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1 Introduction

This paper has two purposes: First, it is a preliminary report on introspective data (the author's collected database of his own native speaker intuitions) bearing on a topic usually studied from a sociolinguistic viewpoint: the distribution of the tense and lax low front vowels /ǣ:, æ/ (phonetically [eᵊ, æ]) in Philadelphia English. This database, summarized in 2.1, is more comprehensive than any that has been published to date, particularly in regard to these two sounds' distribution in non-word-final syllables. (The complete database will appear in a larger treatment of this subject still in preparation.) Secondly, in this paper I analyze a facet of the /æ~ǣ:/pattern before nasals in non-final syllables not noticed in the literature thus far. In so doing, I argue for the role of syllable weight, ambisyllabicity, the Iambic-Trochaic Law, Optimality Theory (OT), and phonetic grounding conditions relating nasality to [ATR] in developing an explanatory analysis of this complex phenomenon. In comparison with previous OT analyses of /æ~ǣ:/, I differ with Benua's (1995) invocation of a target/trigger tautosyllabicity requirement, and with Morén's (1997) claim that in the similar New York City pattern lax /æ/ is long and tense /ǣ/ is short.

The structure of the paper is as follows: In section 2, I provide a description of the facts of my idiolect, critique previous analyses in the literature on Philadelphia /æ/-tensing in light of my data, and offer a revised analysis in atheoretical terms. In section 3, I develop an OT analysis of the facts, arguing that it offers a more principled account than a rule-based one, and in the end suggesting what implications my analysis might have for future sociolinguistic work on this topic.

2 Philadelphia /æ/-Tensing

Table 1 below shows the contrastive monophthongal vowels of Philadelphia English.[1] The most typical pronunciations (or conventional transcriptions) of

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the diphthongal phonetic realizations of the tense vowels appear in square brackets beside each such vowel:

	front		back	
	tense/long	lax/short	lax/short	tense/long
high	i: [iy]	ɪ	ʊ	u: [uw]
mid	e: [ey]	ɛ	ʌ/ə	o: [ow]
low	ǣ: [eᵊ]	æ	a	ɔ: [oᵊ]

Table 1: Monophthongal vowel inventory of the Philadelphia dialect

This inventory differs from that of most other dialects of English in the extension of the tense-lax contrast to both low vowels. The back low vowel contrast /a, ɔ:/ of Philadelphia is robustly attested in several other American dialects, but the situation is different for the front low vowels: While in most dialects of English [ǣ:], if it occurs, is merely an allophone (or the sole realization) of /æ/, in the New York City and Philadelphia dialects (and also some other East Coast and Southern American dialects — cf. Labov 1994, pp. 334, 465) it contrasts marginally with /æ/ at the classical phonemic level, as shown by the following minimal and near-minimal pairs:

(1)	<u>lax /æ/</u>		<u>tense /ǣ:/</u>[2]	
	a. *bănner*		*bānn-er*	'one who bans'
	b. *vănish*		*vānn-ish*	'like a van'
	c. *grămmar*		*Grāmmer*	(actor's name, with *-er* pseudo-suffix)
	d. *băde*	past tense of *bid*	*bād*	
	e. *hăve*		*hālve*	< *hālf*
	f. *căn*	(Aux)	*cān*	(N or V)
	g. *ăn*		*Ānn*	
	h. *căm*	< *cămera*	*cām*	'machine part'
	i. *măth*	< *măthematics*	*aftermāth*	
	j. *decăf*	< *decăffeinated*	*cālf*	

[1] In this paper I use "Philadelphia English" to mean the dialect of English spoken by the majority of non-AAVE speakers raised in the Philadelphia metropolitan area and born in the 1960's or earlier.

[2] Note that I am abstracting away from the sociolinguistically or stylistically governed variability between /æ/ and /ǣ:/, as a result of which /æ/ may be substituted for /ǣ:/ quite freely before voiceless fricatives, less freely before /d, v, ð/, and only occasionally before nasals (in stylistically marked speech), but not vice versa: /ǣ:/ is almost never substituted for /æ/, except in dialect borrowings (e.g. *Santa Āna winds* — a term the author learned while living in California — alongside *Ănna, Santăna*).

k. *speech păth* < *p*[ə]*thology*, *pāth*
(cf. *păthological*)
l. *PĂTH* (acronym)

These surface minimal pairs break down once structure is taken into account: (1a-c) contrast non-derived words with words containing Level II suffixes, (1d-g) contrast function words and specially derived verbs with normal content words, (1h-k) contrast truncated and non-truncated forms, while (1d, k-l) involve low-frequency words and spelling pronunciations. In fact, the distribution of /ǣː/ and /æ/ is highly predictable according to a complex set of factors that has been studied by many linguists over the years (Ferguson 1972, Kahn 1976, Rotenberg 1978, Payne 1980, Kiparsky 1989, Labov 1994, Benua 1995, and Morén 1997, among others).

