

The Foot as a Phonotactic Domain: *aw* and *wa* in English

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1 Introduction

Of all the constituents of the prosodic hierarchy, it is surely the syllable that has been called on to do the most work in phonological and phonetic analysis. For all that, there have always been questions about whether the syllable's place in phonology is just quite as central as is often thought. The question I take up here concerns the extent to which the syllable can be said to act as a domain for segmental phonology. The main point I want to make is that many segmental patterns that are standardly analyzed in syllabic terms are better understood as operating within the foot.

This point has already been made elsewhere in relation to a number of segmental phenomena in English. Examples include tapping and glottalling of *t*, deletion of *h*, pre-fortis vowel clipping, and (in certain non-rhotic dialects) deletion of *r* (see for example Harris 1994, to appear, Davis & Cho 2003). One context that recurs in these patterns is intervocalic position, which is typically accommodated in syllabic analyses through ambisyllabicity. There are many reasons to reject this device, some of which I review below. Not the least of these is the point that stating the patterns in terms of the foot provides a much simpler analysis.

In this paper, I will further push the case for a foot-based approach to segmental phonology by presenting evidence from two more segmental patterns in English. Both involve phonotactic restrictions between a vowel and a following consonant.

One of the patterns is well enough known to have made it into the Halle & Clements (1983) workbook: the diphthong *aw* cannot be followed by any consonant other than a coronal. This explains why we have words such as **shout**, **crown**, etc. but none along the lines of **awk*, **awm*, etc. It has been claimed that the domain within which this restriction holds – call it the awT pattern – is the syllable rime (references to follow).

The other pattern is rather less well studied. It has to do with the sound change that caused historical short *ǣ* to merge with short *ō* after *w*, which explains why **what** rhymes with **hot** rather than **hat** (as the **a**-spelling might

have suggested). The change was blocked when a dorsal consonant followed, which explains why **wax** rhymes with **lacks** rather than **locks**. As we will see, the dorsal blocking effect – call it the waK pattern – occurs under essentially the same prosodic conditions as awT. So if the syllabic analysis is valid for awT it should also be valid for waK.

The extent to which the awT and waK patterns can be considered phonologically regular and synchronically live is revealed by word counts that I have extracted for this paper from the CELEX2 lexical database (Baayen *et al.* 1996).

Available descriptions of awT fail to note that it also holds before an unstressed vowel; hence **powder**, **thousand**, etc., but nothing along the lines of **awgə*, **awvi*, etc. The same detail is observable with waK: it holds not only when the blocking dorsal occurs word-finally or in a final cluster (as in **wax**) but also when it occurs before an unstressed vowel (as in **wagon**). This environment can only be accommodated within a syllabic analysis by allowing the intervocalic consonant to affiliate with the syllable to its left – most usually by assuming it to be ambisyllabic. However, I will argue here that the grounds for rejecting ambisyllabicity in general also apply in particular to these two phonotactic patterns. In any event, there is an alternative analysis that is much simpler: to say that the domain within which the patterns operate is the foot.

Here is the running order for the paper. The evidence for treating awT and waK as foot-centered patterns is presented in §2 and §3 respectively. §4 outlines weight-related reasons for preferring the particular foot analysis proposed here over alternatives based on ambisyllabicity or on maximally bimoraic feet. The main conclusions are summarized in §5.

2 *aw*

In English, the vowel in the MOUTH class of words (**mouth**, **loud**, **cow**, etc.) can vary considerably in quality from one dialect to another. For our immediate purposes, we can abstract away from these differences and symbolize it as the diphthong *aw* that occurs in standard and many other varieties.

Under the awT restriction, the only kind of consonant that can follow *aw* is a coronal. This can be a single stop (1a), a fricative (1b), an affricate (1c), a nasal (1d), or some cluster of these (1e).

- (1) (a) shout, pout, crowd, loud
 (b) mouse, louse, browse, carouse, mouth (n.), south, mouth (v.)
 (c) couch, slouch, gouge
 (d) town, brown
 (e) mount, fount, mound, ground, lounge, scrounge, pounce,
 flounce, joust
 (f) howl, owl
 (g) sour, power

Depending on the dialect, the coronal can also be a liquid (see (1f) and (1g)). It can be a lateral in those varieties that do not show a historically excrescent schwa in this context (and thus have *fawl*, for example, rather than *fawəl*). The same can be said of *r* in those rhotic varieties that lack excrescent *ə* (and thus have *sawr* rather than *sawər*). Non-coronals cannot follow *aw*; hence the absence of words along the lines of **lawp*, **lawk*, **lawf*, **lawm*, **lawŋk*.

