Trisyllabic Shortening and Two Affix Classes*

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1. Introduction

Trisyllabic Shortening is a phenomenon in English prosody which has received much attention within the theoretical framework of Lexical Phonology (Kiparsky (1982)). Trisyllabic Shortening occurs when a word containing a long vowel, such as *nation*, takes a suffix from a particular class called the 'Level 1' affixes, such as *-al*, placing the long vowel in a position three or more syllables from the right edge of the word. In this position, the initially long vowel shortens: *national*.

Lexical Phonology is a derivational theory which posits various strata in which morphemes are concatenated and phonological rules may apply. Morphemes subcategorize for the stratum in which they will be added to a word, and many phonological rules are dependent on morpheme concatenation before they are able to apply. Since the derivation is serial, rules from a later level do not apply until previous levels are finished. In Lexical Phonology, Trisyllabic Shortening has been characterized by the application of a rule within the first stratum, or 'Level 1', of English phonology. This rule applies only within Level 1, to words which contain Level 1 affixes. A word which doesn't concatenate morphemes at Level 1 misses its chance for the application of Trisyllabic Shortening, so shortening doesn't occur in these words.

In contrast, mainstream Optimality Theory (Prince and Smolensky (1993)) does not posit multiple levels of derivation. In this constraint-based system all morphemes of a word are present in the input, and possible output candidates are evaluated in one step. Because of this, Optimality Theory (OT) cannot treat morphologically-sensitive alternations such as Trisyllabic Shortening via level-ordering in which some phonological constraints are only applied to certain inputs. However, such phenomena can be analyzed within OT by multiplying constraints, such as FOOTBINARITY (Prince and Smolensky (1993)), into parochial constraints whose effects are visible only with inputs of a certain morphological type, such as $\text{FOOTBINARITY}_{\text{Class 1}}$, and general constraints which affect all inputs,

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such as FOOTBINARITY. Since these constraints are separately rankable, the result is that although a constraint such as FOOTBINARITY applies to all inputs, for certain inputs (e.g. words with Class 1 affixes) it may be given a higher priority via a higher ranking of FOOTBINARITY$_{\text{Class 1}}$. In this paper I account for Trisyllabic Shortening within OT by presenting just such an analysis. I argue that in English FOOTBINARITY is given higher priority for words which contain affixes from one particular group (Class 1) than it is for words with other affixes and unaffixed words. This analysis accounts for the vowel length alternations of Trisyllabic Shortening by appealing to the well-attested cross-linguistic tendency for stress feet to be moraically binary, without positing multiple levels or rankings.

The organization of this paper is as follows. First, I review a Lexical Phonological analysis of Trisyllabic Shortening, as given in Kiparsky (1982) and Borowsky (1990). I then present an OT analysis of the data, and motivate the need for a division of FOOTBINARITY into FOOTBINARITY$_{\text{Class 1}}$ and FOOTBINARITY. This is followed by an alternate analysis, based on output-output correspondence, which fails to account for the data.

Throughout this paper I make a number of assumptions regarding underlying representations. This paper focuses on the length alternations associated with Trisyllabic Shortening. In English, however, length alternations also result in vowel quality alternations. Since I wish to focus only on vowel length, not vowel quality, I will assume throughout the paper that all underlying vowels are lax, and that long lax vowels are pronounced as tense. The richness of the base within OT prevents such constraints on input structure, but I make them in order to limit the scope of this paper to vowel length only. I assume that other constraints, not discussed here, will force long vowels in English to surface as tense, and short vowels to surface as lax, regardless of underlying vowel quality (cf. Hammond (1997)). The assumed vowel inventory of English, as based on a standard American West Coast dialect, is given in (1):

(1) English Vowels

/ɪ/ [ɪ]	/ɛ/ [ɛ]	/æ/ [æ]	/ɑ/ [ɑ]	/ʌ/ [ʌ]
/ɪ:/ [ɑ^{j}]	/ɛ:/ [ɪ^{j}]	/æ:/ [ɛ^{j}]	/ɑ:/ [o$^{\omega}$]	/ʌ:/ [ʊ$^{\omega}$]

2. Trisyllabic Shortening

Kiparsky (1982) gives an extensive account of Trisyllabic Shortening. In Kiparsky's analysis, Trisyllabic Shortening follows from the rule given in (2), which shortens a vowel when it is followed by two or more vowels, the first of which is unstressed.

(2) *Trisyllabic Shortening*
$V \rightarrow$ [-long] / __ $C_0V_iC_0V_j$ where V_i is not metrically strong (Kiparsky (1982), p. 35).

