# Asymmetrical Glide Patterns in American English: The Resolution of CiV vs. CuV Sequences*

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This paper presents an analysis of (American) English consonant-glide-vowel sequences, accounting for the asymmetry between [CjV] and [CwV] sequences from underlying /CiV/ and /CuV/, respectively. In underlying /CuV/ sequences, the high back vowel becomes part of an onset cluster (e.g. *quote*) and is subject to the restrictions imposed on other types of onset clusters. In underlying /CiV/ sequences, the high front vowel either coalesces with a following /u/ to form the diphthong [ju] as in *cute* or it forms a nucleus on its own with the second vowel parsed in a second syllable (i.e., *Kyoto* [ki.o.to]). The asymmetry is attributed to a preference for parsing high front vowels as peaks and high back vowels as margins where possible. An optimality theoretic analysis is developed which accounts for this asymmetry in the context of corresponding asymmetries in other areas of English phonology.

**Keywords:** glides, American English, syllabification, optimality theory, onset clusters

## 1. Introduction

English phonology allows a number of consonant clusters in syllable onset position. With the exception of s-initial clusters which pattern differently in many ways and must be treated separately, all of the allowable onset clusters of English must rise sharply in sonority. The allowable onset clusters of English include obstruent plus liquid ([l] or [r]) and obstruent plus labial glide ([w]), with some systematic restrictions that are due primarily to OCP constraints (i.e., constraints militating against two consonants within an onset being too similar). Some examples are given in (1).

(1) Onset clusters in English
Obstruent plus [l]: *glue, blade, fly, play, clean, slack*

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Obstruent plus [r]: *prove, truck, three, crack, green, draw, bran, frank, shrink*
Obstruent plus [w]: *queen, dwell, swing, twin, thwart, guava, schwa*

Several groups of clusters are systematically missing from this list. Clusters of two labial segments (*[pw], *[bw], *[fw]) are banned in English, and there is also a ban on [+anterior] coronal consonants followed by [l] (*[tl], *[dl], *[θl], *[ðl]). Given a generic sonority scale like the one in (2) from Clements (1990), we can say that onset clusters in English must rise at least two steps on the sonority scale to be acceptable.

(2) Generic sonority scale

| less sonorous | | | | | | | | more sonorous |
|---|---|---|---|---|---|---|---|---|
| obstruent | < | nasal | < | liquid | < | glide | < | vowel |

This minimal distance constraint, accompanied by a constraint banning sonorant plus sonorant clusters which eliminates any potential nasal plus glide clusters, is generally accepted as being sufficient to account for the inventory of onset clusters in English. Most other gaps in the onset cluster inventory are accidental, attributable to historical factors, or phonological conditioning. For example, underlying /sr/ sequences will be palatalized to [ʃr] by many speakers. The lack of /sr/ clusters in modern English is a systematic gap in the phonology of English. This is evident in the pronunciation [ʃri] vs. [sri] for the place name *Sri Lanka* (both pronunciations are given in the AHD[1]) and in the difficulty speakers have with [sr] clusters in general. Most of our underlying (modern) /ʃr/ sequences come from Old English /skr/ via the more general /sk/ > /ʃ/ change between Old English and Middle English[2] (see also Iverson & Salmons (2005) for a discussion of this change and its implications in coda position). The gap left by the /sk/ > /ʃ/ change has been filled in the modern language by later borrowing of words with /skr/ clusters from Old French or Old Norse. And while we have no native words beginning with /ʃ/ followed by /l/ or /w/, we readily borrow such words and names (*schwa*, *Schweitzer*, *schlep*, *schlock*, etc.). We also have no native words beginning with voiced fricatives followed by liquids or /w/, but again have little trouble with them in borrowings (*zwieback, Vladimir, vroom*, etc.).

The remaining gap and the issue of primary interest to the present paper, however, is the lack of obstruent plus palatal glide clusters as opposed to ob-

[1] Pronunciations are taken from the *American Heritage Dictionary* (2000) unless otherwise noted.

[2] This is supported by a search through the AHD which reveals only the following roots (after eliminating proper names): *shred* < OE *scrēade, shrew* < OE *scrēawa, shriek* < ME *shriken* of Scandinavian origin, *shrift* < OE *scrift*, *shrike* < OE *scrīc, shrill* < ME *shrille, shrimp* < ME *shrimpe, shrine* < OE *scrīn*, *shrink* < OE *scrincan*, *shrive* < OE *scrīfan, shroud* < OE *scrūd, shrub* < OE *scrybb, shrug* < ME *shruggen.*

struent plus labial glide clusters. Obstruent plus palatal glide clusters would meet the minimum two step sonority rise required of English onset clusters, so we might expect to find good examples of at least some such clusters in English words. There are some surface sequences in English that initially appear to be onset clusters consisting of a consonant plus palatal glide, but these sequences do not pattern in the same way the onset clusters in (1) do. Some examples of consonant plus palatal glide sequences are given in (3). The palatal glide in each of these examples is associated with the syllable nucleus rather than being part of an onset cluster.

