AMBISYLLABICITY IN AN OPTIMAL-THEORETIC MODEL OF ENGLISH STRESS ASSIGNMENT

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Abstract: English stress has notoriously eluded regularization, both by traditional derivational models and by Optimal-Theoretic accounts. A general pattern of moraic trochees in which consonants are moraic and final syllables are extrametrical can be asserted, especially for nominals, but this remains a very rough approximation. Optimality Theory may offer the means of attaining a significantly closer fit. Although complete regularization is impossible due to cases of lexically specified stress, it still seems likely that impressive empirical coverage can be gained by beginning with an OT translation of the oft-repeated generalization and building upon it.

This expansion and elaboration of the traditional approximation crucially includes accommodation for the possibility that the relationship between stress and weight may be bidirectional, with stress driving changes in the expected syllabification as well as syllabification driving ultimate stress placement. Since a main point of OT is to avoid stepwise derivational cycles, syllabification and stress assigment should ideally occur more-or-less simultaneously in the Evaluator, which the upcoming analysis aims to capture by incorporating the notion of ambisyllabicity. Upon reaching a purely phonological account, we briefly discuss the potential applications for morphological constraints, namely root faithfulness and affix-specific effects.

1. Introduction

English stress is traditionally generalized into a system in which primary stress falls on the penultimate syllable if it is heavy and on the antepenultimate syllable in any other case. In a derivational paradigm, this would be implemented by assuming leftward-built moraic trochees in which the rightmost syllable is extrametrical but primary stress is otherwise right-aligned. Clash (i.e. multiple consecutive stressed syllables) is also assumed prohibited. This accounts for two of the most frequent stress patterns in English, comprised respectively of words with primary stress on a heavy penult and words with stress on an antepenult which is followed by a light penult. Examples of each include the following, syllabified for the time being according to Maximal Onset (rhotacized vowels are treated as long).

(1a) Penultimate CVV			(1b) Penultimate CVC		
aroma	incarnation	horizon	agenda	synopsis	utensil
/əˈɹoʊ.mə/	/ˌɪŋ.kɑˑˈneɪ.ʃən/	/həˈɹaɪ.zən/	/əˈd͡ʒɛn.də/	/sɪˈnɒp.sɪs/	/juːˈtɛn.sɪl/

(2) Stressed Antepenult with Penultimate CV

cinema	original	venison	elephant	Canada	Africa
/ˈsɪ.nə.mə/	/əˈɹɪ.d͡ʒɪ.nəl/	/ˈvɛ.nɪ.sən/	/ˈɛ.lɪ.fənt/	/ˈkæ.nə.də/	/ˈæ.fɹɪ.kə/

As you can see, nouns are especially prone to follow this generalization (Pater 2004). Secondary stress, as demonstrated in *incarnation*, is assumed to always precede primary stress and iterate as many times as it can without creating clash. Altogether, the prototypical derivation according to a traditional rules-based model would proceed like this:

	/ɪŋ.kɑˑ.neɪ.ʃən/	/sɪ.nɒp.sɪs/	/ɛ.lɪ.fənt/
Footing	(x) (x) (x) <>	<>(x) <>	(x •)<>
Anti-Clash	(x •) (x) <>	----------	----------
Primary	(x •) (X) <>	<> (X) <>	(X •)<>

As has long been noted, however, this system is no more than a very broad generalization and fails to capture substantial numbers of words. Most of these words which we would need to classify as exceptions tend to be morphologically complex, but some are monomorphemic. For instance, consider the free root *delicatessen* as well as the composites *atomic* and *systematic*, which should surface as /ˌdɛ.lɪˈkə.tɛ.sən/, /ˈæ.tɒ.mɪk/, and /sɪsˈtɛ.mæ.tɪk/.

	/dɛ.lɪ.kə.tɛ.sən/	/æ.tɒ.mɪk/	/sɪs.tɛ.mæ.tɪk/
Footing	(x •)(x •)<>	(x •)<>	(x)(x •)<>
Anti-Clash	----------	----------	<> (x •)<>
Primary	(x •)(X •)<>	(X •)<>	<>(X •)<>

What empirical coverage this model does offer nevertheless seems sufficient to suggest that it is at least on the right track. The objective of this paper, then, is to build on that basis to determine if a more inclusive model can be found. It does not claim to regularize every single word in the English lexicon, but it does aspire to propose a means by which the exceptions may be reduced significantly in number and explained as instances of lexically specified stress amidst a lexicon of which the "regular" majority is prosodically underspecified. First, some initial assumptions will be made explicit. Next, the derivational generalization described above will be translated into an initial Optimal-Theoretic analysis. The possibility of stress-based re-syllabification and the conundrum that it presents to our preliminary analysis will then be introduced, thus leading us to begin revising and expanding it. Finally, the apparent limits of a strictly phonological paradigm will be discussed along with the potential utility of morphologically sensitive constraints in refining our model further.