2.1 The Distribution of /æ, ǣː/ in One Speaker's Idiolect

The distribution of /æ, ǣː/ in monosyllables and word-final syllables in my idiolect of Philadelphia English is as follows:

(2) /ǣː/ occurs…
a. before /d/ only in the three words *glād* (variably), *mād*, and *bād*, never in *săd, hăd, păd* etc.;
b. i. variably (see fn. 2) before the non-Dorsal voiceless fricatives /f, θ, s/: (e.g. *grāph, bāth, māss, āsk, pāst, rāsp*, etc.)
ii. except usually not in…
low-frequency, archaic or "learnèd" words (i.e. learned later) (e.g. *găffe, chăff, wrăth, hăst, văs, băss*),
dialect borrowings, acronyms, interjections, ideophonic words (e.g. *dăft, TĂSS, alăs, riff-răff*),
many proper Ns (e.g. *Condé-Năst* (cf. common noun *nāsty*), *Blăss, Plăth, Grăff*),
nor in most truncations (e.g. *heart căth(eterization), Măss.*);
c. before /v, ð/ derived from /f, θ/ by the fricative voicing mutation associated with pluralization and denominal verb formation: *pāths, bāths, cālves, hālves; cālve, hālve;*
d. i. robustly before the non-Dorsal nasals /m, n/ (e.g. *cāmp, rām, mān, hānd, plānt, dānce, Bānff, amarānth, brānch, trāns* …)

ii. except not in…
normally unstressed function words when spoken in isolation or contrastively stressed (*ăn, ăm, thăn, căn, ănd*),
ablauted verbs: (*swăm, răn, begăn*),
certain truncations (e.g. *Jăn(et), action căm(era), Păn Ăm*, yet cf. *exām (< exămination), Dān (< Dăniel)*, etc.),
and certain acronyms & borrowings: *LĂN, Surinăme*, yet cf. *Afghān, Chān, Hām, Amsterdām*.

The facts for non-final syllables are even more complicated:

(3) /ǣː/ occurs...
a. before /d/ only in suffixed forms of *glād, mād, bād*: *glādly, māddening*, vernacular *bāddest*;
b. i. before /f, θ, s/ + V only in suffixed forms of monosyllables with /æ̯/ (e.g. *grāssy, lāughing; mă̄ssive, gră̄phic*),
ii. otherwise /æ/ is the norm (e.g. *căstle, tăffy, anăthema*, etc.);
c. variably (see fn. 2) before /f, θ, s/ + C, only if C = [–cont, –vce],
i. in common words (e.g. *āfter, bāsket, pāsture, plāstic, rāspy*),
ii. but never in…
low-frequency/learnèd words (e.g. *băstion, chăstise, ăspirate*), acronyms, most proper names (e.g. *NĂFTA, Ăspen, Hăskins*), or where C is derived from a voiced fricative (*hăsta, hăfta*),
iii. and never where C = [+cont] (e.g. *năphtha, blăsphemy*), or [+son] (e.g. *ăthlete, Cătherine, Dăphne, Lăszlo, Mătthew*), (the one example where C = [–cont, +vce] (*Ăfghan*) could be attributed to its low frequency or borrowed status instead);
d. before /v, ð/ in the Level II suffixed forms *cālving, hālving*;
e. i. before surface [ŋ] + heterosyllabic velar in some cases, (e.g. *pān*[kʰ]*reas, vānguàrd, Cāncún, Lāncàster*),
ii. but not all (cf. *g*[æ̃ỹ]*ngréne, B*[æ̃ỹ]*ncròft, Fr*[æ̃ỹ]*ncónia*), and never before [ŋ] + tautosyllabic C ([æ̃ỹ]*nger, pl*[æ̃ỹ]*nk*);
f. i. before /m, n/ + V only across Level II (#) boundary (e.g. *Aʸnnie, tānner, cānning, clāmmy*),
ii. otherwise /æ/ (e.g. *sănity, plănet, pănorăma, Miămi, ămmo, cănnon, ănimal, cămel, bănner*);
g. i. before /m, n/ + C as long as C = [–son], (e.g. *āmple, bānter, ānchovy, pāncreas, āmber, cāndy, tāngerine, vānguard, Stānford, ānthropology, Frāncis, mānsion, Mānhattan, ānvil, ĀNZAC*),