(3) Consonant plus [j] sequences
[mj] music, mute, mucus, mule, mural, muse
[pj] puny, puke, putrid, pew, pure, pupil
[bj] beauty, bugle, butte, bucolic
[fj] fume, fuse, feud, few, fuel, fugue, fury
[vj] view
[kj] cute, cucumber, cube, cue, cupid, cure
[hj] huge, hew, human, humor
[gj] gew gaw, gules

Davis and Hammond (1995) discuss several characteristics of consonant plus [j] sequences that set such sequences apart from onset clusters. First, sonorants can precede [j] as in the [mj] sequences in (3) while true onset clusters are restricted to obstruent-initial sequences. And while we could hypothesize that there is no OCP constraint against sonorant-sonorant clusters, that would leave us with no principled explanation for the unacceptability of *[nw] clusters and other potential sonorant-sonorant clusters. On the other hand, we can provide a principled explanation below for the presence of the [mj] sequences in (3).

Second, the consonant plus [j] sequences in (3) are all followed by a single vowel: [u]. Consonant plus [j] sequences that are followed by other vowels are rejected by native speakers of English (*[mjo], [*pjæ], *[kje], etc.). True onset clusters, on the other hand, impose no restrictions on the quality of the following vowel, as we saw in the examples in (1), above.

Davis and Hammond also give evidence from language games that force speakers to split syllables between onset and nucleus showing that consonant plus [w] sequences are treated as a unit in these games, but consonant plus [j] sequences are not. For example, in Pig Latin, a game in which speakers move the word-initial onset to the end of the word followed by the vowel [e], speakers presented with the word *cute* are more likely to respond with [jutke] than *[utkje] but when presented with a word like *twin* the response is uniformly [ɪntwe].

These characteristics taken together point to a nuclear analysis of [ju] and a ban on onset clusters consisting of an obstruent plus [j] that cannot be accounted for by the minimal distance analysis outlined above. If a potential onset cluster need only meet the minimum sonority distance and more distance is better (Vennemann 1988), we would expect *Cw* and *Cj* clusters to be equally good. But the two glides ([w] and [j]) pattern asymmetrically in English onset clusters.

One part of the solution to handling the asymmetry in clusters containing glides is to make finer-grained distinctions within the sonority hierarchy. Adopting Kiparsky's (1979) more elaborated hierarchy in (4) will help us to explain the asymmetry under discussion.

(4) Sonority hierarchy

| | | | |
|---|---|---|---|
| stops < fricatives | < nasals < l < r < w < j < u < i < o < e < a | | |
| (obstruents) | < nasals < l < r < | (u < i) | < ([-high]) |

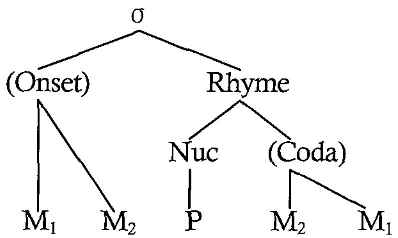
Making a sonority distinction between stops and fricatives proves to be unnecessary for the task at hand. It would also require the introduction of additional restrictions on stop plus nasal clusters, which would then meet the minimal distance requirement of two steps, so I do not take up this distinction here. Stops and fricatives are collapsed into a single obstruent class via encapsulation of constraints (Prince & Smolensky 1993/2002). There is also some disagreement in the literature over the phonemic status of the glides in English. Some analyses argue that glides are phonemically distinct from their vowel counterparts (e.g., Chomsky & Halle 1968). Other analyses (e.g., Anderson 2001, Giegerich 1992) treat glides and corresponding vowels as positional variants of a single underlying segment. I take the second position in this paper because the surface realization of an underlying high vowel/glide in the consonant-high vowel/glide-vowel environment is entirely predictable. Therefore, surface high vowels and surface glides are both assumed to be high vowels underlyingly. It is syllabification that differentiates the two.

The sonority scale in (4) identifies high front vowels/glides as more sonorous than high back vowels/glides. Modifying our earlier description of clusters to require a minimum sonority distance of two steps (which, given our sonority scale in (4) would allow clusters of obstruent plus [l r w] and the banned obstruent plus [j] clusters as well) and a maximum sonority distance of four steps, thus eliminating obstruent-[j] clusters, would then be descriptively adequate to account for the asymmetry. It does not, however, explain why an apparent maximum sonority distance restriction would be present given that a steeper sonority slope is generally considered to be better than a shallower one (Vennemann 1988). This is the question I take up in the analysis that follows. The lack of C plus [j] onset clusters will be shown to be due to the interaction between constraints governing which segments make good peaks (or nuclei) and constraints governing the acceptable onset clusters. This analysis will also account for the differences between /iu/ and /i/ followed by other vowels. I begin with an optimality theoretic analysis of onset clusters in the next section, then turn to an analysis of CiV sequences in section 3.