The effect of this rule is to cause the alternations shown in (3). Alternating vowels are underlined.

(3) mitər ~ mɛtrɪkəl	/ɛː/ ~ /ɛ/	koʷn ~ kɑnəkəl	/ɑː/ ~ /ɑ/
əbsin ~ əbsɛnəti		koʷd ~ kɑdəfaʲ	
dəskrit ~ dəskrɛʃən		oʷmənɑmənəs	
sen ~ sæ̱nəti	/æː/ ~ /æ/	dəvaʲn ~ dəvɪnəti	/ɪː/ ~ /ɪ/
neʃən ~ næʃənəl		baʲbəl ~ bɪbləkəl	
prəfen ~ prəfænɪti		faʲnaʲt ~ ɪnfɪnəti	

Trisyllabic Shortening only operates in certain morphological environments, however. It does not apply to morphologically simple words (4a), nor does it apply in environments created by the addition of certain affixes (4b).

(4) a. naʲtɪŋgel (*nɪtɪŋgel)
aʲvəri (*ɪvəri)
oʷvərtʃər (*ɑvərtʃər)
ɪngridiənt (*ingrɛdiənt)
b. ʃipɪʃ ~ ʃipɪʃli (*ʃɛpɪʃli)
feθfəl ~ feθfəlnəs (*fæθfəlnəs)
oʷpən ~ oʷpənɪŋ (*ɑpənɪŋ)
saʲnəs ~ saʲnəsoʸd (*sɪnəsoʸd)

In Lexical Phonology, the fact that Trisyllabic Shortening does not apply to monomorphemic words (4a) is accounted for by the Strict Cycle Condition, which states that cyclic rules which are structure-changing apply only in derived environments.[1] Under Kiparsky's analysis, Trisyllabic Shortening is a cyclic rule which applies at Level 1. A derived environment is created by the addition of a morpheme or the application of a structure-changing phonological rule within the

[1] Non-structure-changing phonological rules include syllabification, stress assignment, and feature-filling rules, which are structure-adding. These rules are exempt from the Strict Cycle Condition, as formulated in Kiparsky (1985).

same cycle. Since in monomorphemic words no additional morphemes are attached at Level 1 (or at any level), such words can only undergo cyclic rules after the application of a non-cyclic structure-changing rule (such as Schwa Insertion and the vowel shifting rule which changes the quality of long vowels, shown in (5) below). However, all Level 1 structure-changing rules are cyclic, resulting in the fact that monomorphemic words cannot undergo any cyclic rules (such as Trisyllabic Shortening (TRI)) at Level 1. A simplified derivation of the monomorphemic word *ivory* is shown in (5). Underlines indicate vowel changes.

(5)	Underlying Representation:		/ɪːvɑrɛː/
	Level 1	Morphemes added:	------------
		Stress Assignment:	(ɪ́ː.vɑ) rɛː
		TRI:	------------ (cannot apply)
	Level 2	Morphemes added:	------------
		Schwa Insertion:	(ɪ́ː.və̲) rɛː
		Vowel Shift:	(á̲ʲ.və) riʲ
	Surface Representation:		[áʲvəriʲ]

Because no morphemes have been concatenated at Level 1, Trisyllabic Shortening cannot be applied. Since Schwa Insertion and the Vowel Shift rule are non-cyclic, they can apply at Level 2, despite the lack of morpheme concatenation.

The polymorphemic words which do not undergo Trisyllabic Shortening (4b) are accounted for by the fact that the suffixes which create the trisyllabic environment (e.g. *-y*, *-ness*, *-ing*, *-oid*) are applied at Level 2. Because at Level 1 these words have not yet undergone any morpheme concatenation, these words, like monomorphemic words, cannot undergo any cyclic rules at Level 1. This is illustrated in (6) with a simplified derivation of the words *national*, which has a Level 1 suffix, and *opening*, which has a Level 2 suffix. *National* is polymorphemic at Level 1, and undergoes Trisyllabic Shortening, while *opening* is still monomorphemic at Level 1 and Trisyllabic Shortening fails to apply.

