FLAPPING AND OTHER FATES OF /t/ AND /d/ IN NORTH AMERICAN ENGLISH

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1. Introduction

English, a Germanic language that originated in Western Europe, is now the most widely spoken language in the world. It is the national language or an officially recognized language in countries on every continent. Not surprisingly, there are many regional variants in spoken English at all linguistic levels, but it is aspects of phonology that most readily identify an English speaker’s origin.

One feature characteristic of most varieties of North American English is the so-called “flapping” of medial /t/ and /d/ in words such as ‘city’ and ‘muddy’, resulting in a rhotic sound usually represented as [ɾ] in the International Phonetic Alphabet. Reference to this phenomenon comes up frequently in discussions of phonological alternation, e.g. Hayes (2001:§§2.3.5, 3.4.5, 6.2.2, 9.1), but I am unaware of a comprehensive account considering the full range of environments where flapping occurs as well as related allophones of /t/ and /d/. A careful study of medial /t/ and /d/ reveals that a full account of the environment for “flapping” is not only complex, but also that flapping is but one of several related phonological adaptations that these phonemes undergo in medial environments.

This paper describes allophonic variation of /t/ and /d/ for my own speech. While there are individual and dialectal differences, I believe that my speech is fairly typical of North American English in this respect. I was born in Corvallis, Oregon and lived exclusively in Oregon until I was in my mid-twenties. For the past 35 years or so, I have
lived primarily in Southern California, but because I came here as an adult, my native phonology has not undergone any noticeable influence from the speech of native southern Californians. In any case, I notice little, if any difference between my speech and that of natives (such as my daughters) with respect to alternations involving medial /t/ and /d/.

2. Phonological Sketch

The table below shows the consonant phonemes of my variety of North American English. In cells with two symbols, the left-hand one is voiceless, the right-hand one is voiced. The laryngeal, /h/ is normally voiceless. Other symbols represent voiced sounds.

<table>
<thead>
<tr>
<th></th>
<th>Labial</th>
<th>Dental</th>
<th>Alveolar</th>
<th>Postalveolar</th>
<th>Palatal</th>
<th>Velar</th>
<th>Laryngeal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop</td>
<td>p</td>
<td>b</td>
<td>t</td>
<td>d</td>
<td>k</td>
<td>g</td>
<td></td>
</tr>
<tr>
<td>Affricate</td>
<td>ʃ</td>
<td>dʒ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fricative</td>
<td>f</td>
<td>v</td>
<td>θ</td>
<td>ð</td>
<td>s</td>
<td>z</td>
<td>j</td>
</tr>
<tr>
<td>Nasal</td>
<td>m</td>
<td>n</td>
<td></td>
<td></td>
<td></td>
<td>ι</td>
<td></td>
</tr>
<tr>
<td>Glide</td>
<td>ʍ</td>
<td>w</td>
<td></td>
<td></td>
<td></td>
<td>j</td>
<td></td>
</tr>
<tr>
<td>Lateral</td>
<td></td>
<td>l</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhotic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ɹ</td>
<td></td>
</tr>
</tbody>
</table>

The primary focus of this paper will be medial allophones of /t/ and /d/, covered in subsequent sections. Voiceless stops are aspirated when they initiate a stressed syllable (‘two’ /tu/ → [tʰʊu]) and optionally in word final position. All stops can be pronounced released or unreleased at the end of a word. I will mark aspiration without comment in phonetic forms; I will not mark (un)releasing. The North American English rhotic is sometimes put in the “Alveolar” cell, though there is nothing alveolar about this sound. In my pronunciation, which I think is typical, the tongue is bunched and is drawn toward the back part of the palate. Placement of the /ɹ/ symbol in the table attempts to reflect
this articulation. The non-alveolar nature of /ɹ/ plays a role in medial realizations of /t/ and /d/.

