-(a)licious: a new morpheme obeys existing constraints

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Abstract

This paper argues that the distribution of *-(a)licious* is the result of speakers applying ∗Clash, a well-motived constraint in English, to novel suffixes. Both experimental and corpus data show that the form of the suffix, *-alicious* with schwa or *-licious* without, tends to satisfy ∗Clash. This claim finds support in experimental data. First, the choice of suffix considers the output of the Rhythm Rule, a phonological rule that resolves stress clash by retracting stress. The clash-avoiding variant is more likely in words where stress clash can't be avoided through the Rhythm Rule. Second, the choice of suffix is sensitive to the strength of the stress clash. When the clash is strongest, the clash-avoiding suffix is most likely. The fact the Rhythm Rule has an effect in cases of suppletive allomorphy suggests that suffix selection can, at least on occasion, consider the output of phonological processes. These results support a view of morphophonology in which suffix selection is conditioned by language-wide phonological constraints. Furthermore, the suffix *-(a)licious* proves challenging to analyses of morphophonology that rely exclusively on phonological subcategorization.

Keywords: English, phonology, morphophonology, allomorphy, stress clash

1 Introduction

The suffix *-(a)licious* is relatively novel and fully productive in English. In this paper, I argue that its distribution is driven by phonological output constraints that are active across the language, helping to avoid marked structures such as stress clash. The term *output constraints* is used here in the sense of Optimality

Theory's markedness constraints (OT: Prince and Smolensky 2004). In OT, markedness constraints can be violated even when they are active in a language, their effects emerging only under certain conditions. In English, although constraints on rhythmic structure are often violated, they nevertheless emerge to decide the form of *-(a)licious*.

The suffix *-(a)licious* combines with a noun or adjective to derive an adjective with a positive connotation. For instance, a *puppy-licious* thing possesses some positive qualities of puppyhood. The shape of the suffix, *-alicious* or *-licious*, is conditioned by a number of phonological factors, such as final segment and final stress. The schwaful variant, *alicious* [əlɪʃɨs], tends to occur after stressed syllables and consonants (a-b), while the schwaless variant *-licious* [lɪʃɨs], tends to occur after stressless syllables (c-e).

(1) Examples with *-(a)licious*

a. hunk-alicious

b. John-alicious

c. puppy-licous

d. booty-licious

e. puppet-licious

There are three reasons to take *-(a)licious* seriously. The first is that *-(a)licious* provides a new case of probabilistic Phonologically-Conditioned Suppletive Allomorphy (PCSA). The alternation between the schwaful and schwaless forms cannot be straightforwardly accounted for as the result of epenthesis or deletion, lending itself to analysis as the choice between two suppletive allomorphs. The second reason is that *-(a)licious* avoids stress clash, with a sensitivity to the strength of the clash. The schwaful suffix is most likely when the clash is strongest, less likely when the clash is weak, and least likely when there's no clash at all. The third is that the choice between *-alicious* and *-licious* is sensitive to the Rhythm Rule. The clash-avoiding variant *-alicious* is less likely when the stress clash can be avoided by the Rhythm Rule.

Taken together, these findings suggest that the distribution of *-(a)licious* is conditioned by an output constraint, such as ∗Clash, which prohibits consecutive stressed syllables (stress clash, see Selkirk 1984). More generally, this means that affix selection is sensitive to phonological constraints on outputs, at least for some affixes. The use of output constraints in PCSA has been pursued in many OT accounts of PCSA, starting with Mester (1994) and continuing with work such as Wolf (2008). Sensitivity to output constraints presents a challenge for accounts of the phonology-morphology interface, such as those in Paster (2006) and Embick (2010), in which affix selection is determined exclusively by subcategorization frames. These subcategorization frames consider the input to suffixation and not its phonological consequences, and as a result, are insufficient for a case like *-(a)licious*. As discussed later in the paper, there are compelling arguments for subcategorization frames, and taken together with the experiment presented here, the conclusion of this paper is that both mechanisms are independently necessary to account for the full set of phenomena.

This paper is organized as follows. Section 2 presents the basic distribution of *-(a)licious*, including arguments for the treatment of *-(a)licious* as PCSA. Section 3 presents the hypothesis that the choice of suffix is driven by stress clash, and shows the predictions of such a theory. Section 4 presents the results of a corpus search. The corpus data show that *-(a)licious* is conditioned by phonology, but exactly which phonological factors condition the suffix is unclear (final segment, stress, syllable count, or some combination). An experiment, presented in Section 5, shows that stress conditions *-(a)licious*, and the suffix is sensitive to the Rhythm Rule. Section 6 discusses these results in light of two theories of the morphology-phonology interface, concluding that the data support a theory in which morphology is conditioned by language-wide phonological output constraints. Section 7 concludes.

2 Background on -(a)licious

This section presents the basic distribution of *-licious* and *-alicious*. Experimental and corpus data suggest that *-(a)licious* is conditioned by stress and segmental context. A number of other suffixes follow the same pattern as *-(a)licious*, including the suffix *-(a)thon*, whose phonological conditioning is used in this paper as a point of coparison with *-(a)licious*. The existence of non-alternating suffixes in English shows that the alternation between *-alicious* and *-licious* is not the result of deletion or epenthesis, but instead an instance of PCSA.

2.1 The distribution of -(a)licious

The suffix *-(a)licious* is relatively novel, coming into its own in the 1990s and since achieving the status of fully productive suffix, as shown by Zimmer (2006) and Zwicky (2006). The suffix *-(a)licious* is one of many neologistic suffixes named LIBFIXES by Zwicky (2010). Libfixes are suffixes that have been liberated from their source words and seem to fall somewhere between compounds and true suffixes. Most, if not all, the previous discussion of libfixes has focused on their sources and productivity, and not their phonological conditioning.

As shown in the introduction, the shape of *-(a)licious* is conditioned by both stress and the identity of the final segment. The variant *-alicious*, with an initial schwa, is preferred by roots ending in a stressed syllable, while the schwaless variant is preferred by roots that end in a stressless syllable. The stress conditioning of *-(a)licious* is shown below, with examples taken from the non-fiction portions of the Corpus of Contemporary American English (COCA: Davies 2008-). In examples, I'll indicate stress with overset numbers: 1 indicates primary stress, 2 indicates secondary stress, and so on. Unstressed syllables are unnumbered. I'll spell the schwaful variant of the suffix as *-a̲licious*, but there are a number of variant spellings, all differing in hyphenation and vowel. Again, these data show the schwaful form after final-stress roots, and the schwaless form after non-final-stress roots.

(2) Effect of stress

...σ́+a̲licious	...σ̆+licious
c$\overset{2}{\text{u}}$rve a̲l$\overset{1}{\text{i}}$cious	r$\overset{2}{\text{u}}$by l$\overset{1}{\text{i}}$cious
h$\overset{2}{\text{u}}$nk a̲l$\overset{1}{\text{i}}$cious	t$\overset{2}{\text{u}}$rkey l$\overset{1}{\text{i}}$cious
st$\overset{2}{\text{a}}$rch a̲l$\overset{1}{\text{i}}$cious	c$\overset{2}{\text{o}}$ugar l$\overset{1}{\text{i}}$cious

The shape of the suffix is also conditioned by the final segment of the root. Roots with final consonants prefer *-alicious*, while roots with final vowels prefer *-licious*, as shown below with more COCA examples.

(3) Effect of final segment

...C+a̲licious	....V+licious
curve a̲licious	tree licious
hunk a̲licious	jew licious
low carb a̲licious	ruby licious

The suffix *-(a)licious* has a third form, which won't be discussed at length here. Many l-final roots take *-icious*, without an initial *l*. It's unclear whether this form results from suppletion or [l] deletion.

Determining the phonological conditioning of *-(a)licious* is not straightforward. First, the distribution of *-(a)licious* is probabilistic, and subject to quite a bit of variation. The phonological conditioning can only be understood in terms of tendencies. Consonant-final roots tend to take *-alicious*, but don't always. For example, both *babe-licious* and *babe-alicious* are attested in COCA. This non-categoricality is reflected in speaker intuitions, which are subtle and often uncertain. Second, in corpus data, stress is often conflated with final segment. For instance, many roots that have final stress are also monosyllabic and C-final (e.g. *hunk*), and many roots without final stress are also polysyllabic and V-final (e.g. *ruby*). In Section 4, I'll show that this holds for the Corpus of Global Web-based English (GloWbE: Davies 2013).

The experimental results from Section 5, anticipated below, demonstrate independent effects of final stress and final segment. After controlling for final segment, stress-final roots, such as *police*, still prefer -*alicious*, and non-stress-final roots, such as *cactus*, still prefer *-licious*.