(6) Underlying Representation:		/næ:ʃɑn/	/ɑ:pɛn/
Level 1	Morphemes added:	næ:ʃɑn + æl	------------
	Stress Assignment:	(nǽ:.ʃɑ) næl	(ɑ́.pɛn)
	TRI:	(nǽ.Σɑ) væl	------------
(cannot apply)			
Level 2	Morphemes added:	------------	(ɑ́:.pɛn) + ɪŋ
	Schwa Insertion:	(nǽ.ʃə) nəl	(ɑ́:.pən) ɪŋ
	Vowel Shift:	------------	(ó^w.pən) ɪŋ
Surface Representation:		[nǽʃənəl]	[ó^wpənɪŋ]

Because Trisyllabic Shortening applies only to words which have undergone morpheme concatenation at Level 1, it cannot apply to words which are monomorphemic (e.g. *ivory*) or which contain only Level 2 affixes (e.g. *opening*).

Borowsky (1990) provides a more natural account of Trisyllabic Shortening within Lexical Phonology, by appealing to more general principles of English syllable structure in order to explain the effect. Arguing that stressed syllables attract coda consonants, she provides the following Level 1 resyllabification rule:

(7) V́.CV̆ → V́.C.V̆

The rule in (7) forces all stressed vowels followed by consonants to be parsed into closed syllables. Once this has occurred, the syllable well-formedness constraint in (8) applies, which bans superheavy syllables.

(8) $\sigma \rightarrow C^0V(X)$ (where C^0 is zero or more consonants, and X is a consonant or vowel)

The rule in (8) allows syllables to contain at most two segments (i.e. VV or VC) following an onset. Once the resyllabification rule (7) has applied, stressed syllables are closed (if there is an available coda consonant), so any long stressed vowels will be forced to shorten in order to maintain the well-formedness imposed by (8). Since the resyllabification rule in (7) only operates at Level 1, it feeds Trisyllabic Shortening in words with Level 1 affixes without causing shortening at Level 2.

3. OT Analysis

The division between Level 1 and Level 2 affixes in Lexical Phonology is motivated by such things as differences in stress assignment (*párent/paréntal* (Level 1) vs. *párenthood* (Level 2)), the need to block regular affixes from applying to irregular forms (*mouse/mice*, **mouses*), and the ordering of affixes in cases of multiple affixation (*nonillegible*, **innonlegible*; from Kiparsky (1982)). How these phenomena should be treated within OT is a question for further research, but it appears that at least some irregular or morpheme-specific phenomena will require a treatment that appeals to lexically specified information. For example, the irregular pluralization of *mouse* cannot be said to occur for purely phonological reasons (cf. *blouses*, *spouses*); it must be the case that *mouse* is lexically specified as having an irregular plural. In the case of Trisyllabic Shortening, only certain affixes induce shortening, and there is no clear phonological distinction between those that do and those that do not. For example, although many Level 1 suffixes are vowel-initial (e.g. *-al* in *nation/national*, and *-ual* in *grade/gradual*) and many Level 2 affixes are consonant-initial (e.g. *-hood* in *nation/nationhood* and *-less* in *grade/gradeless*), there are exceptions on both levels. Level 1 affixes such as *-tive* (*describe/descriptive*) and *-tion* (*induce/induction*) cause Trisyllabic Shortening, yet are consonant-initial. And Level 2 affixes such as *-ing* (*describe/describing*) and *-able* (*grade/gradable*) do not cause Trisyllabic Shortening, and yet are vowel-initial. These examples also demonstrate that the two affix classes do not divide along the lines of syllable number. Affixes from both classes can be either one or two syllables long. Instead, it appears that there must be a purely morphological distinction between the two groups. In order to account for this, I assume that affixes are lexically marked as belonging to one of two types, which I will call Class 1 and Class 2, corresponding to Levels 1 and 2 of Lexical Phonology.[2] The proposed analysis for treating Trisyllabic Shortening within OT distinguishes these two affix classes by imposing a stricter requirement on words containing Class 1 affixes that they maintain binary foot structure.

4. FOOTBINARITY and MAXμ

Prince and Smolensky (1993) point out the preference for languages to have moraically binary stress feet (citing examples from Estonian, Latin, Lardil, and English). In subsequent analyses, this preference has been illustrated in languages such as Axininca Campa (McCarthy and Prince (1993)), Indonesian

[2] See Benua (1997) for a full account of these two affix classes in English.

(Cohn and McCarthy (1994)), Tohono O'odham (Fitzgerald (1996)), Yupik (Bacović (1996)), and further analyses of English (Hammond (1995), Pater (1995)). This cross-linguistic preference is formalized in the constraint FOOTBINARITY, defined in (9):

(9) FOOTBINARITY (FTBIN): Feet are binary (bimoraic).[3]

FOOTBINARITY interacts with MAXμ, which requires all moras from the input to be faithfully maintained in output forms.