The majority of awT examples are monosyllabic words, like those in (1) (the Halle & Clements (1983) workbook only asks students to list monosyllables). It is apparently on the basis of examples such as these that the awT restriction has been claimed to hold within the syllable rime (Selkirk 1982, Anderson & Ewen 1987, Spencer 1996, Hammond 1999, Kubozuno 2001).

As would be expected under the rime analysis, awT is also in force in words where the consonant forms a word-internal coda. The examples in CELEX2 are not many, but in all cases the coda is either *n* or *s*:

- (2) (a) bounty, fountain, mountain
 founder, foundry, scoundrel
 council, counsel
 (b) frowsty

The relative paucity of examples with word-internal closed rimes containing *aw* is understandable, given the tight constraints on the type of consonant that can follow any long vowel in this context in English. The coda here is pretty much restricted to the coronals *l*, *n* or *s*, as in **shoulder**, **dainty**, **oyster** (Selkirk 1982, Harris 1994). (It is a synchronic accident that there are no examples of words containing internal *awl* rimes in CELEX2.)

The rime-based studies of awT just cited overlook a third context where the effect is to be observed. It occurs where a post-*aw* consonant is followed by an unstressed vowel (symbolized below as *ǃ*), as in the following examples:

- (3) chowder, doughty, dowdy, powder, rowdy, blowzy, frowsy,
 thousand, tousle, trouser

(3) lists all of the *awCǃ* morphemes to be found in CELEX2. The numbers may be relatively small, but the pattern is clear: here too the consonant

following *aw* must be a coronal. There are no examples of *awC*̃ morphemes where the consonant is a labial or dorsal; hence nothing along the lines of **lawbi*, **lawkl*, **lawmpə*.

It is not difficult to think of further examples of *awC*̃ sequences if we include forms where the unstressed vowel belongs to a word-level affix, as in **louder**, **browser**, **crowning**. Data such as these cannot be considered phonotactically ‘clean’, however. We need to bear in mind that, in English, word-level (level-2) morphology can create segment sequences that ride roughshod over phonological restrictions that are systematically enforced within morphemes or within forms created by root-level (level-1) morphology (see Bermúdez-Otero & McMahon 2006 for discussion and references). Since one of the contexts where *awT* holds is at the end of a word, it is hardly surprising that *awC*+̃ examples derived at word level also only contain coronals. These examples would be consistent with the assumption that *awT* holds as a rime-based restriction within the inner word domain.

A similar point can be made in respect of *awC*+̃ words where the unstressed vowel belongs to a root-level affix; here too the consonant is always coronal. CELEX2 includes the examples **carousal**, **espousal**, **outage**. Since root-level morphology is phonotactically conforming, these might have counted as evidence of a systematic *awT* effect before unstressed vowels. However, it could be argued that the semantics and morphology of these examples are so transparent as to suggest they behave like word-derived forms in containing two phonotactically independent domains.

To summarize: the *awT* restriction holds not just (i) word-finally (**loud**) and (ii) pre-consonantly (**fountain**) but also (iii) before an unstressed vowel (**powder**). The only way a rime-based analysis of this pattern can be generalized over all three of these contexts is to allow the intervocalic consonant in words of the **powder** type to syllabify into the coda of the syllable containing *aw*.

There is, however, a much simpler alternative. The reference to stress alerts us to the fact that the foot is involved here. We can generalize over the three contexts by saying that the *awT* restriction operates within the foot. The foot can be monosyllabic, as in {**loud**} (feet in curly brackets), or disyllabic, as in {**powder**}, {**bounty**}.

The ban on non-coronals is inoperative when a consonant is separated from a preceding *aw* by a foot boundary; hence the possibility of having non-coronals following *aw* in examples such as {**cow**}{**gate**}, {**cow**}{**pat**}. Because of the close relation between feet and words in English, examples of this structure will almost always be morphological compounds. (In principle, we might have expected monomorphemic examples, but CELEX2

does not contain any.)