2. Foundational Assumptions

The analysis to be developed here aspires to be flexible enough to capture, perhaps with a few trivial adjustments, the standard accents of both the United States and the United Kingdom. Throughout the development of an OT approach to English stress patterns, syllable weight will play an important role. A heavy syllable is one that is bimoraic, which in English, means that it contains a long vowel, a diphthong, or a short vowel followed by a coda consonant. However, it must be noted that certain dialects of English, such as the standard American accent, have been analyzed as monochronemic, meaning that vowel quantity is not contrastive. For our purposes, therefore, a vowel shall be considered long if it meets two criteria. First, it should be classified as such in standard British speech. Second, it must be phonotactically free to occur word-finally in both American and British speech.

There are two important North American features that merit further consideration. The first is the *father-bother* merger, a loss of rounding contrast in the low back vowels by which the originally contrastive /ɒ/ has been subsumed by /ɑː/ into the fused phoneme /ɑ/. Most instances of contemporary North American /ɑ/ notably correspond to British /ɒ/. Moreover, there does not appear to be any lexical item in which a correspondence between North American /ɑ/ and British /ɑː/ has visibly altered stress. With respect to prosody, North American /ɑ/ thus seems to pattern like whatever its British counterpart is frequently enough to justify transcribing the Old-World distinction for current purposes. So while the forthcoming data uses /ɒ/, which unambiguously qualifies as monomoraic, using /ɑ/ in its place can be safely presumed to yield the same results.

Not quite as universal throughout North American speech but still very pervasive is the *cot-caught* merger, which similarly merges /ɔː/ with /ɑ/. Although this fusion greatly increases the number of words with word-final /ɑ/ that correspond to an unambiguously long vowel in British English (e.g. *law*, *raw*), there remain a few notable pockets of North America without it, so its influence on stress may therefore be safely left to more specifically dialectological research. By the intuition of the native Anglophone author, no word readily comes to mind in which the stress seems to be impacted by this merger either.

While it maintains both /ɑː/ and /ɒ/, at least as a notational convention, the accent on which my transcriptions are based is rhotic and adheres to the North American distribution of /æ/ (e.g. *bath* is pronounced /bæθ/, not /bɑːθ). Altogether then, we are left with seven short vowels, four long vowels, eight diphthongs, and four rhotacized vowels. The rhotacized vowels are treated as bimoraic.

SHORT VOWELS: /æ/, /ɛ/, /ɪ/, /ɒ/, /ʊ/, /ʌ/, /ə/
LONG VOWELS: /ɑː/, /iː/, /ɔː/ /uː/
DIPHTHONGS: /aɪ/, /aʊ/, /eɪ/, /ɔɪ/, /oʊ/, /ɛə/, /ɪə/, /ʊə/
RHOTACIZED VOWELS: /ɑˠ/, /ɜˠ/, /ɔˠ/, /əˠ/

It is also worth briefly noting that the short high tense vowels [i] and [u], are considered to be unstressed allophones of their long counterparts, though some conservative British accounts will classify them as allophones of their lax counterparts instead

Another presupposition which deserves some attention is the phonemic status of schwa. This is not an uncontroversial assumption. Schwa is never stressed in English and alternates in suspiciously unpredictable ways with other vowels in morphological derivation. For instance, consider the related words *photograph* versus *photography* (/ˈfoʊtəgɹæf/ versus /fəˈtɒgɹəfiː/) or *original* versus *originality*. There, schwa alternates with /oʊ/, /ɒ/, and /æ/, and this inconsistency in which vowels take its place suggets that those full vowels may be underlying while the schwa is a surface realization. Nevertheless, there is some evidence to suggest that it may not be that clean-cut. Lee (2006), for instance, examines the interaction between schwa-final roots and certain suffixes that can be explained by positing that at least some schwas are present in the underlying form. He observes that adding the suffix *–ic* to many words with final *–a* incite inconsistent strategies for relieving the resultant hiatus. *Aorta* becomes *aortic* (/eɪˈɔɾ.tə/ → /eɪˈɔɾ.tɪk/), demonstrating deletion, but *stanza* becomes *stanzaic* (/ˈstæn.zə/ →/stænˈzeɪ.ɪk/), demonstrating lengthening.

The account offered by Lee is that the respective underlying forms are /eɪˈɔɾ.tə/ and /ˈstænzæ/. The suffix *–ic* must immediately follow a stressed syllable, but a syllable with a nuclear schwa cannot be stressed. In the case of *aorta + ic*, this creates a conflict that resolves itself via deletion. However, since the final vowel of *stanza* is underlyingly /æ/, which, unlike schwa, can be stressed, there is no such conflict in that case. The only conflict in *stanza + ic* is the hiatus between two adjacent short vowels /æ.ɪ/, which is resolved differently via raising and diphthongization. Hence, the superficially different fates of the stem-final schwas are explained straightforwardly by proposing that the schwa is underlying in one but a mere reduction of /æ/ in the other (Lee 2006).