(10) MAXμ: Input moras have output correspondents (i.e., don't delete moras).[4]

The respective ranking of these two constraints determines whether or not vowel shortening is an option, when a language is faced with an input whose moraically faithful output would result in a nonbinary foot. This interaction is shown in tableaux (11) and (12).

(11) Input: /CVVCV/

		FTBIN	MAXμ
a.	(CV.V)(CV)	*!	
b.	(CVV)(CV)	*!	
☞c.	(CV.CV)		*
d.	(CVV.CV)	*!	

The input in (11) contains a long vowel (represented by "VV"). The ranking of FTBIN above MAXμ results in the choice of candidate c, which has a shortened vowel. Candidates a and b both violate FTBIN by having final, monomoraic feet. Candidate d violates FTBIN with its single, trimoraic foot. In (12) the ranking of these two constraints is reversed.

[3] The original definition for FOOTBINARITY, as given in Prince and Smolensky (1993) is "Feet are binary at some level of analysis (μ, σ)" (p.47). The result of this constraint is to require feet that are *minimally* bimoraic, as opposed to the current definition which requires feet to be *exactly* bimoraic. The present definition of FOOTBINARITY is taken from Hammond (1995).
[4] MAXμ is a moraic correspondence constraint, following McCarthy and Prince (1995). The wording of the constraint is borrowed from Baković (1996).

(12) Input: /CVVCV/

		MAXμ	FTBIN
a.	(CV.V)(CV)		*
b.	(CVV)(CV)		*
💣c.	(CV.CV)	*!	
d.	(CVV.CV)		*

When MAXμ outranks FTBIN, candidate c is ruled out for deleting a mora, while the other candidates all faithfully maintain the input moras. This faithfulness, however, is at the expense of FTBIN, which is violated by all three. With this ranking, other constraints would be necessary to determine which candidate is chosen, but any candidate which has shortened vowels (in this case, candidate c) will be ruled out. In this analysis, I assume that long vowels are specified as bimoraic in the input. I do not treat short vowels as having underlying moras, although it makes no difference to the analysis.

5. Nonfinality and ParseSyllable

Nouns and suffixed forms in English are generally analyzed as having unfooted final syllables (e.g. Hayes (1982), Hammond (1995)). In OT this can be characterized by the interaction of NONFINALITY (Prince and Smolensky (1993)), with several other constraints (see Pater (1995) for a full analysis). As originally formulated, NONFINALITY prevents the prosodic head of a word from falling on the final syllable. However, to simplify the interaction of several constraints for our purposes, I follow Hammond (1995) in redefining NONFINALITY as in (13):

(13) NONFINALITY (NONFIN): The final syllable is not footed.

This modified version of NONFINALITY prevents final syllables from being footed. In order to allow the existence of final extrametrical syllables, this constraint must outrank PARSESYLLABLE.

(14) PARSESYLLABLE (PARSEσ): All syllables must be parsed into feet.

The interaction of NONFINALITY and PARSESYLLABLE is shown in the following two tableaux.

(15) Input: /CVVCV/

		NONFIN	PARSEσ
☞a.	(CVV) CV		*
b.	(CVV.CV)	*!	

In (15), NONFINALITY outranks PARSESYLLABLE. Candidate a leaves the final syllable unparsed, and consequently satisfies the higher ranked constraint, NONFINALITY. Candidate b, which is exhaustively parsed into a single foot satisfies PARSESYLLABLE, but thus violates NONFINALITY which requires a final, extrametrical syllable.

(16) Input: /CVVCV/

		PARSEσ	NONFIN
a.	(CVV) CV	*!	
☞b.	(CVV.CV)		*

In (16) PARSESYLLABLE is ranked above NONFINALITY, and the candidate with exhaustive parsing is chosen. A comparison of (15) and (16) shows that these two constraints are in direct opposition: no candidate which satisfies NONFINALITY can also satisfy PARSESYLLABLE, and vice versa. Since we know that NONFINALITY does play a role in English (at least in nouns and suffixed forms), this constraint must outrank PARSESYLLABLE.