## 2. CuV Sequences

Baertsch (2002) proposes an optimality theoretic analysis of onset clusters that derives constraints that determine the relative well-formedness of sonority-governed onset clusters. Under this approach, the structure of the English syllable is as represented in (5). Underlying segments that surface in nuclear position are subject to the relative ranking of the constraints within the Peak hierarchy (Prince & Smolensky 1993/2002) and segments that surface in singleton onset position are subject to the relative ranking of the constraints in the Margin hierarchy (Prince & Smolensky 1993/2002), labeled $M_1$ here.

(5) English syllable template




Note that the syllable structure tree presented in (5) does not allow for a branching peak. One consequence of the non-branching peak is the relatively unusual representation of diphthongs as a single nuclear (P) segment followed by a coda glide ($M_2$) segment.[3] The [ju] diphthong is derived by coalescence of underlying /iu/, filling the single Peak position (with an offglide [w] in the coda position). In addition to restricting the peak to a single segment, the structure in (5) supports the comparative length difference between tense/long vowels and diphthongs vs. lax/short vowels. It also supports the complementary distribution of English long vowel plus single consonant rhymes (the presence of rhymes such as [ejm] and [ejp] but not *[ejmp]) vs. short vowel plus consonant cluster rhymes (where rhymes like [ɛmp], [ɪmp], etc. are acceptable).

3 The details of this representation vs. the more familiar branching nucleus representation are outside the scope of the present paper. See Baertsch (2002) for a more thorough account of this representation applied to Dutch.

Prince and Smolensky's (1993/2002) Peak and Margin hierarchies are provided in (6), reflecting the sonority distinctions presented in (4), above. The Margin hierarchy bears a subscript '1' notation of the Split Margin approach presented in Baertsch (2002).

(6) Prince and Smolensky's Peak and Margin Hierarchies[4]
Peak hierarchy:
*P/Obs » *P/Nas » *P/l » *P/r » *P/u » *P/i » *P/[-hi]
Margin hierarchy:
$*M_1$/[-hi] » $*M_1$/i » $*M_1$/u » $*M_1$/r » $*M_1$/l » $*M_1$/Nas » $*M_1$/Obs

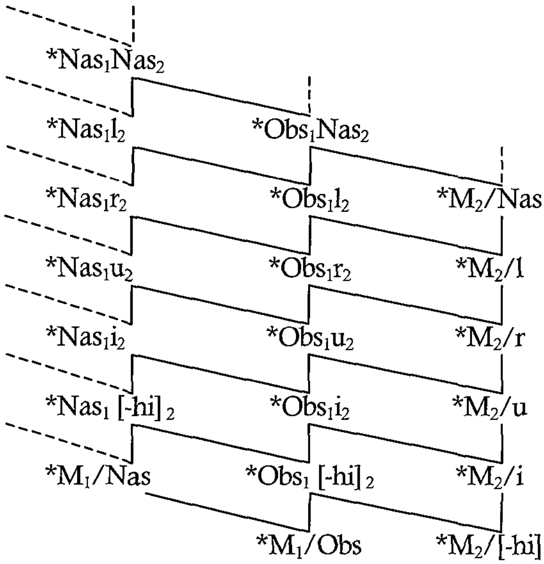
Baertsch (2002) adds a second Margin hierarchy which governs the syllable positions ($M_2$ positions) that prefer high sonority consonants (singleton coda segments and the second segment of onset clusters). The $M_2$ hierarchy is given in (7). The interaction among the constraints in these three hierarchies and the interaction between these hierarchies and other constraints will determine the surface syllabification of underlying segments.

(7) The $M_2$ Hierarchy
$*M_2$/Obs » $*M_2$/Nas » $*M_2$/l » $*M_2$/r » $*M_2$/u » $*M_2$/i » $*M_2$/[-hi]

The sonority distance relationship between two members of an onset cluster is reflected in the conjunction of the $M_1$ and $M_2$ hierarchies using the syllable as the domain, which produces a partially ranked set of complex constraints that govern onset clusters. In most languages, including English, most of these complex constraints (for example, the constraints militating against falling sonority onset clusters) are ranked high enough in the constraint hierarchy that they are never violated by a winning candidate. The relevant (lowest ranking) portion of the conjoined constraints is provided in (8). Constraints in this diagram are violated when both conjunct constraints are violated. For example, the constraint $*Obs_1l_2$ is violated by a candidate in which an obstruent is in $M_1$ position (first segment of an onset cluster) and a lateral consonant ([l]) is in $M_2$ position in the same cluster. Similarly, obstruent plus rhotic onset clusters violate the $*Obs_1r_2$ constraint, and so on.