(4) Stress judgments, controlling for final segment

Context	Example
	pol$\overset{2}{\text{i}}$ce $\underline{\text{a}}$l$\overset{1}{\text{i}}$cious
Final stress	>
	pol$\overset{2}{\text{i}}$ce l$\overset{1}{\text{i}}$cious
	c$\overset{2}{\text{a}}$ctus $\underline{\text{a}}$l$\overset{1}{\text{i}}$cious
Non-final stress	<
	c$\overset{2}{\text{a}}$ctus l$\overset{1}{\text{i}}$cious

Final segment also plays an independent role, as shown below in the examples that control for stress. Vowel-final roots prefer *-licious*, while consonant final roots seem to prefer neither suffix. The unacceptability of an *-alicious* word derived from a vowel-final root, such as *hero-alicious*, is the most clearcut out of all the examples presented here. The data below are again taken from the experiment in Section 5.

(5) Final segment judgments, controlling for stress

Context	Example
V-final	hero licious > hero alicious
C-final	cactus licious ≈ cactus alicious

To summarize, *-(a)licious* is conditioned by both the final segment and the prosodic shape of the root. The next section shows that a number of other suffixes follow the same distribution.

2.2 -(a)thon and other suffixes

To my knowledge, there has been no work on the phonological conditioning of the suffix *-(a)licious*, although a number of suffixes follow a similar distribution. Siegel (1974) describes the suffix *-(e)teria* as subject to the same stress conditioning as *-(a)licious*. In the examples below, a *(t)* indicates that the *t* is not present in the spelling. Stress has been added in the examples below. Just as for *-(a)licious*, the schwaful form tends to occur with final-stress roots, and the schwaless form tends to occur with non-final-stress roots.

(6) Examples of *-teria* and *-eteria* (Siegel, 1974)

...σ́+eteria	...σ̆+teria
c$\overset{2}{\text{a}}$ke et$\overset{1}{\text{e}}$ria	b$\overset{2}{\text{a}}$sket (t)$\overset{1}{\text{e}}$ria
cl$\overset{2}{\text{e}}$an et$\overset{1}{\text{e}}$ria	ch$\overset{2}{\text{o}}$colate (t)$\overset{1}{\text{e}}$ria
h$\overset{2}{\text{a}}$t et$\overset{1}{\text{e}}$ria	c$\overset{2}{\text{a}}$sket (t)$\overset{1}{\text{e}}$ria
f$\overset{2}{\text{u}}$rnit$\overset{3}{\text{u}}$re et$\overset{1}{\text{e}}$ria	c$\overset{2}{\text{a}}$ndy t$\overset{1}{\text{e}}$ria
dr$\overset{2}{\text{y}}$g$\overset{3}{\text{o}}$ods et$\overset{1}{\text{e}}$ria	r$\overset{2}{\text{a}}$dio t$\overset{1}{\text{e}}$ria

The suffix *-(e)teria* is not contemporary, and many present-day speakers lack intuitions about its distribution and meaning. Siegel (1974)'s examples are discussed in Mencken (1936), who cites even earlier work. There are, however, other contemporary suffixes that follow the same pattern, shown below.

(7) Distribution of -*(a)thon* and -*(a)holic*

	-(a)licious	-(a)thon	-(a)holic
σ̆σ́+σ̆σ́	$\text{po}\overset{2}{\text{li}}\text{ce}\ \underline{\text{a}}\overset{1}{\text{li}}\text{cious}$	$\text{po}\overset{1}{\text{li}}\text{ce}\ \underline{\text{a}}\text{th}\overset{2}{\text{o}}\text{n}$	$\text{po}\overset{2}{\text{li}}\text{ce}\ \underline{\text{a}}\text{h}\overset{1}{\text{o}}\text{lic}$
	>	>	>
σ̆σ́+σ́σ̆	$\text{po}\overset{2}{\text{li}}\text{ce}\ \overset{1}{\text{li}}\text{cious}$	$\text{po}\overset{1}{\text{li}}\text{ce}\ \text{th}\overset{2}{\text{o}}\text{n}$	$\text{po}\overset{2}{\text{li}}\text{ce}\ \text{h}\overset{1}{\text{o}}\text{lic}$
σ́σ̆+σ̆σ́	$\overset{2}{\text{ca}}\text{ctus}\ \underline{\text{a}}\overset{1}{\text{li}}\text{cious}$	$\overset{1}{\text{ca}}\text{ctus}\ \underline{\text{a}}\text{th}\overset{2}{\text{o}}\text{n}$	$\overset{2}{\text{ca}}\text{ctus}\ \underline{\text{a}}\text{h}\overset{1}{\text{o}}\text{lic}$
	<	<	<
σ́σ̆+σ́σ̆	$\overset{2}{\text{ca}}\text{ctus}\ \overset{1}{\text{li}}\text{cious}$	$\overset{1}{\text{ca}}\text{ctus}\ \text{th}\overset{2}{\text{o}}\text{n}$	$\overset{2}{\text{ca}}\text{ctus}\ \text{h}\overset{1}{\text{o}}\text{lic}$

The suffix -*(a)thon* is of particular interest here. Both the corpus search and experimental data show that this suffix is phonologically conditioned in a way similar to -*(a)licious*. In the experiment, it's the differences between -*(a)licious* and -*(a)thon*, especially with respect to the Rhythm Rule, that provide a crucial argument for the role of language-wide output constraints in suppletive allomorphy.

There are many more alternating suffixes in English that have the same flavor as -*(a)licious* and -*(a)thon*. An informal survey of English speakers suggest that the distribution of these suffixes is similarly conditioned by stress.

(8) Alternating suffixes that are similar to -*(a)licious*

-(o)rama	-(ma)geddon	-(o)phile	-(a)saurus
-(i)riffic	-(i)verse	-(o)phile	-(o)nomics
-(o)gram	-(a)pedia	-(i)vore	

This paper will only consider -*(a)licious* and -*(a)thon*, but according to the view that -*(a)licious* suffixation is conditioned by output constraints, we might expect all of the suffixes above to be influenced by rhythm in the same way.

2.3 -(a)licious is PCSA

Throughout this paper, I treat the choice between -*licious* and -*alicious* as an instance of Phonologically Conditioned Suppletive Allomorphy (PCSA). Under this account, -*licious* and -*alicious* have separate underlying forms, and the choice between these forms is conditioned by phonological context. The alternative is that *-licious* and *-alicious* are derived from a single underlying form, via epenthesis or deletion.

The claim that *-licious* and *-alicious* do not share an underlying form is motivated by the fact that schwa alternations are limited to subset of English suffixes. If schwa were the result of epenthesis, we would expect it at every morpheme boundary in English, given the right phonological context. The suffixes below have no schwa, even with final-stressed, consonant-final roots. If the schwa in *police-alicious* is epenthetic, the same epenthesis rule should insert one in *police-a-tastic*.

(9) Suffixes that never occur with a schwa, regardless of context

a. -wise:	police-wise	cactus-wise	*police-a-wise
b. -gate:	police-gate	cactus-gate	*police-a-gate
c. -zilla:	police-zilla	cactus-zilla	*police-a-zilla
d. -tastic:	police-tastic	cactus-tastic	*police-a-tastic

If the alternation were the result of deletion, we'd expect schwa deletion in the same contexts that prefer the schwaless *-licious*. The suffixes below always occur with a schwa, even with unstressed V-final roots, the same roots that strongly disprefer *-athon* and *-alicious*.

(10) Suffixes that always occur with schwa, regardless of context

a. -able:	delayable	carryable	*carry'ble (*[kæɹibl̩])
b. -ability:	delayability	carryabiliity	*carry'bility (*[kæɹibɪlɨɾi])

There's one more argument against the epenthesis account for *-(a)licious*. In the previous section, I presented a list of suffixes with both a vowel-less and vowel-ful variant. Not all of the suffixes in the list have an alternating schwa. For example, some speakers produce an [o] in *-(o)rama* or *-(o)phobe*, or an [ɨ/ɪ] in *-(i)riffic* or *-(i)licious*. This provides another argument in favor the PCSA account; the quality of the vowel is unpredictable given the phonological context, contrary to the predictions of an OT analysis of epenthesis.

The discussion above uses morpheme-specificity as a diagnostic of PCSA, as is generally accepted in the literature. This diagnostic assumes that phonological constraints and rules are not stipulated to apply to certain morphemes. Contrary to this assumption, PCSA can be analysed as driven by morpheme-specific phonology, as explored in theories of co-phonologies and lexically-indexed markedness constraints (see Pater 2008 for overview). There appears to be no clear distinction between analyzing a pattern as PCSA or analyzing it as morpheme-specific phonology. Under either approach, the claim remains that general language-wide constraints are able to influence morphologically-specific patterns.

3 Two accounts of PCSA

In this section, I present two hypotheses regarding the source of phonological conditioning in cases of PCSA: the SUBCATEGORIZATION HYPOTHESIS and the LANGUAGE-WIDE CONSTRAINTS HYPOTHESIS. Although they are indistinguishable for the basic distributions of *-(a)licious* and *-(a)thon*, they make different predictions for *-(a)licious* and *-(a)thon* with respect to stress clash and the Rhythm Rule.