(17) *Ranking of NONFINALITY and PARSESYLLABLE in English*
NONFINALITY >> PARSESYLLABLE

6. Class 1 Affixes vs. Other Forms

Having discussed the interaction of FTBIN with MAXμ, and NONFINALITY with PARSESYLLABLE, a few more constraints will be necessary in order to analyze the vowel shortening data. The constraint STRESSWELL (Pater (1995)), prevents stress clash between primary and secondary stresses:

(18) STRESSWELL: No stressed syllable may be adjacent to the head syllable of the Prosodic Word.[5]

[5] The constraint STRESSWELL, as discussed in Pater (1995), prevents adjacent primary and secondary stresses. As Pater points out, stress clash between non-primary stress heads is tolerated in English to a greater degree than clash between primary and non-primary heads. The constraint *CLASH, which prevents any adjacent stresses, is lower ranked. In this paper, however, I do not mark the distinction between primary and secondary stress, but violations of STRESSWELL are only marked in cases where one stress is primary.

The constraints MAX$_{segment}$ and DEP$_{segment}$, which prevent outright deletion or insertion of segments are for our purposes undominated. A summary of the constraints and rankings given so far is shown in (19).

(19) MAX$_{segment}$, DEP$_{segment}$ (undominated)
NONFINALITY >> PARSESYLLABLE
FTBIN, MAXμ, STRESSWELL (not yet ranked)

Since MAX$_{segment}$ and DEP$_{segment}$ are for our purposed undominated, no violations of these constraints will be considered, and the segment faithfulness constraints will be left out of subsequent tableaux.

We now turn to the evaluation of a word such as *national*, which contains a Class 1 affix. Evaluation of Class 1 affixed forms demonstrates the need to rank STRESSWELL and FTBIN above MAXμ. Crucial rankings are marked by a double line.

(20) Input: /næːʃɑn + æl/

		NONFIN	PARSEσ	STRESSWELL	FTBIN	MAXμ
☞ a.	(nǽ.ʃə) nəl		*			*
b.	(néː.ʃə) nəl		*		*!	
c.	(néː)(ʃɑ́n) əl		*	*!		
d.	(nǽ.ʃə)(nǽl)	*!				*
e.	(néː.ʃə)(nǽl)	*!			*	

Since NONFINALITY outranks PARSEσ, candidates d and e are ruled out, leaving only a, b, and c. We know that the correct candidate is a -- [(nǽ.ʃə) nəl] -- so candidates b and c must be ruled out. This is done by ranking STRESSWELL and FTBIN above MAXμ. Since candidate c violates STRESSWELL by having adjacent stresses, and candidate b violates FTBIN by virtue of its trimoraic foot, candidate a correctly emerges as the winner, although it violates MAXμ by deleting a mora and thus shortening the initial vowel. This indicates that both STRESSWELL and FTBIN must outrank MAXμ. There is not yet any evidence for the ranking of PARSEσ, so long as it is dominated by NONFINALITY. Likewise, there is no evidence for the ranking between STRESSWELL, PARSEσ, and FTBIN, so long as both STRESSWELL and FTBIN dominate MAXμ.

The evaluation of *national* in (20) demonstrates the need to rank FTBIN above MAXμ for forms with Class 1 affixes. This interaction is highlighted in (20) by the bold double line. However, this ranking must be reversed for forms with Class 2 affixes and monomorphemic forms. The evaluation of a word with a Class 2 affix, *opening*, is given in (21).

(21) Input: /ɑːpɛn + ɪŋ/

		NONFIN	PARSEσ	STRESSWELL	MAXμ	FTBIN
☞ a.	(óː.pə) nɪŋ		*			*
b.	(ɑ́.pə) nɪŋ		*		*!	
c.	(óː)(pɛ̀n) ɪŋ		*	*!		
d.	(óː.pə)(nɪ̀ŋ)	*!				*
e.	(ɑ́.pə)(nɪ̀ŋ)	*!			*	

As in (20), candidates d and e are ruled out by NONFINALITY. Since we know that candidate a -- [(óː.pə) nɪŋ] -- is the correct output, STRESSWELL and MAXμ must outrank FTBIN. Candidate c violates STRESSWELL with its adjacent stresses, and candidate b violates MAXμ by shortening its initial long vowel, and so with this ranking candidate a is correctly chosen.

The ranking in (21) of MAXμ above FTBIN, however, is the converse of the ranking established in (20). But by comparing the outlined sections of (20) and (21), it is clear that a reversal of the ranking between these two constraints would in both cases result in an incorrect choice. In (20), if MAXμ were to outrank FTBIN, candidate b -- [(néː.ʃə) nəl] -- which has no vowel shortening, would be incorrectly chosen. In (21), if FTBIN were to outrank MAXμ, candidate b -- [(ɑ́.pə) nɪŋ] -- which has a shortened initial vowel, would be incorrectly chosen. From this comparison, it is evident that the distinction between Class 1 affixed forms (e.g. *national*) and Class 2 affixed forms (e.g. *opening*) lies in the ranking between FTBIN and MAXμ. Class 1 affixed forms violate MAXμ by shortening long vowels, in order to satisfy FTBIN and maintain better-formed feet. Class 2 affixed forms have the opposite preference: they sacrifice well-formedness by creating trimoraic feet, in order to faithfully maintain input moras.

