

Phonetic lapse in American English *-ative**

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Abstract

This paper 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 preceded by a vowel or a sonorant (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 a nonce word rating task support this proposal.

1 Introduction

The empirical focus of this paper 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, *-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, *-at-* is stressless
iterative, cumulative, palliative
 - b. If preceded by an obstruent or a cluster, *-at-* bears a secondary stress
investigative, elucidative, administrative

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 paper 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 (e.g. Kenyon & Knott 1944:31). I argue that the existence of the Nanni effect should be viewed as

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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 a rating study of nonce *-ative* forms that support this hypothesis, and pose a challenge for any alternative analysis of the Nanni effect that appeals to the sonority 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 metrical structure more generally.

1.1 Syllabic and phonetic *LAPSE

The theoretical interest of this paper 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 prominences 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
 σ_1 σ_2 σ_3 σ_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, under which the number of assigned violations depends on total phonetic duration: the longer the stressless string, the more violations assigned. The definition of phonetic *LAPSE adopted here (in (4)) assumes that *LAPSE takes into account the raw phonetic duration of a stressless string, and assigns a violation for each millisecond in that string (see Sec. 1.2 for further discussion). As shown in (5), phonetic *LAPSE would identify two stressless strings in *àbracadábra*, δ_1 (*bracad*) and δ_2 (*bra*), and assign more violations to the longer δ_1 .¹

(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
 δ_1 δ_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 stress assignment phenomena. Under a syllabic definition of *LAPSE, the contents of the stressless string should not matter: all stressless strings 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 equal violations of syllabic *LAPSE, the longer interstress interval in *àbraskladábra* is penalized more severely by phonetic *LAPSE.

¹Left unchecked, this phonetic definition of *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 e.g. Payne 1990, McCarthy 2008 on Awajún (Aguaruna).

- (6) Syllabic *LAPSE: content of the stressless material should not matter
 à. bra. ca. dá. bra à. bra. skla. dá. bra
 σ_1 σ_2 σ_3 σ_4 σ_5 σ_1 σ_2 σ_3 σ_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 b r a c a d á b r a à b r a s k l a d á b r a
 δ_1 δ_2 δ_3 δ_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, as in (2), we would not expect lapse resolution phenomena to be sensitive to the duration of a potential stressless string, as all lapses that comprise a given number of syllables should be 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 potential 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 the phonetic definition of *LAPSE.

1.2 Prior work, scope of the paper

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 whiskey* is more likely than retraction in *Korbél tequila*, which is more likely than retraction in *Korbél champágne*. *Korbél tequila* 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 tequila*, 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, discussed further in Sec. 5.2.2). 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 (1989) 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 general finding that the acceptability of a stress clash or lapse is impacted by speech rate lends credence to the first clause of Hayes’s hypothesis: the factors governing rhythmic alternation make reference to physical time, not to more abstract durational properties of segments or sequences of segments, independent of the rate at which they are produced. The results presented in this paper,

too, are consistent with this hypothesis: as discussed in Sec. 4–5, the position of a consonant with respect to stress influences its duration, and these small, phonetically predictable differences in duration affect the rate at which *–at–* bears stress across different contexts. While it is not shown in this paper that speech rate plays a role in the production and acceptability of *–ative* forms, the hypothesis – if the formulation of phonetic *LAPSE in (4) is correct – is that it should.

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 fairly common to assume that what I have referred to as syllabic *LAPSE should actually 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 violations of *LAPSE (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 or should be recast in terms of gradient, phonetically defined *LAPSE and *CLASH is not a question I address here. Similarly, for this paper I assume that *LAPSE and *CLASH come in syllabically- and phonetically-defined 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 investigate. Rather, the primary focus of this paper is to demonstrate that phonetically-defined *LAPSE provides us with one potential answer to the question of where the Nanni effect comes from: in other words, 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 numerous predictions regarding crosslinguistic patterns of stress assignment, these broader topics are left for future work.

1.3 Roadmap

Most of this paper focuses on supporting the claim that stress in *–ative* depends on segmental factors and showing that the observed effects can be explained under the assumption that *LAPSE is phonetically defined. As such: Sec. 2 provides preliminary information on stress in *–ative* forms, and Sec. 3 discusses the results of a dictionary study that confirms the role of segmental information in *–at–* stress. Sec. 4 lays out the hypothesis and explores some predictions. Sec. 5 presents the results of a nonce *–ative* word rating task, showing that speakers of American English prefer *–ative* forms with shorter lapses to those with longer lapses, and that these preferences align with the results from the dictionary study. Sec. 6 discusses an alternative, and Sec. 7 provides concluding discussion.

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 *deprecativ*e and *mutilativ*e, but as stressless in *speculativ*e and *adequativ*e. Before addressing this variability directly, it is first necessary to review some 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, 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 *-ative*), but not on both (so **-àtive*). I assume that the preference to stress *-ive* is implemented as the suffix-specific markedness constraint *STRESS_{-ive}* (8), and 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
<i>stem</i>	<i>suffix</i>	<i>stem</i>	<i>suffix</i>

The location of stress within the stem domain is generally predictable from a combination of phonological and morphological factors (e.g. Nanni 1977, Stanton & Steriade in prep), but these considerations are not relevant here, and for the purposes of this paper 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. *affirmative*, but **affirmàtive*; if the pre-*-ative* vowel does not carry stress, *-at-* can, but does not always carry stress (compare e.g. *législàtive*, where *-at-* is typically stressed, to *spéculàtive*, 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)* \gg *STRESS_{-ive}*, but the fact that *spéculàtive* (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.²

²Does 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. Half of the 20 speakers surveyed flap /t/ before *-ive* in all contexts, suggesting that *-ive* never bears stress. The rest of the speakers flap /t/ before *-ive* in words like *législàtive* but aspirate /t/ in words like *affirmative*. If we assume that the presence of word-internal aspiration diagnoses stress on a following vowel, only this second group of speakers exhibits a preference to stress *-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 consistently do not stress *-ive*, only requires swapping out *STRESS_{-ive}* for *EXTENDEDNONFINALITY* (= no stress on the final two syllables). For speakers that stress *-ive*, the variation between *spéculàtive* (1002) and *législàtive* (1020) diagnoses a conflict between **LAPSE* and *STRESS_{-ive}*; for speakers that don't, the variation between *spéculàtive* (1000) and *législàtive* (1020) diagnoses a conflict between **LAPSE* and *EXTENDEDNONFINALITY*. Crucially, in both groups, *-at-* stressing can be seen as a lapse resolution strategy.

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

	législative		*CLASH(syll)	*LAPSE(syll)	STRESS _{-ive}
☞	a. législat ^{ve} ive	1020			*
●	b. législat ^{ve} ive	1002		*	
	c. législat ^{ve} ive	1022	*!		
	spéculative				
●	a. spéculat ^{ve} ive	1020			*
☞	b. spéculat ^{ve} ive	1002		*	
	c. spéculat ^{ve} ive	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 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).³ The corpus of *-ative* forms collected from the OED included all non-obsolete forms in the dictionary as of July 2017 that were associated with both an IPA transcription and frequency information. In total, 548 *-ative* forms satisfied these criteria. The suffix *-at-* is counted as “stressed” if the vowel is transcribed as an [eɪ], variably or invariably; it is counted as “stressless” if the vowel is always transcribed as [ə]. (Transcriptions for the examples in (12) are from the OED.)

(12) Categorization of forms into “stressed” and “stressless” *-at-*

<i>-at-</i> stressless	<i>-at-</i> stressed	
<i>-at-</i> never stressed	<i>-at-</i> variably stressed	<i>-at-</i> consistently stressed
<i>mollificative</i> /mə'ɫɪfəkədɪv/	<i>communicative</i> /kə'mjʊnə'keɪdɪv/, /kə'mjʊnəkədɪv/	<i>motivative</i> /'mouɪdə'veɪdɪv/

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

³One 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 paper 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 *òrnàtive* and *incùlpàtive*, *-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 *législative* contains two stressless syllables), and those in which *-at-* stress results in syllabic *EXTLAPSE satisfaction (as in *amélioràtive*, where the alternative *améliorative* 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) ($p = .24$), or the consistently stressless cases (*LAPSE = 180/334 stressed; *EXTLAPSE = 9/10 stressed; $p < .01$), but the asymmetry is any case clear.⁴

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

Result of stressing <i>-at-</i>	<i>-at-</i> stressed	<i>-at-</i> stressless	% stressed
a. *CLASH satisfied	238, e.g. <i>législàtive</i>	106, e.g. <i>spéculàtive</i>	69%
i. *LAPSE satisfied	229, e.g. <i>législàtive</i>	105, e.g. <i>spéculàtive</i>	69%
ii. *EXTLAPSE satisfied	9, e.g. <i>amélioràtive</i>	1, <i>detérioràtive</i>	90%
b. *CLASH violation	15, e.g. <i>òrnàtive</i>	216, e.g. <i>quótàtive</i>	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. 5.2.2.)

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. *deprecativè*), *-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).