3.1 Subcategorization and language-wide constraints

In this paper, I'll consider two major approaches to PCSA, both of which aim to characterize the mechanism through which phonology conditions morphology.

I will use the term the SUBCATEGORIZATION HYPOTHESIS (SubH) to refer to the family of theories in which phonological conditioning is a property of lexical representations. Under the SubH, the permissible phonological contexts for an affix are provided by its subcategorization frame, which is encoded on an affix-by-affix basis. This view of morphophonology has been argued by Lieber (1980), Paster (2006), Bye (2008), Embick (2010), among others. Under this sort of account, the phonological conditioning of *-alicious* is the result of a subcategorization frame that requires *-alicious* to combine with stress-final, consonant-final roots. If there are other affixes that are subject to the same conditions, it's because they have similar subcategorization frames.

The alternative, which I will call the LANGUAGE-WIDE CONSTRAINTS HYPOTHESIS (LCH), refers to the family of theories in which PCSA is driven by phonological constraints on outputs. The LCH has been pursued in many OT accounts of PCSA, such as Mester (1994), Kager (1996), and (Mascaro, 1996), and anticipated in pre-OT work such as Siegel (1974) on global affixation conditions. Under this hypothesis, suffix selection avoids marked surface structure, and phonological conditioning is the result of language-wide output constraints, such as *HIATUS and *CLASH. For example, the distribution of *-alicious* and -

licious can be viewed as optimizing on a constraint that prohibits consecutive stresses. For a stress-final root, the form *-alicious* is prefered to *-licious* because, with *-alicious* the output is clashless.

Unlike the SubH, the LCH holds that phonological constraints on PCSA are completely independent of the lexicon, and we expect them to emerge regardless of the suffix at hand. Furthermore, we expect the same constraints to emerge outside of suffixation in the general phonology of the language. The ways SubH and LCH could account for the prosodic conditioning of *-(a)licious* are summarized below.

(11) Subcategorization

-alicious subcategorizes for roots with final stress

(12) Language-wide constraints

The choice between *-ailicious* and *-licious* is determined by a rhythmic constraint like ∗Clash

One additional, important difference between the SubH and the LCH is the sort of phonological information that is available at the time of affixation. The difference between these two approaches is whether PCSA is input-oriented — considering only the input to affixation — or output-oriented — considering the output of affixation. Under the SubH, it's natural to assume that PCSA is input-oriented. Since subcategorization frames evaluate the properties of the stem of affixation, the phonological properties of the affix itself are irrelevant. Under the LCH, PCSA is conditioned by constraints on outputs, and output-oriented as a result. Constraints consider the phonological consequences of affixation, not just the properties of the stem.

Given only the basic distribution of *-(a)licious*, either account above is feasible. Both predict that *-licious* is less likely with final-stress roots than non-final-stress roots. The place where they make different predictions is the interaction of suffix selection and the Rhythm Rule (RR), a phonological rule that resolves stress clash, as in *thirteen men*: th$\overset{2}{\text{i}}$rt$\overset{1}{\text{e}}$en $\rightarrow$ th$\overset{2}{\text{i}}$rt$\overset{3}{\text{e}}$en m$\overset{1}{\text{e}}$n

3.2 Clash and the Rhythm Rule

The Rhythm Rule (RR) has been discussed extensively in earlier work, such as Liberman and Prince (1977), Prince (1983), Hayes (1984) and many others (see Tilsen 2012 for an overview). RR is a phonological rule that resolves stress clash, which occurs when two adjacent syllables carry stress. I'll remain noncommital with respect to the formulation of RR, whether it's prominence transfer, accent deletion, node relabelling, or something else. Instead, I'll focus on the requirements for its application, which are generally agreed upon across the literature.

In the examples below, stress is represented on the metrical grid, since it's useful for visualizing the requirements and restrictions of RR application (Liberman and Prince, 1977; Selkirk, 1984; Nespor and Vogel, 1986). Syllables with more grid marks are more prominent. When two consecutive syllables have grid marks at the same level, a stress clash occurs. In the examples below, a clash occurs in *Di$\overset{2}{a}$ne Ch$\overset{1}{a}$mbers* but not *Christ$\overset{2}{i}$ne McV$\overset{1}{i}$e*.

(13) Stress clash: *Diane Chambers* vs. *Christine McVie*

			×						×
		×	×				×		×
	×	×	×	×		×	×	×	×
a.	Di	ane	Cham	bers	b.	Chris	tine	Mc	Vie

Stress clash is resolved in these cases by reducing the prominence of the first clashing syllable (the second syllable in *Diane*). In the example below, the grid mark of the second syllable of *Diane* retracts to an earlier syllable, repairing the clash between *Diane* and *Chambers*.

(14) *Diane Chambers*: Rhythm Rule applies

						×					×	
		×			×	×			×	←	×	
	×	×		×	×	×	×		×	×	×	×
a.	Di	ane	b.	Di	ane	Cham	bers	c.	Di	ane	Cham	bers

In order for RR to apply, the stress clash must be preceded by a syllable with secondary stress. In terms of the grid, a clashing gridmark must have a landing site to which it can retract. A syllable with a schwa does not project onto the grid, and so a syllable with a schwa does not provide a landing site.

(15) *Malone-Chambers*: Rhythm Rule cannot apply

			×					×	
		×	×			×	↚	×	
	(ə)	×	×	×		(ə)	×	×	×
a.	Ma	lone	Cham	bers	c.	Ma	lone	Cham	bers

To summarize, RR resolves stress clash by retracting stress, and stress retraction is only possible if there is a secondary stress earlier in the word.

3.3 Predictions

The LCH and SubH make different predictions with respect to RR and clash. Given the conditions and restrictions on RR, in this section, I'll show how RR interacts with suffix selection under both accounts.

The suffix -*(a)licious* carries main stress in the word it derives. For example, main stress falls on *licious* in *t$\overset{2}{u}$rkey-l$\overset{1}{i}$cious*. This means that -*licious* is able to trigger RR when it occurs with a root such as *ch$\overset{2}{i}$n$\overset{1}{e}$se*, for example, *ch$\overset{2}{i}$n$\overset{1}{e}$se* → *ch$\overset{3}{i}$n$\overset{2}{e}$se-l$\overset{1}{i}$cious*. This is shown on the grid below.

(16) *chinese-licious*: Rhythm Rule applies

a.

		×
	×	×
a.	chi	nese

b.

				×	
		×		×	
	×	×		×	×
b.	chi	nese	-	li	cious

c.

				×	
	×	←		×	
	×	×		×	×
c.	chi	nese	-	li	cious

RR is still subject to the restriction outlined in the previous section. It won't apply with a word like *police*, since stress is unable to shift to the initial schwaful syllable.

(17) *police-licious*: Rhythm Rule cannot apply

		×
	(ə)	×
a.	po	lice

				×	
		×		×	
	(ə)	×		×	
b.	po	lice	-	li	cious

				×	
	×	↚		×	
	(ə)	×		×	
c.	po	lice	-	li	cious

The fact that -*licious* is able to trigger RR in some roots but not others provides a means to distinguish the LCH and SubH. The question is whether the difference in shiftability between *chinese* and *police* affects the choice between -*licious* and -*alicious*. The LCH predicts a difference between *chinese* and *police*, while the SubH predicts none.

The two approaches are repeated below.

(18) Subcategorization

-*alicious* subcategorizes for roots with final stress

(19) Language-wide constraints

The choice between -*ailicious* and -*licious* is determined by a rhythmic constraint like ∗Clash

If PCSA is determined by an output constraint like ∗Clash, then a root's eligibility to undergo RR will affect its selection of suffix. In an OT grammar, all combinations of suffix and RR are considered together in the candidate set. For a word like *chinese*, there are four relevant candidates. In the candidates below, the first two have undergone RR, and the second two have not. Three of these candidates satisfy *Clash, meaning a speaker has three ways to avoid a stress clash.

(20) Candidate set for *chinese-(a)licious*

a. ch$\overset{3}{\text{i}}$n$\overset{2}{\text{e}}$se-l$\overset{1}{\text{i}}$cious violates *Clash

b. ch$\overset{3}{\text{i}}$n$\overset{2}{\text{e}}$se-$\underline{\text{a}}$l$\overset{1}{\text{i}}$cious satisfies *Clash

c. ch$\overset{2}{\text{i}}$n$\overset{3}{\text{e}}$se-l$\overset{1}{\text{i}}$cious shifted stress, satisifies *Clash*

d. ch$\overset{2}{\text{i}}$n$\overset{3}{\text{e}}$se-$\underline{\text{a}}$l$\overset{1}{\text{i}}$cious shifted stress, satisfies *Clash

For a word like *police*, in which RR cannot apply, only one clashless candidate is viable. The other candidates with shifted stress are ruled out by the restrictions on the application of RR. In *police*, the only way a speaker can avoid a stress clash is to use the schwaful allomorph *-alicious*.