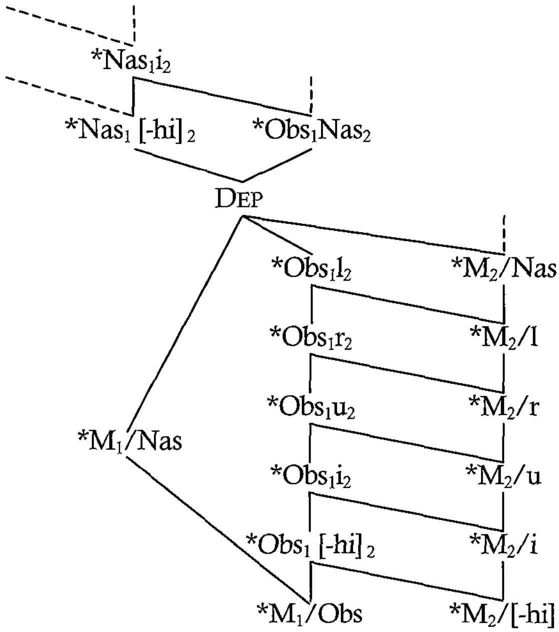
[4] In the hierarchies presented in (6) and (7), *Obs* refers to any obstruent, *Nas* refers to any nasal consonant, *u* refers to any high back vowel ([w], [u], [ʊ]), *i* refers to any high front vowel ([j], [i], [ɪ]), and [-hi] refers to any non-high vowel.

(8) Conjunction of $M_1$ and $M_2$ hierarchies




The ranking of these constraints penalizes specific clusters more or less harshly based on the slope of the sonority rise from the first to the second member of the onset cluster, much like the minimum distance parameters in earlier rule-based analyses of cluster phenomena. The interaction between these constraints and one or more Faithfulness constraints determines which clusters are viable in a given language. In English, DEP dominates $*Obs_1l_2$ and $*M_3/Nas$ and is dominated by $*Obs_1Nas_2$ and $*Nas_1$ $[\text{-hi}]_2$, thus preventing obstruent-nasal onset clusters as well as all sonorant-sonorant clusters (eliminating the need for an additional OCP constraint to rule out sonorant-sonorant clusters), as shown in (9).

(9) English onset clusters[5]




Because DEP dominates the $*Obs_1l_2$, $*Obs_1r_2$, and $*Obs_1u_2$ constraints, candidates with onset clusters consisting of obstruent plus /l/, /r/, or /w/ will be preferred over candidates which insert a vowel to break up the potential cluster.

Given the ranking in (9), an underlying form with an initial obstruent plus nasal sequence, such as *Cnut* /knut/ (the king of England from 1016-1035) will produce the surface form [kənut] with an epenthetic vowel, avoiding violation of the $*Obs_1Nas_2$ constraint by violation of lower ranking DEP instead, as the tableau in (10) shows.

[5] In Korean, on the other hand, onset clusters are normally disallowed. This is reflected in the constraint hierarchy by FAITH (DEP) being dominated by all of the conjoined constraints. Korean does have C+high vowel+vowel sequences. There are no phonotactic restrictions on the consonants allowed before the high vowel, indicating that the surface glides in Korean are in nuclear position, similar to the English [ju] sequence. See Baertsch and Davis (2008) for a more detailed constraint ranking for Korean.

(10) Realization of an initial obstruent-nasal sequence[6]

| /knut/ | *Obs$_1$Nas$_2$ | DEP | *M$_2$/Nas | *M$_1$/Nas | *P/u |
|---|---|---|---|---|---|
| a. .k$_1$n$_2$ut$_2$. | *! | | * | | * |
| b. ☞ .k$_1$ə.n$_1$ut$_2$. | | * | | * | * |

The output associated with an underlying obstruent plus lateral, on the other hand, will parse the two segments as an onset cluster as in (11), violating *Obs$_1$l$_2$ in the winning candidate and thus avoiding the fatal violation of DEP that the epenthetic candidate incurs.