⁴The 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 <i>-at-</i>	Stressless <i>-at-</i>	% stressed	Total
Vowel	22, e.g. <i>annunciative</i> (010-20)	22, e.g. <i>enunciative</i> (210-02)	50%	44
Sonorant	88, e.g. <i>mutilative</i> (10-20)	64, e.g. <i>speculative</i> (10-02)	58%	152
Obstruent	92, e.g. <i>deprecative</i> (10-20)	18, e.g. <i>dubitative</i> (10-02)	84%	110
Cluster	27, e.g. <i>legislative</i> (10-20)	1, e.g. <i>adequative</i> (10-02)	96%	28

The correlation between pre-*-at-* segment identity and rate of *-at-* stress is statistically significant ($p < .001$, Fisher’s Exact Test). To ensure that this effect 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 so as 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 at the end of this discussion.)

- **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).⁵ This information is included so as 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 the existence of 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 $\geq |2|$), as assessed by the

⁵The 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/>.

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 ($\chi^2(3) = 3.28, p = .35$), 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	<i>z</i> 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 in (15), 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). A summary of results is in (16); positive estimates indicate that the second member of the comparison has a higher rate of *-at-* stress.

(16) Summary of pairwise comparisons

Comparison	Estimate	<i>z</i> value	Significant?
Vowel-Sonorant	0.32	0.93	No ($p = .77$)
Vowel-Obstruent	1.63	4.11	Yes ($p < .001$)
Vowel-Cluster	3.30	3.11	Yes ($p < .01$)
Sonorant-Obstruent	1.31	4.30	Yes ($p < .001$)
Sonorant-Cluster	3.00	2.89	Yes ($p < .05$)
Obstruent-Cluster	1.66	1.59	No ($p = .36$)

These results suggest that the main effect in (15) is driven by the sonorant-obstruent comparison, as neither the vowel-sonorant nor the obstruent-cluster comparisons are significant. It is worth keeping in mind though 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 very well 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

In addition to confirming Nanni’s claims regarding rhythmic and segmental influences on *-at-* stress, the present findings also suggest that *-at-* stress is more variable and potentially 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? 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).

4 Hypothesis and extensions

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) (17).

- (17) Different lapse lengths in –ative forms (lapse is underlined)
- a. \acute{V} C₀V –ative shortest lapse
 - b. \acute{V} C₀VR –ative shorter lapse
 - c. \acute{V} C₀VO –ative longer lapse
 - d. \acute{V} C₀VCC –ative 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 *législative*, were –at- stressless, would be longer than the lapse that would result in *méditative*. Note that under this hypothesis, the rhythmic and segmental effects in Sec. 3 have the same source: the longer the stressless string that precedes –at-, the more likely –at- is to bear stress. In other words, stress on –at- is entirely conditioned by rhythmic factors; 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 (C₀, in (17)) ought to also 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 this is correct, 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 (18), there is a recognizable trend, but with a twist: the relative ordering of the sonorant and obstruent groups has reversed.

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

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

As we know that the identity of the pre-*at*- segments is a predictor of *-at*- stress, any assessment of whether or not the poststress segments also play a role must take the pre-*at*- segments into account. To do this, I fit a logistic regression to the forms in (18), with predictors for the identity of the pre-*at*- and poststress segments (pre-*at*- was coded as V=0, R=1, O=2, CC=3; poststress was coded as V=0, O=1, R=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 ($\chi^2(3) = 3.68, p = .30$). However, likelihood ratio tests indicate that a model including predictors for consonants in both positions is a better fit to the data than one that includes only a predictor for the pre-*at*- or the poststress consonants (respectively: $\chi^2(1) = 5.41, p < .05$; $\chi^2(1) = 36.40, p < .001$). Results of a model including these two predictors are summarized in (19).⁶

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

	Estimate	z value	Significant?
Intercept	-1.08	-	-
Pre- <i>at</i> - (V/R/O/CC)	0.97	5.55	Yes ($p < .001$)
Poststress (V/O/R/CC)	0.33	2.30	Yes ($p < .05$)

These results indicate that the identity of poststress segments, like the identity of the pre-*at*- segments, plays a role in governing the rate of *-at*- stress. Crucially, the two are independent: the effect of poststress segments cannot be reduced to the effect of pre-*at*- segments, or vice versa. This, in turn, lends support to the hypothesis that it is properties of the entire lapsed string that determine whether or not *-at*- bears stress, and not just the identity of the pre-*at*- segment(s) (as claimed by Nanni 1977; see also discussion in Sec. 6).

Why, though, might sonorants and obstruents behave differently according to whether they are post-stress or pre-*at*-? One possibility is that the relative average duration of sonorants and obstruents depends on their position within the string. Perhaps it is the case that, in between two stressless vowels (i.e. VxV , where x stands for a consonant), obstruents are on average longer than sonorants, but post-tonically (i.e. in $\acute{V}xV$, where x again stands for a consonant), sonorants are on average longer than obstruents. While to the best of my knowledge there is no evidence that this hypothesis in its full form is correct, Warner & Tucker (2011) show that American English stops are on average longer in inter-unstressed position (or VxV) than they are in post-stress position (or $\acute{V}xV$); see also Zue & Laferriere (1979) for the same observation regarding the alveolar series. Further evidence consistent with post-tonic obstruent shortening (and post-tonic sonorant lengthening) is in Sec. 5.1.

The hypothesis advanced in this section makes a number of further predictions; the next section focuses on two. First, if trends in the dictionary data are representative of native speaker judgments, we would 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 that contain a pre-*at*- obstruent (all else being equal). 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 that both of these predictions are correct.

⁶Post-hoc Tukey HSD tests on an alternative model in which the poststress predictor is coded as a categorical variable reveals no significant differences among the individual categories. This relative lack of differentiation among the categories could be an indication that segments immediately following a primary stress are more similar in duration than those in other contexts (e.g. between two stressless syllables), though more work is needed to verify this.

5 Rating study

To probe the predictions above, I designed a nonce-word rating task. 200 nonce *-ative* forms were recorded by a native speaker of American English, and the majority of these forms were presented as a rating task to 50 native American English speaking participants. Acoustic analysis of the stimuli shows that the phonetic properties of the nonce *-ative* forms are roughly as expected, given the hypothesis under consideration and the trends in the dictionary data; results from the rating study show that American English speakers prefer *-ative* forms with phonetically shorter lapses to those with phonetically longer lapses. The stimuli and their acoustic properties are discussed in more detail in Sec. 5.1, and the rating study is discussed in Sec. 5.2. Sec. 5.3 provides a short summary.

5.1 Stimuli and their acoustic properties

The nonce *-ative* forms used in this study were composed of one of five “stems” (20), and one of twenty “endings” (21). Four of the stems were trochaic, and one was iambic; the iambic forms were used as an attention check in the rating study, as discussed further in Sec. 4.2. The twenty endings included bare *-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 100 forms.

(20) Nonce <i>-ative</i> “stems”		
Type	Stem (orthography)	Stem (IPA)
Trochaic	<i>demi</i>	[ˈdɛmə] (before a consonant), [ˈdɛmi] (before a vowel)
	<i>figi</i>	[ˈfɪgə] (before a consonant), [ˈfɪgi] (before a vowel)
	<i>sacki</i>	[ˈsækə] (before a consonant), [ˈsæki] (before a vowel)
	<i>sobi</i>	[ˈsɒbə] (before a consonant), [ˈsɒbi] (before a vowel)
Iambic	<i>pino</i>	[pʰəˈnoʊ]

(21) Nonce <i>-ative</i> “endings”	
Type	Ending
None (V)	<i>-ative</i>
Sonorant (R)	<i>-rative</i> , <i>-lative</i> , <i>-native</i> , <i>-mative</i>
Obstruent (O)	<i>-bative</i> , <i>-dative</i> , <i>-gative</i> , <i>-pative</i> , <i>-kative</i> , <i>-fative</i> , <i>-sative</i> , <i>-zative</i>
Cluster (CC)	<i>-klative</i> , <i>-prative</i> , <i>-sklative</i> , <i>-sprative</i> , <i>-dlative</i> , <i>-dmative</i> , <i>-dnative</i>

Two versions of each form, one with *-at-* stressed ([eɪɪv]~[eɪɪv̩]) and one with *-at-* stressless ([ətʰɪv]) were recorded by a native speaker of American English. Each *-ative* form was produced in the frame *a X-ative paper*. Recordings were made on a Marantz PMD660 recorder and an Audio Technica ATM-75 head-mounted microphone, in a soundproof booth at New York University.

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 *sóbimàtive*, the interstress duration comprises the total durations of /b/ through /m/ (Fig. 1); in *sóbimative*, the interstress duration comprises the total durations of /b/ through the end of /t/’s aspiration (Fig. 2). Inspection of these interstress durations revealed several generalizations. First, the identity of the pre-*at-* material has the expected effect on overall lapse duration in stressless *-at-* forms: on average, lapses with a pre-*at-* cluster are longer than lapses with a pre-*at-* obstruent, which are longer than lapses with a pre-*at-* sonorant or vowel (Fig. 3).