ii. with only a few exceptions (*somnămbulist, dămsel, Săntăna, fănd*[æ̃ỹ]*ngo, cănt*[æ̃ỹ]*nkerous*: all very odd in some way),
iii. and only rarely when C = [+son] (e.g. *Stānley, Scānlan* with possible pseudo-affixes, *dāmnátion, Dăniélle, ămnésia* with following stress),
iv. otherwise /æ/: *Hămlet, Cămry, făm(i)ly, căm(e)ra, cănyon, ămnesty*, etc.

2.2 Critique of Some Previous Analyses of Philadelphia /æ/

The pattern for monosyllables and word-final syllables given in (2) above is well known and described in the literature. However, the greater complexity of the polysyllabic (non-final) pattern, the lower frequency of the polysyllabic items in spontaneous speech, and the sociolinguistic rather than introspective focus of recent studies have been a barrier to systematic identification and analysis of the full range of facts for non-final syllables listed in (3). As a result, even the most comprehensive analyses to date, summarized in rule form below in (4-6), tell only part of the story:

(4) Ferguson (1972): $\text{æ} \rightarrow \bar{\text{æ}} \,/\, \_\; \{m, n, f, \theta, s\} \begin{Bmatrix} C \\ \# \end{Bmatrix}$

(5) Payne (1980): $\begin{bmatrix} +\text{low} \\ -\text{back} \end{bmatrix} \rightarrow [+\text{tense}] \,/\, \begin{bmatrix} \overline{} \\ -\text{weak} \end{bmatrix} \begin{bmatrix} +\text{ant} \\ \begin{Bmatrix} [+\text{nas}] \\ \begin{bmatrix} +\text{cont} \\ -\text{vce} \end{bmatrix} \end{Bmatrix} \end{bmatrix} \begin{Bmatrix} \# \\ C \end{Bmatrix}$

(6) Labov (1994) (condition: if $\alpha = +$, then select β):

$$\begin{bmatrix} +\text{low} \\ +\text{ant} \end{bmatrix} \rightarrow [+\text{tense}] \,/\, (-\text{seg})^{\beta} \begin{bmatrix} \overline{} \\ -\text{Weak} \\ +\text{Reg} \end{bmatrix} \begin{bmatrix} +\text{ant} \\ \begin{Bmatrix} \begin{bmatrix} \alpha\text{nas} \\ \gamma\text{cont} \\ +\text{tense} \\ +\text{sib}^{\delta} \end{bmatrix} \end{Bmatrix} \end{bmatrix} \begin{pmatrix} \#^{\delta} \\ [+\text{cons}]\, C_0\, V^{\beta} \end{pmatrix}$$

Each of the rules in (4-6) above appropriately excludes /d/ from the set of triggering following environments, since there is nothing predictable about the distribution of /ǣ:/ before /d/ (2a, 3a): Children acquiring the Philadelphia dialect must simply memorize that *bād, mād, glād* and their derivatives have /ǣ:/. As a result, the case for /æ, ǣ:/ as underlyingly distinctive vowels rests not on the surface minimal pairs cited in (1) – which as mentioned above actually reflect a measure of grammatical predictability in the distribution of /æ, ǣ:/ – but on the need for lexical listing of /æ, ǣ:/ in words before /d/, and as I will argue briefly below, also before fricatives. This fact requires any analysis of the /æ, ǣ:/ pattern in other environments (i.e. before nasals) to treat /æ/-tensing as the neutralization of an underlying contrast rather than a case of allophony.

A flaw shared by (4-6) is the attempt to unify the pattern of tensing before fricatives with that before nasals, when in fact the two patterns are subject to entirely distinct conditions of sociolinguistic variability and distinct sets of grammatical and lexical exceptions. To begin with the variability facts (cf. fn. 2), tense /ǣ:/ may be quite readily replaced with lax /æ/ when before a voiceless fricative (2bi, 3ci) (but not *vice versa*, whence the need for a contrast), while /ǣ:/ may be replaced with /æ/ before nasals only in a very marked "hypercorrect" speech style.