(11) Realization of an initial obstruent-lateral sequence

| /klu/ | DEP | *Obs$_1$l$_2$ | *M$_2$/l | *M$_1$/l | *P/u | *M$_1$/Obs |
|---|---|---|---|---|---|---|
| a. ☞ .k$_1$l$_2$u. | | * | * | | * | * |
| b. .k$_1$ə.l$_1$u. | *! | | | * | * | * |

The tableau in (12) shows how the constraints in (9) interact with other constraints in the hierarchy resulting in surface onset clusters from underlying /CuV/ sequences. In this sequence, C is a segment that is only allowed to surface in onset or coda position (it cannot be the peak of the syllable) and V is a segment that will surface in peak position. The underlying /u/ in this sequence could potentially be parsed either as part of an onset cluster (as [w]) or as a nuclear element (as [u]). I have given several potential parses in this tableau of the underlying form /tuin/ 'twin'. In candidate (a), the underlying /u/ is parsed as the second segment of an onset cluster, violating the *Obs$_1$u$_2$ constraint. The nucleus of this candidate includes only the /i/ of the underlying form and as a result of being parsed in peak position violates the constraint against high front vowels in peaks. This is also the winning candidate.

(12) Realization of CuV sequences[7]

| /tuin/ | DEP | *M$_1$/u | *P/u | *Obs$_1$u$_2$ | *P/i | ONSET | *M$_2$/i | UNIF |
|---|---|---|---|---|---|---|---|---|
| a. ☞ .t$_1$w$_2$ɪn$_2$. | | | | * | * | | | |
| b. .t$_1$w͡ɪn$_2$. | | | *! | | * | | | * |
| c. .t$_1$uj$_2$n$_1$. | | | *! | | | | * | |
| d. .t$_1$u.ɪn$_2$. | | | *! | | * | * | | |
| e. .t$_1$ə.w$_1$ɪn$_2$. | *! | * | | | * | | | |

[6] Periods in the candidate set indicate syllable boundaries. Subscript 1 indicates singleton onset position or the first member of an onset cluster, subscript 2 indicates singleton coda or the second member of an onset cluster. No subscript indicates the segment is in peak (nuclear) position.

[7] Violations of *M$_1$/Obs, *M$_1$/Nas and *M$_2$/Nas are not shown in this tableau as they do not impact the analysis at hand.

Like candidate (a), the other candidates in this tableau also retain all of the segments of the underlying form but parse them in different ways. Candidate (b) coalesces the /u/ and the /i/ of the underlying form into a diphthong akin to the [ju] diphthong discussed in the preceding section. This candidate also violates the Faithfulness constraint UNIFORMITY ('no coalescence', McCarthy & Prince 1995) because the two underlying vocalic segments are merged into a single (contour) segment on the surface. In candidate (c), the /i/ has been parsed as an offglide (an $M_2$ segment), thus avoiding coalescence. However, whether the phonetic realization of this diphthong includes an onglide [wi] as in candidate (b) or an offglide [uj] as in candidate (c), the presence of the high back vowel in the nucleus incurs a fatal violation of the constraint against nuclear [u] (*P/u). Candidate (d) is a bisyllabic parse which likewise fatally violates the constraint against nuclear [u]. Candidate (e) avoids violation of *P/u by inserting a schwa, thus allowing the /u/ to be parsed as a singleton onset (a violation of *$M_1$/u). But the violation of Dep incurred by the epenthetic vowel is fatal.

Because of the ease with which /u/ is parsed as part of an onset cluster with obstruents, we expect /CuV/ sequences other than /Cui/ to be parsed similarly and this is indeed the case as we see in (13). A /CuV/ sequence beginning with any consonant other than an obstruent will be parsed as a bisyllabic [Cu.V] because the onset cluster parse would fatally violate a very high ranking conjoined constraint.

(13) Realization of CuV sequences

| | /kuæk/ | *P/u | *$Obs_1u_2$ | ONSET | *$M_2$/Obs | *$M_1$/Obs | *P/[-hi] |
|---|---|---|---|---|---|---|---|
| a. ☞ | .$k_1w_2æk_2$. | | * | | * | * | * |
| b. | .$k_1u.æk_2$. | *! | | * | * | * | * |

While the ranking *P/u » *$Obs_1u_2$ in the present analysis implies a preference in the language for parsing high back vowels at the margin of a syllable rather than as a syllable nucleus, this does not imply that high back vowels cannot be parsed as nuclei. In fact, a nuclear parse of /u/ is arguably more common than the margin parse just discussed. Because a nucleus is a requirement for a well formed syllable and the *P/u constraint is dominated by DEP (and NUC – 'have a nucleus'), underlying high back vowels will usually be parsed as nuclear, as we see in the tableau in (14).

(14) Realization of CuC sequences

| /kul/ | DEP | *P/l | *P/u | $^*Obs_1 u_2$ | $^*M_2/l$ | $^*M_2/u$ | $^*M_1/Obs$ |
|---|---|---|---|---|---|---|---|
| a. $.k_1w_2ɫ.$ | | *! | | * | | * | * |
| b. ☞ $.k_1uɫ_2.$ | | | * | | * | | * |
| c. $.k_1w_2əɫ_2.$ | *! | | | * | * | * | * |

A nuclear parse of /u/ will be the realization of any CuC sequence simply because there is no better parse of such a sequence. For an underlying /u/ to be parsed as part of an onset cluster, a vowel must follow it.