(21) Candidate set for *police-(a)licious*

a. pol$\overset{2}{\text{i}}$ce-l$\overset{1}{\text{i}}$cious violates *Clash

b. pol$\overset{2}{\text{i}}$ce-$\underline{\text{a}}$l$\overset{1}{\text{i}}$cious satisifies *Clash

c. p$\overset{2}{\text{o}}$lice-l$\overset{1}{\text{i}}$cious shifted stress ruled out by RR restrictions

d. p$\overset{2}{\text{o}}$lice-$\underline{\text{a}}$l$\overset{1}{\text{i}}$cious shifted stress ruled out by RR restrictions

If PCSA is subject to *Clash, *police*-type words should occur with *-alicious* more often than *chinese*-type words.

On the other hand, if PCSA is determined by subcategorization frames, then all words with final stress will prefer *-licious* and *-alicious* to the same degree, regardless of whether they can undergo RR. Under the SubH, affix selection does not consider the phonological shape of the affix or the output of affixation. Since RR is triggered by the affix itself, the grammar has no way of knowing whether the clash will be resolved by RR.

This prediction only holds so long as there is no subcategorization frame that distinguishes between *police*- and *chinese*-type words. This kind of subcategorization frame would have to distinguish between stress-final words that contain a preceding secondary stress (such as *chinese*) and stress-final words that do not (such as *police*). There are three reasons to doubt such a subcategorization frame. First, it would perfectly mirror the conditions on RR, duplicating a phonological rule in the lexicon. Second, it would have to refer to nonlocal phonological context, for instance, a secondary stress somewhere earlier in the word. Subcategorization frames are generally taken to be local, for instance, in Paster (2009). Third, if the corpus results are any indication, there's practically no evidence for such a subcategorization frame for language learners. As shown in the corpus results in Section 4, less than 1% of the roots that occur with *-(a)licious* have final stress and preceding secondary stress.

While the LCH predicts a difference between *police* and *chinese* for *-(a)licious*, it predicts no difference between *police* and *chinese* for *-(a)thon*. Unlike *-(a)licious*, *-(a)thon* takes secondary stress in the words it derives, as in *c$\overset{1}{a}$ctus-th$\overset{2}{o}$n* (cf. *c$\overset{2}{a}$ctus-l$\overset{1}{i}$cious*). Since *-(a)thon* takes secondary stress, it is unable to trigger RR. As shown below, a main-stress syllable does not lose its stress from RR. RR applies in *antique armchair*, but not the compound *antique dealer*.

(22) *antique armchair*: Rhythm Rule applies

		×
	×	×
a.	An	tique

			×	
		×	×	
	×	×	×	×
b.	An	tique	arm	chair

			×	
	×	←	×	
	×	×	×	×
c.	An	tique	arm	chair

(23) *antique dealer*: Rhythm Rule cannot apply

		×
	×	×
a.	An	tique

		×		
		×	×	
	×	×	×	×
b.	An	tique	dea	ler

		×		
	×	↚	×	
	×	×	×	×
b.	An	tique	dea	ler

Since the syllable *ese* carries main stress in *chin$\overset{1}{e}$se-th$\overset{2}{o}$n*, RR cannot apply. The non-application of RR for *chin$\overset{1}{e}$se-th$\overset{2}{o}$n* is shown below.

(24) *chinese-thon*: Rhythm Rule cannot apply

		×		
		×		×
	×	×		×
a.	chi	nese	-	thon

		×		
	×	↚		×
	×	×		×
a.	chi	nese	-	thon

Under the LCH, the likelihood of a suffix being chosen is directly linked to RR eligibility. For a suffix like *-licious*, in which RR can apply, there should be a difference between RR-eligible root like *chinese* and RR-ineligible roots like *police*. For a suffix like *-thon*, for which RR never applies, there should be no difference between *chinese* and *police*. The SubH, on the other hand, predicts no relationship between RR-eligibility and suffix selection. If such a relationship appears to hold, it is pure coincidence.

One final prediction of the LCH is that the strength of the stress clash should have an effect on suffix selection. There is evidence that suggests that stress clash in English is a gradient constraint, differentiating between degrees of clash. Under the LCH, if *-(a)licious* is driven by stress clash, it should be sensitive to these differences. There are a number of ways in which clashes may differ in strength. For example, Hayes (1984) gives a number of examples that show the RR is more likely to apply when two clashing stresses are closer, and the effect of distance on RR is confirmed experimentally in McCormack and Ingram (1995), who distinguish three levels of stress clash in the application of English RR. In an analysis of English secondary stress, Pater (2000) proposes a stress clash constraint which differentiates between a secondary-secondary clash and a primary-secondary clash, following from the fact that the former is more likely to be tolerated in English. A similar constraint, which is only violated by clashes with primary stress, is used in Kager (2001)'s analysis of cross-linguistic stress typology.

4 Corpus results

This section summarizes a corpus search which shows that *-(a)licious* and *-(a)thon* are used productively to derive new words, and the choice between allomorphs is influenced by both segmental and prosodic factors. These findings are replicated in the experimental data presented in Section 5, providing two independent pieces of evidence on the distribution of *-(a)licious* and *-(a)thon*. The corpus results provide a start, but they leave many unanswered questions. In the corpus, the exact prosodic factors that condition *-(a)licious* are unclear, and the corpus results are consistent with both the SubH and the LCH.

The ambiguous conditioning environment in the corpus data raises the following question. If the corpus data are representative of a speaker's day-to-day language experience, how do speakers acquire the patterning of *-(a)licious* given the lack of clear, unambiguous data? I argue that speakers do so by extending language-wide prosodic conditions to the new suffixes.

The corpus search was conducted over the Corpus of Global Web-Based English (GloWbE:Davies 2013), a 1.9-billion-word corpus representing 20 different English-speaking countries. The choice of GloWbE over another corpus, such as COCA, was motivated by its inclusion of more *-(a)licious* words. Since GloWbE is a corpus of web-based English, it includes usernames, restaurant names, website names, etc., types of words which lend themselves to formation with *-(a)licious*.

Given how many items are proper names, token frequency counts for *-(a)licious* and *(a)thon* in GloWbE are not informative. The token frequency of a blogname has more to do with its popularity than phonological shape. Moreover, most instances of words with *-(a)licious* or *-(a)thon* occur only once in the corpus. Instead of considering raw counts, I'll consider the type frequency for each context, that is, how many unique roots appear with a given suffix.

4.1 Results for -(a)licious

The data were collected as follows. A search for words ending in *licious* yielded 325 unique licious-words after exclusions. A word was included if its root was unambiguous, given its context. The context of each word was examined by hand. If only part of the root was present, a word was considered a blend and excluded. For example, *cavalicious* is a blend between *cavalier* and *delicious*. Words with ambiguous roots were also excluded. For example, *lanalicious* is compatible with both the parses *Lana-licious* and *LAN-alicious*. A root was unambigious if the boundary was indicated with punctuation or capitalization, only one parse seemed possible, or the context provided the intended parse. Words were also excluded if they were typos (e.g. *relicious* for *religious*) or if the root ended in an *l* (e.g. *pixellicious*), since *l*-final roots tend to take the variant *-icious*.

The tables below show the number of unique words that appear with either *-licious* and *-alicious*, sorted by phonological context.

(25) Number of unique words with *-licious* and *-alicious*, sorted by final segment of the root

	C-final	V-final
-licious	62	136
-alicious	125	1

(26) Number of unique words with *-licious* and *-alicious*, sorted by stress of the root

	Final stress	Non-final stress
-licious	51	147
-alicious	119	8

At face value, these results suggest both an effect of final segment and an effect of stress. However, in the corpus data, stress is correlated with final segment (r=0.64). Roots tend to be consonant-final with final stress (e.g. *John*) or vowel-final with non-final stress (e.g. *Joey*). There are few vowel-final, final-stressed words (e.g. *Joe*) or consonant-final non-final-stressed words (e.g. *Jacob*).

If stress is taken into account by limiting analysis to final-stress roots, we still find an effect of final segment. The table below shows that final-stress roots prefer *-alicious*, while non-final-stress roots prefer *-licious*. For the tables that follow, chi-square tests were performed, and their results are presented alongside the tables.

(27) Number of unique final-stressed *-(a)licious* words, sorted by final segment of the root

	C-final	V-final	
-licious	33	18	
-alicious	117	2	chi-square 35.69, d.f.=1, $p<0.001$

Likewise, stress still has an effect after controlling for final segment. The table below shows that, among roots with final stress (mostly monosyllabic roots), C-final ones prefer *-alicious*, while V-final roots ones

-licious.