Figure 1: Interstress interval in *sóbimàtive*

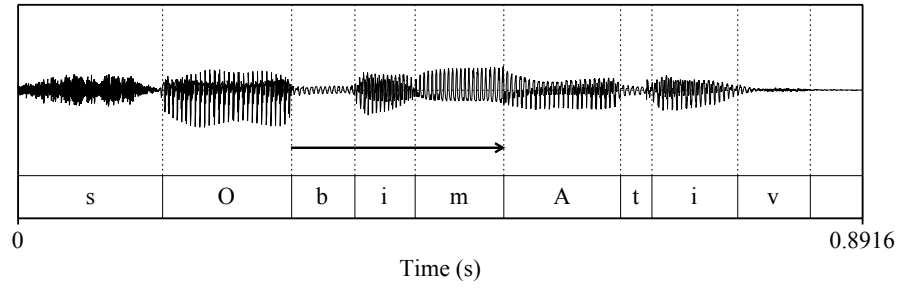


Figure 2: Interstress interval in *sóbimàtive*

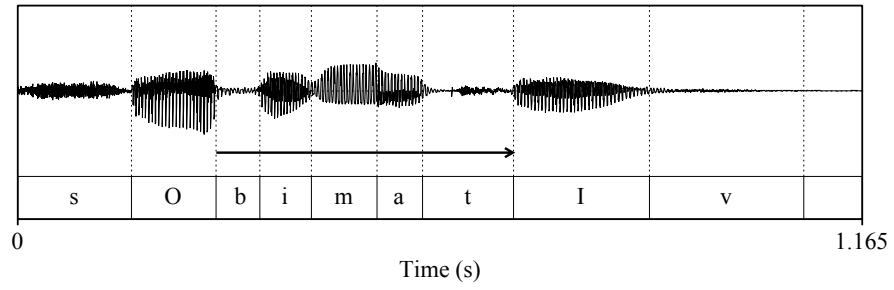
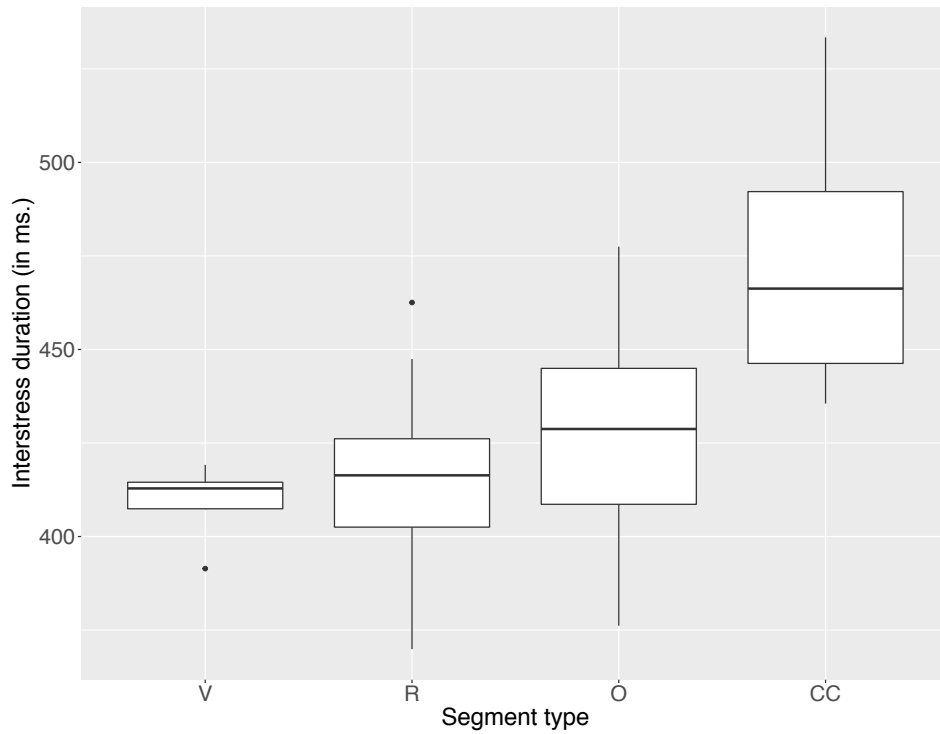


Figure 3: Duration of lapse in stressless *-ative* form by pre-*at-* segment category



These findings line up with the dictionary data in the way predicted by the hypothesis. It is thus plausible to think that *-CCative* forms bear stress at higher rates than *-Oative* forms, and *-Oative* forms at higher rates than *-Rative* and *-ative* forms, because the length of the potential lapse decreases across these categories. (The phonetic data do not suggest a difference in lapse length between *-ative* and *-Rative* forms; recall though that this pairwise comparison was not significant in the dictionary data, so this result is not entirely unexpected.) While Fig. 3 suggests that there is considerable variability in the durations of the various members of these categories – voiced stops, for example, are as a class 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 the result of interest. A linear regression with interstress duration as the dependent variable and segment type coded as a continuous predictor (V=0, R=1, O=2, CC=3) indicates that this correlation is significant ($p < .001$).⁷

Recall that not only the identity of the pre-*at-* segments influences the rate of *-at-* stress: the identity of the post-stress segments matters too. The dictionary data, however, suggests that the post-stress consonants' contribution is slightly different than that of the pre-*at-* consonants': while lapses with a pre-*at-* obstruent lead to increased rates of *-at-* stress compared to lapses with a pre-*at-* sonorant, lapses with a post-stress obstruent lead to decreased rates of *-at-* stress compared to lapses with a post-stress sonorant. The prediction of the current hypothesis, then, is that lapses with a post-stress sonorant ought to be longer than lapses with a post-stress obstruent, all else equal.

The fact that the stimuli included only four trochaic stems mean that this prediction is difficult to test in a systematic way. However: *sobi-*, *figi-*, and *sacki-* have a post-stress obstruent and *demi-* has a post-stress sonorant, so a more limited test is possible. To see if the prediction regarding the role of post-stress consonants was borne out, I considered only those forms that ended in *-bative*, *-gative*, *-kative*, and *-mative* (so as to restrict the comparison class to those sounds included as both pre-*at-* and post-stress segments). When categorized by the sonority of the pre-*at-* consonant, [m]-containing lapses and [b,g,k]-containing lapses are fairly comparable in duration (Fig. 4a). When categorized by the sonority of the post-stress consonant, however, the [m]-containing lapses are much longer than the [b,g,k]-containing lapses (Fig. 4b). The comparison between these two figures lends further credence to the hypothesis that the contribution of a given segment to the overall duration of a lapse depends in part on its position relative to stress, and to the more specific hypothesis that post-stress obstruents are shortened (and post-stress sonorants are lengthened).

In sum, acoustic analysis of these nonce *-ative* forms reveals that the broad trends discovered in the dictionary study are 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.

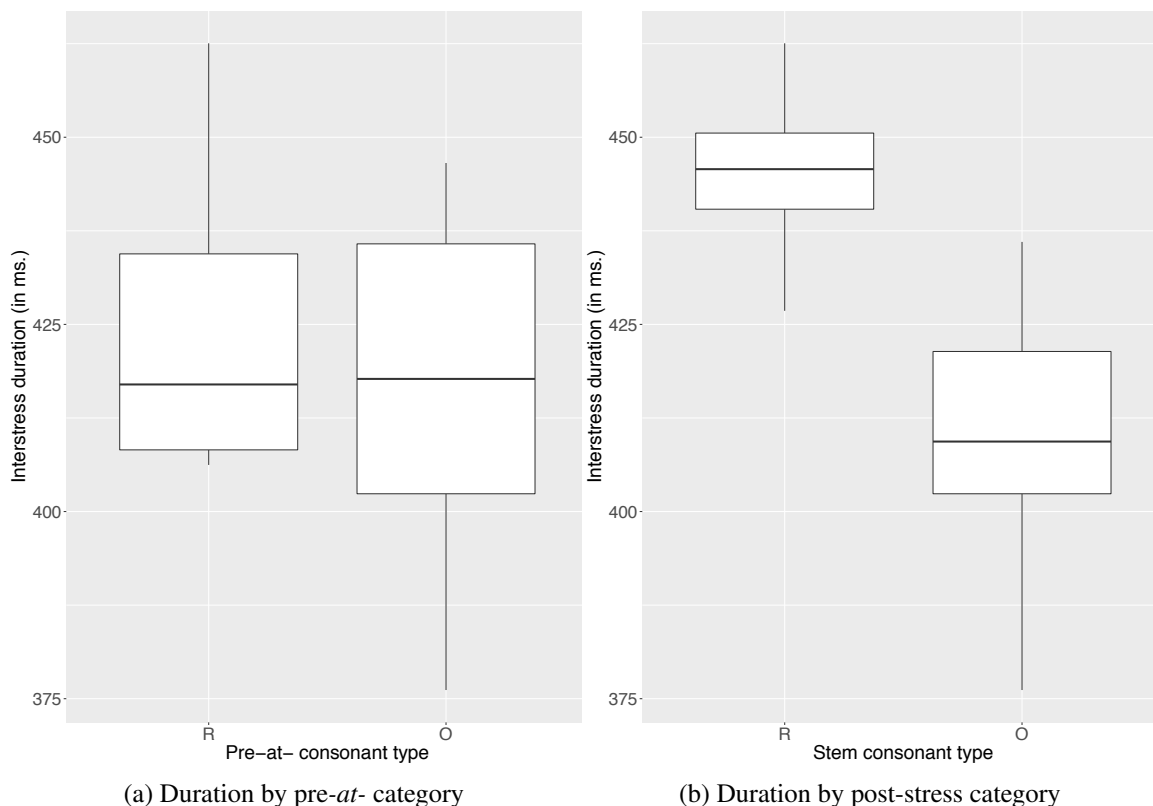
5.2 Rating study

The next step in testing the current hypothesis is to see if American English speakers are sensitive to differences in lapse duration, and if they prefer phonetically shorter lapses to longer ones. This subsection describes results from an online rating study showing that this is in fact the case.