Note that this analysis is based on a rather traditional view of the English foot, in which the first syllable of a disyllabic trochee can be light (as in {**city**}), heavy (as in {**powder**}), or superheavy (as in {**bounty**}). Below we'll consider whether the analysis is compatible with other models of English foot structure.

3 *wa*

Going purely on the **a**-spelling, we might have expected **want** to rhyme with **pant**. Originally it did, a state of affairs that is preserved in Scots and some regional dialects in England. The reason **want** now rhymes instead with **font** has to do with a sound change that caused historical short *ǣ* to merge with short *ɔ̄* after a labial-velar (see for example Jespersen 1909, Lass 1999). At least initially, the change was phonologically regular, affecting inherited Germanic words (generally spelt with **w**, as in (4a)) as well as established Romance loans (mostly spelt with **qu**, as in (4b)).

- (4) (a) swan, swap, want, wash
(b) quality, quantity, quarrel, squad

For the purposes of the present paper, I'll refer to these collectively as the 'wa' words. The change also affected historically voiceless **wh**, which accounts for why **what** rhymes with **hot** rather than **hat** – not just in dialects that retain the contrast between *w* and *ɥ* (**witch** ≠ **which**) but also in those that have lost it.

At the time the change was in progress (roughly from the late fifteenth century to the mid eighteenth), short *ǣ* was a front unround vowel, while short *ɔ̄* was back and round (Lass 1999). The change can thus be seen as assimilatory: *ǣ* underwent rounding and backing under the influence of a preceding consonant that is itself round/labial and back/velar. The change, which I will refer to as 'wa'-darkening, has left its mark on most present-day dialects of English (but not on Scots).

There is a fair amount of present-day variation in the developments of short *ǣ* and *ɔ̄*, a reflection of the fact that both vowels have undergone certain dialect-specific changes in particular phonological contexts. Short *ǣ* has been subject to various combinations of tensing/lengthening, front-raising and retraction (the last resulting in merger with broad *a* in **calm**, etc.). Short *ɔ̄* has undergone various combinations of unrounding, fronting and tensing/lengthening (the last resulting in merger with historical *au* in **caught**, etc.). (For overviews of the dialect differences that result from these various developments, see for example Schneider *et al.* (2004).)

Words with 'wa' have been caught up in these changes no less than other words with historical *ǣ* and *ɔ̄*. However, for the purposes of studying

the current phonology of ‘wa’, we can abstract away from the resulting dialect differences and speak of two generic vowel categories which I’ll label ‘A’ and ‘O’. In the past, all ‘wa’ words had A. As a result of ‘wa’-darkening, most of these words, including those in (4), now have O. Depending on the dialect, O in these words can show up as unround central *a* or back *ɑ*, or as round low *ɒ* or mid *ɔ*. For example, in one dialect we might find *a* in **what** and *ɔə* in **warm** (New York City for example), while in another we find *ɒ* in **what** and *ɔː* **warm** (London for example); all of these variants count as O.¹

Just how regular is ‘wa’-darkening? The total number of ‘wa’ words in CELEX2 is 148 (excluding morphological derivatives). The O vowel occurs in 117 of these, A in 40. Included in these sub-totals are nine words listed as varying between the two vowels. At first sight, this looks pretty irregular. On closer inspection, however, a significant proportion of the 40 words that appear to be exceptions to ‘wa’-darkening turn out to display a striking sub-regularity.

Going by the **wa**-spelling alone, we might have expected **wax** to rhyme with **locks**. The reason it rhymes instead with **lacks** is that darkening was blocked when ‘wa’ was followed by a dorsal consonant (Jespersen 1909). The resulting waK pattern is almost completely regular. Of the 24 words in CELEX2 containing ‘wa’ plus *k*, *g* or *ŋ*, 23 have A, listed here:

- (5) (a) quack, Sarawak, thwack, WAC, wack, wax, whack
 (b) scallywag, swag, wag, quagga, swagger, waggery, waggie, wagon, wagonette
 (c) quango, swank, twang, wangle, wank, whang

The remaining word is only partly exceptional: CELEX2 records **quagmire** as having both A and O variants.