The vowel phonemes of my variety of English are in the table below:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>[+high, +tense]</td>
<td>i</td>
<td>u</td>
<td>aɪ  ɐ  ɔɪ</td>
<td></td>
</tr>
<tr>
<td>[+high, -tense]</td>
<td>i</td>
<td></td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>[-high, -low, +tense]</td>
<td>e</td>
<td></td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>[-high, -low, -tense]</td>
<td>ɛ</td>
<td></td>
<td>ʌ</td>
<td></td>
</tr>
<tr>
<td>[+low, (-tense)]</td>
<td>æ</td>
<td></td>
<td>a</td>
<td></td>
</tr>
</tbody>
</table>

Most English speakers diphthongize tense vowels, particularly the mid ones. In my speech, the tense vowels tend to start slightly lax, then rise, and for back vowels, increase in rounding, e.g. /e/ \(\rightarrow [ɛ̝]\), /u/ \(\rightarrow [ʊ̝\ ɔ̝]\), etc. There is, however, much variation depending on speech rate and consonantal environment. For monophthongs, I will thus use the single vowel symbols in the table. All vowel nuclei, including diphthongs, are reduced to [ə] when unstressed. I formulate this rule in (1) for easy reference throughout the paper. The vowel “ə”, though always somewhere in the mid to high central region, shows considerable phonetic variation. I therefore simply use the IPA symbol in the rule.

(1) UNSTRESSED VOWEL REDUCTION: \([+\text{syllabic}}] \rightarrow [ə]

Stress plays a crucial role in English phonological alternations, such as vowel reduction and alternations involving /t/ and /d/. I will not attempt to formulate stress placement rules in this paper, simply taking the placement of stress as part of the representation of a word at the time other rules come into play.
3. Flapped Consonants and the Environment for Flapping

An alveolar flap, $\mathbf{r}$, as an intervocalic allophonic variant of /t/ and /d/ is a well-known feature of North American English. The examples in (2a) show that the flaps in the left-hand column are allophonically related to stops in the words in the right-hand column, and moreover that stops must be the underlying phonemes, since there is a voiceless vs. voiced contrast that cannot be predicted by the environment. The words in (2b), though they have no alternants with stops, likewise provide evidence that $\mathbf{r}$ is in complementary distribution with phonetic alveolar stops since the starred variants with stops do not exist in normal spoken North American English. Spelling and dialects that do not flap /t/ and /d/ confirm the stops to be the source of the flaps.

(2) a. writing $\mathbf{\text{ˈɾəɪrɪŋ}}$ write $\mathbf{\text{ˈɾaɪt}}$
    seated $\mathbf{\text{ˈsɪɾəd}}$ seat $\mathbf{\text{ˈsɪt}}$
    quotient $\mathbf{\text{k*ɾəbɊ}}$ quote $\mathbf{\text{k*Ɋt}}$
    riding $\mathbf{\text{ˈɾəɪrɪŋ}}$ ride $\mathbf{\text{ˈɾaɪd}}$
    seeded $\mathbf{\text{ˈsɪɾəd}}$ seed $\mathbf{\text{ˈsid}}$
    readable $\mathbf{\text{ˈɾəɪbɊɊ}}$ read $\mathbf{\text{ˈɾɪd}}$

b. attic $\mathbf{\text{ˈæɾək}}$ but no *$\mathbf{\text{ˈætək}}$
    parity $\mathbf{\text{ˈpɛɾəɾɊɾɪ}}$ but no *$\mathbf{\text{ˈpɛɾəɊɾɊɾɪ}}$
    paddock $\mathbf{\text{ˈpæɾəɾɊk}}$ but no *$\mathbf{\text{ˈpædəɾɊk}}$
    parody $\mathbf{\text{ˈpɛɾəɾɊɾɪ}}$ but no *$\mathbf{\text{ˈpɛɾəɊɾɊɾɪ}}$

A couple of notes on phonetic realization of these words are in order. First, in my own speech, I do not believe that I fully neutralize /t/ and /d/ to a single, undifferentiated flap $\mathbf{r}$, except perhaps in an allegro colloquial speech style. I have thought about this and produced thousands of tokens of these sounds for myself over many years, always with the same conclusion: while the tongue makes little or no alveolar contact with the alveolar ridge for /t/, there is contact for /d/, which I actually “feel”, not only in the tongue contact, but also as a telescoping of the voicing into my head. Neither “flapped”
sound is a true stop, however, and the phonetic difference plays no role in the flapping process itself. I will therefore transcribe all examples with undifferentiated [ɾ].