The following changes were made to the recordings described above to create experimental stimuli. 20 of the recordings were not used: these included 18 *-ative* forms with local repetition of identical consonants (like *sobibative*), and one pair of forms that were not segmentally matched due to speaker error. Stimuli were normalized for amplitude and monotonized to 130.81 Hz (using Praat

⁷Post-hoc Tukey HSD tests on an alternative model, in which segment type is coded as a categorical predictor, find significant pairwise differences between the CC category and the others, all at $p < .001$, but not elsewhere.

Figure 4: Contribution of pre-*at*- R and O vs. contribution of post-stress R and O



Vocal Toolkit, Corrette 2012); this was done in part to remove differences in amplitude and intonation among the recordings, and in part to make the recordings sound synthesized. As participants were told that they were helping researchers develop speech synthesis software that can produce complicated English words in a natural way, this modification also made the task more plausible.⁸ The resulting stimuli are available on the author’s website, as supplemental materials to the paper.

The survey was constructed with TurkTools (Kotek & Erlewine 2016), and fifty participants 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. The geographical restriction was imposed in an effort to limit the participant pool to native speakers of American English; the latter two restrictions were imposed in an attempt to reduce the amount of noise in the data. Each participant was presented with 90 audio recordings, together with the nonce word’s orthographic representation (e.g. *sackigative*, *sackilative*). The order of presentation was randomized by participant, and no participants heard any minimal pairs: a participant who heard *sóbigàtive*, for example, did not hear *sóbigative*. Participants were asked to assign each recording a score, from 1 (least natural) to 7 (most natural), and were compensated \$1.80 for their time.

⁸Stress in English is in part cued by pitch, meaning that monotonization of the recordings removed one potential cue to stress. Durational information was still readily available, however, and appears to be sufficient to cue the presence of stress: I verified with an American English speaker that the location of main stress and the stressed vs. stressless character of *-at-* were recoverable in the stimuli. (For an overview of cues to stress in English and elsewhere see Hayes 1995:5-8.)

When deciding whether or not to include the responses from each participant, I attempted to verify that they were a native speaker of American English, and that they were attending to differences in stress in the stimuli. A failure to meet either one of these criteria meant that the participant's responses were excluded from the analysis. In total, responses from 17 participants were excluded.

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

The survey included three demographic questions, following the presentation of all stimuli: “Are you a native speaker of English?”, “Did you grow up in the US?”, and “Do you currently live in the US?”. An answer “no” to any of these three questions would have disqualified the participant. All 50 participants answered “yes” to all three questions, meaning that no participants were excluded on these grounds. (In addition, 9 participants reported speaking another language.)

- ***Was the participant attending to differences in stress in the stimuli?***

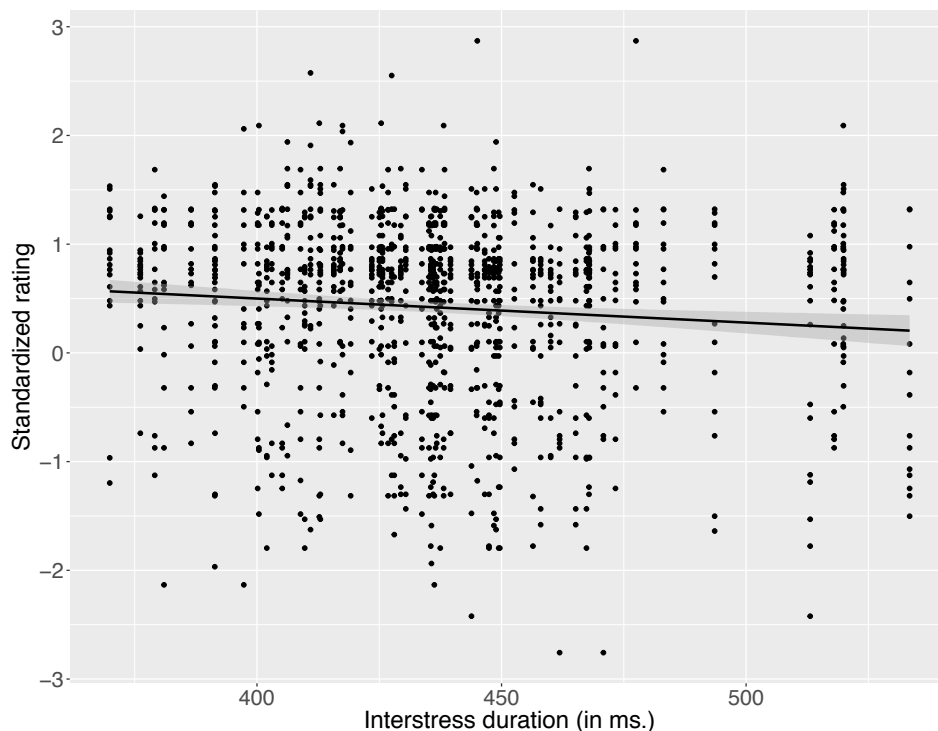
The iambic stems were included in the rating task as a way to determine, independent of the question of interest, whether or not the participant was attending to accentual properties of the stimuli. Recordings with iambic stems came in two types: those with a clash (e.g. *pinóbative*) and those with perfect alternation (e.g. *pinóbative*). If a participant did not rate the forms with perfect alternation significantly higher than forms with a clash (as assessed with a linear regression), their responses were not included in the analysis. English exhibits a marked dispreference for stress clashes, so a failure by a native English-speaking participant to make this distinction likely indicates that either the participant did not listen to the recordings (as stress was not recoverable from the orthographic representations), or that the participant was attending to other, non-accentual properties of the stimuli (whatever those may have been). The interest of this study is in how participants react to differences in lapse length, so responses from participants who failed this check are potentially uninformative. In total, 17 participants were excluded on these grounds.⁹

Responses from the remaining 33 participants were z-scaled, so as to neutralize participant-specific uses of rating scales (e.g. some participants assigned most forms a lower rating, where as some participants assigned most forms a higher rating). Fig. 5 plots the interstress duration against the standardized participant rating for all trochaic forms with a stressless *-at-*. While the data are noisy, the downward slope of the trend line indicates that forms with longer interstress durations were, on average, assigned lower ratings. This is exactly as predicted: phonetically longer lapses are dispreferred relative to shorter ones.

To show that this result is meaningful, it is necessary to confirm that it cannot be attributed to other independent factors, because it is possible that participants' responses were influenced by other aspects of the stimuli. It could be the case, for example, that participants assign forms with the clusters *dl* or *dm* uniformly low scores, as these clusters are infrequent in English. It could also be the case that participants exhibit a dispreference for particular forms, perhaps according to various violations they incur of low-ranked phonotactic constraints (e.g. in *sobisative*, the non-local co-occurrence of the two *s*'s may be dispreferred). Sec. 5.2.1 presents the results of a mixed effects model that accounts for these possibilities, and shows that the main effect of interstress duration is a significant predictor of participant rating within the trochaic forms with stressless *-at-*. Sec. 5.2.2 briefly discusses aspects of the results for the rest of the stimuli.

⁹It is worth noting that including these participants' responses does not change the crucial results of the experiment (in 5.2.1): interstress duration is still a significant predictor of participant rating in the stressless trochaic forms. Excluding these participants was done as a precautionary measure, as it was not clear what they were attending to in the stimuli.

Figure 5: Negative correlation between interstress duration and standardized rating



5.2.1 Statistical analysis of trochaic forms with stressless *-at-*

In order to confirm that interstress duration plays a role in participant ratings of stressless trochaic *-ative* forms, there are four additional factors that need to be taken into account, listed below.

- ***Stem identity***

It is possible that some stems are preferred to others: speakers may, for reasons completely independent of interstress duration, prefer words that begin with *demi-* to words that begin with *sobi-* (or vice versa, or some other preference among stems).

- ***Ending identity***

Particularly with respect to the clusters (*kl*, *pr*, *skl*, *spr*, *dl*, *dm*, and *dn*), it is possible that speakers prefer some stem endings to others, for reasons that are completely independent of interstress duration. *dl* is not a very frequent cluster in English, for example, and may be dispreferred for this reason. To give another example: no attested *-ative* words end in *-zative*, and it is possible that speakers disprefer these nonce forms because they do not resemble attested forms.