(28) Number of unique C-final *-(a)licious* words, sorted by stress of the root

	Final stress	Non-final stress
-licious	33	29
-alicious	117	8

chi-square 41.61, d.f.=1, p<0.001

In the table above, stress is assumed to be responsible for the prosodic conditioning of *-(a)licious*. However, in the corpus data, there's no way to rule out that it's actually the number of syllables that's responsible. This is due to the nearly perfect correlation between the two predictors. Out of 159 polysyllabic roots, only four have final stress: *cravat, dessert, conserve, cafe*. In the analysis, then, stress and syllable count are interchangeable as predictors.

4.2 Results for -(a)thon

A corpus search for *-(a)thon* was carried out using the same methods, except l-final roots were included in the analysis. There were 340 words with *-(a)thon* after exclusions, and their phonological distribution is reported below. Like *-alicious*, there is an overall preference for *-athon* after C-final and final-stress roots.

(29) Number of unique words with *-thon* and *-athon*, sorted by final segment of the root

	C-final	V-final
-thon	21	22
-athon	279	14

(30) Number of unique words with *-thon* and *-athon*, sorted by stress of the root

	Final stress	Non-final stress
-thon	5	38
-athon	246	47

Unlike *-(a)licious*, *-(a)thon* seems to exhibit more diversity in the stress patterns of its roots. This is presumably due to the fact that *-(a)thon* can combine with verbs, unlike *-(a)licious*, and verbs are more likely to be stress-final than nouns. As a result, it's possible to tease apart syllable count and stress for *-(a)thon*, as done below.

After controlling for both final segment and number of syllables, there is still an independent effect of stress on *-(a)thon*. The table below shows a difference between final and non-final stress in polysyllabic, C-final roots. Stress-final roots prefer *-athon* to a greater degree than non-stress-final roots.

(31) Number of unique C-final polysyllabic *-(a)thon* words, sorted by stress of the root

	Final stress	Non-final stress	
-thon	0	16	
-athon	29	40	chi square 8.42, df=1, p<0.01

There is also an effect of final segment, as shown in the table below. Among polysyllabic roots with non-final stress, C-final roots prefer *-athon*, and V-final roots prefer *-thon*.

(32) Number of unique polysyllabic *-(a)thon* words with non-final stress, sorted by final segment

	C-final	V-final	
-thon	16	22	
-athon	40	7	chi square 15.42, df=1, p<0.001

In the *-(a)thon* data, there is no independent evidence of an effect of number of syllables. Looking at C-final words with final stress, we find no significant difference between monosyllables and polysyllables.

(33) Number of unique C-final final-stressed *-(a)thon* words, sorted by number of syllables

	1 syllable	2+ syllables	
-thon	5	0	
-athon	210	29	chi square 0.02, df=1, p=0.9

In the corpus data, there's one interesting difference between *-(a)licious* and *-(a)thon*. Overall, *-(a)thon* is more likely to occur with a schwa than *-(a)licious*, regardless of context. This preference for a *-athon* comes up again in the experimental results, with participants choosing *-athon* more than they choose *-alicious*. In this paper, I won't offer an explanation for the difference.

One explanation that, while attractive, doesn't work out, is that the difference between schwa in *-(a)licious* and *-(a)thon* is the result of frequency-conditioned deletion. In cases of frequency-conditioned deletion, such as schwa deletion in English, more frequent words are more likely to undergo deletion (Hooper, 1976). In the experiment, though, speakers rated *-(a)thon* as more frequent than *-(a)licious* in both perception and production, opposite to the prediction of frequency-conditioned deletion.

In summary, the same factors that condition *-(a)licious* also condition *-(a)thon*. While the exact nature of the prosodic factor is unclear in the case of *-(a)licious*, the evidence for *-(a)thon* supports stress as a conditioning factor, and not syllable count. The basic distribution of both suffixes is replicated in the experiment presented later in the paper.

4.3 Summary

There are three conclusions to draw from the corpus results. First, *-(a)licious* and *-(a)thon* are being used productively to derive new words. In the corpus, there are over 300 unique words derived with each of *-(a)licious* and *-(a)thon*, and the majority of these words only occur once. Second, these suffixes are phonologically conditioned, although the exact conditioning of *-(a)licious* is unclear given the corpus data alone. These findings are replicated in the experiment, presented in Section 5. The fact that the phonological conditioning of these suffixes appears both in the corpus data and experiment supports the experiment's ecological validity. The third conclusion is that the corpus results are consistent with both the LCH and SubH. As discussed in Section 3, the basic stress conditioning can be captured under either type of account. In the next section, we'll see an experiment that tests the different predictions of the LCH and SubH using the Rhythm Rule,.

5 Experiment

The experiment presented in this section is designed with two goals in mind. The first is to collect data on the basic distributions of *-(a)licious* and *-(a)thon*, testing to see if there are independent effects of final segment and final stress.

The second is to test the predictions of the LCH. Under the LCH, RR-eligibility should have an effect on suffix selection. Roots that can undergo RR, such as *chinese*, will occur more often with *-licious*, relative to roots that cannot, such as *police*. In addition, the LCH predicts that the difference between *chinese*- and *police*-type words will disappear for the suffix *-(a)thon*, since this suffix is unable to trigger RR. A final prediction of the LCH is that the distribution of *-(a)thon* and *-(a)licious* will be sensitive to the strength of stress clash. There is independent evidence that ∗Clash differentiates between primary-secondary and secondary-secondary clashes. If both *-(a)thon* and *-(a)licious* are conditioned by a language-wide output constraint, then this distinction should hold for both suffixes.

The results of the experiment show that the distributions of *-(a)licious* and *-(a)thon* are conditioned by both final segment and final stress. The results also show that suffix selection is affected by RR-eligbility, consistent with the LCH. RR-eligible roots select *-licious* more often than RR-ineligible roots, and for *-(a)thon*, there is no difference between RR-eligible and RR-ineligible roots. Moreover, both *-(a)licious* and *-(a)thon* are sensitive to the strength of stress clash, as predicted by the LCH.

5.1 Methods

Participants

The experiment was conducted online using Ibex[1]. Participants were recruited through word-of-mouth and social media, and were not reimbursed in any way. There were 107 participants after exclusions. Four participants were excluded because they indicated on the exit survey that they used stress as a criterion for selection, or noticed a difference in stress across conditions. Although they did not mention the Rhythm Rule or stress shift, these participants were not considered linguistically naive. All participants indicated that they were native English speakers.

Materials

Participants were presented with *-licious* and *-alicious* or *-thon* and *-athon* versions of a noun, for example, *chinese-alicious* and *chinese-licious*. Speakers were asked to choose the form they would say, along with indicating their confidence as *definitely* or *probably*. Choices were presented in random order on screen. All items were presented in English orthography in random order. A list of items is included in the appendix.

The experiment tested 50 unique nouns, differing in stress pattern and final segment. Nouns belonged to one of five different contexts, presented below. The numbers in the stress context column represent the stress pattern of the noun: 1 is a primary-stressed syllable; 2 is secondary-stressed syllable; and 0 is an unstressed syllable.

(34) Phonological contexts of test nouns

Example	Stress context	Final segment
police-type	01	consonant
chinese-type	21	consonant
cactus-type	10	consonant
hero-type	10	vowel
underwear-type	102	consonant

The first three contexts were included to test the effects of final stress and RR. The *chinese* and *police* stress contexts were included to compare RR-eligible (21) and RR-ineligible roots (01). The *cactus* stress context was included to test the basic stress-conditioning of *-(a)licious* and *-(a)thon*. The list of *police*-type nouns and the list of *chinese*-type nouns were balanced with respect to frequency and final consonant. These three groups all consisted of disyllabic, consonant-final nouns.

The experiment also contained two other contexts: vowel-final nouns like *hero*, to test the segmental conditioning of the suffixes, and secondary-stress-final nouns like *underwear*, to test the effect of final secondary stress, and the difference between weak and strong stress clashes.

These five groups of nouns were crossed with the two suffixes, giving ten conditions. Each condition contained ten items. Participants saw five items from every condition, with no repeat of nouns. In other words, each participant saw every noun once, paired with either *-(a)thon* or *-(a)licious*.

The experiment contained 30 fillers. Like the test items, all fillers compared schwaful and schwaless variants of words derived with *-(a)thon* and *-(a)licious*. The fillers contained a mix of different final consonants and stress contexts, and were all trisyllabic. Ten fillers were presented from each group presented below.

(35) Phonological contexts of fillers

Example	Stress context	Final segment
japanese-type	201	consonant
acoustic-type	010	consonant
alaska-type	010	vowel

5.2 Results

Response times

Given that the experiment was conducted over the internet, response time cutoffs were used to ensure that participants were focusing on the experimental task. The mean response time was 2172 ms. Responses were excluded from analysis if they were less than two standard deviations below the log-transformed mean response time. This means that only responses above 290ms were considered.