Secondly, tensing before fricatives occurs quite rarely in all but the most common core vocabulary (cf. 2bi, 3bi, 3ci vs. 2bii, 3bii, 3cii), whereas before nasals in word-final syllables it is extremely common (2di), occurring as a rule in all but the most marginal cases. These marginal cases (2dii) can be ascribed to other overriding factors: (a) ablauted verbs, whose vowels, in rule-based theory, are not derived until after /æ/-Tensing, cf. Kiparsky 1989, (b) normally unstressed function words and truncations in which a full vowel is reconstructed from an underlying /ə/ (or unspecified /V/) under orthographic influence, and (c) only a small minority of acronyms and borrowings that for various reasons appear not yet fully incorporated into the core phonological system.

As a result of these pervasive differences between tensing before fricatives and before nasals, and due to parallels between aspects of the /d/ and fricative patterns (cf. 2a, 3a; 2bi, 3bi), I propose separating the fricative and nasal patterns and instead treating occurrences of /ǣ:/ before fricatives in the same way as those before /d/: by lexical specification. The greater frequency of /ǣ:/ before fricatives than before /d/, left unexplained by this approach, can be attributed to the historical residue of an earlier productive pattern (cf. Labov 1994, pp. 39-40, 334, 535; Ferguson 1972, p. 271-2), whence its restriction to core vocabulary. The phonetic incompatibility of tenseness ([+ATR]) with [+low] tongue position (cf. Archangeli & Pulleyblank 1994) is a universal principle ensuring that, in the absence of overriding language-specific factors, the default low front vowel assigned to neologisms and other non-core lexical items will be lax.

What remains, then, is to identify what overriding language-specific factors are responsible for the overwhelming prevalence of /æ/-tensing before nasals in monosyllables (2dii), and what additional principles govern the distinctive pattern of systematic exceptions to tensing before nasals in polysyllables (3fii, 3giv). The rules in (4–6) fail to capture the nuances of those exceptions, discriminating only between trigger + V and trigger + {C, #}. While this distinction, a classic SPE-style indirect reference to syllable structure, is a step in the right direction, it is in need of refinements that take the intricacies of English syllable structure into account by distinguishing among types of C that may follow the trigger. Such refinements are now possible in light of the fuller range of polysyllabic data summarized in (3), specifically (3fii, 3gi, 3giv): For tensing to occur, the C following the trigger nasal must be [–son]. Since Vs are sonorant, the real distinction, then, is between the presence of [–son] vs. [+son] after the trigger, rather than C vs. V.
In light of this insight, having eliminated the fricatives from consideration and identified independent factors accounting for exceptions, we may reduce (and update) the rules in (4-6) to the following formulation:

(7) /æ/-Tensing (descriptive statement): $æ \rightarrow \begin{bmatrix} +\text{ATR} \\ +\text{long} \end{bmatrix} / \_\_ [\text{+nas}] \begin{Bmatrix} \# \\ [-\text{son}] \end{Bmatrix}$

I leave out the specification that the nasal trigger be non-Dorsal on the premise that before /ŋ/, the process represented in (7) is automatically blocked (thanks to the Elsewhere Condition or its OT equivalent) by a more specific process changing /æ/ to [æy].

It should be noted that even though the rule in (7) is more productive than the now-lexicalized tensing of /æ/ before fricatives in that it has few exceptions and applies equally to neologisms and core vocabulary, nonetheless for various reasons it is responsible for only a handful of alternations all involving marginal lexical items:

(8) *căn/cān't, Ăfghān/Ăfghănistān, Hām/Hămite*

Thus the evidence for this process is primarily distributional, reflecting conditions on possible phonological structures, and therefore lends itself more to a formal analysis in terms of constraints than to one in terms of rules. In the next section I will outline such an analysis.

3 The Role of Syllable Structure and Weight in Philadelphia /æ/–Tensing: an OT Analysis

The dearth of alternations resulting from Philadelphia /æ/-Tensing is not the only reason for a constraint-based reanalysis of this process. As formulated in (7), the rule offers no hint of explanation: (a) Why is there a connection between nasality of the trigger and tensing or lengthening of the vowel? (b) Assuming that in a restrictive phonological typology a rule may only perform one operation, which one is the primary change – tensing or lengthening, and by what independent principle does that change then trigger the other? (c) Moreover, given standard assumptions about locality, why should the environment *following* the nasal trigger determine whether the process applies or not? (d) Finally, the presence of the disjunction {#, [–son]} reveals a missed generalization, presumably one related to syllable structure.