Other evidence that schwa may not always be a mere surface reduction of an underlying full vowel comes from orthography. Notoriously common spelling errors such as **seperate* for the standard *separate* demonstrate substantial uncertainty over which vowel to use, for instance, in the second syllable of *separate*, which happens to be pronounced as a schwa. If there was a full vowel in the underlying mental representations of such items, we would expect far less of this kind of difficulties. It is also highly suggestive that, wherever schwa alternates with a full vowel, that full vowel consistently seems to be one which is very typically associated with the grapheme that lies in the relevant position. In such highly literate cultures as the world's major Anglophone nations tend to be, we likely cannot dismiss the possibility that the phonologically unpredictable full vowel that alternates with schwa in derivational morphology is retrieved from the spelling rather than anything underlying within the stem. Hence, for the purposes of the current analysis of stress, including morphologically induced stress shifts, the best assumption to make for now may be that any schwa which persists throughout all morphological derivatives of the host root is underlying, while any schwa that can be shown to alternate at least once through affixation is a mere surface realization. This is the model that will guide the input transcription in the ensuing discussion.

Finally, while the forthcoming analysis seeks to significantly reduce the number of apparent exceptions to a regularized English stress system, it does not seek to eliminate them entirely. The existence of genuine exceptions to a generally robust account can be shown by pairs such as *idea* and *mania* (/aɪˈdiːə/ and /ˈmeɪniːə/). Both of these words contain two heavy syllables followed by a light one, and yet stress is assigned differently in each, suggesting that only one can be

part of a regular system. This paper presupposes that lexical items which can be considered regular are such because they are underspecified for stress, while true exceptions are anomalous because stress is specified in their underlying forms. This entails an undominated stress faithfulness constraint that will be assumed but not explicitly discussed for the sake of concision.

3. Initial OT Implementation

As a first approximation of a comprehensive Optimal-Theoretic analysis of English stress assignment, let us translate the traditonal rules-based description outlined in the introduction into OT terms. Presumed undominated are three main constraints: *CLASH, FT-BIN, and TROCH (or *IAMB), defined below.

*CLASH: do not stress two or more consecutive syllables; one violation per stressed syllable to the immediate left of another stressed syllable

FT-BIN: every foot must contain at least two moras and at most two syllables; one violation per foot which is either monomoraic or contains three or more syllables

TROCH/*IAMB: every bisyllabic foot must be left-headed; one violation per right-headed bisyllabic foot

In addition to these top-tier constraints, the following constraints can also be surmised from the rules of the derivational analysis.

NON-FIN: the rightmost syllable of a word should not be included in a foot; one violation for any word that foots its final sylable

ALIGN-R(P): align primary stress with the right edge of a word; one violation per syllable not bearing primary stress counting from right to left

PARSE(σ): every syllable must be parsed into a foot; one violation per extrametrical syllable

One might be tempted to use a STRESS-to-WEIGHT constraint as well, penalizing any stressed light syllables. However, FT-BIN and NON-FIN actually derive the effects of such a constraint. Since the final syllable is extrametrical via NON-FIN, a penultimate light syllable cannot be footed alone due to FT-BIN. It has no choice, but to join with the preceding syllable to form a foot. TROCH will then ensure that that preceding syllable will be the head regardless of its weight. If the penult is heavy, ALIGN-R(P) will ensure that it bears primary stress, while *CLASH will prohibit the stressing of the antepenult, even if it too is heavy. For example, the word *utensil* would be evaluated as shown.

Tableau 1: *utensil*

/juːtɛnsɪl/	NON-FIN	ALIGN-R(P)	PARSE(σ)
(ˌjuː.tɛn)(ˈsɪl)	*!		
(ˈjuː.tɛn)<sɪl>		**!	*
→ <juː>(ˈtɛn)<sɪl>		*	**

The most obvious ranking for this analysis is NON-FIN >> ALIGN-R(P), PARSE(σ). If this were reversed, any final syllable that was naturally heavy would automatically bear primary stress, which would be very problematic due to the remarkable rarity of terminal-stress words in the English lexicon. For instance, let us examine the word *university*.