Results for -(a)licious

The table below reports the mean proportion of schwaful responses for *-(a)licious* items. Standard errors, in parentheses below, report variance across subjects.

(36) Table of means for *-(a)licious*

Example	Context	Proportion *-alicious*
police-type	01 C-final	0.93 (0.01)
chinese-type	21 C-final	0.80 (0.03)
cactus-type	10 C-final	0.45 (0.03)
hero-type	10 V-final	0.07 (0.01)
underwear-type	102 C-final	0.74 (0.03)

Chi-square tests were performed on the contrasts of theoretical interest: final vs. non-final stress, RR-eligible vs. RR-ineligible words, and so on. The results are presented in the table below. All comparisons were significant at the $p<0.001$ level after Bonferroni correction for multiple comparisons. No additional comparisons were performed on the data.

(37) Chi-square tests for *-(a)licious*

Contrast	Groups compared	Chi-square (d.f.)	p-value
final ● non-final stress	police ● cactus	274.96 (1)	p<0.001
RR ● non-RR	police ● chinese	38.60 (1)	p<0.001
final V ● final C	hero ● cactus	189.29 (1)	p<0.001
secondary ● unstressed	underwear ● cactus	93.03 (1)	p<0.001
main ● secondary stress	police ● underwear	69.50 (1)	p<0.001

The tests above show that both final segment and final stress have an effect on the choice between *-licious* and *-alicious*, consistent with the basic distribution of *-(a)licious* found in the corpus. The schwaful form is more likely with final-stress roots (*police*) than non-final-stress roots (*cactus*). In addition, *-alicious* is less likely with vowel-final roots (*hero*) than consonant-final roots (*cactus*).

These results also show that the distribution of *-(a)licious* is consistent with the LCH. As predicted by the LCH, RR-eligible roots (*chinese*) are more likely to appear with *-licious* than RR-ineligible roots (*police*). Also consistent with LCH, the choice between *-licious* and *-alicious* is conditioned by the strength of the clash. The schwaful variant is most likely with main-stress-final roots (*police*), where the clash is strongest, less likely with secondary-stress-final roots (*underwear*), where the clash is weaker, and least likely with non-final-stress roots (*cactus*), where there is no clash.

Results for -(a)thon

The mean proportions of schwa responses for *-(a)thon* are presented in the table below, along with standard errors in parentheses.. Overall, there were more schwaful responses for *-(a)thon* items than *-(a)licious* items, mirroring the differences between *-(a)thon* and *-(a)licious* in the corpus data.

(38) Table of means for *-(a)thon*

Example	Context	Proportion *-athon*
police-type	01 C-final	0.99 (0.005)
chinese-type	21 C-final	0.98 (0.01)
cactus-type	10 C-final	0.79 (0.02)
hero-type	10 V-final	0.29 (0.03)
underwear-type	102 C-final	0.94 (0.01)

As wad done for *-(a)licious*, chi-square tests were performed for each comparison of interest.

(39) Chi-square tests for *-(a)thon*

Contrast	Groups compared	Chi-square (d.f.)	p-value
final • non-final stress	police • cactus	97.07 (1)	p<0.001
RR • non-RR	police • chinese	0.64 (1)	p=0.42
final V • final C	hero • cactus	248.16 (1)	p<0.001
secondary • unstressed	underwear • cactus	112.77 (1)	p<0.001
main • secondary stress	police • underwear	15.16 (1)	p<0.001

The results for *-(a)thon* look similar to the results for *-(a)licious*, with one exception. There is no significant difference between RR-eligible words and RR-ineligible words for *-(a)thon*. This finding is consistent with the LCH, which predicts that the difference between RR-eligible roots and RR-ineligible roots should only arise for suffixes that are able to trigger RR, which *-(a)thon* is not. [2]

5.3 Regression model

To see if there was an interaction between RR-eligibility and suffix, results were analyzed used mixed effects logistic regression. Logistic regression is appropriate given a response variable that is binary and categorical (e.g. schwa vs. no schwa) (Jaeger, 2008). Since the goal of the regression model is to determine whether there is an interaction, only consonant-final, disyllabic words were considered, such as *cactus, police*, and *chinese*.

The stress conditions, *cactus*-type, *chinese*-type, and *police*-type, were treated as a 3-level factor, ordered in the direction predicted by the LCH.

(40)	Level 1	Level 2	Level 3
	non-final stress	final stress, RR	final stress, no RR
	(e.g. *cactus*)	(e.g. *chinese*)	(e.g. *police*)

This three-way contrast was divided into two main effects using Helmert coding. The contrasts for the stress factors were coded as in the following table.

(41)	Non-final	rr
cactus	+2	0
chinese	−1	+1
police	−1	−1

Non-final compares Level 1 with higher levels (*cactus* vs. *chinese* and *police*), while rr compares Level 2 with higher levels (*chinese* vs. *police*). rr does not make any predictions about *cactus*-type words, since they have a value of 0 for rr.

The contrasts for suffix were coded as below.

(42)	Suffix
-licious	+1
-thon	−1

The model included fixed effects for suffix (Suffix), stress pattern (Non-final), Rhythm Rule eligibility (rr), and the interaction rr x Suffix. The model also contained random intercepts for Subject and Item. In additional, random slopes were included for Subject, for Non-final, rr, Suffix.

The results of the model are presented below. Effects with a Z–value greater than 2 or less than −2 are significant. In the table below, a positive estimate indicates that, as the factor increases, the likelihood of the schwaful variant (*-alicious* or *-athon*) increases. A negative estimate indicates that the likelihood of the schwaless variant (*-licious* or *-thon*) increases as the factor increases. In other words, positive means more schwa, and negative means less.

(43) Logistic regression results [3]

	Coefficient	Z-value	p-value
(Intercept)	3.17	16.21	$p<0.001$
NON-FINAL	−1.17	−12.32	$p<0.001$
RR	−0.41	−1.70	$p=0.09$
SUFFIX(licious)	−1.17	−10.70	$p<0.001$
RR X SUFFIX	−0.72	−2.957	$p<0.001$

All of the main effects included in the model are significant, except for RR. I'll now go factor-by-factor and describe what to take away from the significance of each.

NON-FINAL: The negative value of the factor NON-FINAL shows that non-final-stress roots are more likely to occur with *-licious* and *-thon* than *-alicious* and *-athon*. In other words, stress-final roots are more likely to occur with a schwaful suffix, confirming the basic distribution presented in Section 2.

SUFFIX: The negative value of the factor SUFFIX shows that words derived with *-(a)licious* are less likely to occur with schwa than words derived with *-(a)thon*. In other words, there is a greater overall preference for *-athon* than *-alicious*.

RR X SUFFIX: The interaction between RR and SUFFIX shows that RR-eligibility has a greater effect in words derived with *-(a)licious* than in words derived with *-(a)thon*. This last result is the one most of interest here: the effect of RR-eligibility is dependent on suffix. This can be seen in the mean proportions from the experiment, reported in the tables in (36) and (38). There is a 0.13 difference between RR and non-RR words for *-(a)licious*, but only a 0.01 difference between RR and non-RR for *-(a)thon*.

The interaction between the suffix and RR-eligibility supports the LCH. Under the LCH, the choice of suffix is closely tied to whether or not the RR can apply. It predicts that RR only will only have an effect in suffixes that can trigger it. If a suffix can't trigger RR, then there should be no difference between RR-eligible roots (*chinese*) and RR-ineligible roots (*police*).

6 Discussion

As shown by the corpus and experimental data, the schwaful allomorphs, *-alicious* and *-athon*, are more likely with final-stress roots, and the schwaless allomorphs, *-licious* and *-thon*, are more likely with non-final-stress roots. This finding is consistent with both the LCH and SubH. As shown in Section 3, both approaches are able to model the basic stress facts.

The place where the two theories differ is in their predictions for RR, and the experimental results show an effect of RR-eligibility for both roots and suffixes. RR only has an effect in RR-eligible roots with RR-triggering suffixes. This finding is consistent with the LCH, in which suffix selection is sensitive to stress clash, but not expected under the SubH. To capture the effect of RR-eligibility and maintain the SubH, we must find a subcategorization frame that differentiates between *chinese, *police*, and *cactus*. Such a frame is necessary to account for the different rates of *-alicious* in *chinese-alicious* and *police-alicious*. Furthermore, this subcategorization frame must hold of *-(a)licious*, but not *-(a)thon*. How or why *-(a)thon* would have a different subcategorization frame is unclear.