Second, many speakers, even though they neutralize the underlying distinction in consonants to [ɾ], reflect the underlying difference with greater vowel length before [ɾ] < /d/ than before [ɾ] < /t/, e.g. ‘seated’ → [ˈsɪɾəd] vs. ‘seeded’ [ˈsɪɾəd]. In my speech, such a length distinction is extremely small, if it exists at all. I will therefore ignore it.

Before refining the the description of the environment where flapping takes place, let us delimit the class of consonants that undergo flapping. Flapping does not affect non-alveolar consonants, i.e. labials (‘wiping’), postalveolars (‘hitching’), and velars (‘hiking’) all remain stops in environments where /t/ and /d/ flap. Flapping likewise does not affect fricatives, i.e. dentals (‘tithing’) and alveolars (‘rising’) remain fricatives. However, though less frequently commented on than /t/ and /d/, /n/ can, at least optionally, undergo flapping, as in (3).

(3) running [ˈɹʌɾɪŋ] or [ˈɹʌɾɪŋ] run [ˈɹʌn]
    trainable [ˈtuəɾəbl] or [ˈtuəɾəbl] train [ˈtɾɛn]
    thinnest [ˈθɪɾəst] or [ˈθɪɾəst] thin [ˈθɪn]

Hayes (2001:§9.1), in a slightly different context (see below) claims that the flap is nasalized, and I have marked it as such here. I am not convinced, however, that the flap is nasalized beyond some nasalization leaking over from the nasalized vowel, i.e. unlike the fully nasal /n/ from which the flaps in (3) derive, flapping results in significant deNasalization. Instrumental study would be required to resolve this.

One crucial enviromental feature holds for all the examples of flapping that we have presented so far, namely, flapping requires that the flap initiate, or at least precede an
unstressed syllable. Flapping is not possible in words such as *quotation* (cf. ‘quotable’ [ˈkwətəbl]), *addiction* (cf. ‘addict’ [æərəkt]), *benéficient* (cf. ‘benefit’ [bəˈfɪʃənt]).

With the facts presented so far, we can formulate a first approximation of the flapping rule as in (4):

(4) ALVEOLAR STOP FLAPPING:
(1st approximation)

\[
\begin{array}{c}
\text{CORONAL} \\
\text{anterior} \\
\text{-continuant}
\end{array}
\rightarrow
\begin{array}{c}
\text{voice} \\
\text{flap} \\
\text{+syllabic}
\end{array}
\]

\[
\begin{array}{c}
\text{+stress} \\
\text{-syllabic}
\end{array}
\]

(An alveolar stop, including /n/ (recall that nasals are [-continuant]), becomes a flap intervocalically when initiating an unstressed syllable.)

It is assumed that the change to the feature [+flap] automatically carries the features [+approximant, +sonorant, +continuant], which also differentiate the flap from the input consonants. The feature [+voice] is necessary because [-voice] flaps exist. The feature [nasal] is not necessary if the flap deriving from /n/ is nasalized, as marked in (3).

The rule in (4) gives the preceding environment as a vowel. This turns out to be not quite correct, as examples in (5) show. I have selected words which, in most cases, have alternants with the non-flapped sound, e.g. ‘sort’ vs. ‘sorting’, but I have not included non-flapped alternants in the table.