Tableau 2: **ùnivèrsitý*

/juːnɪvɝsɪtiː/	PARSE(σ)	NON-FIN	ALIGN-R(P)
*→ (ˌjuː.nɪ)(ˌvɝ.sɪ)(ˈtiː)		*	
(ˌjuːnɪ)(ˈvɝ.sɪ)<tiː>	*!		**

Tableau 3: *ùnivérsity*

/juːnɪvɝsɪtiː/	NON-FIN	ALIGN-R(P)	PARSE(σ)
(ˌjuː.nɪ)(ˌvɝ.sɪ)(ˈtiː)	*!		
→ (ˌjuːnɪ)(ˈvɝ.sɪ)<tiː>		**	*

The relative ranking of PARSE(σ) and ALIGN-R(P) cannot yet be determined, but it ultimately proves moot, as neither ranking can eliminate the ambivalence seen in words like *etymological* (schwa alternation, as seen here with /ɒ/ and /æ/, is outside the scope of this paper).

Tableau 4: *etymological*

/ɛtɪmɒlɒd͡ʒɪkæl/	NON-FIN	ALIGN-R(P)	PARSE(σ)
<ɛ>(ˌtɪ.mə)(ˌlɒ.d͡ʒɪ)(ˈkæl)	*!		*
→ <ɛ>(ˌtɪ.mə)(ˈlɒ.d͡ʒɪ)<kəl>		**	**
→ (ˌɛ.tɪ)<mə>(ˈlɒ.d͡ʒɪ)<kəl>		**	**

However, this is not the most serious challenge to this initial model. A much greater challenge lies in research suggesting that the relationship between stress and syllable weight may not be monodirectional.

4. Stress-Based Resyllabification and Ambisyllabicity

The idea of stress-based resyllabification is perhaps best illustrated by the work of Hammond (1995). He begins by observing that the rule for allophonic aspiration of voiceless stops, which usually states that it occurs whenever the stop would serve as the simple onset of a stressed syllable (/ˈTV/ → [ˈTʰV], where T is any voiceless stop), could be streamlined if stress-based re-syllabification were used. Such a re-syllabification rule (/ˈV.CV/ → [ˈVC.V]) would shift a single intervocalic consonant into a preceding stressed syllable even if it meant violating the Maximal Onset

Principle (MOP). This would presumably bleed the rule of voiceless stop aspiration, thus enabling it to apply to all simple onsets regardless of stress but still predict the same licit surface forms (cf. /ˈbæt.ə˞/ → [ˈbæɾ.ə˞] instead of /ˈbæ.tə˞/ → [ˈbæ.tʰə˞]).

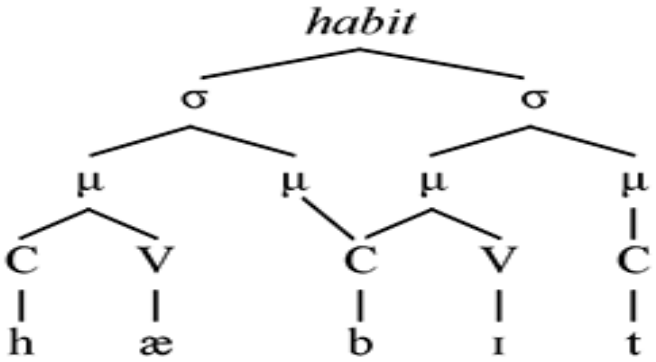
The theoretical benefits of this approach are questionable, as it could be said to be simply taking a parameter out of the original aspiration rule and giving it its own rule, generating no net gain in simplicity. However, Hammond does provide some interesting empirical evidence for some type of re-syllabification by comparing syllable recognition in English and French, in the latter of which stress falls much more regularly on the ultima.

Citing the work of Cutler et al. (1986), Hammond examines the results of a fragment monitoring task. In this type of experiment, subjects are presented with audio output consisting of a short and nonsensical sequence of familiar sounds followed by a full word in their language. They are asked to indicate whether the word begins with the preceding fragment. Response times are then recorded. In the experiment carried out by Cutler and colleagues, French-speaking subjects responded significantly faster when the nonce fragment formed what the MOP would predict to be the first syllable of the following word. English-speaking subjects, however, showed no such correlation, responding equally whether the fragment's boundaries coincided with those of the word's first syllable or not. For example, the Francophones matched /pa/ to /paˈlas/ and /pal/ to /palˈmie/ faster than they did /pal/ to /paˈlas/ or /pa/ to /palˈmie/, while the Anglophones matched both /bæ/ and /bæl/ to both /ˈbæləns/ and /ˈbælkəniː/ equally fast.

To Hammond, this implies that /bæl/ is perceived as the first syllable of both *balance* and *balcony*, even though the MOP predicts that the first syllable of the former should be /bæ/ instead. Hammond proposes to implement this phenomenon in OT with a new constraint, NOONSET, which seeks to prohibit unstressed syllables from having onsets and must outrank ONSET in order to realize stress-induced re-parsing. Such a constraint can be justified, Hammond claims, by West Aranda, in which stress never falls on an onsetless syllable unless to avoid violating the higher-ranked NON-FINALITY. He also argues that English lexical statistics support NOONSET, because among words with three or more syllables, a significantly greater proportion of those without initial stress begin with a vowel rather than a consonant (Hammond 1995).