We would not, however, want to say that the ranking between FOOTBINARITY and MAXμ changes depending on the morphology of the input. If this were true, there would be two different phonologies of English: one operating whenever an input had a Class 1 affix, the other operating for words with Class 2 affixes. Since this solution seems a bit extreme, we can instead characterize the difference between these two affix classes by means of a parochial constraint. Because words with Class 1 affixes differ from words with Class 2 affixes and unaffixed words by their stricter obedience to FOOTBINARITY, we can characterize this by ranking a parochial constraint FOOTBINARITY$_{\text{Class 1}}$ above the general FOOTBINARITY constraint. FOOTBINARITY$_{\text{Class 1}}$ requires that words containing Class 1 affixes maintain binary feet.

(22) FOOTBINARITY$_{\text{Class 1}}$: In words with Class 1 affixes, feet are binary (bimoraic).

Since words with Class 1 affixes would rather maintain good foot form than preserve input moras, as demonstrated in (20), FTBIN$_{\text{Class 1}}$ must dominate MAXμ. Words with Class 2 affixes, however, preserve input moras at the expense of foot form, as demonstrated in (21), and therefore MAXμ must dominate FTBIN. The resulting ranking between these three constraints is given in (23):

(23) FOOTBINARITY$_{\text{Class 1}}$ >> MAXμ >> FOOTBINARITY

With this ranking, we re-evaluate *national* (Class 1) and *opening* (Class 2). As the interaction between NONFINALITY and PARSEσ has already been demonstrated, and the higher ranking of NONFINALITY forces all winning candidates to include a final extrametrical syllable, these two constraints are left out of subsequent tableaux.

(24) Input: /næ:Σɑn + æl/

		STRESSWELL	FTBIN$_{\text{CLASS 1}}$	MAXμ	FTBIN
☞ a.	(nǽ.ʃə) nəl			*	
b.	(né:.ʃə) nəl		*!		*
c.	(né:)(ʃàn) əl	*!			

Candidate c is ruled out by STRESSWELL for having adjacent stresses. The crucial interaction is between FTBIN$_{\text{CLASS 1}}$ and MAXμ. Since this word contains a Class 1 affix, FTBIN$_{\text{CLASS 1}}$ applies and rules out candidate b, correctly choosing candidate a as the winner.

(25) Input: /ɑ:pɛn + ɪŋ/

		STRESSWELL	FTBIN$_{\text{CLASS 1}}$	MAXμ	FTBIN
☞ a.	(ó:.pə) nɪŋ				*
b.	(ɑ́.pə) nɪŋ			*!	
c.	(ó:)(pɛ̀n) ɪŋ	*!			

Tableau (25) shows the evaluation of a word with a Class 2 affix. Since all candidates vacuously satisfy FTBIN$_{\text{CLASS 1}}$ (because the word does not contain any Class 1 affixes), the crucial ranking is between MAXμ and the general constraint

FTBIN. Candidate b is ruled out for deletion of a mora, and candidate a is correctly chosen as the winner.

The tableau in (26) shows that this ranking will result in the correct candidate being chosen for monomorphemic words, such as *ivory*, as well.

(26) Input: /ɪ:vɑrɛ:/

		STRESSWELL	FTBIN$_{CLASS 1}$	MAXμ	FTBIN
☞ a.	(áʲ.və) ri:				*
b.	(ɪ́.və) ri:			*!	
c.	(áʲ)(vɑ́r) i:	*!			

STRESSWELL rules out candidate c, which has adjacent stresses. FTBIN$_{CLASS 1}$ is vacuously satisfied by all candidates because there are no Level 1 affixes in this form. As with the Class 2 affixed form, the candidate which faithfully preserves all input moras (candidate a) is chosen over the one which maintains bimoraic feet (candidate b). This ranking of constraints correctly chooses candidate a -- [(áʲ.və) ri:] -- as the output form.

The final ranking of constraints is summarized in (27).