(5)  

<table>
<thead>
<tr>
<th></th>
<th>Medial /t/</th>
<th>Medial /d/</th>
<th>Medial /n/</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>preceding /ʌ/</td>
<td>sorting</td>
<td>boarding</td>
</tr>
<tr>
<td></td>
<td>warty</td>
<td>[ˈsɔrəɾi]</td>
<td>[ˈboɹɾi]</td>
</tr>
<tr>
<td>b.</td>
<td>preceding /l/</td>
<td>melting</td>
<td>building</td>
</tr>
<tr>
<td></td>
<td>faulty</td>
<td>[ˈfɔlɹi]</td>
<td>[ˈbɹɪɾi]</td>
</tr>
<tr>
<td></td>
<td>lardy</td>
<td>[ˈlɔɹɾi]</td>
<td>[ˈlaɹɾi]</td>
</tr>
<tr>
<td></td>
<td>corny</td>
<td>[ˈkɔɹɾi]</td>
<td>[ˈkɔɹɾi]</td>
</tr>
</tbody>
</table>

\(^1\) I have been unable to find a good example of a word with intervocalic /ľn/. The example here is the last name of the British author, A.A. Milne, who wrote the Winnie the Pooh books. His name is actually pronounced ['mɪln], but my mother, who read these books to me and my brothers when we were children, pronounced it [ˈmɪlni] or [ˈmɪlni], and I had a high school classmate with this name who used the disyllabic pronunciation.

\(^2\) This word means ‘having to do with baths’. I have never heard or used this word, but I am confident of how to pronounce it!
Looking first at the examples in (5d), it is clear that if an obstruent precedes the alveolar stop, flapping is impossible. If the preceding sound is a sonorant, the situation is more complicated, however. Flapping always takes place if the preceding sonorant is /ɹ/, as in (5a). Flapping is optional if the preceding sonorant is /l/, as in (5b). After /n/, as in (5c), flapping is obligatory for /t/ but blocked for /d/. There is a good articulatory reason for this, which we can summarize as follows: A PRECEDING SONORANT CONSONANT BLOCKS FLAPPING IF THE SONORANT INVOLVES ALVEOLAR CONTACT.

Preceding /ɹ/ (flapping obligatory): As noted in section 2, North American English /ɹ/ is a palato-velar approximant involving no alveolar contact. It is, in fact, a non-syllabic vocoid sound.

Preceding /l/ (flapping optional): The optionality has to do with two possibilities for pronouncing /l/. Recall that syllable final /l/ in English is velarized. I find that when I make the flap version in a word like ‘faulty’ [ˈfaulti], I raise the tongue dorsum toward the velum and curl the front part of the tongue up for “l-coloring”, but I make no alveolar contact for the /l/ itself. For the stop pronunciation as in [ˈfalti], however, I make actual alveolar contact during the /l/, then prolong the alveolar contact, releasing it as a stop.

Preceding /n/ (flapping obligatory for /t/, blocked for /d/): Here we must introduce another rule of English phonology, cited in Hayes (2001:§9.1) and given here in (6):
(6) /n/ DELETION BEFORE /t/:  
\[
/\text{n/} \rightarrow \emptyset /\text{t} \begin{cases}
\text{+syllabic} \\
\text{-stress}
\end{cases}
\]

The rule in (6) deletes /n/ before /t/ when the –nt cluster is at the end of a word, as in ‘scent’ [sɛt], or before an unstressed syllabic sound, as in ‘scented’ [sɛɾad]. Note that the presence of the underlying nasal remains because of VOWEL NASALIZATION, which nasalizes any vowel preceding a nasal consonant. VOWEL NASALIZATION must ordered before rule (6). Because of rule (6), /t/ in words like those in (5c) does not have a preceding consonant at all! It therefore undergoes flapping as it would after any vowel. On the other hand, /n/ is NOT deleted before /d/ in the environment of rule (6), meaning that the sound preceding /d/ in words like those in (5c) is actually the alveolar nasal [n], a sound involving alveolar tongue contact.

Let us introduce a feature [±apical], where [+apical] means “contact of the apex of the tongue in the anterior region”. We can now revise our flapping rule (4) as in (7), with a non-apical sonorant consonant preceding the potentially flapped sound. Note that this rule must follow (6) in order to remove the [+apical] /n/ before flapping applies.