To the list of waK examples given in (5) we can add words that failed to make it into CELEX2 (either because they are too new or were perhaps deemed too colloquial). At *urbandictionary.com*, for example, we find scores of words beginning with *wæk-*, many of which are disyllables, e.g. **wackard**, **wackal**, **wackle**, **wacko**. (The morphology and etymology of many of these words are obscure.)

The waK blocking effect is quite specific to dorsals. Palato-alveolars, the consonants closest to them in place, failed to block retraction; hence the appearance of O in **squash**, **wash**, **watch**, etc.

To underline just how phonologically regular the waK pattern is, let us compare its effects with the remaining ‘wa’ words that unexpectedly also

¹Another context where historical *ā* has dark-merged with *ɔ/au* is before *l*, especially when this is word-final or pre-consonantal; hence O in **tall**, **fall**, **salt**, etc. There are a few words where the two sources of darkening converge, e.g. **wall**, **squall**.

have A – those where the vowel is not followed by a dorsal consonant. The behavior of these words really is irregular. Of the 18 such words listed in (6), 17 appear in CELEX2 (I've added WAP). Some of the words are recorded in CELEX2 as having the regular O variant in addition to exceptional A.

- | | | | |
|-----|-------|-----|---------------------------------------------------------------------------|
| (6) | A | (a) | swam, loquacity, aquatic |
| | | (b) | palsy-walsy, WAP |
| | | (c) | wigwam, wham |
| | A ~ O | (d) | twat |
| | | (e) | kumquat, kwashiorkor, loquat, quatercentenary,
swastika, wadi, wassail |
| | A ~ O | (f) | Guatemala, suave, Taiwan |

The A variant in (6f) is entered in CELEX2 as broad *a* (in those dialects where this vowel occurs in, for example, **calm** and stands in contrast with both *æ* (**hat**) and *ɒ* (**hot, caught**)).

In the case of the words in (6a) and (6b), we can plausibly appeal to analogy, one of the best acknowledged sources of exceptionality in sound change. The words in (6a) all exhibit root-level morphology. The past-tense form **swam** evidently retains A under pressure from a strong-verb prototype in *æ*, cf. **sang, began, ran**. We could speculate that A in **loquacity** and **aquatic** represents the *æ* of the *æ~ey* component of Vowel Shift (**vanity–vain, volcanic–volcano**, etc.), cf. **loquacious, aquaceous**. In the reduplicative form **palsy-walsy** ((6b), presumably a word-level compound), **-walsy** retains the A of its base. Likewise, **WAP** retains the A of its base **application**.

The A variant of **twat** in (6d) is almost certainly borrowed from one of the regional British dialects where 'wa'-darkening never took off.

As for the other words, those in (6c), (6e) and (6f), I have no sensible explanations to offer for the unexpected occurrence of the A variants – other than to note that most are relatively recent loans or non-English proper names.

To summarize: there are two distinct ways in which 'wa' words can deviate from the basic darkening pattern. On the one hand, we have the words in (6); these are true exceptions that apparently lack any kind of systematic phonological motivation. On the other, we have the words in (5), which exhibit a robust phonological regularity: 'wa'-darkening is blocked when a dorsal consonant follows.

What is the domain within which the waK restriction holds? The dorsal must immediately follow 'wa' in one of the following contexts: in absolute word-final position (7a), in a final cluster (7b), in an internal coda (7c), or before an unstressed vowel (7d).

- (7) (a) quack, Sarawak, scallywag, swag, twang, thwack, WAC, wack,

- wag, wax, whack, whang
 (b) swank, wank, wax
 (c) quango, wangle
 (d) quagga, swagger, wacko, waggery, waggle, wagon, wagonette

As with awT, all of the contexts illustrated in (7) can be subsumed under the foot. The foot may be monosyllabic (as in {**wag**}, {**wax**}) or disyllabic (as in {**wangle**}, {**wagon**}).

4 Vowel-consonant phonotactics and weight

Let me now explain why the particular foot-based analysis of the awT and waK patterns I have proposed here is preferable to two other prosodically based accounts, one based on ambisyllabicity, the other on the maximally bimoraic foot.

