidence emerges here is consistent with the hypothesis that phonetic versions of *LAPSE and *CLASH are active. Furthermore, the existence of similar trends in *–ative* and *–ization* forms supports this article's claim that the Nanni effect reveals something very general about the grammar of stress in American English, and is not just an idiosyncratic property of *–ative* forms.

7.3 Conclusions

This article has argued, on the basis of patterns in words ending in *–ative* (and secondarily, *–ization*), that constraints regulating the distribution of prominence must be able to make reference to fine-grained durational information. But if the majority of evidence for phonetically-defined accentual constraints comes from rare Latinate forms, like the *–ative* and *–ization* cases discussed above, this result raises the question of how the English-learning child knows that phonetic versions of *LAPSE and *CLASH exist. While one possibility is that these constraints are universal, in the sense of Prince & Smolensky (2004), I believe the more likely possibility is that the evidence for phonetically-defined *LAPSE and *CLASH is more general than we have seen in this article, and that the learner applies to *–ative* and *–ization* forms what she has induced from more general facts about the distribution of lexical stress in English. Understanding exactly what these more general facts are is a topic I leave for future work.

Before closing, it is worth noting that the argument for phonetically-defined rhythmic constraints may have broader implications for theories of stress. Throughout this article I have tacitly assumed that English stress ought to be analyzed in a foot-free framework (e.g. Gordon 2002): the distribution of prominence is regulated by grid-based constraints like *LAPSE and *CLASH, not constraints that regulate the size and placement of metrical constituents. The evidence that *LAPSE (and perhaps *CLASH) is phonetically defined presents a problem for theories of stress that do not appeal to rhythmic constraints (e.g. Martínez-Paricio & Kager 2015) as it is not clear how the effect documented in this article – the positive correlation of *–at-* stress with interstress duration – could be captured in these theories. In short, the Nanni effect provides an argument that rhythmic constraints

must be able to reference fine-grained durational information, and potentially an argument for the inclusion of rhythmic constraints in theories of stress more generally.

Appendix: results of statistical models

Results of the statistical analysis for Task 1 (which manipulated the pre-*at-* segments) and Task 2 (which manipulated the poststress segments) are below. A summary of the fixed effects is in Table 3. Interstress duration (the predictor of interest) and its associated values are bolded. Significance codes can be interpreted as follows: . = $p < .1$, * = $p < .05$; ** = $p < .01$. A summary of the random effects follows in Table 4.

Table 3: Summary of fixed effects for Tasks 1 and 2

Factor	Task 1			Task 2		
	Coefficient	*z* value	Significant?	Coefficient	*z* value	Significant?
Intercept	-3.20	–	–	-4.99	–	–
Interstress duration	**8.60**	**2.80**	******	**8.36**	**2.48**	*****
Ending: *b*	-0.10	-0.40		-0.20	-0.55	
Ending: *d*	0.17	0.62		0.69	2.12	*
Ending: *dl*	-0.37	-1.29		-0.31	-0.79	
Ending: *dm*	-0.73	-2.53	*	-0.20	-0.53	
Ending: *dn*	-0.63	-2.14	*	-0.14	-0.35	
Ending: *f*	-0.81	-2.71	**	-0.18	-0.46	
Ending: *g*	0.36	1.26		0.21	0.61	
Ending: *k*	-0.08	-0.26		-0.22	-0.63	
Ending: *l*	-0.46	-1.57		0.49	1.44	
Ending: *m*	-0.49	-1.80	.	0.05	0.15	
Ending: *n*	-0.66	-2.43	*	0.29	0.87	
Ending: *p*	-0.17	-0.58		-0.04	-0.12	
Ending: *r*	-0.63	-2.23	*	0.26	0.77	
Ending: *s*	-0.21	-0.71		0.17	0.48	
Ending: *sk*	0.72	2.02	*	-0.56	-1.35	
Ending: *skl*	-0.29	-0.83		-0.85	-1.56	
Ending: *sp*	-0.34	-1.04		-0.38	-0.89	
Ending: *spr*	-0.03	-0.08		-0.38	-0.79	
Ending: *z*	0.04	0.14		0.25	0.76	

Table 4: Summary of random effects for Tasks 1 and 2

Groups	Name	Task 1			Task 2		
		Variance	Std. Dev.	Corr.	Variance	Std. Dev.	Corr.
Item	(Intercept)	0.00	0.00		0.00	0.00	
Participant	(Intercept)	8.00	2.83		10.85	3.29	
	Interstress duration	30.51	5.52	-0.85	20.07	4.48	-0.74

References

2017. OED Online. Oxford University Press. Online resource (accessed July 2017).

Alber, Birgit. 2005. Clash, lapse and directionality. *Natural Language and Linguistic Theory* 23. 485–542.

Bates, Douglas, Martin Maechler, Ben Bolker & Steve Walker. 2015. Fitting Linear Mixed-Effects Models Using lme4. *Journal of Statistical Software* 67. 1–48.

Becker, Michael & Jonathan Levine. 2013. Experigen – an online experiment platform. Available at http://becker.phonologist.org/experigen.

Benua, Laura. 1997. *Transderivational Identity: Phonological Relations Between Words*. Amherst, MA: UMass Amherst dissertation.

