A Case of the Sonority Conversion: The Less Sonorous Tap than the Lateral and Nasals in Present-Day American English

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Abstract

The issues this paper addresses are the sonority conversion, which is defined as different ranking of sonority in a certain language, and the case taken from a variety of English. While Rhotic has larger sonority value than Lateral and Nasal in the general ranking, in Present-Day American English the tap, a rhotic, is less sonorous than the lateral and nasals but more sonorous than obstruents. In addition to attested phonological and phonetic nonrhoticity, the sonority-based criteria on the former involve syllabic consonant formation, tautosyllabicity of clusters, segments preceding syllabic consonants and the ban on the sequence of three sonorant consonants and those on the latter the least satisfaction regarding the Syllable Contact Law and the restriction on syllable-final tapping.
Keywords: the sonority conversion, tap, lenition, tongue movement, the Maximum Coda Principle

1. Introduction

Classical phonology established general sonority scale, in the sense that the ranking holds to every language. There exists, however, different ranking of sonority in a certain language, which is referred to as the sonority conversion. Previous research has provided only limited cases on this subject: those between semivowels and liquids. It is the purpose of this paper to uncover a different sort of the sonority conversion: the lower sonority of Present-Day American English (henceforth AmE) taps relative to the lateral and nasals.

AmE taps are a widespread allophone derived from underlying /t/ or /d/:

(1) better, city, water, party, center, guilty, atom, daddy

Consonant lenition or consonant weakening is grounded in the phonetic motivation that effortful consonants shift to effortless ones and gives rise to reduction in constriction degree or duration (Kirchner 2001, 2004).[1] While consonant lenition (e.g. /t/ → [ʔ], /f/ → /v/) is typical to intervocalic positions, some, not all, of the

AmE tappings are equal to the generalization (cf. those in 1).

AmE has both flap and tap (e.g. Ladefoged 2006: 171). Phonetically, the former requires the tongue to be curled up beforehand, while the latter does not. Phonologically, 'r'-coloured vowel in the rhyme is pronounced as the former, while intervocalic consonant, for the most part, in the coda as the latter. This paper is concerned with the tap in AmE. It belongs to rhotic like those in other languages (e.g. Trask 1996: 350), but, in my assertion, the tap has smaller sonority value than the lateral and nasals, contrary to the general hierarchy. This fact therefore functions as a piece of evidence with respect to the sonority conversion.

The present paper is structured as follows. Section 2 introduces previous research and objective criteria on the sonority conversion. Section 3 examines related phonological and phonetic phenomena, according to which the AmE tap differs from the majority of rhotics. Section 4 adduces four pieces of evidence on the less sonorous tap than the lateral and nasals and section 5 two pieces of evidence on the more sonorous tap than obstruents. Each of the six conditions is, by and large, sonority-based. Section 6 gives concluding remark.

2. The Sonority Conversion

Sonority means relative loudness of segments. Important works on sonority include Selkirk (1984), Clements (1990), Rice (1992), Blevins (1995), Zec (1995) and de Lacy (2004). Other things being equal, a segment with higher sonority has more loudness than the other with lower sonority. The opposite ranking of sonority is referred to as consonantal strength (Murray and Vennemann 1983, Vennemann 1988). The general sonority hierarchies for both consonants and vowels (see de Lacy 2004 and Kenstowicz 2004 for that for the latter) are demonstrated independently of each other and High Central Vowel has higher sonority relative to Semivowel by the distance of one:

(2) <u>The general sonority scale for consonants</u>
Semivowel > Rhotic > Lateral > Nasal > Voiced Fricative > Voiceless Fricative > Voiced Stop > Voiceless Stop

(3) <u>The general sonority scale for vowels</u>
Low Vowel > Mid Peripheral Vowel > High Peripheral Vowel > Mid Central Vowel > High Central Vowel

In the rankings in (2) and (3) Semivowel and Low Vowel are the most sonorous, respectively. In order to clarify this scale, pronounce, for instance, coronal semivowel, coronal nasal, coronal voiceless fricative and coronal voiceless stop in your language. Incidentally, the four segments have crosslinguistically high frequency and the sonority conversion has not been observed between each of the consonants. The ranking of sonority below shows the general one of semivowels and liquids in the level of each segment (/j/ has the largest value):