A nonlinear version of (7), were it even possible, would not resolve the above problems, since there is no feature spreading, no connection in feature geometry between [+ATR] and [+nas], and lengthening of the vowel would entail addition of a timing slot, not a feature change, forcing us to split the rule in two distinct processes, one inserting a V slot and one inserting a [+ATR] autosegment. Further, as I will show in section 3.2, it is not possible to replace the disjunction {#, [–son]} with a simple reference to syllable structure that does not also violate locality. For all these reasons, I will not attempt to reformulate (7) in nonlinear terms.

An OT account, however, can unify a conspiracy of distinct processes under a single rubric via the interaction of independently motivated constraints that all contribute to the same surface configuration. It must also derive an empirically adequate analysis from instantiations of general principles embodied in ranked, violable constraints. Such an account can improve upon (7) if it moves toward an explanation of the connection between vowel nasality, tenseness, and length while at the same time resolving the syllable structure question in a non-arbitrary way. In this section I will argue that such an account is possible if we make certain plausible assumptions about English phonetics, vowel system, and syllable structure.

3.1 Nasality, Tenseness, and Length in English Vowels

To begin with, I will argue that there is a phonetic basis for a phonological connection between nasality and [ATR], the feature I take to be responsible for the tense-lax distinction in English. First, it is known that the acoustic properties of nasality tend to have an effect on perceived vowel height which can lead to phonological processes that lower [–low] vowels and/or raise [+low] vowels (cf. Wright 1986). It is also known that the tongue gestures for [+low] and [+ATR] are physically incompatible, that across languages [+high, –ATR] is dispreferred, and that, all other features being equal, [–ATR] tends to result in a slight lowering of the tongue body, and [+ATR] in a slight raising thereof (cf. Archangeli & Pulleyblank 1994). Thus vowel height and tongue root position tend to be articulatorily interrelated. In addition, they appear to be acoustically related in that both affect pharyngeal cavity size, which inversely correlates with F1, the usual acoustic measure of tongue height (cf. Ladefoged 1993). Thus in a language like English with a rich system of vowel height and [ATR] contrasts, it stands to reason that the slight acoustic effect that nasality has on F1 might be more likely interpreted by learners as a change in [ATR] rather than a change in tongue height.

If this reasoning is correct, then to ensure the tensing of /æ/ before nasals in English we may posit a feature cooccurrence constraint, *æ̃, that disfavors lax low nasalized vowels:

(9) ***æ̃:** *[+nas, +lo]/[–ATR]
If a vowel is low and nasalized, it is not lax.

This constraint need not refer to the nasality of the following trigger consonant because of the independent process whereby English vowels are nasalized before nasal consonants. In OT terms this is due to an alignment constraint that spreads nasality from a nasal to a preceding string of sonorants:

(10) **ALIGN(nas):** ALIGN([+nas], L, [+son], L)
If a sequence of sonorants contains a [+nas] feature specification, that feature spreads leftward to the beginning of the sonorant sequence.

Ranking ALIGN(nas) above the appropriate faithfulness constraints ensures that vowels before nasals are not left unnasalized to satisfy *æ̃. A high ranking of the universally available faithfulness constraints MAX(low) and MAX(nas) guarantees neither vowel height nor the trigger C's nasality are altered to satisfy *æ̃ and ALIGN(nas). In addition, to prevent *æ̃ from tensing the other low lax vowel /a/ to become /ɔ/ before nasals, universally motivated MAX(ATR) must be highly ranked. Since the fully contrastive /a, ɔ/ are distinguished only by their [ATR] values, all occurrences of /a/ must be specified [–ATR] in lexical entries. The same is presumably true in words that contain /æ/ followed by a fricative or /d/, since there /æ/ contrasts lexically with /ǣ:/. But in all other environments, including before nasals, there is no need for underlying [±ATR] specifications on low front vowels. Thus MAX(ATR) derives the inapplicability of *ǣ̃ to /a/ automatically from the fully contrastive status of /a, ɔ/.