Elzinga and Eddington (2014) provide an alternative account based on the notion of ambisyllabicity seminally posited by Kahn (1976). The claim is that, under certain conditions, a consonant may simultaneously be parsed as both the coda of the preceding syllable and the onset of the following one. In other words, a specific consonant segment is linked to a C-slot in the timing tier, but that C-slot is parsed twice, thus straddling the syllable boundary.

Figure 1: Ambisyllabic Parsing of *habit*



Due to the experimental focus of their paper, Elzinga and Eddington provide some empirical evidence for the psychological reality of ambisyllabicity to bolster that offered by Hammond's work. Their experiment consisted of a questionnaire featuring 44 words drawn from an overall pool of 627. There were three parts to it. In the first part, participants were asked to identify the first or last part of a particular word from three choices. For instance, if presented with *standard*, subjects had to choose between *sta*, *stan*, and *stand*. Whether the query asked for the first or last part varied randomly. The second part was a sort of decoy intended to distract the participants by asking them to count the number of syllables in each word on a random list of 30. The third section was a reiteration of the first using the same words, though whether the questionnaire asked for the first or last part of each word was presumably re-randomized.

A total of 7,649 responses were collected, 21.4% of which yielded answers indicating perceived ambisyllabicity. Several predictor variables were considered, including the age and education of the participants, the tenseness/quantity of the vowel preceding the consonant(s) in question, and orthographic gemination. All possible pairs of these variables were evaluated via advanced statistical analysis. Although the most robust predictive variable cross-indexations were age by orthographic gemination and education by orthographic gemination, a decent correlation was also found between ambisyllabic interpretations and stressed lax (i.e. short) vowels. Moreover, the orthographic gemination common to both of the strongest predictors has been theorized to be an indirect reflection of a particular phonetic property, and a stressed lax vowel has been proposed to be that very attribute. Treiman and Danis (1988), as cited by Elzinga and Eddington, found that 66% of bisyllabic English words with an initial stressed lax vowel are spelled with their medial consonants orthographically geminated, while no words with an initial stressed tense vowel bear such geminations (Elzinga and Eddington 2014)

The nature of ambisyllabicity and the rigor of its empirical basis remains debatable, but whatever its ultimate source, it seems at least prevalent enough in English to pose an important question regarding regular stress assignment. If ambisyllabicity is available to the phonological grammar, what prevents a light penult from simply sharing the following consonant to become heavy rather than compelling the stress to shift further leftward? The initial generalization states that syllabic weight influences stress placement. The implicit assumption in such an approach is

that syllabification is established in a discrete derivational cycle that precedes stress assignment, but now, it seems that stress can also influence syllabification. In other words, we can no longer be certain if a syllable is stressed because it is heavy or heavy because it is stressed. It's a matter of whether the proverbial egg or the proverbial chicken ultimately comes first. It could probably be resolved by positing multiple cycles of derivation, but the very point of Optimality Theory is to eliminate the need for such a stepwise process. The question then becomes, how can we incorporate ambisyllabicity into a single-cycle OT account of English and simultaneously accomplish empirical coverage that significantly improves on that of the traditional generalization?

5. Incorporating Ambisyllabicity

If we wish to allow stress-induced ambisyllabicity, a crucial step is to ensure that it is both adequately flexible and adequately restricted. The problem just described above, in which the relationship between stress and weight appears to become circular, can perhaps be illustrated by returning to the word *venison* and asking ourselves a relatively simple question. The system evaluates the word from right to left. The ultima is extrametrical, so it advances to the penult, and this is where the circularity rears its ugly head. If we dispense with the earlier assumption that syllabification is set in stone prior to stress assignment, the grammar then has two equally viable options for dealing with a potentially light penult. It can either proceed to the antepenult or invoke ambisyllabicity on the /s/ in order to render the penult heavy and thereby optimal for stress placement. In that case, what is there to prevent *venison* from surfacing as /vɛˈnɪs-sən/ (the ambisyllabic consonant is indicated with a hyphen) instead of the attested /ˈvɛnɪsən/?

The answer lies in the extrametricality of the final syllable, /sən/. It leaves the potentially ambisyllabic consonant unfooted, and as such, it may be disqualified from participating in any ambisyllabic re-parsing. This can be stipulated outright or easily implemented through an undominated constraint, *<AMBI>.

*<AMBI>: ambisyllabicity can only take place within a foot and can never apply to extrametrical segments or cross foot boundaries; one violation per segment that is parsed ambisyllabically into a foot of which it would not otherwise be a part

Ranking *<AMBI> above NON-FIN results in the correct prosody for *venison.*

Tableau 5: *venison*

	/vɛnɪsən/	*<AMBI>	NON-FIN
	<vɛ>(ˈnɪs-)<-sən>	*!	
	<vɛ>(ˈnɪs-sən)		*!
→	(ˈvɛn-nɪ)<sən>		

In fact, Anderson and Ewen (1987) are cited by Elzinga Eddington as having reached a similar conclusion, stating that ambisyllabicity is preferred in foot-medial position and discouraged across foot boundaries.