One reason to take these results seriously is the degree to which the experimental results mirror the corpus results. This supports the ecological validity of the experimental results, suggesting that they are representative of actual language production. The tables below compare the experimental and corpus results for *-(a)licious* and *-(a)thon*. The two tables below show compare the corpus and experimental data for *-(a)thon*

(44) Experimental vs. corpus results for *-(a)thon*, rate of *-athon*

Data	Final stress	Non-final stress	Roots considered
Experiment	0.99	0.79	C-final, disyllabic
Corpus	1.00	0.71	C-final, polysyllabic (mostly disyllabic)

(45) Experimental vs. corpus results for *-(a)thon*, rate of *-athon*

Data	C-final	V-final	Roots considered
Experiment	0.79	0.29	Disyllabic, non-final stress
Corpus	0.74	0.21	Polysyllabic, non-final stress

There is enough variation among roots with *-(a)thon* in the corpus data to closely match the experimental conditions, and the tables above show that the rates are relatively similar across the two datasets. This close matching of items in the experimental and corpus data is not possible for *-(a)licious*. There aren't enough C-final disyllables to recreate the experimental conditions. Despite this, the same patterns can be observed in both the experimental and corpus data. The comparisons with *-(a)licious* are presented below.

(46) Experimental vs. corpus results for *-(a)licious*, rate of *-alicious*

Data	Final stress	Non-final stress	Roots considered
Experiment	0.93	0.45	C-final, disyllabic
Corpus	0.78	0.21	C-final, any number of syllables

(47) Experimental vs. corpus results for *-(a)licious*, rate of *-alicious*

Data	C-final	V-final	Roots considered
Experiment	0.45	0.07	Disyllabic, non-final stress
Corpus	0.78	0.10	Stress-final (mostly monosyllabic)

Both the experimental and corpus evidence converge to support the segmental and prosodic conditioning of *-(a)thon* and *-(a)licious*, but only the experimental data is able to bear on RR, which, as noted, is the main source of difference between the predictions of the LCH and SubH.

One alternative account for the RR results is that the RR-eligible words used in the experiment are not in fact alternating stress-final words. For example, Cooper and Eady (1986) report that *thirteen*, normally pronounced as stress-final in its citation form, is much more often produced as stress-initial elsewhere, even in contexts where RR does not apply. In other words, for some speakers, *thirteen* actually has lexically initial stress, essentially behaving like *cactus*. Under this sort of account, the fact that there is a difference between RR-eligible and RR-ineligible words reflects the fact that RR-eligible words (like *thirteen* and *chinese*) are more likely to have lexically initial stress, and RR-ineligible words (like *police*) are less likely to have initial stress. The important thing to note about the lexical stress account is that it maintains that, for some speakers, *chinese* and *thirteen* have initial stress regardless of their prosodic context. While this account provides an alternate explanation for the difference between *police-alicious* and *chinese-alicious*, it also predicts that there should be a difference between *police-athon* and *chinese-athon*, especially given that *-(a)thon* is conditioned by final stress. The fact that RR-eligibility has an effect for *-(a)licious* but not *-(a)thon* shows that there is more going on than lexicalization of initial stress. To summarize, RR-eligibility has an effect on the choice between *-licious* and *-alicious*, showing that language-wide phonological constraints can sometimes influence suffix selection. The rest of the discussion section shows how these results fit into the broader picture of PCSA. The conclusion is that, while the results provide support for language-wide output constraints in PCSA, there is still good reason to believe that subcategorization occurs. The conclusion, then, is that neither theory is sufficient for the full typology of PCSA. Both theories are necessary, even though they overlap quite a bit in empirical scope. This view, in which some cases of PCSA happen in the phonology and some in the morphology, has been pursued in Lapointe and Sells (1997) and Dolbey (1997).

6.1 Language-wide constraints

Proponents of the LCH, for example Tranel (1996), have argued that subcategorization accounts fail to capture generalizations about PCSA. Cases of PCSA tend to repair marked surface structure, such as a hiatus in the case of *a* and *an* in English, and cases of PCSA within a language tend to conspire to avoid the same marked structures as the general phonology. These generalizations fall out of a theory in which phonological alternations and all of the cases of PCSA in a language are driven by the same set of constraints, but not a theory in which phonological conditioning is specified on a morpheme-by-morpheme basis.

There a number of arguments for language-wide constraints in PCSA. The first argument for this approach is that PCSA seems to be conditioned by the same phonological factors that condition alternations, such as stress, syllable structure, and phonotactic. For example, the distribution of *-licious* and *-alicious* could be attributed to independently motivated constraints, such as ∗Clash and ∗Lapse.

(48) ∗Clash — Assign one violation mark for every sequence of two stressed syllables.

(49) ∗Lapse — Assign one violation mark for every sequence of two unstressed syllables.

Using ∗Clash and ∗Lapse captures the generalization that the choice between *-licious* and *-alicious* avoids a sequence of two consecutive stressed syllables or unstressed syllables (a stress lapse). In the examples below, forms with perfect rhythm are judged as better than forms with clashes and lapses.

(50) Examples with perfect rhythm

σσ́+σσ́	police-alicious	police-athon	police-aholic
σ́σ+σ́σ	cactus-licious	cactus-thon	cactus-holic

(51) Examples with a stress clash or lapse

σσ́+σ́σ	*police-licious	*police-thon	*police-holic
σ́σ+σσ́	?cactus-alicious	?cactus-athon	?cactus-aholic

The effects of rhythmic constraints can be observed across English. In addition to the Rhythm Rule, stress clash conditions a number of cases of variation in English, such as: derivation with the suffix *-ize* Plag (1999); the dative alternation, *give John the book* vs. *give the book to John* (Anttila et al., 2010); the genitive alternation, *the car's wheel* vs. the *wheel of the car* Shih et al. (to appear); optional *to* (Wasow et al., 2012); optional *that* (Lee and Gibbons, 2007); and word order (McDonald et al., 1993). The similarity between *-(a)licious*, *-(a)thon* and these other alternations follows under LCH, in which all of the cases are conditioned by the same set of rhythmic output constraints.

The second argument is that many cases of PCSA within a single language seem to conspire to satisfy the same constraints. For example, allomorphy in French tends to avoid hiatus. There are dozens of allomorphic pairs in French, in which the consonant-final variant appears before vowels, and the vowel-final variant appears before consonants (Tranel, 1998; Perlmutter, 1998; Steriade, 1999). This can be analyzed in OT as the result of a constraint like Onset, a constraint which exerts an influence throughout French -- in resyllabification, schwa epenthesis and deletion, and liaision (Tranel, 2000).

(52) Onset Assign one violation for every onsetless syllable.

(53) Examples of PCSA in French

a.	bel homme	[bɛl ɔm]	beautiful man
b.	beau garçon	[bo gaʁsɔ̃]	beautiful boy
c.	petit homme	[pœtit ɔm]	short man
d.	petit garçon	[pœti gaʁsɔ̃]	short boy
e.	huit hommes	[ɥit ɔm]	eight men
f.	huit garçons	[ɥi gaʁsɔ̃]	eight boys
g.	cet homme	[sɛt ɔm]	this man
h.	ce garçon	[sø gaʁsɔ̃]	this boy

A speaker of French takes advantage of allomorphy whenever possible. If she has two variants of single word, she'll choose the variant that maximizes onsets and minimizes codas. Under the LCH, the similarity across allomorphs follows from the fact that the same set of markedness constraints conditions the choice for each pair.

A similar argument can be made for the stress-conditioned English suffixes. Each of the English suffixes that has a schwaful and schwaless variant is conditioned by stress, and each suffix is conditioned by stress in the same way. For *-(a)thon*, *-(a)holic*, and *-(a)licious*, as well as the long list of suffixes presented in Section 2, the schwaful variant occurs after a stressed syllable, and the schwaless variant occurs after a stressless syllable. Under the SubH, each of these suffixes independently specifies its preferred stress context, and the fact that they all specify the same context is an accident. The alternative is that the similarities betweens suffixes is the product of historical change, as Berg (2011) has argued for a number of phonologically-conditioned English allomorphs, such as *a/an*, *my/mine*, and *thy/thine*. This sort of account, though, doesn't have anything to say about *-(a)licious*, which is still in the infancy of suffixhood.

Proponents of the SubH, particularly Paster (2009) and Embick (2010), claim there are no cases for which the language-wide constraint approach is strictly necessary. On the other hand, there are a number of cases that necessitate a subcategorization approach. The cases that have been reported to support the LCH, especially cases where stress constraints condition PCSA, such as Armenian (Kager, 1996), Latin (Mester, 1994), and Saami (Orgun and Dolbey, 2007), have been challenged by the aforementioned authors, and reanalyzed as subcategorization.

6.2 Subcategorization

Under the SubH, the distribution of *-licious* and *-alicious* would be determined by their lexical entries, such as the ones below.

(54) licious — occurs with roots ending in a stressed syllable

(55) alicious — occurs with roots ending in an unstressed syllable

As argued throughout the paper, frames like these are insufficient for a case like *-(a)licious*. The facts are that *-(a)licious* is sensitive to the strength of stress clashes, and it's affected by RR-eligibility of its root. The suffix -*(a)licious* behaves exactly as we'd expect it to if it were determined by a constraint against stress clash. Moreover, there are many suffixes in English that follow the same pattern, and there isn't always sufficient evidence for a learner to posit a subcategorization frame.