(7) ALVEOLAR STOP FLAPPING:

(\text{revised})
\[
\begin{array}{c}
\text{+ CORONAL} \\
\text{+ anterior} \\
\text{- continuant}
\end{array}
\rightarrow
\begin{array}{c}
\text{+ voice} \\
\text{+ flap}
\end{array}
/\text{ [+syllabic] ([-syllabic}
\begin{array}{c}
\text{+ sonorant} \\
\text{- apical}
\end{array}
\text{- stress}\)
\]

The interaction of (6) and (7) has an interesting result with pairs of words like those in (8). The derivations in (9) show how the phonetic forms arise:

\footnotesize
\begin{footnotesize}
\footnotesize
\footnotesize
\footnotesize

\footnotesize
\footnotesize
\footnotesize
\footnotesize
\footnotesize

3 Blocking of /n/ deletion before /d/ is undoubtedly related to the fact that both are underlyingly voiced, making an /nd/ cluster a sort of phonological unit whose components differ only in nasality. Other languages also treat nasal+homorganic voiced stop clusters as more tightly bound than corresponding clusters with a voiceless stop.

\end{footnotesize}
\footnotesize
\footnotesize
\footnotesize
\footnotesize
\footnotesize
\footnotesize
The two underlying forms come out homophonous. What is of interest is that the flaps have different underlying sources, one from underlying /n/ and the other from underlying /t/. As already noted, it may be necessary to add a rule of FLAP NASALIZATION under the influence of the preceding nasalized vowel to give /ɾ/ in both words, though I have expressed some doubt above as to whether the flap is actually fully nasalized to the extent that the original nasal consonant or even the nasalized vowel are nasalized.

### 4. Flapping in the Context of Other Coronal Stop Reductions

To this point, we have been tacitly assuming that the [+syllabic] segment following the flapped consonant is a vowel. Consider the data in (10):

<table>
<thead>
<tr>
<th>Underlying</th>
<th>Medial /t/</th>
<th>Medial /d/</th>
<th>Medial /n/</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOWEL NASALIZATION</td>
<td>'ʌn-i'</td>
<td>'ʌn-ti'</td>
<td>'ʌn-i'</td>
</tr>
<tr>
<td>/n/ DELETION (6)</td>
<td>-----------</td>
<td>-----------</td>
<td>'ʌn-i'</td>
</tr>
<tr>
<td>FLAPPING (7) (optional for /n/)</td>
<td>'ʌnri'</td>
<td>'ʌnri'</td>
<td>'ʌnri'</td>
</tr>
<tr>
<td>Output</td>
<td>[ˈʌnri]</td>
<td>[ˈʌnri]</td>
<td>[ˈʌnri]</td>
</tr>
</tbody>
</table>

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4 Hayes (2001:6/10-12) has a different account, using a rule of POST-NASAL /t/ DELETION, claiming that the phonetic results would be, for example, ‘planning’ [ˈplænɪŋ] and ‘planting’ [ˈplænɪŋ], with full nasal consonants in the homophonous forms. I do not think English needs a rule of /t/ DELETION. My judgment is that where the words are homophonous, they are phonetically [ˈplænɪŋ], with a flap, perhaps nasalized. ‘Planning’ can optionally be pronounced with a full nasal [n], but this is not a valid pronunciation for ‘planting’, at least for me.

5 The IPA provides two ways to write the North American syllabic “r”: [ɹ] and [ɾ]. I use the latter since it better reflects the relationship of the phonetic output to the underlying source in [ʌ].
c. /l/ following