There must also be a constraint against ambisyllabic consonants in general. Although it would be ranked so low as to have its effects masked in most cases, its ranking relative to two other low-ranked constraints is worth observing here. When the grammar is faced with a light syllable that surfaces as stressed, it must reliably choose ambisyllabicity over simply shifting a consonant leftward. This can be executed by placing *AMBI between ONSET and *CODA. For example, in the word *gorilla*, the /l/ must be parsed as ambisyllabic rather than simply switching allocation from the ultima to the penult. The form that emerges also exhibits a NON-FIN violation, since all candidates that satisfy it are excluded either by TROCH/*IAMB or by a *SCHWÁ constraint (introduced below), which lies in the same undominated tier.

*SCHWÁ: a syllable whose underlying nuclear vowel is /ə/ must not be stressed; one violation per stressed syllable with schwa as its nucleus

Tableau 6: *gorilla*

	/gəɹɪlə/	*SCHWÁ	NON-FIN	ONSET	*AMBI	*CODA
	(ˈgə.ɹɪ)<lə>	*!				
	<gə>(ˈɹɪl.ə)			*!		*
→	<gə>(ˈɹɪl-lə)				*	*

As shown above, the potential output (ˈgə.ɹɪ)<lə> stresses a syllable with a nuclear schwa, which is sufficient to disqualify it due to the high ranking of *SCHWÁ. The only way to avoid this would be to violate the equally ranked TROCH/*IAMB with (gəˈɹɪ)<lə>. The candidate <gə>(ˈɹɪ.lə), with neither leftward shift nor ambisyllabicity, is eliminated by STR-to-WT. Deemed redundant in our original analysis, it now proves important for motivating ambisyllabic re-parsing. It is accompanied by two other constraints for a total of three that should be added to the hierarchy along with *SCHWÁ.

STR-to-WT: stressed syllables must be heavy/polymoraic; one violation per stressed light syllable

*LAPSE: there must be no more than three consecutive unstressed syllables in a word; one violation per consecutive unstressed syllable after the third

ALIGN-L(W,F): the left edge of a word must be aligned with the left edge of a foot; one violation per unfooted syllable from the left

The first two of the above constraints join *<AMBI> and *SCHWÁ in the undominated tier. The third, ALIGN-L(W,F), must rank below ALIGN-R(P), as shown by revisiting the word *utensil*.

Tableau 7: **útensil*

	/juːtɛnsɪl/	ALIGN-L(W,F)	ALIGN-R(P)
*→	(ˈjuː.tɛn)<sɪl>		**
	<juː>(ˈtɛn)<sɪl>	*!	*

Tableau 8: *uténsil*

/juːtɛnsɪl/	ALIGN-R(P)	ALIGN-L(W,F)
(ˈjuː.tɛn)<sɪl>	**!	
→ <juː>(ˈtɛn)<sɪl>	*	*

ALIGN-L(W,F) proves more helpful in resolving the ambivalence of the *etymological* case that we encountered earlier.

Tableau 9: *etymological*

/ɛtɪmɒlɒd͡ʒɪkəl/	NON-FIN	ALIGN-R(P)	ALIGN-L(W,F)	PARSE(σ)
<ɛ>(ˌtɪ.mə)(ˌlɒ.d͡ʒɪ)(ˈkəl)	*!			*
<ɛ>(ˌtɪ.mə)(ˈlɒ.d͡ʒɪ)<kəl>		**	*!	**
→ (ˌɛ.tɪ)<mə>(ˈlɒ.d͡ʒɪ)<kəl>		**		**

The *LAPSE and *SCHWÁ constraints prove critical in words such as *secretary* or *delicatessen*. The former is unusual in the distance between the primarily stressed syllable and the word's right edge, while the latter is unusual in the placement of primary stress on what seems to be a light penult. Nevertheless, especially if we then promote ONSET to rank above NON-FIN, our revised hierarchy regularizes both of them.