Proponents of the SubH, for example Paster (2009), have argued that constraint-based accounts are insufficient to capture the full range of PCSA data. For example, in cases of opaque allomorphy, the conditioning environment that selects between allomorphs isn't available in the output. There are also cases of phonological conditioning that are as arbitrary and unnatural as one would expect given no-holds-barred lexical subcategorization.

The first argument for the subcategorization view is the existence of cases of opaque PCSA, in which the conditioning environment is present in the UR, but absent in the output. For example, in Polish, the allomorph /e/occurs after coronals, while /u/occurs after prepalatals. The choice of allomorphs completely ignores a process of palatalization, and the resulting pattern cannot be stated in terms of the surface (Łubowicz, 2006).

(56) Opaque allomorphy in Lubowicz 2006

a.	o lis/t/	o lis[t]	letter.nom
b.	o lis/c/	o lis[c]	leaf.nom
c.	o lis/t/+e	o lis[c]+e	letter.loc
d.	o lis/c/+u	o lis[c]+u	leaf.loc

It's still possible to account for opaque allomorphy under the markedness account, but only with some additional mechanisms. Łubowicz (2006), for instance, analyzes the data above as the result of contrast preservation. While possible for Polish, this analysis may not be available for other cases of opaque allomorphy.

The second argument against using markedness constraints in PCSA is the existence of cases that refer to phonological context, but are not straightforwardly conditioned by independently motivated phonological constraints. The canonical example of this is from Haitian Creole, in which PCSA serves to create marked syllables (Klein, 2003).The suffix *-la* occurs with C-final roots, while *-a* occurs with V-final roots.

(57) Haitian Creole definite suffix *la/a*

a. C-final roots liv-la book

b. V-final tu-a hole

Cases like the one above have been taken as evidence in support the subcategorization view, although they are open to reanalysis. For example, Klein (2003) analyzes the pattern above as the result of a constraint on morphological/syllabic alignment. By choosing *la* with *liv*, the morpheme boundary aligns with the syllable boundary. Again, although Haitian Creole can be reanalyzed, it's doubtful that such a move is possible for every case of PCSA. This especially looks unlikely given the number of cases of phonologically-arbitrary PCSA. For example, in a survey of cases of syllable-counting allomorphy by Paster (2005), the number of non-optimizing cases seems to outweigh the number of optimizing cases.

6.3 Metrical consequences

In addition to providing an argument for language-wide constraints, the experimental results demonstrate the clash in English is not a categorical phenomenon.

Recall that the *-alicious* form of the suffix is used to avoid a stress clash, as shown below.

(58) Police-alicious

					×	
		×			×	
	ə	×		ə	×	×
a.	po	lice	-	i	li	licious

				×	
		×		×	
	ə	×		×	×
b.	po	lice	-	li	licious

In the examples above, a schwaful syllable is able to intervene between two stressed syllables. The typical formulation of the rhythm rule defines clash in such a way that a syllable with schwa won't prevent a clash.

(59) A stress clash results when there are two adjacent grid marks on the same level, without an intervening grid mark on the immediately lower level.

The motivation for this restricted definition is cases like the one below, in which a stress clash occurs between two non-adjacent syllables. As indicated by the shaded marks, there is a clash between *pei* and *ssa*, which causes stress to move to *Tai*. This sort of movement is only possible if schwa does not count as an intervener with respect to stress clash.

(60) Taipei Assassins: stress clash across schwa

				×						×	
		×		×	×		×	←		×	×
	×	×	ə	×	×		×	×	ə	×	×
a.	Tai	pei	A	ssa	ssins	b.	Tai	pei	A	ssa	ssins

The worry, then, is that schwa counts as an intervener with respect to PCSA, but not with respect to the Rhythm Rule. The answer is that schwa in English is a weak intervener. It's not as desirable as a full syllable, but it's certainly better than nothing. The buffer provided by schwa is not enough to prevent the RR from applying, as above, but it is enough to prefer *-alicious* to *-licious*. The evidence for the status of schwa as weak intervener is presented below. Hayes (1984) claims that words with a one-schwa lapse between clashes are more likely to undergo the rhythm rule than words with a two-schwa lapse between clashes. This behavior is only expected if schwa is present -- at least in some form -- on the grid.

(61) Disyllabic stress intervals clash less than monosyllabic stress intervals -- words on the right resist Rhythm Rule relative to those on the left (Hayes, 1984)

a.	Mississippi Mabel	Minneapolis Mike
b.	Punxatawny Pete	Passaconaway Pete
c.	analytic thought	analytical thought
d.	diacritic markings	diacritical markings
e.	the Passamaquoddy verb	the Potawatomi verb
f.	Alabama relatives	Alabama connections
g.	European history	European historian
h.	Oklahoma congressman	Oklahoma congressional district
i.	two thousand one	two thousand and one

Futher evidence for the status of schwa as weak intervener comes from Tilsen (2012), who reports the results of a production experiment on RR. The experiment compares the productions of clashing and non-clashing contexts, and finds that speakers resolve stress clash using RR, at least in prepared speech. The interesting thing is that the non-clash contexts in Tilsen (2012) are actually words with schwa as an intervener (e.g. *gazelle*, *buffalo*). If schwa did not count as a weak intervener, then we'd expect no difference between the clash in *japanese gazelle* and the clash in *japanese gecko*, contrary to (Tilsen, 2012)'s findings.

In addition to the status of schwa as a weak intervener, the experimental results show that *-(a)licious* and *-(a)thon* are sensitive to the strength of stress clash. The schwaful *-alicious* is most likely in a primary-primary clash (*police-alicious*), less likely in a secondary-primary clash (*underwear-alicious*), and least likely when there's no clash at all (*cactus-alicious*). This provides another piece of evidence for fine-grained differences in stress clashes.

7 Conclusion

This paper has provided a number of arguments to support the claim that the distribution of the suffix *-(a)licious* is conditioned by *CLASH, a constraint that is synchronically active and well-motivated in English. Speakers extend their grammatical knowledge of rhythmic structure to new suffixes like*-(a)licious* and *-(a)thon*, choosing the forms of the suffix that avoid stress clash and hiatus.

There are two pieces of evidence to support the claim that *-(a)licious* is conditioned by stress clash. The first is that suffix *-(a)licious* is sensitive to the strength of stress clash. When stress clashes are strongest, the clash-avoiding is most common. The second piece of evidence for the role of stress clash is the interaction of suffix selection and the Rhythm Rule (RR), a rule that resolves clashes. Roots that can avoid a clash by undergoing RR are less likely to choose the clash-avoiding variant, *-alicious*. The relationship between suffix selection and RR is further supported by the fact that suffixes that can trigger RR show an effect of a root's RR-eligiblity, while suffixes that cannot trigger RR show no effect of a root's RR-eligibility.

More generally, these results support the LANGUAGE-WIDE CONSTRAINTS HYPOTHESIS. Under the LCH, the source of phonological conditioning in cases of PCSA is language-wide constraints. The alternative, the SUBCATEGORIZATION HYPOTHESIS, holds that phonological conditioning is encoded in the lexical entry of every suffix. This sort of account does not fit the *-(a)licious* data. Speakers have no evidence for positing a subcategorization frame that can capture the Rhythm Rule facts, and under this account, the similarity between different stress-conditioned suffixes, such as *-(a)thon* and *-(a)licious*, is a coincidence.

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8 Appendix

Test items

The experimental items are below, sorted by condition, with stress context in parentheses. Note some variation in pronunciation, especially for trisyllabic words. Variable stress indicated with an asterisk (*).

(62) cactus words (10)

acid	basket	decade	gossip	magic
necklace	office	patrick	pirate	secret

(63) police words (01)

balloon	cologne	debate	design	estate
grenade	japan	maroon	parade	police

(64) chinese words (21)

antique	berlin	brunette	caffeine	champagne
chinese	concrete	corvette	routine	thirteen

(65) underwear words (102)

alphabet	dinosaur	exercise	honeymoon	hurricane
limousine*	nicotine	silverware	underwear	valentine

(66) hero words (10)

chili	china	cookie	cuba	drama
hero	jackie	menu	russia	zero

Fillers

None of these items were includes in the anlaysis.

(67) acoustic words (010)

acoustic	adhesive	apprentice	ceramic	deposit
detective	electric	exhibit	explosive	objective

(68) alaska words (010)

alaska	antenna	aroma	banana	bikini
gorilla	korea	nevada	piano	spaghetti

(69) japanese words (201)

afternoon	halloween*	japanese	magazine*	cigarette*
souvenir	tambourine	violin	volunteer	pioneer