Boersma, Paul & David Weenink. 2017. Praat: doing phonetics by computer [computer program]. version 6.0.31. http://www.praat.org.

Corretge, Ramon. 2012. Praat Vocal toolkit: a Praat plugin with automated scripts for voice processing. http://www.praatvocaltoolkit.com/index.html.

Davis, Stuart. 1988. Syllable onsets as a factor in stress rules. *Phonology* 5. 1–19.

Elenbaas, Nine & René Kager. 1999. Ternary rhythm and the lapse constraint. *Phonology* 16. 273–329.

Esposito, Anna & Hubert Truckenbrodt. 1998. A Note on Raddoppiamento Sintattico and the Phonological Phrase in Italian. Ms., International Institute for Advanced Scientific Studies and Rutgers University.

Fox, John. 2003. Effects Displays in R for Generalised Linear Models. *Journal of Statistical Software* 8. 1–27.

Fox, John & Sandford Weisberg. 2018. Visualizing Fit and Lack of Fit in Complex Regression Models with Predictor Effect Plots and Partial Residuals. *Journal of Statistical Software* 87. 1–27.

Garcia, Guilherme D. 2017. Weight gradience and stress in Portuguese. *Phonology* 41–79.

Gordon, Matt. 2002. A factorial typology of quantity insensitive stress. *Natural Language and Linguistic Theory* 20. 491–552.

Gordon, Matthew. 2005. A perceptually-driven account of onset-sensitive stress. *Natural Language and Linguistic Theory* 23. 595–653.

Gouskova, Maria & Kevin Roon. 2013. Gradient clash, faithfulness, and sonority sequencing effects in Russian compound stress. *Laboratory Phonology* 4. 383–434.

Green, Thomas & Michael Kenstowicz. 1995. The Lapse Constraint. Ms., MIT. ROA-101, Rutgers Optimality Archive.

Hayes, Bruce. 1984. The phonology of rhythm in english. *Linguistic Inquiry* 15(1). 33–74.

Hayes, Bruce, Colin Wlson & Ben George. 2009. Maxent grammar tool. Software package.

Hothorn, Torsten, Frank Bretz & Peter Westfall. 2008. Simultaneous Inference in General Parametric Models. *Biometrical Journal* 50. 346–363.

Kager, René. 1994. Ternary rhythm in alginment theory. Ms., Utrecht University.

Kenyon, John Samuel & Thomas Albert Knott. 1944. *A Pronouncing Dictionary of American English*. Springfield, Massachusetts: Merriam.

Kuznetsova, Alexandra, Per B. Brokhoff & Rune H. B. Christensen. 2017. lmerTest Package: Tests in Linear Mixed Effects Models. *Journal of Statistical Software* 82. 1–26.

Li, Ping & Yaushiro Shirai. 2000. *The acquisition of lexical and grammatical aspect*. Berlin & New York: Mouton de Gruyter.

Liberman, Mark & Alan Prince. 1977. On Stress and Linguistic Rhythm. *Linguistic Inquiry* 8. 249–336.

MacWhinney, Brian. 2000. *The CHILDES project (3rd Edition)*. Mahwah, NJ: Lawrence Erlbaum.

Marotta, Giovanna. 1983. Rhythmical constraints on "Syntactic Doubling". *Journal of Italian Linguistics* 8. 35–52.

Martínez-Paricio, Violeta & René Kager. 2015. The binary-to-ternary rhythmic continuum in stress typology: layered feet and non-intervention constraints. *Phonology* 32.

McCarthy, John J. 2008. The serial interaction of stress and syncope. *Natural Language and Linguistic Theory* 26. 499–546.

Nanni, Debbie L. 1977. Stressing Words in -Ative. *Linguistic Inquiry* 8. 752–763.

Nespor, Marina & Irene Vogel. 1989. On clashes and lapses. *Phonology* 6. 69–116.

Payne, David L. 1990. Accent in Aguaruna. In Doris L. Payne (ed.), *Amazonian linguistics: Studies in lowland South American languages*, 185–212. Austin, TX: University of Texas Press.

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

Prince, Alan S. 1983. Relating to the grid. *Linguistic Inquiry* 14(1). 19–100.

Ryan, Kevin M. 2014. Onsets contribute to syllable weight: Statistical evidence from stress and meter. *Language* 90. 309–341.

Stanton, Juliet. to appear. Stress in *–ative* and the Role of Pre-*at-* Segments: Evidence from Dictionary Studies. In *Proceedings of the 36th West Coast Conference on Formal Linguistics*, Cascadilla Proceedings Project.

Stanton, Juliet & Donca Steriade. in prep. Stress and the cycle, in English and elsewhere. Ms., NYU and MIT.

Steriade, Donca. 1999. Lexical Conservatism. In *Linguistics in the Morning Calm, Selected Papers from SICOL 1997*, 157–179. Linguistic Society of Korea, Hanshin Publishing House.

Steriade, Donca. 2012. Intervals vs. syllables as units of linguistic rhythm. Handouts, EALING, Paris.

Treiman, Rebecca & Catalina Danis. 1988. Syllabification of intervocalic consonants. *Journal of Memory and Language* 27. 87–104.

Zuraw, Kie. 2000. *Patterned Exceptions in Phonology*. Los Angeles: University of California dissertation.