Because $^*Obs_1i_2$ is dominated by $^*Obs_1u_2$ which is in turn dominated by DEP, we have reason to expect that obstruent plus /iV/ sequences should also be parsed as [Cj] onset clusters with the remaining vowel parsed as a simple nucleus. But we saw in section 1 that these clusters do not seem to occur and thus could present a problem for our optimality theoretic analysis. In the next section, I take up the OT analysis of CiV sequences.

## 3. CiV Sequences

In contrast to CuV sequences, CiV sequences do not surface as onset clusters. While there are several distinct realizations of CiV sequences, the underlying /i/ in each is parsed as nuclear rather than as part of an onset. The preference in English seems to be for /i/ to be parsed as a nuclear element rather than a margin (onset/coda) element where possible and this preference is reflected in the constraint ranking by the domination of *P/i by the cluster constraint $^*Obs_1i_2$, as we see in (15).

(15) Constraint ranking for CiV sequences
... *P/u » $^*Obs_1u_2$ » $^*Obs_1i_2$ » *P/i ...

As we saw in the examples in (3), sequences of consonant followed by /iu/ are generally parsed as onset C plus the nuclear diphthong [ju]. The constraint ranking in (15) accounts for this realization, as the tableau for /kiut/ *cute* in (16) shows.

(16) Realization of Ciu sequences[8]

| /kiut/ | Dep | OCP[hi] | *P/u | *$Obs_1i_2$ | *P/i | *$M_1$/i | Ons | *$M_2$/u | Unif |
|---|---|---|---|---|---|---|---|---|---|
| a. .$k_1j_2ut_2$. | | | * | *! | | | | | |
| b. ☞ .$k_1\widehat{ju}t_2$. | | | * | | * | | | | * |
| c. .$k_1ɪw_2t_1$. | | *! | | | * | | | * | |
| d. .$k_1ɪ.ut_2$. | | | * | | * | | *! | | |
| e. .$k_1ə.j_1ut_2$ | *! | | * | | | * | | | |

The candidates given in this tableau are similar to the candidates that were given for the CuV sequence in the previous section. However, in this tableau, the candidate with an onset cluster, candidate (a), fatally violates the constraint militating against obstruent+[j] onset clusters. Candidate (c) manages to avoid violation of *P/u by parsing the /u/ as an $M_2$ segment (an offglide), but is eliminated instead by a high ranking OCP[hi] constraint which is fatally violated because two adjacent rhyme segments have the same [hi] feature.[9] Candidate (d) incurs a fatal violation of the Onset constraint leaving candidate (b), which on the surface is almost indistinguishable from candidate (a). Candidate (b) with the coalesced nuclear [$\widehat{ju}$] becomes the winning candidate. Note also in this tableau that the onset of the winning parse violates only very low-ranking *$M_1$/Obs. Switching the initial obstruent for another, more sonorous segment will return a similar winning candidate as all of the relevant $M_1$ constraints are dominated by *$M_1$/i.

In many dialects of American English, the diphthong [ju] occurs only after noncoronal consonants, as we see in (17). It is retained in some British dialects.

(17) Diphthong [ju] after coronal consonants

| | Middle English | Modern: American dialects | British dialects |
|---|---|---|---|
| *new* | [nɪuə] | [nu] | [n$\widehat{ju}$] |
| *blew* | [blɪu] | [blu] | [bl$\widehat{ju}$] |
| *due* | [dɪuə] | [du] | [d$\widehat{ju}$] |
| *Tuesday* | [tɪuəsdæɪ] | [tuzdɪ] | [t$\widehat{ju}$zdɪ] |

Because the loss of /i/ in these forms occurred in the Early Modern English period (Wright & Wright 1924), I assume that the /i/ is no longer in the underlying form of words with initial coronal consonants like those in (17) in the

[8] Violations of *$M_1$/Obs and *$M_2$/Obs incurred by onset and coda obstruents are not shown in this tableau. The OCP[hi] constraint militates against adjacent segments within a rhyme sharing a feature, in this case [+hi].