- ***Specific word (item)***

It may be the case that speakers prefer some *-ative* forms to others. For example: speakers might prefer a word like *sobilative* to a word like *sobisative*, due to the co-occurring *s*'s in *sobisative*. In addition to these segmental considerations: while the stimuli were normalized for amplitude and

monotonized, it is still the case that there is acoustic variation among them (e.g. in the amplitude of the final [v] relative to that of the stressed vowel) that participants may have responded to.

- **Individual grammars (participant)**

All participants in the study appear to be native speakers of American English, but it is possible that their grammars differ on a participant-by-participant basis: social factors that are known to be correlated with grammatical differences, like age and regional dialect, were not controlled for.

The model discussed in this section includes a random intercept for item (1|Item) and a by-participant random slope and intercept for interstress duration (1+Interstress|Participant). The dependent variable for the model was standardized rating, and the independent variables were interstress duration (a continuous predictor), the identity of the pre-*at-* material (a categorical predictor, sum-coded, with “vowel” as the reference level), and stem identity (a categorical predictor, sum-coded, with *demi-* as the reference level). The model was fit using the lmer function of R’s lme4 package (Bates et al. 2015), and *p*-values were obtained with R’s lmerTest package (Kuznetsova et al. 2017).

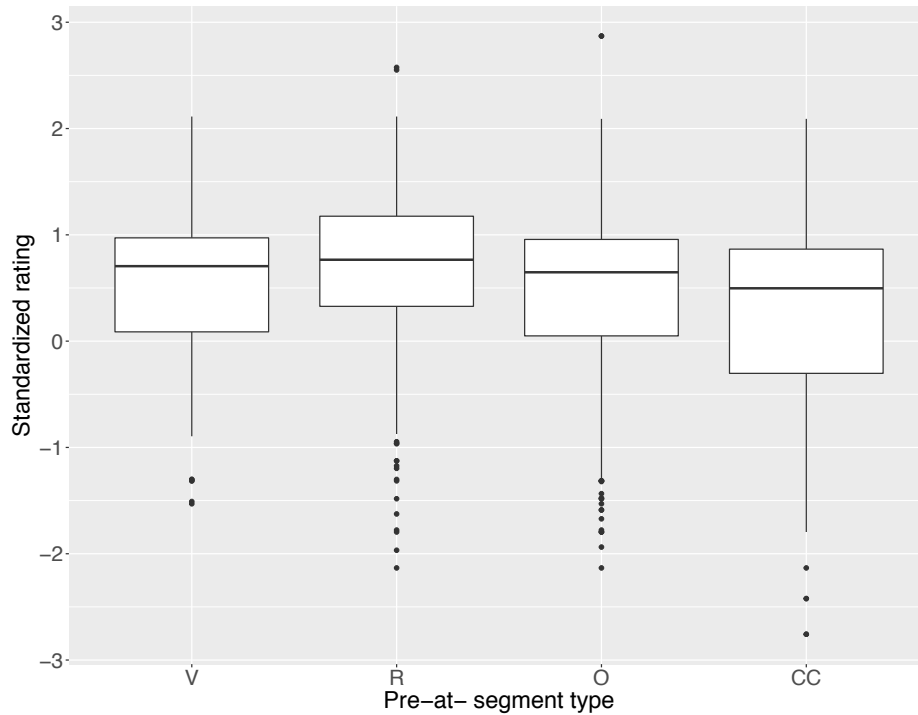
Table 1: Summary of fixed effects for stressless *-at-* model (significant effects only)

Factor	Coefficient	<i>t</i> value	Significant?
Intercept	2.54	–	–
Interstress duration	-4.50	-2.57	Yes (<i>p</i> < .05)
Stem: <i>figi-</i>	-0.28	-3.31	Yes (<i>p</i> < .001)
Stem: <i>sacki-</i>	-0.30	-4.39	Yes (<i>p</i> < .001)
Stem: <i>sobi-</i>	-0.34	-4.69	Yes (<i>p</i> < .001)
Ending: <i>r</i>	0.35	2.50	Yes (<i>p</i> < .05)
Ending: <i>skl</i>	0.56	2.30	Yes (<i>p</i> < .05)

As is evident from the summary in Table 1, stem and ending identity played a role in participant judgments: participants dispreferred *figi-*, *sacki-*, and *sobi-* forms relative to *demi-* forms (perhaps because *demi-* is an existing morpheme); in addition, participants preferred forms ending in *-rative* and *-sklative* relative to forms ending in bare *-ative*. The main result of interest here, though, is the significant effect of interstress duration: as predicted by the current hypothesis, a higher interstress duration is significantly correlated with a lower rating. Likelihood ratio tests indicate that a model including a predictor for interstress duration is a significantly better fit to the data than an otherwise equivalent model that does not ($\chi^2(1) = 6.56, p < .05$), and that a model including a three-way interaction for interstress duration, stem identity, and ending identity is not a significantly better fit to the data than the model summarized in Table 1 ($\chi^2(48) = 57.34, p = .17$).

This analysis establishes that interstress duration influences participants’ rating of *-ative* forms, but there is the alternative possibility that participants are not responding to duration at all: perhaps they are actually responding to the sonority of the pre-*at-* segments. As is evident from Fig. 6, participant ratings more or less reflect the trends in the dictionary data: the ratings for lapses with clusters are on average lower than the ratings for obstruents, which are on average lower than the ratings for sonorants. While this is unsurprising, given that interstress duration is significantly correlated with sonority (Fig. 3) and participant rating (Table 1), it also raises the possibility that participants are attending to sonority of the pre-*at-* segments, and not interstress duration.

Figure 6: Standardized rating by sonority of pre-*at*- segment(s)



To investigate this possibility, I fit a second model to the data under discussion here. Instead of including a predictor for interstress duration, the model included a categorical predictor for pre-*at*- consonant type (sum-coded, with “vowel” as the reference level); instead of including a by-participant random slope and intercept for interstress duration, the model included a by-participant random slope and intercept for pre-*at*- segment type. The models were in all other respects identical. Goodness of fit measures, however, suggest that the model appealing to interstress duration is preferable: the sonority-based model has a BIC (Bayesian Information Criterion, Schwarz 1978) of 3021.87, while the duration-based model has a BIC of 2991.67. Generally speaking, a lower BIC indicates a better model fit. This last result is important because it verifies a fundamental component of the hypothesis: sonority, at least regarding the role it plays in governing *-at*- stress, is just a proxy for duration. Nanni’s original discovery appears to have been a discovery about the role of gradient phonetic distance in lapse resolution phenomena, not a discovery about sonority-driven stress.¹⁰

5.2.2 Additional results

This section briefly describes additional results of the experiment. Taken together, the results suggest that both morphological and accentual information play a role in participant ratings, and that

¹⁰Another measure used in this context is the Akaike Information Criterion, or AIC (Akaike 1974); the models’ AICs differ by about 0.3, which is too small a value to be informative (see e.g. Dziak et al. 2012:5). It is also possible to fit a model with predictors for both interstress duration and sonority: this is less than ideal, because the factors are collinear, but the results do indicate that the effect of interstress duration ($p < .001$) subsumes the effect of sonority ($p = .94$).

phonetic *LAPSE and its analogue, phonetic *CLASH, are likely active more generally.

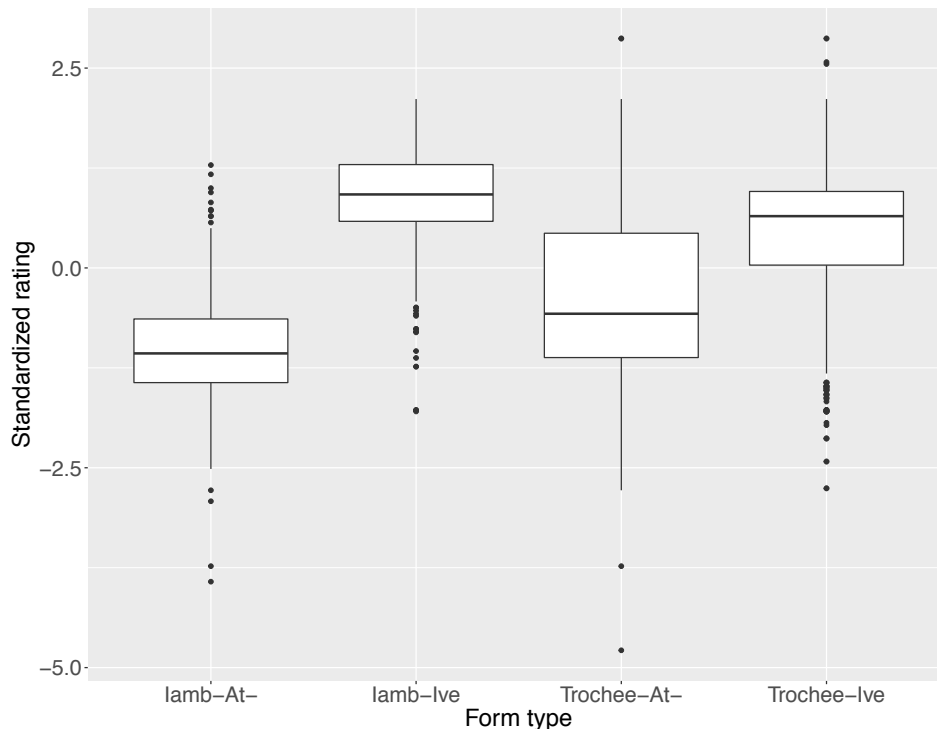
We start by considering average participant ratings for the four subtypes of stimuli. Recall that each nonce word had either an iambic stem (*pinó-*) or a trochaic stem (*démi-*, *fígi-*, *sácki-*, or *sóbi-*), and each form had either stressed *-at-* (*-átive*) or stressed *-ive* (*-átive*). This means that there was one type of form that violated syllabic *CLASH and one that violated syllabic *LAPSE (22).