(4) /j/ > /w/ > /r/ > /l/ (e.g. Kiparsky 1979: 432)

The sonority conversion tends to happen between semivowels and liquids, as claimed in Hankamer and Aissen (1974: 137-139).[2] The one that, for example, /r/ is more sonorous than /w/ suggests a case of the sonority conversion owing to the different ranking from the general one:

(5) <u>Sanskrit</u>
/r/, /j/ > /w/ > /l/ (Steriade 1982: 329)

(6) <u>Early West Germanic</u>
/j/ > /r/ > /l/ > /w/ (Suzuki 1989, 1996: 297-307)

I observe that the cases of the sonority conversion like above are assumed to rather commonly occur in other languages than Sanskrit and Early West Germanic under the conditions of, for semivowels and liquids, a wide variety of variations and changes and the difference between onsets and rhymes. The former make the segments, in some cases, more vocalic and, in others, more consonantal. In the latter, on the basis of syllabic generalizations, the segments become more consonantal in the onset and more vocalic in the rhyme. I use the term the sonority conversion when discussing the current issue. This paper defines *the sonority conversion* as *different ranking of sonority in a certain language, in comparison with the general ranking*.

Then, it must be considered whether the analysis of the sonority conversion is built on experimental phonetics or phonological pattern. The one based on experimental phonetics does not give correct analysis due to the following three reasons; (a) sonority differs among speakers so that others give rise to different result; (b) it also diverges for every speech and can not be valued correctly; (c) it becomes different between the onset and the coda, for consonants, or between stressed and unstressed syllables, for vowels. For some consonants and vowels which occur in both of the environments, sonority differs according to the positions. For instance, in PDE, the sonority of /ɪ/ differs between stressed and unstressed syllables and that of plain [t] between the onset and the coda. The former is ascribed to the much stronger pronunciation in stressed syllables and the latter stems from the difference between released stops in the onset and both released and unreleased ones in the coda. The one in the stressed vowel and the one in the onset are more sonorous for each segment, respectively.

The sonority conversion is highly relevant to syllables and after the notion of syllables was established, the research on the sonority conversion began. Needless to say, this line of research necessitates the prerequisite that phonologists have intuitions on sounds, but the objective criteria for the sonority conversion must be based on phonological generalizations relevant to sonority. More specifically, the following become the key factors on this issue: the Sonority Sequencing Principle, the Syllable Contact Law, the Nucleus Constraint, sonority-based syllabification, all of which being sonority-based and deriving possible or impossible patterns from the highest or the lowest limit; the case is that a sonority-based phenomenon occurs, if a segment is, say, more sonorous than Voiced Fricative or less sonorous than Rhotic. Phonological derivations (i.e. strengthening and weakening processes, derivations and crosslinguistic patterns) and phonetic difference (e.g. lip-opening for vowels and movement and posture of the tongue for consonants) are added to another pieces of evidence. Needless to say, the Sonority Sequencing Principle, the Syllable Contact Law and the Nucleus Constraint are based on syllables and the sonority. The Sonority Sequencing Principle specifies the rise and fall of sonority for consonants preceding or following syllabic nuclei. The second one defines the preference of higher sonority of final segment in the preceding syllable and of lower sonority of initial in the following syllable. The third gives the generalization that nuclei are occupied by a more sonorous segment than onsets and codas. The claim that the sonority conversion is based on phonological generalizations related to sonority is justified due to the fact that the evidence is considered to be objective, definite and accountable for it. In terms of accountable evidence following the intuition on sounds, pattern-oriented generalizations for the sonority conversion are compared to allophonic distributions for syllabifications.

3. Phonology and phonetics of AmE taps

3.1. Phonological derivations

As stated, AmE taps are derived from an alveolar stop as a phonetic variant:

(7) /t, d/ → [ɾ]

The derivation in (7) stems from the following facts; since AmE speakers might possibly pronounce the alveolar stops in the same environments as those of the tap, the underlying /t/ or /d/ makes sense (simple derivation, including identical form between input and output, is one of the factors to analyze underlying forms); the tap commonly appears in intervocalic position, where consonant lenition processes, like that in (7), have high frequency both in English and crosslinguistically.