(27) *Final Rankings*
FAITH (undominated)
NONFIN >> PARSEσ
NONFIN >> STRESSWELL, FTBIN$_{CLASS 1}$ >> MAXμ >> FTBIN

7. Alternate Analysis

An alternate analysis of these two affix classes is given by Benua (1997), who appeals to output-output correspondence constraints. Benua's analysis rests on a family of constraints requiring correspondence between output forms containing the same root. For example, the constraint OO-ANCHOR requires words containing the same root, such as *párent/párenthood* to have stress assigned to the same syllable of the root. In Benua's analysis, the difference between words with Class 1 affixes and other words is that words with Class 1 affixes violate output-output correspondence more than words with Class 2 affixes; that is, the roots of Class 1 affixed forms are less similar to their isolation forms than the roots of Class 2 affixed forms are. For example, with respect to stress assignment, a Class 2 affixed form (e.g. *párenthood*) has stress on the same syllable as the isolation form of the root (e.g. *parent*). The same is not true for Class 1 affixed forms (e.g. *paréntal*).

From data such as these, Benua concludes that Class 2 affixes require words to be more faithful to their inputs. This is characterized by ranking the parochial constraint OO_2-ANCHOR above the general OO-ANCHOR constraint, mediated by a constraint ALIGN-R, which requires stress to be aligned at the rightmost syllable of a word.

(28) OO-ANCHOR: In an affixed word, stress falls on the same syllable of the root as in
the isolation form of the root.

(29) ALIGN-R: Main stress is on the rightmost syllable of a word.

This analysis is illustrated in the following two tableaux, which evaluate *párenthood* and, *paréntal* respectively.

(30) Input: /pɛ:rɛnt + hʊd/

		NONFIN	STRESSWELL	OO_2-ANCHOR	ALIGN-R	OO-ANCHOR
☞a.	(pɛ́:.rɛnt)hʊd				*	
b.	pə(rɛ́nt)hʊd			*!		*
c.	(pɛ̀:)(rɛ́nt)hʊd		*!			
d.	(pɛ̀:)rənt(hʊ́d)	*!				

As in all previous tableaux, NONFINALITY is highly ranked, and here it rules out candidate d for parsing a final syllable. Candidate c is ruled out by STRESSWELL for its two adjacent stresses. Because this word contains a Class 2 affix, OO_2-ANCHOR is active and rules out candidate b for failing to place stress on the initial syllable of the root, where it is located in the isolation form *párent*. Candidate a is correctly chosen as the output.

For words which do not contain Class 2 affixes, OO_2-ANCHOR has no effect, allowing ALIGN-R to determine the output. This is illustrated in (31) in the evaluation of a Class 1 affixed form, *parental*.

(31) Input: /pɛ:rɛnt + æl/

		NONFIN	STRESSWELL	OO_2-ANCHOR	ALIGN-R	OO-ANCHOR
☞a.	pɛ:(rɛ́nt)əl					*
b.	(pɛ́:.rɛnt)əl				*!	
c.	(pɛ̀:)(rɛ́nt)əl		*!			
d.	(pɛ̀:)rənt(ǽl)	*!				

Once again, candidates c and d are ruled out by STRESSWELL and NONFINALITY, respectively. OO_2-ANCHOR is vacuously satisfied, and ALIGN-R rules out candidate b. The remaining candidate is a, which is chosen as the output form although it violates OO-ANCHOR by failing to stress the same root syllable as in the isolation form *párent*.

From these data, it appears that Benua's generalization is correct: that is, that the difference between Class 1 and Class 2 affixes is that Class 2 affixed words are more faithful to their roots' isolation forms than are Class 1 affixed words. However, if we apply the same reasoning to the vowel shortening data, we see that this is not the case.[6] In order to demonstrate, let us consider an output-output correspondence analysis of the Trisyllabic Shortening data.

Since it is Class 1 affixed forms which undergo vowel shortening, while Class 2 affixed forms do not, Benua's generalization appears at least initially to be correct: Class 2 affixed forms are moraically more faithful to their isolated roots (e.g. [(ó:)pən]/[(ó:.pə) nɪŋ] -- same number of moras in root) than are Class 1 forms (e.g. [(né:)ʃɑn]/[(nǽ.ʃə) nəl] -- fewer moras in root of affixed form). Since this is true, it appears that Class 2 affixed forms require a stricter moraic faithfulness to their roots than do Class 1 affixed forms. We can characterize this with the constraints OO-IDENTμ and OO_2-IDENTμ, as defined below.

(32) OO-IDENTμ: The roots of affixed forms are moraically identical to their isolation forms.

(33) OO_2-IDENTμ: The roots of Class 2 affixed forms are moraically identical to their isolation forms.