<table>
<thead>
<tr>
<th>Word</th>
<th>Pronunciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>site’ll</td>
<td>[sɑɪt̩]</td>
</tr>
<tr>
<td>portal</td>
<td>[pɔr̩t̩]</td>
</tr>
<tr>
<td>Walt’ll</td>
<td>[wɔlt̩]</td>
</tr>
<tr>
<td>mantle</td>
<td>[mæt̩]</td>
</tr>
<tr>
<td>written</td>
<td>[ˌwriʔ̩n]</td>
</tr>
<tr>
<td>carton</td>
<td>[kɑr̩n]</td>
</tr>
<tr>
<td>molten</td>
<td>[mɔl̩n]</td>
</tr>
<tr>
<td>Clinton</td>
<td>[klɪn̩n]</td>
</tr>
<tr>
<td>pardon</td>
<td>[pɑrd̩n]</td>
</tr>
<tr>
<td>bolden</td>
<td>[bold̩n]</td>
</tr>
<tr>
<td>Condon</td>
<td>[kɔnd̩n]</td>
</tr>
</tbody>
</table>

The data in (10) show that in nearly all cases where a word final unstressed syllable consists of a sonorant consonant alone or of an underlying /ə+sonorant/, the phonetic result is a syllabic sonorant. We can account for this by a pair of rules. Rule (11) deletes ə before a word final sonorant in words where we know a vowel must be present (as in atom—cf. atomic, with a full vowel preceding the m). Rule (12) syllabifies a word final sonorant after another consonant.

(11) PRE-SONORANT DELETION:  
\[
\begin{array}{c}
\rightarrow \emptyset / [-\text{syllabic}] \quad \left[+ \text{consonantal} \quad + \text{sonorant} \quad - \text{DORSAL}\right]_{\text{word}} \\
\end{array}
\]

(The feature [-DORSAL] excludes /ŋ/, e.g. ‘hitting’ → [ˈhɪŋ̩], not *[ˈhɪŋ̩].)

/æt̩m/ → ˈæt̩m (by rule 1) → ˈætm (by rule 11)

(12) SONORANT SYLLABIFICATION:  
\[
\begin{array}{c}
\left[+ \text{consonantal} \quad + \text{sonorant}\right] \rightarrow [+\text{syllabic}] / [-\text{syllabic}] \quad \text{word} \\
\end{array}
\]

(from rule 11) ˈætm → [ˈæt̩m]

When the sonorant consonant is /n/, as in (10a), or /m/, as in (10b), the FLAPPING rule in (7) applies to the medial alveolar. However, when the sonorant is /l/ or /n/, as in (10c-d) the outcomes are different. When the syllable following /t, d, n/ is syllabic [], as

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6 As in, “This site’ll astonish you,” speaking of a World Wide Web site.
in (10c), the medial alveolars are laterally released /t’, d’, n’/. When the syllable following /t, d/ is syllabic [n], as in (10d), /t/ → [ʔ] and /d/ → [dʰ] (nasally released d). We can formulate rules for cases like (10c) and (10d) as in (13) and (14) respectively:

(13) LATERAL RELEASE: + CORONAL + anterior - continuant → [+lateral release] / → [+lateral + syllabic] word

(14) a. /t/ TO [ʔ]: /t/ → ʔ / → [+nasal + syllabic] word

b. NASAL RELEASE: /d/ → [+nasal release] / → [+nasal + syllabic] word

As in the case of preceding sonorants, illustrated in (5), the failure of FLAPPING to apply in cases such as (10c-d) relates to whether or not the tongue makes alveolar contact in pronouncing the syllabic sonorant. With [ŋ] and [m] there is no such contact, and FLAPPING applies. With [l] and [n] there is alveolar contact. It would be a tough articulatory trick to first flap, then quickly return for the alveolar contact for [l] or [n], but if the underlying stops /t, d, n/ are actually pronounced as stops, it is an easy matter to release laterally directly to an [l] or to drop the velum, releasing directly to an [n]. In the case of /t/ + [ŋ], as in ‘written’ [ˈɹɪʔn], the gesture is somewhat different: the /t/ is, in effect spread over two segments, with the “voiceless stop” portion appearing in the [ʔ] and the “alveolar” portion taken over by the following [n].

Note that (13) and (14), as well as (7) FLAPPING must all follow (11) and (12), the rules that create syllabic sonorant consonants. Rules (7), (13), and (14) are really all

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7 I have trouble deciding exactly what I do with –ltl and –ldl sequences, as in ‘Walt’ll’ and ‘mold’ll’! I suspect in unguarded colloquial speech style, I use lateral release followed by syllabic l, but in attempts to self-consciously produce these utterances, if I can pronounce them convincingly at all, I vary between lateral release + syllabic [l] and flap + [al].