In (7), there is much distance of the sonority in comparison with other types of consonant lenition. Providing the tap has the sonority as the rhotic in the general ranking in (2), both of the sounds differ by the degree of 5 or 6. Many other consonant lenition processes have the difference by the degree of 1 or 2 (e.g. /t/ → [d], /k/ → [x]). This means that, given the general sonority hierarchy, the derivation of the AmE tap is unusual.

Taps in many languages outside English are derived from /r/. The languages contain, for instance, Japanese (Kubozono 1999: 47), Norwegian (Kristoffersen 2000: 24), Modern and Present-Day British English (Wells 1982: 43), the Indo-Aryan language Marathi (Pandharipande 1997: 542) and many others. The four languages above do not refer to all of the ones with the derivation, but represent only some examples.

Owing to the fact that taps belong to rhotic, the taps derived from /r/ are considered to be more natural than those derived from coronal stops. Derivations are likely to have cause and effect. As a matter of fact, a relevancy between the sonority conversion and derivation is observed in other case. In Early West Germanic /w/ was less sonorous than /r/ and /l/, as shown in (6), and obstruents were historically derived from /w/. The /w/ in /wr, wl/ clusters in Early English and the phoneme itself in other Early West Germanic languages underwent the phonological change:

(8) <u>Early English</u>

/wr, wl/ → /br, bl/

/wr/ → /vr/ (Minkova 2003: 367 and others)

(9) <u>West Germanic languages other than English</u>

/w/ → fricative (Suzuki 1989: 33 and others)

The /w/ in Early West Germanic constitutes the input and the AmE tap the output. Be that as it may, the derivation of the Early West Germanic /w/ is related to the consonants with lower sonority and the /w/ has lesser sonority value. It is the first step, therefore, that since the AmE tap is derived from the consonants with lower sonority, the tap is expected to be less sonorous than other rhotics.

The lenition from coronal stop(s) to rhotic, like the AmE tap, holds, in total, to 16 languages all over the world (Kirchner 2001: 80). This type of derivation is involved in Late Modern and Present-Day British English (cf. Wells 1982, Broadbent 2008), but there is no clear evidence that this rhotic shows an example of the sonority conversion. It is not the case that all of the languages with the phonological process relate to the sonority conversion. In particular, the British tap may have phonological evidence, but not phonetic one in the literature. Thus, the phonological aspect does not adduce the enough evidence and the phonetic aspect must be examined.

3.2. Phonetic movements

The tap and coronal stops in AmE share the articulator of alveolar ridge, but have different manner of articulation. Thus, they are predicted to have some articulatory difference. The tap in AmE is different from those in other languages and may or may not be identified with voiced /t/ (Wells 1982: 248-252). Although flaps and taps do not have identical articulation, de Jong (1998) focuses on the AmE flapping and observes that the motion of the tongue is very similar between flap and [d]. This paper expects the phonetic characteristic to be grounded in the following articulation of the general sounds at issue and the AmE tap; while, for tap and flap, the front of the tongue moves rapidly to the alveolar ridge and returns to the neutral position, for [d], it firmly attaches to the alveolar ridge or the dental; in this articulatory way, the AmE tap is approximately between the rhotic in general and the coronal voiced stop in general; the AmE tap has the tongue contact between the quick and firm attachments on the alveolar ridge. The articulatory way sounds not only like a rhotic, but also like a voiced stop (e.g. the pronunciation of the AmE tap in the words *better* and *city*). The AmE tap therefore sounds like between rhotic and coronal voiced stop in other languages.[3] This makes a sharp contrast with the central approximant of /r/, which is phonetically identical to schwa except for the obstruction of air flow (Gick 2002).

It is therefore predicted that AmE taps are not exactly a rhotic consonant in terms of sonority scale.

In the remainder of this article several pieces of sonority-based evidence on the language-specific ranking of AmE taps will be posited.