[9] While the same OCP[hi] constraint will be active in parsing long high vowels /ii/ and /uu/ as [ij] and [uw], the violations in these cases will not be fatal because of higher ranking ID[hi] and ID[rnd] constraints. See Baertsch (2004) for more explicit detail on the resolution of these underlying vowel sequences.

relevant modern American dialects. Because it never surfaces in these dialects, Lexicon Optimization (Prince & Smolensky 1993/2002) would remove it from the UR. However, the constraint ranking established thus far gives us an indication as to what may have happened to the original underlying /i/. Low ranking UNIFORMITY indicates that coalescence is/was an active process in the language. Coalescence of a coronal consonant with /i/ can occur without loss of [Coronal] place features (/niu/ > /$n^j$u/) with subsequent loss of the subsidiary [-ant] feature of the /i/ in favor of the [+ant] feature of the coronal consonant (/$n^j$u/ > /nu/ with no violation of MAX[Cor]). However, a non-coronal consonant cannot incorporate a coronal /i/ in this way without loss of the [Coronal] feature. While this is a possible explanation for the historical facts, it is not a process that is strong in the modern language as speakers of dialects that lack [ju] after coronal consonants have no difficulty producing such sequences.

As for CiV sequences in which the second vowel is not /u/, we see a different outcome. While English has no native lexical items with CiV sequences where the vowel is anything other than /u/, we have borrowed a number of words from a wide variety of languages with exactly such sequences. Some examples are given in (18) along with a transcription of the first pronunciation for each given in the American Heritage Dictionary (AHD 2000).[10]

(18) Other CiV sequences

| | |
|---|---|
| *Kyoto (Japan)* | [ki.ˈo.to] |
| *(Lake) Kioga (Uganda)* | [ki.ˈo.gə] |
| *kiosk* | [ˈki.ɑsk] |
| *Tiahuanaco (Bolivia)* | [ˌti.ə.wə.ˈnɑ.ko] |
| *tiara* | [ti.ˈær.ə] |
| *Tierra (del Fuego)* | [ti.ˈɛr.ə] |
| *Niamey (Niger)* | [ni.ˈɑ.me] |
| *niello* | [ni.ˈɛl.o] |
| *liaison* | [ˈli.e.ˌzɑn] |
| *Liepaja (Latvia)* | [li.ˈɛp.ə.jə] |
| *piano* | [pi.ˈæn.o] |
| *Pierrefonds (Quebec)* | [pi.ɛr.ˈfõn] |

[10] For some of these words (*Kyoto, Tierra del Fuego, Niamey, Liepaja, piano, Pierrefonds*), a secondary pronunciation is given which represents the /i/ as a glide (presumably as part of an onset cluster). I take this as an indication that for some (educated) speakers, [j] can either cluster with a preceding consonant or coalesce with it, but for most speakers the cluster realization of this segment is illicit. However, note that five of the six words with secondary cluster pronunciations are place names, leaving *piano* as the only word in the list with a secondary pronunciation. Also note that the cluster pronunciation is not listed in earlier dictionaries such as Webster's (1961). For those speakers whose dialect/idiolect does allow a cluster pronunciation, the constraint ranking would be *P/i >> *$Obs_1i_2$, but the cluster pronunciation is still systematically excluded from the speech of most speakers.

In each of the examples in (18), the preferred surface realization of the CiV sequence is bisyllabic. This realization is unrelated to stress or the quality of the second vowel. Accounting for the realization of these sequences requires some addition to the constraint ranking established thus far. The ranking as it stands would require that the /i/ in each of these sequences be parsed as a nuclear segment, but the diphthongs that would result from coalescence of the /i/ with vowels other than /u/ are disallowed in English (*[jo], *[jɑ], *[je], etc.). There are two differences between [ju] and *[jo], *[jɑ], *[je], etc. The first difference is that the latter are rising sonority diphthongs while the former is not. None of the diphthongs that are allowed in English, whether fully in the peak ([ju]) or shared between peak and M2 ([aj], [ij], etc.), rise in sonority. They are either equal sonority (as is the case with [ij]) or falling sonority. This indicates the presence of a constraint against rising sonority diphthongs (*RISING, Rosenthall 1994).

Secondly, the [ju] diphthong shares a [+hi] feature while in the other diphthongs the two underlying segments differ in height. This indicates the presence of a constraint requiring identity of features within the Peak (similar to Pulleyblank's (1997) ICC constraints and Lombardi's (1999) AGREE constraints). Once an AGREE[hi] constraint is included in the hierarchy, as the tableau representing /piæno/ *piano* in (19) shows, the bisyllabic parse of such /CiV/ sequences surfaces as the winning parse.[11]

(19) Realization of CiV sequences

| | /piæno/ | $*Obs_1i_2$ | AGREE[hi] | *P/i | ONSET | UNIF | *P/[-hi] |
|---|---|---|---|---|---|---|---|
| a. | $.p_1j_2$æ.$n_1$o. | *! | | | | | * |
| b. | $.p_1\widehat{j}$æ.$n_1$o. | | *! | * | | * | * |
| c. ☞ | $.p_1$i.æ.$n_1$o. | | | * | * | | * |

In this last tableau, the candidates provided include the onset cluster parse, the nuclear diphthong parse, and the bisyllabic parse of the /iV/ vowel sequence. In this example, as in the previous example, the onset cluster candidate (a) is eliminated by its violation of $*Obs_1i_2$. The coalesced diphthong candidate (b) is eliminated by its violation of AGREE[hi], leaving the bisyllabic candidate as the winner even though it breaks the vowel sequence into two syllables. As we can see from this tableau, other sequences consisting of an obstruent followed by /i/ and a second non-high vowel will surface as bisyllabic as well.