8 An unstressed syllable ending in [-n] following word final –n will be pronounced [an], as in ‘runnin’ [ˈrunən]. The pronunciation of the medial /n/ will thus be covered by rule (7).
doing the same thing: they all, in some sense, “reduce” alveolar non-continuants in what
might be viewed as a “weak” position, namely, “word medial before an unstressed
syllable.” It is a shortcoming of our formalism that there is no way to collapse (7), (13),
and (14) into a single coherent rule.

In fact, there are variant pronunciations that show that different “reductions” apply
depending on how the rules apply. Consider the date in (15):

<table>
<thead>
<tr>
<th></th>
<th>‘Sheraton’ /ʃeɹətən/</th>
<th>‘Sheridan’ /ʃeɹədən/</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pronunciation 1</td>
<td>Pronunciation 2</td>
<td>Pronunciation 1</td>
</tr>
<tr>
<td>ʃeɹətn</td>
<td>ʃeɹədn</td>
<td>ʃeɹədən</td>
</tr>
<tr>
<td>ʃeɹətn̩</td>
<td>ʃeɹədən</td>
<td>ʃeɹədən</td>
</tr>
<tr>
<td>ʃeɹəʔn̩</td>
<td>ʃeɹədən</td>
<td>ʃeɹədən</td>
</tr>
<tr>
<td>[ʃeɹəʔn̩]</td>
<td>[ʃeɹədən̩]</td>
<td>[ʃeɹədən̩]</td>
</tr>
</tbody>
</table>

My own most natural pronunciations are those in the “Pronunciation 1” columns,
where all the rules apply and the underlying /t/ vs. /d/ distinction is retained. However,
many speakers have “Pronunciation 2”. We can account for this by not applying (11-12),
i.e. by retaining the underlying intervocalic environment, in which case (7) FLAPPING
applies, resulting in neutralization of the /t/ vs. /d/ distinction. Some speakers do not
apply (11) and (12) in other environments, either. For example, in the Spring 2003
Linguistics 120A class, some students pronounced utterances such as ‘site’ll’ as [sɑɹəl],
with [ə] retained (or inserted?) before the final /l/ and consequent flapping of the /t/.
Environments allowing variants such as those in (15) and the extent of speaker variation
in environments such as those illustrated in (10) are topics worth further investigation.
5. Summary

The table below summarizes the rules we have seen and their ordering relations:

<table>
<thead>
<tr>
<th>Rule</th>
<th>Order Relation</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOWEL REDUCTION (1)</td>
<td>Must precede (11) SCHWA DELETION</td>
</tr>
<tr>
<td>VOWEL NASALIZATION</td>
<td>Must precede (6) NASAL DELETION</td>
</tr>
<tr>
<td>NASAL DELETION (6)</td>
<td>Must precede (7) FLAPPING (accounts for why /t/ flaps after a nasal, as in “hunting”, but /d/ does not, as in “bending”)</td>
</tr>
<tr>
<td>SCHWA DELETION (11)</td>
<td>Must precede (12) SYLLABIFICATION (seems to be optional for some speakers and/or in some environments)</td>
</tr>
<tr>
<td>SYLLABIFICATION (12)</td>
<td>Must precede the “alveolar reduction rules” (13, 14, 7)</td>
</tr>
<tr>
<td>LATERAL RELEASE (13)</td>
<td>As a group, these are “alveolar reduction rules”, all of which apply medially preceding an unsressed syllable. We would like to collapse them as one process, but here our formalism fails.</td>
</tr>
<tr>
<td>/t/ TO [ʔ], NASAL RELEASE (14)</td>
<td></td>
</tr>
<tr>
<td>FLAPPING (7)</td>
<td></td>
</tr>
</tbody>
</table>

**REFERENCE**