Having motivated the primary connection between nasality and tenseness in the process of /æ/-tensing, it now remains for us to account for the connection between tenseness and vowel length. A glance at the Philadelphia vowel chart in (1) above shows that all tense vowels are long (phonetically diphthongized in most cases), while all lax vowels are short. Space does not permit the search for a cross-linguistic justification of this pattern, but its very existence is an empirical fact we cannot ignore. I therefore propose the following pair of constraints, which I group together under one name since they do not operate independently in the analysis that follows:

(11) **ATR/μ:** a. $*[-\text{ATR}]_{\mu\mu}$: Lax vowels are not short.
b. $*[+\text{ATR}]_{\mu}$: Tense vowels are not long.

(12) tableau for *plan*: ATR/μ, ALIGN(nas), MAX(low, ATR, nas), *ǣ̃

/plÆn/	ATR/μ	ALIGN	MAX	*ǣ̃
[plæn]		*!		
[plĕn, plæd]			*!	
[plæ̆̃n, plǣ̃:n]	*!			√/*
[plǣ̃n]				*!
☞ [plǣ̃:n]				

At this point we have addressed the first two questions (a–b) about /æ/–Tensing (rule (7) above) raised in section 3, concerning the relationship between target and trigger, by positing three substantive constraints: (a) *ǣ̃, arguably grounded in perceptual phonetic facts relating nasality to tensing in low vowels, (b) ALIGN(nas), an instantiation of Generalized Alignment responsible for vowel nasalization in English, and (c) ATR/μ, which correlates length with tenseness in Philadelphia English. Independently motivated faithfulness constraints (MAX) round out the analysis, summarized in (12). Our next task is to seek a principled explanation for the sonority condition on the sound following the trigger nasal in rule (7), one that addresses problems (c-d) from the beginning of section 3.

3.2 Sonority Sequencing in Syllable Margins

Whenever a disjunction such as {#, C} appears in an SPE-style descriptive rule (cf. (13a) below), it can usually be replaced with the syllable bracketing reference "$]_\sigma$" as shown in (13b), resolving both the problem of the missed generalization and the locality problem raised at the beginning of section 3 (points c–d). This is because, in a language with simple syllable structure, an environment like (13b) below really amounts to the requirement that target and trigger belong to the same syllable, schematized in (13c):

(13) a. $/ \_\_ C_1 \begin{Bmatrix} C_2 \\ \# \end{Bmatrix}$ b. $/ \_\_ C_1]_\sigma$ c. $\begin{matrix} & \sigma & \\ & / \quad \backslash & \\ / \_\_ & & C_1 \end{matrix}$

However, in a language like English that allows complex codas, the nonlinear formulation in (13c) is not necessarily always equivalent to (13b), since C_2 may be in the same syllable as C_1. I illustrate this in (14b) with reference to the statement of /æ/-Tensing formulated in (7) above. Here we can see that (13c) covers all of the cases in (14b), while (13b) excludes (14b):

(14) a. $/ \_\_ C_1.\#$ b. $/ \_\_ C_1C_2.\#$ c. $/ \_\_ C_1.C_2V$
plān *plānt* *plāntar*

Thus (13c) is not merely a notational variant of (13b) that explicitly meets the locality condition on rule environments, but it is in fact required for empirical coverage of the cases represented in (14).

The environment formulation in (13c) also correctly excludes cases such as (15a) from undergoing the tensing rule:

(15) a. $/ \_\_ .C_1V$ b. $/ \_\_ C_1.\underset{[+son]}{C_2} V$

plănet *Cămry, făm(i)ly, cănyon, ămnesty*

However, (13c), as it does not distinguish sonorants from obstruents, still fails in that it would include (15b) above in the rule's purview, incorrectly predicting tense /ǣ:/. This is the reason for the specification {#, [–son]} in (7) instead of {#, C}. Therefore the challenge before us is: can we reinterpret the environment of (7), schematized in (16) below, in the same way that (13c) reinterprets (13a), without a disjunction or locality violation?

$$(16) / \_\_ C_1 \left\{ \begin{matrix} \# \\ [-\text{son}]_2 \end{matrix} \right\}$$

In what follows I will argue that this is impossible in a rule-based framework, and that instead an OT analysis is necessary to capture the relevant generalization.