Recall the conjunction of linearly expressed environments where awT and waK operate: (i) word-finally, (ii) before a consonant, and (iii) before an unstressed vowel. Syllable-based approaches to English segmental phonology have been confronted with this conjunction before. It is essentially the same combination of contexts where we find, for example, *t*-tapping, *t*-glottalling and *h*-deletion. According to a syllabic analysis, the positions are unified under the coda. The word-final consonant is assumed to occupy a coda in basic syllabification, while the prevocalic consonant affiliates with the coda of the preceding syllable (in violation of the otherwise basic onset-only syllabification of VCV sequences). In the most widely adopted version of this approach, the intervocalic consonant is ambisyllabic (see for example Kahn 1976, Borowsky 1986, Hammond 1999).

For the sake of argument, let us consider whether ambisyllabicity provides a viable treatment of awT and waK. According to this approach, both restrictions are stated over the rime: ‘any consonant following *aw* within the same rime must be coronal’; ‘a dorsal consonant following ‘*wa*’ within the same rime blocks darkening’. In both cases, the coda consonant is either word-final (as in **loud**, **what**) or ambisyllabic (as in **powder**, **wagon**).

There is a whole slate of reasons for rejecting ambisyllabicity in general. These have been set out in detail elsewhere, so I will not repeat them all here (see for example Harris 1994, 2004, Jensen 2000, Bermúdez-Otero 2011). I will limit myself to a brief consideration of two arguments that are most relevant to awT and waK.

One pretty straightforward argument against ambisyllabicity should be stated right away: why enrich prosodic theory in this way when there is a simpler analysis based on an independently motivated entity, the foot?

The other argument centers around the interaction between phonotactics and weight. For ambisyllabic analyses of processes such as tapping,

glottalling and *h*-deletion to get off the ground at all, it is necessary to allow an intervocalic consonant to become affiliated with any kind of preceding open syllable, regardless of its weight. This is because these processes are blind to weight: tapping occurs in **meter** (where the relevant syllable is heavy) no less than in **city** (with a light syllable, at least in basic syllabification). The upshot is the creation of novel internal superheavy rimes (such as the *mi:t-* of **meter**). This turns out to have certain undesirable consequences.

The weight issue does not arise when an ambisyllabic analysis is applied to waK. The relevant vowel is historically short, so ambisyllabicity in a word such as **wagon** will create no more than a heavy rime (*æg*). (This is essentially the thinking behind the traditional description of short vowels as ‘checked’ in English.) In contrast, weight is very much an issue with an ambisyllabic treatment of awT. Because *aw* is inherently heavy, any newly-closed rime it appears in will inevitably be superheavy. We might reasonably expect these novel rimes to parallel VVC rimes that exist independently of ambisyllabicity, from the standpoint of both phonotactics and weight. It is a problem for this overall approach that they don’t.

According to the ambisyllabicity analysis, there are two locations where independently superheavy rimes occur: word-internally before a following onset (as in **bounty**) and word-finally (as in **loud**). The coda of the internal type is subject to the severe phonotactic restrictions mentioned earlier; it is largely limited to *n, l, s*. This is in stark contrast to the novel superheavy rimes created by ambisyllabicity, where any kind of consonant is allowed to become a coda. In this respect, the novel internal rimes are instead phonotactically similar to final VVC]. This is as we’d expect if both sequences are treated as superheavy rimes. The problem is that the evidence for analyzing final vowel-consonant sequences (whether VVC] or VC]) as rimes is pretty slim. For one thing, the analysis is undermined by the observation that the final consonant acts extrametricaly (cf. Hayes 1982); in failing to contribute to the weight of the preceding rime, it does not behave like a coda. So the ambisyllabic analysis presents us with an anomaly: novel internal rimes behave like final VVC] in terms of phonotactics but not in terms of weight.

The word-final sequence that most closely resembles independent superheavy internal rimes is the VVC part of VVCC], as in **paint, bold, yeast**, etc. Here the absolute final consonant behaves extrametricaly, while the preceding VVC provides a perfect fit with independently existing internal VVC rimes, in terms of both phonotactics and weight. The C in both sequences is subject to the *n//s* restriction; hence phonotactic parallels such as **dainty-paint, boulder-bold, Easter-yeast**. And the C in both sequences bears weight. This is where the closest parallel exists between superheavy

VVC sequences, but it is not at all reflected in the ambisyllabic analysis.

The anomalies between weight and phonotactics that ambisyllabicity throws up simply do not arise with the foot-based treatment of *awT* and *waK* presented above.