In order to have an effect, the parochial constraint OO_2-IDENTμ must be the higher ranked of the two. As in the proposed analysis, the crucially conflicting constraint

[6] Benua (1997) does not provide an analysis of the vowel shortening data. The analysis given here is my own interpretation of her analysis, as applied to the present data.

is FOOTBINARITY, because the contrast between these two affix classes is between faithfulness (as represented by MAXμ in the proposed analysis, or by OO-IDENTμ in the output-output correspondence analysis) and well-formedness (FTBIN in both analyses). If FTBIN intervenes between the two output-output constraints, the evaluation of a Class 2 affixed word, such as *opening* is as shown in (34).

(34) Input: /ɑ:pɛn + ɪŋ/

		STRESSWELL	OO_2-IDENTμ	FTBIN	OO-IDENTμ
☞ a.	(ó:.pə) nɪŋ			*	
b.	(á.pə) nɪŋ		*!		*
c.	(ò:)(pɛ́n) ɪŋ	*!			

Candidate c is ruled out by STRESSWELL, leaving only a and b. Since candidate b has fewer moras in its root than the root isolation form -- [(ó:)pən]-- it is ruled out by OO_2-IDENTμ, resulting in candidate a as the correct output.

For Class 1 affixed forms, such as *national*, OO_2-IDENTμ has no effect, as shown in (35).

(35) Input: /næ:ʃɑn + æl/

		STRESSWELL	OO_2-IDENTμ	FTBIN	OO-IDENTμ
☞ a.	(nǽ.ʃə) nəl				*
b.	(né:.ʃə) nəl			*!	
c.	(nè:)(ʃɑ́n) əl	*!			

Since this word contains no Class 2 affixes, OO_2-IDENTμ is vacuously satisfied. Because of this, the decision is made by FTBIN, which rules out candidate b for its trimoraic foot. The resulting winner is candidate a, although it does not have the same number of moras in its root as the isolation form -- [(né:)ʃən].

Thus far, the output-output analysis appears to correctly account for the data. However, the evaluation of a monomorphemic word, such as *ivory*, demonstrates the inadequacy of this analysis.

(36) Input: /ɪ:vɑrɛ:/

		STRESSWELL	OO_2-IDENTμ	FTBIN	OO-IDENTμ
a.	(áʲ.və) ri:			*!	
❸b.	(ɪ́.və) ri:				
c.	(àʲ)(vɑ́r) i:	*!			

Since this is a root word in isolation (i.e. a monomorphemic word), neither of the output-output constraints apply. The final decision is thus made by FTBIN, which rules out candidate a for having a trimoraic foot, incorrectly choosing candidate b as the winner.

The problem with this analysis is that by making the generalization that Class 2 affixed words are more *faithful* than other words (via the higher ranking of parochial Class 2 output-output constraints), the analysis also predicts that monomorphemic words will behave like Class 1 affixed forms (i.e. by being less faithful and more well-formed). Any analysis which appeals to *Class 2* parochial constraints cannot account for the fact that monomorphemic words group together with Class 2 affixed words, rather than Class 1. For this reason, the data require an analysis which appeals instead to *Class 1* parochial constraints, and thus sets the Class 1 affixed words off as different from Class 2 affixed and monomorphemic words.

In fact, an output-output correspondence analysis cannot account for these data, because the difference between Class 1 and Class 2 affixes is not a question of faithfulness, but rather of well-formedness. As illustrated by the fact that monomorphemic words group with Class 2 affixed words, it is Class 1 affixed words which are different. Class 1 affixed words are unique in their stricter maintenance of well-formed (i.e. moraically binary) feet. Since output-output correspondence imposes faithfulness, rather than well-formedness, requirements, such an analysis cannot account for an alternation which is fundamentally a question of well-formedness.

8. Conclusion

In this paper I have given an OT analysis of Trisyllabic Shortening, a phenomenon analyzed within Lexical Phonology as being the result of a very serial derivation. Within OT such morphologically-sensitive alternations are characterized well through the use of parochial constraints, such as $\text{FOOTBINARITY}_{\text{CLASS 1}}$. The crucial point to my analysis is that there is a sub-group of affixes in English (the Class1 affixes) which impose upon words a stricter requirement for stress feet to be moraically binary than is observed by words not containing such affixes. I have shown that output-output correspondence cannot account for the difference between Class 1 and Class 2 affixes, because the difference between the groups is one of well-formedness, rather than of faithfulness. Although for most words of English, faithfulness to underlying moraic structure is more important than having perfect trochees, words which include a Class 1 affix prefer to maintain good foot form, at the expense of moraic faithfulness.

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