Tableau 10: *delicatessen*

/dɛlɪkətɛsən/	*LAPSE	*SCHWÁ	ONSET	NON-FIN	ALIGN-R(P)	ALIGN-L(W,F)
(ˈdɛl-lɪ)<kə.tɛ.sən>	*!				****	
(ˌdɛl-lɪ)(ˈkət-tɛ)<sən>		*!			**	
(ˌdɛl-lɪ)<kə>(ˈtɛs)<ən>			*!		*	
<dɛ>(ˌlɪk-kə)(ˈtɛs-sən)				*	*	*!
→ (ˌdɛl-lɪ)<kə>(ˈtɛs-sən)				*	*	

Tableau 11: *secretary*

/sɛkɹətɛɹiː/	*LAPSE	*SCHWÁ	ONSET	NON-FIN	ALIGN-R(P)	ALIGN-L(W,F)
<sɛ>(ˈkɹət-tɛ)<ɹiː>		*!			**	*
(ˌsɛk-kɹə)(ˈtɛɹ-ɹiː)				*!		
→ (ˈsɛk-kɹə)<tɛ.ɹiː>					***	

Returning to our two alignment constraints, however, we find that the currently proposed ranking, as supported by *utensil*, makes the incorrect prediction for bisyllabic words with a final heavy syllable, an initial syllable whose nuclear vowel is short, and only one intervening consonant. In such words, assuming an undominated PARSE(FT) constraint mandating metric parsing, NON-FIN must be violated in order to foot the word at all. Not footing the final syllable leaves only a single light syllable, which can not be footed as per FOOT-BIN. Plus, that initial light

syllable cannot be made heavy via ambisyllabicity, because doing so would violate *<AMBI>. Since the final syllable is heavy, then, that is where the optimal form would place the stress. For example, the word *happy* would surface as /hæˈpiː/ instead of /ˈhæpiː/.

Tableau 12: *happý*

	/hæpiː/	*<AMBI>	ONSET	NON-FIN	ALIGN-R(P)	ALIGN-L(W,F)	PARSE(σ)
	(ˈhæp-)<-piː>	*!					
	(ˈhæp)<iː>		*!				
*→	<hæ>(ˈpiː)					*	*
	(ˈhæp-piː)				*!		

This apparent conflict can be resolved by exploding the NON-FIN constraint into NON-FIN(FT) and NON-FIN(STR). The former would be identical to the original NON-FIN, which impedes footing of a final syllable. The latter would be more specific, prohibiting the stressing of a final syllable. By placing NON-FIN(STR) between NON-FIN(FT) and ALIGN-R(P), the effect is to decree that, if a final syllable must be footed, it cannot serve as the head of that foot.

Tableau 13: *háppy*

	/hæpiː/	NON-FIN(STR)	ALIGN-R(P)	ALIGN-L(W,F)	PARSE(σ)
	<hæ>(ˈpiː)	*!		*	*
→	(ˈhæp-piː)		*		

Altogether, the current ranking of all constraints so far discussed is as follows. STR-to-WT is tentatively placed in the undominated tier, since no words spring to mind for the native English-speaking author in which a violation of STR-to-WT is unambiguously evident on the surface. Its precise placement may be a question for future research. The experimental results obtained by Elzinga and Eddington in particular suggest that it may not be entirely undominated, but for our current purposes, the ultimate answer to this question has no visible impact.

FT-BIN, PARSE(FT), TROCH/*IAMB, *CLASH, *LAPSE, *SCHWÁ, *<AMBI>, STR-to-WT >> ONSET >> NON-FIN(FT) >> NON-FIN(STR) >> ALIGN-R(P) >> ALIGN-L(W,F) >> PARSE(σ) >> *AMBI >> *CODA

6. Beyond Phonological Criteria

We have until now explored constraints and rankings based on purely phonological criteria, and we already have greater empirical coverage than the traditional generalization produces, as shown by cases such as *gorilla* or *delicatessen*, for which the more approximate model would have predicted /ˈgəˑɹɪˑləˑ/ and /ˌdɛˑlɪˈkəˑtɛˑsənˑ/. Although the above OT analysis was developed using nouns and adjectives as test cases, many verbs can also be regularized using the same system. *Sully*, for instance, follows the model of *happy*.

Tableau 13: *sully*

/sʌliː/	ONSET	NON-FIN (FT)	NON-FIN (STR)	ALIGN-R(P)	ALIGN-L(W,F)	PARSE(σ)
(ˈsʌl)<iː>	*!			*		*
<sʌ>(ˈliː)		*	*!		*	*
→ (ˈsʌl-liː)		*		*		

However, a purely phonological account has its limits, as shown by the following problematic cases of *imágine* and *prefér*.

Tableau 14: *ímagine*

/ɪmædʒ͡ɪn/	ONSET	NON-FIN (FT)	NON-FIN (STR)	ALIGN-R(P)	ALIGN-L(W,F)	PARSE(σ)
*→ (ˈɪm-mæ)<dʒ͡ɪn>	*			**		*
<ɪ>(ˈmædʒ͡-dʒ͡ɪn)	*	*!		*	*	*

Tableau 15: *préfer*

/pɹɪfɜˬ/	ONSET	NON-FIN (FT)	NON-FIN (STR)	ALIGN-R(P)	ALIGN-L(W,F)	PARSE(σ)
*→ (ˈpɹɪf-fɜˬ)		*		*		
<pɹɪ>(ˈfɜˬ)		*	*!		*	*