To reinterpret (16) in more explanatory terms we need to identify what common thread unites the two environments in (15) to the exclusion of those in (14), or vice versa. The contrast between (15b) and (14c) holds the key, since both are syllabified in the same way under standard cross-linguistic assumptions about syllable structure. What distinguishes (15b) and (14c) is their sonority sequencing: Since C_1 = [+nas], (14c) is necessarily a sequence of declining sonority, while (15b) represents a sonority increase or plateau. In syllable structure terms, this means that (14c) is a possible complex coda while (15b) is not. If we then assume ambisyllabicity in English as per Kahn (1976) et al., we may go so far as to classify the consonant sequence in (14c) as an actual coda. (Briefly, in English the initial consonant of an unstressed syllable is ambisyllabic if it is the final member of a sequence of consonants that can form the coda of a preceding stressed syllable.)

Reanalyzing the environments in (14-15) in terms of ambisyllabicity, we arrive at the schemata in (17-18) below, where an underscore beneath a C indicates it is ambisyllabic:

(17) a. / __ C_1.# — *plān* b. / __ C_1C_2.# — *plānt* c. / __ $C_1\underline{C}_2$V — *plāntar*

(18) a. / __ $\underline{C}_1$V — *plănet* b. / __ $C_1.\underset{[+\text{son}]}{C_2}$ V — *Cămry, făm(i)ly, cănyon, ămnesty*

Viewed in this light, we are now able to distinguish (18b) from (17c), yet it is still not obvious what (18a-b) have in common with each other to the exclusion of (17a-c). Since in English surface [æ, ǣ:] are always stressed (otherwise they reduce to schwa) and the following syllable in (17c, 18a-b) is unstressed, all the environments in (17-18) now exhibit tautosyllabicity between target and trigger. Thus Benua, who presupposes ambisyllabicity in her (1995) OT account of /æ, ǣ:/ in truncated forms, characterizes cases like (17a-c) as satisfying an *exclusive* tautosyllabicity requirement, in contrast to (18a), where the trigger belongs simultaneously to two syllables. Yet her generalization is merely an ambisyllabic reinterpretation of (13c), and as such does not account for the contrast between (18b) and (17c).

To integrate (18b) into our analysis we need to focus on the two properties it shares with (18a), the first of which is syllable weight: In (18a-b) the target V is in a heavy (bimoraic) syllable, closed by a single C, while in (17c) it is in a superheavy (trimoraic) syllable, closed by two Cs. This distinguishes (18a-b) from (17b) as well, but not from (17a). Rather, it is the second property shared by (18a–b), the presence of a following V, that differentiates them from (17a). Thus what makes (18a-b) exceptions to the general pattern of /æ/-tensing before nasals is the intersection (i.e. conjunction, rather than disjunction) of two conditions: (a) light(er) weight of the target V's syllable and (b) presence of a following unstressed syllable.

Having at last identified what distinguishes (18) from (17) without resorting to a disjunction, we are now in a position to seek a plausible reason for this contrast. The role of ambisyllabicity, which treats stressed and unstressed syllables differentially, suggests the relevance of metrical theory: In metrical terms, the sequence of a stressed syllable followed by an unstressed syllable found in (17c, 18a-b) constitutes a disyllabic trochaic foot. In contrast, (17a-b) represent monosyllabic feet, while the difference between (17c) and (18a-b), as noted above, is in the weight of the foot's first syllable. If we consider the bimoraic syllables of (18a-b) to be functionally light (given the impossibility of actual light stressed syllables under ambisyllabicity) and the trimoraic syllable of (17c) to be heavy, then (18a-b) are optimal trochees according to Hayes's (1995) Iambic/Trochaic Law, which favors syllables of equal weight in disyllabic trochees. Bakovic (1996) reinterprets this generalization in OT terms, drawing on Prince's (1990) notion of rhythmic harmony, as a constraint favoring higher values of *grouping harmony*, defined as the ratio (in mora count) of a foot's second syllable to its first:

(19) **FTHARM** (rewording of Bakovic's (1996) constraint):
The grouping harmony of a disyllabic foot in the output is greater than that of its correspondent grouping in the input.

Assuming other higher-ranked constraints guarantee that consonants are not deleted, underlyingly tense vowels are not laxed and shortened, and ambisyllabicity is not violated in order to satisfy FTHARM, this constraint will have an effect in Philadelphia English only in the case of /æ/ before a nasal, where /æ/ is underlyingly unspecified for [ATR] (and hence also for weight).