(22) Four categories of stimuli

Stem type	Stress type	
	<i>-at-</i>	<i>-ive</i>
Iambic	e.g. <i>pinóàtive</i> Violated: *CLASH(syll)	e.g. <i>pinóative</i> Violated: –
Trochaic	e.g. <i>démiàtive</i> Violated: –	e.g. <i>démiative</i> Violated: *LAPSE(syll)

Fig. 7 shows that participant ratings depend on both stem type and stress type, in a way that only partially reflects the accentual categories they belong to. The preference for forms like *pinóative* (without a clash) relative to *pinóàtive* (with a clash) is expected, as participants were included only if they reliably distinguished forms from these two categories. The fact that most participants (33/50) made this distinction, however, indicates that syllabic *CLASH played an important role.

Figure 7: Standardized rating by nonce form type

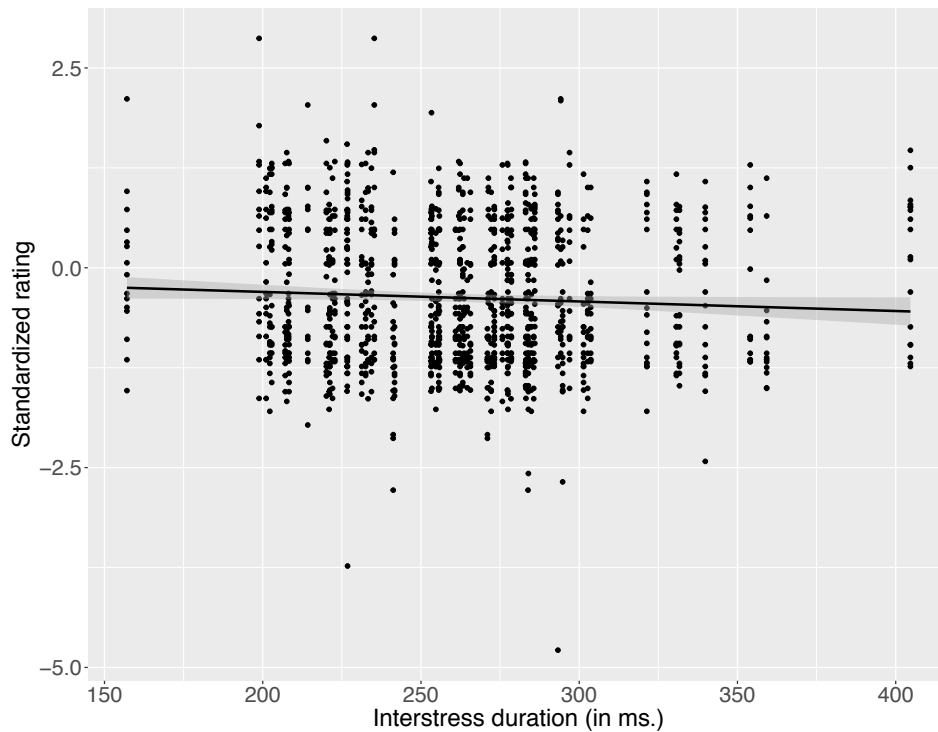


The participants' response to the two classes of trochaic forms is more surprising. The higher rating for forms like *démiative* relative to forms like *démiàtive* seems to suggest that *-at-* stress is actually

dispreferred overall, in direct contrast to the preference for *-at-* stress that is expected by the activity of *LAPSE (under any definition) and that is reflected in the dictionary study. Importantly, however, this does not reflect a global preference for *LAPSE violation: forms like *pinóative* (where *LAPSE is satisfied), have a higher average rating than forms like *démiative* (where *LAPSE is violated).¹¹ What, then, is the source of the preference for *LAPSE violation in trochaic forms? One possibility is that this reflects the activity of STRESS_{-ive}, a markedness constraint that prefers stress to fall on the suffix *-ive* (as motivated and defined in Sec. 2). All together, the results in Fig. 7 indicate that *CLASH(syll) and STRESS_{-ive} both played an important role in participants' ratings of *-ative* forms, and that *LAPSE(syll) was subordinated to STRESS_{-ive}.

When we look at the results for each form type in more detail, further evidence for phonetically-defined accentual constraints becomes apparent. As is evident from Fig. 8, a shorter interstress duration is also correlated with higher ratings for the trochaic forms with *-at-* stress: a word like *sáckiprâtive*, for example, is preferable to a word like *sáckilâtive* ($p < .01$, mixed effects model¹²). While this result was not necessarily predicted, it is in fact expected given the definition of phonetic *LAPSE proposed in Sec. 1.1: more milliseconds separate the stresses in *sáckiprâtive* than separate the stresses in *sáckilâtive*, and thus *sáckiprâtive* receives a more significant *LAPSE violation. Thus even among forms that satisfy syllabic *LAPSE, phonetic *LAPSE exerts an effect.

Figure 8: Effect of interstress distance in *-ive*-stressed trochees

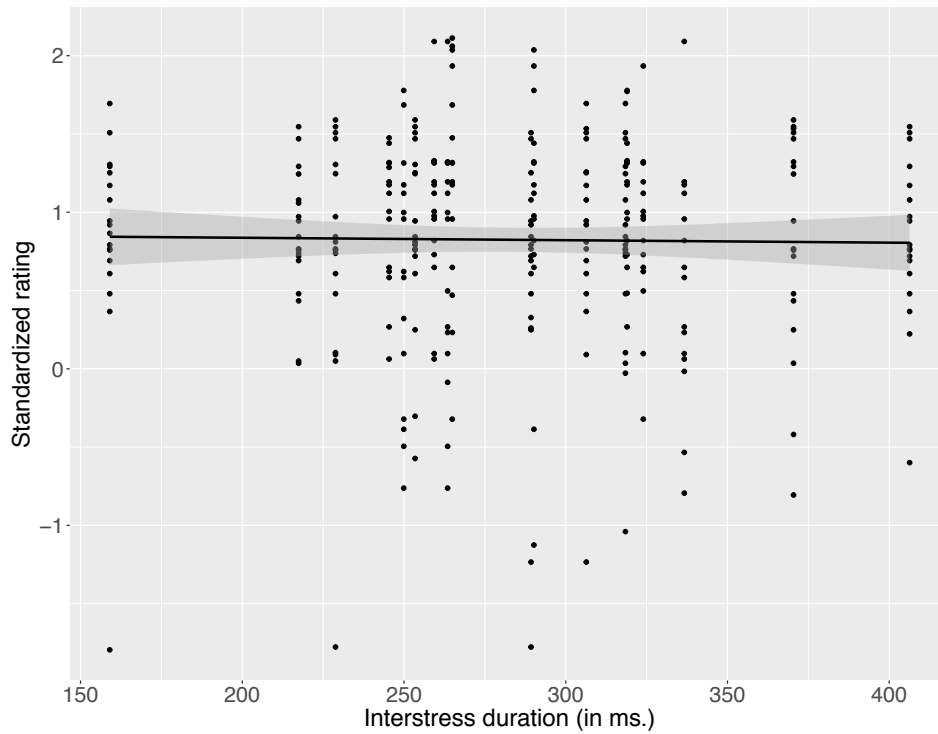


¹¹Post-hoc Tukey's HSD tests on a model of the data in Fig. 7 find that all pairwise comparisons between word types are significant at $p < .001$. The model had a fixed effect for form type, a random intercept for item, and a by-participant random slope and intercept for form type.

¹²The model fit to the *-ive*-stressed trochees was identical to the model fit to the *-at*-stressed trochees in Sec. 5.2.1.

Is it always the case, though, that English speakers prefer shorter stressless strings to longer ones? A closer look at the iambic forms suggests that this is not the case. For the iambic forms with *-ive* stress, interstress duration does not appear to play a role: the curve has a very slight negative slope, as is visible in Fig. 9, but the effect is not significant ($p = .80$, mixed effects model).¹³ As is evident from Fig. 10, however, we find a positive correlation between interstress duration and rating in forms that violate syllabic *CLASH (e.g. *pinóàtive*, *pinóbàtive*): the more time between the stresses, the higher rating the form gets (the trend, though clear, is not significant; $p = .15$).