As noted earlier, the analysis proposed here assumes an inventory of foot shapes in English that includes uneven syllabic trochees. With *awT*, this allows us to define adjacency between *aw* and a following coronal in trochees with an initial heavy syllable (as in {**powder**}) as well as in those with an initial superheavy (as in {**bounty**}). (The bimoraicity of *aw* means that light-light trochees do not figure in the *awT* restriction.) This account is clearly incompatible with an analysis of the English foot as maximally bimoraic (as proposed for example by Hayes 1995).

Maximal foot bimoraicity predicts that where phonotactic restrictions on vowel-plus-consonant sequences are prosodically conditioned they can only ever involve short vowels. With *waK*, for instance, the monomoraicity of the short vowel *æ* leaves room for the following dorsal consonant to fall within the same foot, both in monosyllables (as in {**wag**}, where the consonant itself occupies the second mora) and in disyllables (as in {**wagon**}, where the consonant occupies the onset of the syllable containing the second mora).

With *awT*, the situation is quite different, because of the length of the diphthong. Being bimoraic, *aw* will saturate any foot it finds itself in, under this analysis. The diphthong thus could never occupy the same foot as a following consonant. Any such consonant would either remain unfooted, as in {**loud**}, {**powder**}, or belong to a separate foot, as in the compound examples such as {**cow**}{**pat**} mentioned above.

In fact, maximal foot bimoraicity also rules out a syllable-based treatment of any phonotactic restriction that holds between a long vowel and a following consonant. In particular, it forestalls any attempt to salvage a syllabic analysis of *awT* by resorting to ambisyllabicity. The intervocalic consonant in a form such as **powder** could not be captured into the syllable containing *aw* without violating maximal foot bimoraicity: *{**powd**}er.

As our case study of *awT* demonstrates, the prediction that prosodically conditioned VC phonotactics can only ever involve short vowels is incorrect. There is as much of a phonotactic interaction between the *aw* and *d* of **powder** as there is between the *wæ* and *g* of **wagon**.

The difficulty maximal foot binarity faces in dealing simultaneously with the facts of weight and the facts of vowel-consonant phonotactics in English is just one of several reasons to stick with the traditional view that English has syllabic trochees larger than two moras (for a referenced summary of other reasons, see Hammond 2006).

5 Conclusion

Although the awT and waK patterns are phonologically regular, neither of them looks particularly natural, at least as first sight. Behind each pattern lies a familiar historical scenario where an accumulation of individually natural sound changes arrives at an end point that is phonetically arbitrary.

The main historical source of *aw* in present-day English is long *ū* via Vowel Shift. The absence of non-coronals following *aw* is mainly due to two factors that were in place before Vowel Shift got under way. Firstly, some non-coronals were missing from the relevant context, either because there was simply no source for them in Old English or because they had been removed from the system through weakening or deletion (see Lass 1999). Secondly, *ū* had been subject to selective shortening, with the result that shortened reflexes were diverted out of the path of Vowel Shift, which only targeted long vowels (Jespersen 1909).

As to why following dorsals should prevent ‘wa’-darkening, the historical and comparative dialect evidence supports the reconstruction of these consonants as palatal at the time the change was in progress (see Harris 1987). This explains the blocking effect: being front, the dorsals were able to exert an assimilatory influence on *ǣ* that restrained it from backing.

Although now phonetically arbitrary, neither of the synchronic patterns bequeathed by these historical developments could be described as dramatically unnatural in the way that we sometimes find with patterns involving abstract underlying representations or derivational opacity. Nevertheless, they both illustrate the point that phonological grammars are full of systematic patterns that lack any synchronically active phonetic motivation.

The domain within which the awT and waK restrictions hold is the foot. They can be added to the growing data-bank of foot-based segmental patterns that we find in English and other languages (including the English *t*-allophony and *h*-deletion examples mentioned above). Many of these effects show a clear leftward bias in the way they are distributed within feet, reflecting the left-headedness of trochees. It is true that the phonotactic patterns associated with awT and waK do not show this sort of leftward asymmetry (beyond the more general fact that a full vowel must occur in the head syllable of the foot). Nevertheless, they still show how the foot can act as a vehicle that carries phonological segments to phonetic expression.

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