4. The smaller sonority value than the lateral and nasals

4.1. The nonsyllabicity of the tap

The nuclei of a syllable are highly relevant to sonority since, assuming a basic syllable theory, they must have larger sonority scale than the onset and the coda. The following constitutes one of the syllable-based generalizations:[4]

(10) HNuc (The Nuclear Harmony Constraint)
A higher sonority nucleus is more harmonic than one of lower sonority. (Prince and Smolensky 2004: 20)

Sonority plays an essential role in the status of nucleus. Basically, all vowels occupy the nuclei of a syllable and have larger sonority value than all consonants. Sonorant consonants have much more possibilities of syllabicity than obstruents due to the higher sonority and the mid sonority of sonorant consonants has a clue to the analysis in this section.

Let us observe the examples showing the relevancy between sonority and syllabic nuclei in AmE:

(11) a. how b. way
[hæw] [wej]

(12) a. /w/ quality, dwell
b. /j/ beauty, huge

(13) a. near b. cure
[nɪr] [kjʊr]

First, the semivowels in (11) occupy the second elements of the diphthongs (e.g. Roach 2000:125). The AmE notations differ from the corresponding British ones. The semivowels have the largest sonority value among consonants (see the hierarchy in 2). Second, semivowels occur also in the onset either as singleton or as the prevocalic consonant of clusters. Concerning the latter semivowels as in the words in (12), /j/ constitutes a part of the nucleus and /w/ a part of the onset (cf. Davis and Hammond 1995) and /j/ is more sonorous than /w/ in the sonority hierarchy of the individual segments in (4). Thus, the more sonorous one becomes a part of the nuclei. Third, the examples in (13) show that /r/ occupies the second element of the diphthongs. Rhotic has the second largest consonantal sonority following semivowels and consonants with lesser sonority than rhotic are banned in the position. The generalization of more sonorous nuclei, therefore, holds to the sonorant consonants in AmE.

Next, we turn to observe the following pairs of pronunciations. AmE speakers implement the syllabic consonants in (14), but not those in (15) (cf. Wells 2008 for the nonsyllabic taps in AmE):

(14) a. fish<u>ery</u> b. strug<u>gle</u> c. oft<u>en</u> d. happ<u>en</u> e. brok<u>en</u>
[r̩] [l̩] [n̩] [m̩] [ŋ̍]

(15) a. densi<u>ty</u> b. syllabic<u>ity</u> c. specifi<u>ty</u>
*[ɾ̩] *[ɾ̩] *[ɾ̩]

Then, the relevancy between the phonetic implementation of each syllabic consonant and the sonority hierarchy must be examined on the basis of the facts that syllabic consonants occupy the nuclei of a syllable and that segments with higher sonority are more suitable for the nuclei.

On the one hand, all of liquids and nasals are capable of occupying a syllabic status. Among the segments that might become syllabic consonants, rhotics are the most sonorous and the lateral has the second largest sonority. In AmE, the close connection between higher sonority and syllabic nuclei is manifested in very frequent syllabic [r]. As other piece of evidence (Hammond 1999), stressed syllabic consonants consist of, for the most part, [r̩] or [r̩ː] (e.g. y<u>our</u>, f<u>ir</u>st, st<u>ir</u>) and, with fewer frequencies, [l̩] (e.g. b<u>ull</u>, m<u>ull</u>). On the other hand, the AmE taps in (15) do not become syllabic, despite the environment of syllabic consonants of underlying schwa plus a liquid in unstressed syllables and of the less sonorous preceding segments. The nonsyllabic status of the AmE taps is shared by the majority of obstreunts. While syllabic consonants occupy the nuclei of a syllable, the status of the tap differs from other sonorants.

Some phonological phenomena are grounded in phonetics (e.g. movement and posture inside oral cavity and duration), not in phonological ones (e.g. sonority and the OCP). As well as phonetically based phonological constraints (Boersma 1998, Flemming 2002, Hall 2004, Hayes and Steriade 2004, Kirchner 2001, Pater 1999, among others), some phonological changes have phonetic bases: Anglian Smoothing (Howell and Wicka 2007) and vowel syncope in Mussan (Blevins 2008). According to Oda (2008a), the increase and nonincrease of syllabic consonants in the history of English is accounted for by phonetic, not phonological, motivations. However, this does not mean that all aspects of English syllabic consonants are phonetically motivated. The argument in this section is what consonant occupies syllabic nuclei, different from the increase and nonincrease. The sonority of the former is irrelevant to the increase since the distribution of syllabic consonants remains similar throughout the every period of English.