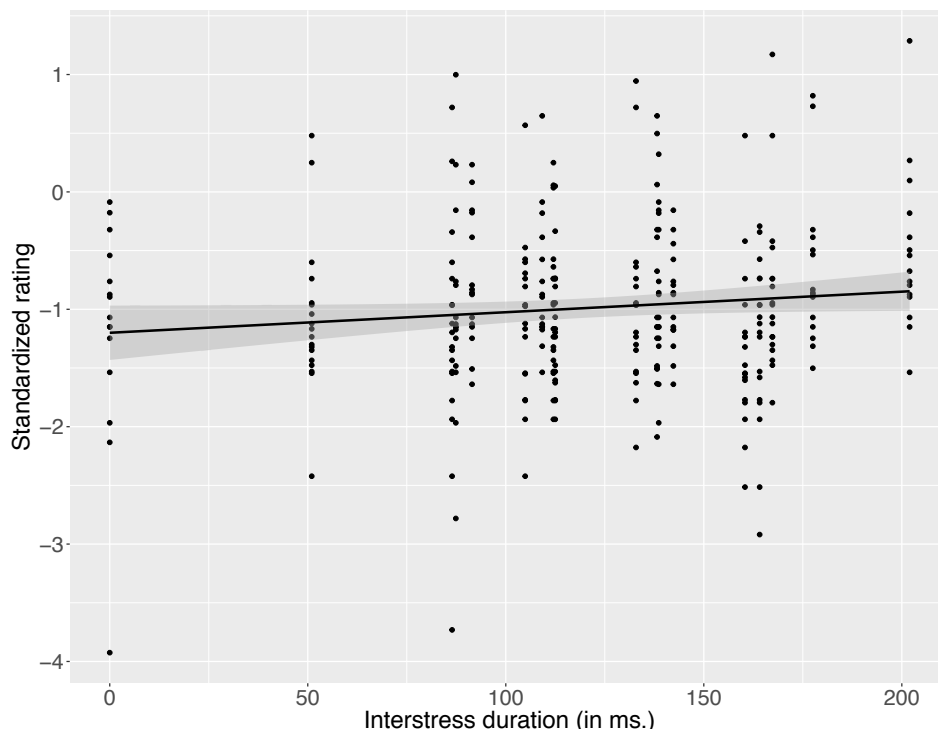
Figure 9: Effect of interstress distance in *-ive*-stressed iambs



One possible explanation for this trend is that it reflects the activity of phonetic *CLASH, which assigns a penalty whose severity is inversely correlated with the distance between two stresses (the shorter the duration between two stresses, the worse the penalty; see Gouskova & Roon 2013 for a gradient definition of syllabic *CLASH). A form like *pinósklàtive* has more milliseconds between its two stresses, and is thus rated higher than a form like *pinóàtive* (where there is no break between the stresses). Such an effect is consistent with what we know about effects of phonetic *CLASH in other languages: in Italian, for example, lengthening of a consonant between two stressed vowels appears to ameliorate a clash (see Marotta 1983, Esposito & Truckenbrodt 1998). Phonetic *CLASH

¹³The models of each subset of the iambic data included a fixed effect for interstress duration and a by-participant random slope and intercept for interstress duration. The models had a limited number of parameters relative to those fit to the trochaic data because the iambic stimuli were more limited, due to their intended function as an attention check: there was only one iambic stem, and as such, any effect of the ending could not be dissociated from an item effect (since each iambic item had a different ending). An experiment with a larger and more varied set of iambic stimuli would be necessary to further investigate the effect of interstress duration in forms of this type.

Figure 10: Effect of interstress distance in *-at*-stressed iambs



necessarily conflicts with phonetic *LAPSE, and the opposite trends observed in the trochaic and *-at*-stressed iambic forms suggest that both are active in American English, perhaps conspiring to bring the interstress duration to a single optimal value. As the evidence for phonetic *CLASH from this experiment is only suggestive, however, I leave a fuller investigation of its effects and potential interactions with phonetic *LAPSE to future work.¹⁴

6 Against an onset-sensitive alternative

Davis (1988) claims that 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 nothing or a sonorant (*palliative*, *speculative*). Assuming that an obstruent onset (e.g. *investigative*) is more likely to attract stress than a sonorant onset (e.g. *speculative*), and that a cluster onset (e.g. *administrative*) is more likely to attract stress than an obstruent onset (e.g. *investigative*), a probabilistic version of Davis's claim could be adapted to the variable dictionary data in the following way: the heavier its onset, the more likely the penultimate

¹⁴Do the dictionary data provide evidence that *CLASH is phonetically defined? Not really. Of the 41 cases where *-at*- stress would involve clash across a sonorant (e.g. *compellative*, 3 (7%) stress *-at*-; of the 75 cases where *-at*- stress would involve clash across an obstruent (e.g. *legative*), 5 (6%) stress *-at*-; and of the 115 cases in where *-at*- stress would involve clash across a cluster (e.g. *calmative*), 7 (or 6%) stress *-at*-. But for potential evidence that effects of gradient clash may be visible in dictionary data more generally, see Sec. 7.2 on *-ization*.

syllable is to bear stress. (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.)

Note that in (23), 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 entertained two parses. The first number in the cell is the count if an *s*-consonant cluster is split across the syllable boundary (e.g. *legis.lative*); the second number is the count if the entire cluster belong to the onset (*legi.slative*). As is clear from (23), the same trend holds when the forms are categorized in this way.

(23) Onset-sensitive reinterpretation of the OED data

Onset type	Stressed <i>-at-</i>	Stressless <i>-at-</i>	% stressed	Total
None	22/22, e.g. <i>annunciative</i>	22/22, e.g. <i>enunciative</i>	50%/50%	44/44
Sonorant	91/90, e.g. <i>mutilative</i>	64/64, e.g. <i>speculative</i>	59%/58%	155/154
Obstruent	100/99, e.g. <i>deprecativ</i>	18/18 e.g. <i>dubitativ</i>	85%/85%	118/117
Cluster	16/18, e.g. <i>registrativ</i>	1/1, e.g. <i>adequativ</i>	94%/95%	17/19

There are several reasons why Davis’s proposal is less desirable than the current hypothesis. The first is that it cannot explain why the identity of the poststress segments should affect *-at-* stress: as discussed in Sec. 4, words like *segregativ* (with a poststress cluster) stress *-at-* at higher rates than words like *celebrativ* (with a poststress sonorant), to give just one example. Any analysis that focuses on the role of only the pre-*-at-* segments cannot capture the observation that *-at-* stress depends on the identity of all segments in the stressless string. The phonetic lapse hypothesis, on the other hand, predicts that this should be the case.

Even if we ignore the poststress segments and focus only on the pre-*-at-* segments, the available evidence still indicates that the phonetic lapse hypothesis makes more accurate predictions. It is possible to dissociate the predictions of the phonetic lapse and onset-sensitive hypotheses by splitting each group in (23) 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 obstruent, some have an antepenultimate coda (as in *dissertativ*) and others do not (as in *deprecativ*). The phonetic lapse hypothesis predicts that forms like *dissertativ* should stress *-at-* at higher rates than forms like *deprecativ*, 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.

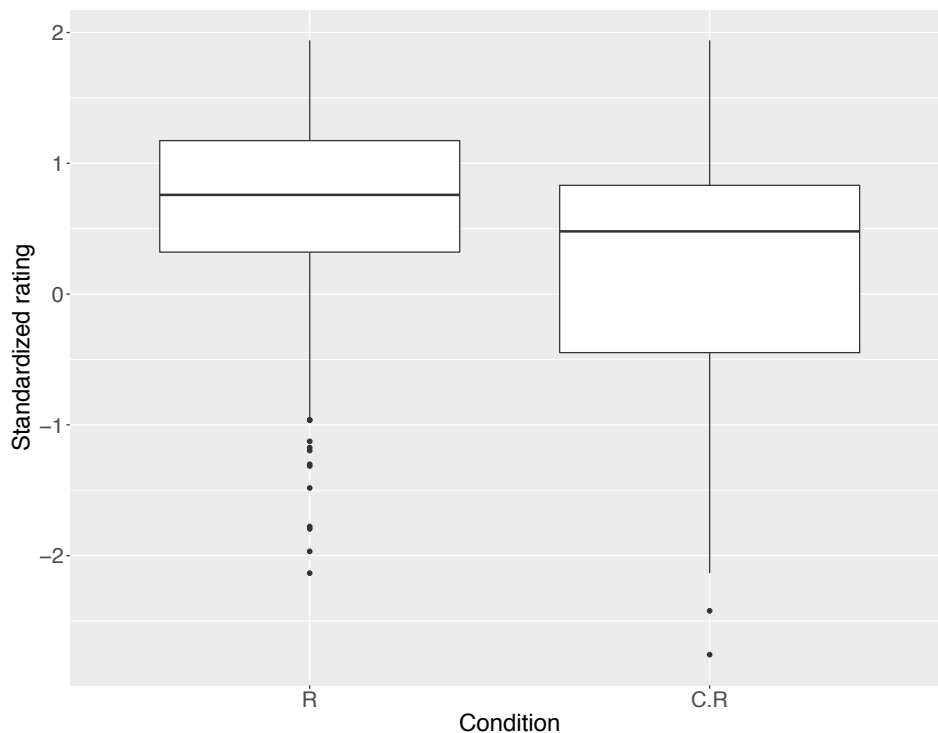
In (24), forms from each onset type are subdivided into two subgroups: (i) forms without an antepenultimate coda, and (ii) forms with an antepenultimate coda. (Forms in which the penultimate syllable lacks an onset are excluded, as there necessarily is no antepenultimate coda.) An invariant generalization in (24) is that if a form has an antepenultimate coda, it stresses *-at-*; among the forms 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.