[11] The AGREE[hi] constraint is not in competition with the OCP[hi] constraint in the tableau in (16). AGREE[hi] requires segments sharing a node (Peak) to agree in this feature. The OCP[hi] constraint militates against adjacent segments within a rhyme (Peak and $M_2$) sharing features.

## 4. Conclusion

The analysis presented in this paper accounts for the attested realizations of consonant plus high vowel plus vowel sequences in English. High front vowels in these sequences are pulled into the nucleus of the syllable. They either coalesce with a following high back vowel into the diphthong [ju] or are parsed as a simple nucleus leaving the following vowel to be parsed into a second syllable. It is the preference for nuclear parses of such segments that prevent them from surfacing in onset clusters. In contrast, there is no such preference with respect to the high back vowel and as a result, high back vowels are parsed as the second segment of an onset cluster if a higher sonority segment (a better nucleus) follows it. A high back vowel is parsed as nuclear when followed by a consonant.

The asymmetry evident in the realizations of the CiV vs. CuV sequences is paralleled in simple onset position as well. Compare, for instance, the number of words beginning with a high back glide onset followed by a high back vowel in peak position with the relatively rare initial onsetless syllables beginning with a high back vowel in (20). On this theory, both would begin with underlying /uu/ sequences, but the standard parse in this situation is for the first /u/ to take an $M_1$ onset position. The onsetless words on the right, on the other hand, are all marked in some way. They are onomatopoetic, interjections of surprise, borrowed, etc. and must be lexically marked for the onsetless pronunciation.

(20) Initial /uu/ sequences

| Onset glides | Onsetless |
|---|---|
| *wool* | *ooh* |
| *wood* | *oops* |
| *wolf* | *ouzo* |
| *woman* | *ooze* |
| *wolverine* | |
| *would* | |
| *woof*, etc. | |

In contrast, words beginning with an underlying /ii/ sequence show the opposite pattern, as we see in (21). In this set, it is the onsetless parse that is standard. The words beginning with a glide in onset position are the ones that are marked in the same ways that the onsetless words were marked in (20).

(21) Initial /ii/ sequences

| Onset glides | Onsetless |
|---|---|
| *yip* | *each* |

| | |
|---|---|
| *yin* | *eagle* |
| *Yiddish* | *ease* |
| *yippee* | *eat* |
| | *eager* |
| | *ear* |
| | *east* |
| | *easy* |
| | *eaves*, etc. |

An analysis like the one presented in this paper, in which the relative well-formedness of onset clusters is determined not only by the sonority profile of the underlying segments but also by the tendency to draw high sonority segments into the nucleus of the syllable could prove to be explanatory in other languages as well. Clements' (1990) demisyllable analysis of onset clusters indicates that obstruent plus liquid clusters are the least marked two segment onset clusters because such clusters have the steepest sonority rise both from the onset to the liquid and from the liquid to the nuclear vowel. In cluster analyses that incorporate the sonority sequencing principle and a minimum sonority distance parameter (e.g., Steriade's (1982) analysis of Greek clusters), the larger sonority rise the better the cluster irrespective of the following vowel. These two approaches are at odds with one another when many more sonority distinctions are necessary within the class of obstruents than within the class of vowels, as is the case with Steriade's analysis of Greek. An analysis that focuses only on a minimum sonority distance cannot account for the distribution of English glides presented here. A demisyllable analysis would predict considerable skewing in the lexicon toward onset clusters followed by low vowels in order to maximize slope from liquid/glide to following vowel. The approach employed in the current analysis incorporates aspects of both, recognizing the advantage of a steep sonority rise in an onset cluster yet allowing for interaction between constraints determining the relative well-formedness of nuclear segments and constraints determining the relative well-formedness of onset segments and onset clusters in determining the surface realization of underlying segments that are able to fill either onset or nuclear position. While the presentation here is limited to the CiV/CuV context, it accounts for these data and does it in the context of a larger analysis that predicts asymmetry in the patterning of high vowels/glides in other aspects of syllabification as well. The asymmetrical patterning of the high vowels/glides in word-initial position mentioned above is one such environment as are the patterning of offglides and intervocalic glides, but such matters must be left for future research.

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