Given the input (18a) or (18b), then, FTHARM will favor lax short [æ] over tense long [æ̃ː] in the output, since [æ] will form a bimoraic syllable with the following /n/, thereby violating FTHARM less than [æ̃ː], which will form a trimoraic syllable:

(20) tableau for *planet*: FTHARM » *æ̃

/plÆnVt/	FTHARM	*æ̃
☞ [plæ̆n̠ət]	*	*
[plæ̃ːn̠ət]	**!	

In the case of (17c), though, FTHARM is maximally violated by both [æ] and [æ̃ː] in the output, provided we assume (as does Bakovic) that the grammar does not distinguish degrees of superheaviness beyond a mora count of 3. This is because the stressed syllable is already superheavy by virtue of its complex coda /nt/, regardless of the length of the syllable's vowel. As a result, then, FTHARM plays no role in choosing the optimal form, and [æ̃ː] is selected by the lower-ranked *æ̃ constraint:

(21) tableau for *plantar*: FTHARM equally violated by candidates

/plÆntr/	FTHARM	*æ̃
[plæ̆nt̠ɹ̩]	**	*!
☞ [plæ̩̃nt̠ɹ̩]	**	

Thus with a few independently motivated assumptions about metrical structure in English (ambisyllabicity and the rhythmic harmony principle behind the Iambic-Trochaic Law) we can do away with the problems of non-locality and disjunction raised in points (c-d) at the beginning of section 3, provided we abandon the rule-based approach to /æ/-Tensing shown in (4-7) in favor of an OT analysis in which these metrical principles interact straightforwardly with phonetic grounding principles favoring tense or lax low front vowels in different environments.

3.3 Conclusions

The success of this analysis of the Philadelphia polysyllabic /æ/-tensing pattern makes a case not only for the greater explanatory power of OT over rule-based phonology, but also for the relevance of OT to the study of phonological variation: Even though the database for this paper was introspectively collected and represents only one speaker's idiolect, I believe the analysis presented here will be of use to future sociolinguistic research on this topic in that it provides (a) new hypotheses to test against corpora of spontaneous speech from a cross-section of Philadelphia English speakers, and (b) a new way of looking at Philadelphia /æ/-tensing in terms of interacting constraints rather than a single rule, an approach that has implications for what is to be considered a sociolinguistic variable in this and other patterns.

References

Archangeli, Diana and Douglas Pulleyblank. 1994. *Grounded Phonology*. MIT Press.

Bakovic, Eric J. 1996. Foot Harmony and Quantitative Adjustments. Rutgers Optimality Archive #168.

Prince, Alan. 1990. Quantitative Consequences of Rhythmic Organization. In CLS 26, vol. 2: Papers from the Parasession on the Syllable in Phonetics and Phonology, ed. K. Deaton et al., 355-398.

Benua, Laura. 1995. Identity Effects in Morphological Truncation. In *Papers in Optimality Theory (University of Massachusetts Occasional Papers 18)*, ed. Jill N. Beckman et al., 77-136. University of Massachusetts, Amherst.

Ferguson, Charles A. 1972. 'Short *a*' in Philadelphia English. In *Studies in Linguistics in honor of George L. Trager*, ed. M. Estellie Smith, 259-274. The Hague: Mouton.

Hayes, Bruce. 1995. *Metrical Stress Theory: Principles and Case Studies.* University of Chicago Press.

Kahn, Daniel. 1976. Syllable-Based Generalizations in English Phonology. Doctoral dissertation, MIT.

Kiparsky, Paul. 1989. Phonological Change. In *Linguistics: The Cambridge Survey*, ed. Frederick Newmeyer, 363-415. Cambridge University Press.

Labov, William. 1994. *Principles of Linguistic Change, vol. 1: Internal Factors.* Cambridge, MA: Basil Blackwell.

McHugh, Brian D. In preparation. Tense and Lax /æ/ in Philadelphia English.

Morén, Bruce. 1997. Markedness and Faithfulness Constraints on the Association of Moras: The Dependency between Vowel Length and Consonant Weight. MA thesis, University of Maryland, College Park.

Payne, Arvilla C. 1980. Factors Controlling the Acquisition of Philadelphia Dialect. In *Locating Language in Time and Space*, ed. William Labov, 143-178. Academic Press.

Rotenberg, Joel. 1978. The Syntax of Phonology. Doctoral dissertation, MIT.

Wright, James T. 1986. The behavior of nasalized vowels in the perceptual vowel space. In *Experimental Phonology*, ed. John J. Ohala and Jeri J. Jaeger, 45-67. New York: Academic Press.

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