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

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

Stronger evidence that the presence of an antepenultimate coda matters is present in the rating study: within the R onset type, participants display a preference for *-Rative* forms (with no antepenultimate coda) to *-C.Rative* forms (with an antepenultimate coda). To see this, consider the participants' responses to six kinds of stressless *-ative* form: those ending in *-l/m/native* (R), and those ending in *-dl/dm/dnative* (C.R). In these forms, the penultimate onsets are matched; only the antepenultimate coda in the C.R forms differentiates them. As shown in Fig. 11, participants assigned higher ratings to forms in the R category than to forms in the C.R category. (The between-group difference is significant at $p < .01$ in a linear regression also including fixed effects for stem and ending identity.)

Figure 11: Ratings of R (*-l/m/native*) and C.R (*-dl/dm/dnative*) forms



Is this difference between the two classes of forms expected? Not if the acceptability of an *-ative* form depends only on the penultimate syllable's onset, as an analysis that appeals to onset sonority would predict: the classes of forms are identical in that respect. The difference is however predicted if the acceptability of an *-ative* form depends on the length of the stressless string preceding *-at-*: all

else being equal, a string that includes a stop-sonorant cluster is longer than one that includes only a sonorant. In sum, then, the extant dictionary and behavioral data suggest that the phonetic lapse hypothesis provides a more explanatory analysis of the Nanni effect than do available alternatives.

7 Discussion and conclusion

This paper 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 a nonce word rating task, 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 phonetically 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* forms are mirrored in *-ization* forms; 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? Does the fact that this paper focuses on a specific morphophonological corner of English undermine the very general hypothesis advanced here? 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 *législatīve* must be produced as *législàtīve* or *législatīve* (**législatīve*). 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 *législatīve* must resemble that of *législation* and *législate*, while stress in the suffixal domain is governed by other constraints.¹⁵ I formalize this dispreference against shifting stem stress as $\text{BD-IDENT}(\text{stress})_{\text{stem}}$; see Benua (1997) on transderivational correspondence constraints. To simplify presentation, in (25) I assume a syllabic definition of *LAPSE.

(25) Possible *LAPSE violation in *speculative*

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

¹⁵It is irrelevant here whether the morphological base of *legislative* is *legislate* or *legislation*, so I do not take a stand.

Candidate (25c), with shifted stress relative to *lègislát(ion)*, is ruled out by BD-IDENT(stress)_{stem}: the initial stress of *lègislát(ion)* has been removed, and a peninitial stress has been added. Candidate (25a), which violates STRESS_{-ive}, ties with candidate (25b), which violates *LAPSE(syll); the fact that *lègislàtive* is preferred 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. *challengeable*, from *chállenge*), a large majority (375/393) permit violation of *LAPSE 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.

(26) Possible *LAPSE violation in *speculative*

challenge-able Base: chállenge 10	BD-IDENT(stress) _{stem}	*LAPSE(syll)
☞ a. chállenge-able 10-00		**
b. challéng-e-able 01-00	*!*	*

What differentiates *-ative* from *-able* is the fact that *-able* typically does not resolve *LAPSE violations except under very 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. *medícinale*, 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 *lègisl-*) 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 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 gram-

matical principle peculiar to *-ative*. Of the 548 *-ative* forms considered in this study, the mean OED frequency bin is 2.8. As noted by the OED, forms in bin 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”.¹⁶ 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. Like forms in *-ative*, stress on the first suffix in *-ization* is variable: the OED transcribes *ruggedization* with and without *-ize-* stress (*rùggedizátion* and *rùggedizátion*), *dogmatization* with *-ize-* stress (*dògmatizátion*), 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 [*'noudər-*], or monosyllabic [*'noudr-*]), 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 (27), with transcriptions from the OED.

(27) Categorization of forms into “stressed” and “stressless” *-ize-*

<i>-ize-</i> stressless	<i>-at-</i> stressed	
<i>-ize-</i> never stressed	<i>-ize-</i> variably stressed	<i>-ize-</i> consistently stressed
<i>migmatization</i> /,mɪgmədə'zeɪf(ə)n/	<i>ruggedization</i> /ˌrʊgə'daɪ'zeɪʃən/ /ˌrʊgədə'zeɪʃən/	<i>dogmatization</i> /ˌdɒgmə'taɪ'zeɪʃən/

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.

¹⁶See <http://public.oed.com/how-to-use-the-oed/key-to-frequency/> for discussion of frequency bin characteristics.

The table in (28) subdivides *-ization* forms into two larger categories: those in which stressing *-ize-* would result in a clash with the stem (e.g. *Màoizátion*, (28b)), and those in which it would not (e.g. *mòrphinizátion*, (28a)). 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 *stìgmatizátion*, (28a.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 *kèratinizátion*, (28a.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 ($p < .05$).

(28) Rates of *-ize-* stressing by rhythmic context (all constraints are syllabically defined)

Result of stressing <i>-ize-</i>	<i>-ize-</i> stressed	<i>-ize-</i> stressless	% stressed
a. No clash with stem	651 (<i>mòrphinizátion</i>)	25 (<i>virilizátion</i>)	96%
i. *LAPSE satisfied	461 (<i>stìgmatizátion</i>)	23 (<i>macàdamizátion</i>)	95%
ii. *EXTLAPSE satisfied	190 (<i>kèratinizátion</i>)	2 (<i>cùlturalizátion</i>)	99%
b. Clash with stem	54 (<i>Màoizátion</i>)	29 (<i>fàscizátion</i>)	65%

Stress in *-ization* thus appears to be rhythmically conditioned in the same way as stress in *-ative*: the longer the lapse that needs to be resolved, the more likely the inner suffix is to bear stress.

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. *mòrphinizátion*). As is evident from (29), the identity of the pre-*-ize-* consonants (i.e. the *n* in *mòrphinizátion*) does not appear to play a role in the distribution of *-ize-* stress: the rate of *-ize-* stress does not vary by segmental category (Fisher's Exact Test, $p = .80$).

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

Segment	Stressed <i>-ize-</i>	Stressless <i>-ize-</i>	% stressed	Total
Vowel	2, e.g. <i>Sàudiizátion</i>	–	100%	2
Sonorant	319, e.g. <i>pìcturizátion</i>	17, e.g. <i>perìpherizátion</i>	95%	336
Obstruent	123, e.g. <i>dràmàtizátion</i>	5, e.g. <i>pỳritizátion</i>	96%	128
Cluster	17, e.g. <i>sòuthèrñizátion</i>	1, e.g. <i>psychiàtrizátion</i>	94%	18

The identity of the poststress consonants does, however, appear to play a role in *-ize-* stress. As shown in (30), 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. *nùclearizátion*), *-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.

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

Segment	Stressed <i>-ize-</i>	Stressless <i>-ize-</i>	% stressed	Total
Vowel	18, e.g. <i>ionizáció</i>	3, e.g. <i>psychiátrizáció</i>	86%	21
Sonorant	116, e.g. <i>Hellenizáció</i>	10, e.g. <i>mámmönizáció</i>	92%	126
Obstruent	168, e.g. <i>atomizáció</i>	7, e.g. <i>macádamizáció</i>	96%	175
Cluster	159, e.g. <i>nuclearizáció</i>	3, e.g. <i>migmatizáció</i>	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 *Màgyàrizáció*, or the *rx* in *Màrxizáció*). There appears to be a link between segmental identity and the rate of *-ize-* stress: clash across a cluster, for example, is more frequent than clash across a sonorant. This trend is largely consistent with the experimental results for *-ative* forms discussed in Sec. 5.2.2, and is predicted by phonetic *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.

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

Segment	Stressed <i>-ize-</i>	Stressless <i>-ize-</i>	% stressed	Total
None	5, e.g. <i>Màozáció</i>	1, e.g. <i>Jùdàizáció</i>	83%	6
Sonorant	14, e.g. <i>Màgyàrizáció</i>	15, e.g. <i>pàrallèlizáció</i>	48%	29
Obstruent	18, e.g. <i>stàtizáció</i>	9, e.g. <i>fàscizáció</i>	67%	27
Cluster	17, e.g. <i>Màrxizáció</i>	4, e.g. <i>sòlmizáció</i>	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 paper'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 paper has argued that constraints regulating the distribution of prominences must be able to make reference to fine-grained durational information, on the basis of patterns in *-ative* (and secondarily, *-ization*) forms. 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 in fact more general than we have seen in this paper, 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 have chosen to 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 paper I have tacitly assumed that English stress ought to be analyzed in a foot-free framework (e.g. Gordon 2002): the distribution of prominences 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. Kager & Martínez-Paricio 2014) as it is not clear how the effect documented in this paper – the positive correlation of *-at-* stress and 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.

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