The first counter-example represents a class of words that may be best accounted for by lexically specified stress that is preserved via an undominated faithfulness constraint, as briefly suggested at the beginning of this paper. The class of words represented by the second counter-example could also be explained in the same way, but here, it might be particularly worthwhile to explore other options. Bisyllabic forms with stressed heavy ultimas characterize a suspiciously common pattern among English verbs, one that often occurs even when the penult is also heavy (e.g. *infér*) and especially when the ultima is "super-heavy" (e.g. *retúrn, invént*), with the terminal syllable having either CVCC or CVVC structure. One possibility, of which the author was reminded by a reviewer of this work, is to propose that verbs are subject to a different constraint ranking, perhaps one that promotes ALIGN-R(P) or demotes NON-FIN(STR).

However, even with such a model that re-ranks certain constraints if the input is a verb, we may yet be missing one or more important generalizations. In most of these bisyllabic verbs with primary stress on a heavy ultima, that final syllable consists of what may be analyzed as a bound root. For instance, aside from *prefér*, there is also *infér*, *defér*, and *confér*. Most or all of these are formed by combining prefixes and roots of Greco-Latinate origin. Whether this reflects modern morphological structure or the mere etymology of words that are now processed as monomorphemic is as yet unclear, but if the historical morpheme boundaries remain psychologically salient enough, then such items could be further regularized by the incorporation of root faithfulness and

other morphology-based constraints. After all, some degree of root faithfulness seems operative even on derivative words consisting of more quotidian and/or Germanic elements such as the verbs *undó* and *remáke*, for which the model hitherto developed would predict *úndo* and *rémake* respectively. The system could then be further elaborated and enhanced by affix-specific constraints of the sort described by Benua (1997). Cases such as *átom* → *atómic* demonstrate that at least some affixes can override prevailing patterns, while seemingly anomalous contrasts such as that between *extérminator* and *extèrminátion* reinforce the demonstration that not all affixes are treated equally in prosodic parsing.

7. Conclusion

In any case, these potential elaborations all involve constraints that refer to morphological composition, so it seems that the model herein developed pushes the limits of a strictly phonological OT account of English stress assignment. Nevertheless, with the use of ambisyllabicity as an important mechanism, it achieves noticeably greater empirical coverage than the traditional rule-based account, and further refinement via morphology-based constraints is fertile ground for future research. The aim of this paper was, first, to address the conundrum presented to most previous accounts of English stress by the possibility of stress-induced resyllabification, and second, once that had been succesfully integrated into a new OT model, to briefly examine the limitations that remain, thereby providing fodder for suggested future inquiry. In the process, we confirmed that a purely phonological account will accomplish much, but a truly robust system practically demands the role of constraints referring to morphology, specifically root faithfulness and affix-specific effects. Polymorphemic words such as *undó* or *remáke* (as a verb) are not evaluated correctly by a paradigm that refers only to phonology.

The overall result of this exercise is a syncretism of the stress-based resyllabification of Hammond and the ambisyllabicity examined by Elzinga and Eddington, with the prospect of even further refinement via morphological constraints such as those proposed by Benua and Lee. One might recall, though, that the work of Elzinga and Eddington (2014) suggests that the STRESS-to-WEIGHTT constraint assumed in current discourse to be the driving force of ambisyllabicity may not be the only possible cause thereof. Hence, the precise role(s) of ambisyllabicity as well as morphologically driven constraints seem to present a worthwhile field for future investigation, with the overall analysis presented here offering one scenario which may help in the systematization of English stress should they both prove to be as prominent as some researchers have claimed.

WORKS CITED

Anderson, John Mathieson, and Colin J. Ewen. *Principles of dependency phonology*. No. 47. Cambridge University Press, 1987.

Benua, Laura. *Transderivational Identity: Phonological Relations Between Words*. Dissertation, University of Massachussetts. 1997

Cutler, Anne, et al. "The syllable's differing role in the segmentation of French and English." *Journal of memory and language* 25.4 (1986): 385-400.

Elzinga, Dirk, and David Eddington. "An experimental approach to ambisyllabicity in English." *Topics in Linguistics* 14.1 (2014): 34-47.

Hammond, Michael. *Syllable Parsing in English and French*. 1995. Rutger's Optimality Archive.

Kahn, Daniel. *Syllable-Based Generalizations in English Phonology*. Dissertation, Indiana University. 1976

Lee, Yongsung. *Underlying Schwas in English*. 2006. Korean Journal of Languages and Linguistics.

Pater, Joe. *On the Non-Uniformity of Weight-to-Stress and Stress Preservation Effects in English*. 1995. Rutger's Optimality Archive.

Treiman, Rebecca, and Catalina Danis. "Syllabification of intervocalic consonants." *Journal of memory and language* 27.1 (1988): 87-104.