4.2. Coda consonants

Syllable-based generalizations state that nonsyllabic consonants occur in the onset and the coda and that some, in particular allophones, are restricted to either position. As many phonologists (e.g. Kahn 1980, Selkirk 1982, Borowsky 1986, Gussenhoven 1986, Rubach 1996) have suggested, aspirated voiceless stops (i.e. [p^h, t^h, k^h]) and the devoicing of sonorant consonants (e.g. [w̥, l̥]) are confined to the onset and glottal stops (i.e. [ʔ] derived from /t/) and the deletion and epenthesis of alveolar stops to the coda. The AmE tap occurs in coda-final positions (cf. the five papers above), although it is the correct expression that the tap appears in non-foot-initial positions (Jensen 2000, see also Kiparsky 1979).[5] All of the underlined segments in (16) are pronounced as the tap and syllabified in general to the coda:

(16) a. put it on b. sent a letter c. city d. water

The tap is preceded by a vowel or by a vowel plus a sonorant consonant (cf. Kahn 1980, Selkirk 1982, Picard 1984, Borowsky 1986, Gussenhoven 1986, Wells 1990 and Rubach 1996). The majority of the examples in (16) demonstrate the taps preceded by a vowel. When the tap follows a sonorant consonant, the sonorant consonant is a rhotic (17a), the lateral (17b) or the alveolar nasal (17c):

(17) a. party b. guilty c. center

The underlined clusters have crosslinguistically very rare existence. Given the general sonority hierarchy in (2), those in the coda lateral plus rhotic and nasal plus rhotic violate the Sonority Sequencing Principle since the rhotic becomes more sonorous than the lateral and the alveolar nasal. Dimoraic rhymes in stressed syllables (the Stressed Syllable Law) hold to the majority of stress languages, but PDE has some, not all, stressed syllables with more than two morae. While the Stressed Syllable Law has the priority for some cases, other condition is superior for others. There is the agreement that AmE taps appear definitely in the coda unless the Stressed Syllable Law is used. It is therefore asked why the coda-final taps in (17) are allowed to occur despite the violation of the Stressed Syllable Law (i.e. three or four, rather than two, morae). Whether or not maximum syllabifications work is the clue to the violation.

Tautosyllabicity and sonority profile correlate with each other due to the Sonority Sequencing Principle. In Polish some marked onset clusters appear as phonotactic constraints and those like /rt/ and /lk/ in the onset violate the Sonority Sequencing Principle owing to the more sonorous first consonant:

(18) a. rtec ‘mercury’ kar.ty ‘cards’ b. lkac ‘sob’ pal.ka ‘stick’

When the onset clusters with the worse sonority profiles occur word-medially, they become heterosyllabic (Rubach and Booij 1990: 122). The profiles militate against the Maximum Onset Principle, which specifies that if phonotactic patterns of consonants are allowed, the consonants are maximally syllabified to the onset.

The second evidence in the same line stems from PDE. The Maximum Onset Principle tends to hold to the ones with good sonority contour like /dr/, but not to the ones with bad contour like /st/ (Treiman and Zukowski 1990) despite the fact that both are regarded as English phonotactic patterns:

(19) a. Madrid b. estate
[məˈdrɪd] [ɪsˈteɪt]

Present-Day English has the effect of the Maximum Coda Principle as well as the Maximum Onset Principle. The Maximum Coda Principle is suggested by Hammond (1999: 134) and Wells (1990) and supported by some pieces of allophonic evidence, but may operate only for some, if not all, examples and only for some speakers. Compare the underlined sequence in (20a) and that in (20b):

(20) a. helper b. strengthen
[ˈhelp.ə] [ˈstreŋkθ.n̩]

I consider that, in that sense, if sonority profile is better, Max-Coda has higher effect and that the underlined segments in (20a) receives more possibility of the maximum syllabification than those in (20b). It is because the former has a good sonority profile but because the latter definitely does not. The examples in (18)-(20) converge to illustrate that the tautosyllabicities, more or less, are ascribed to the good sonority profiles. The examples with a sonorant consonant plus the tap in AmE are repeated below:

(21) a. party b. guilty c. center = (17)

There is the crosslinguistic preference of the Stressed Syllable Law, but the examples with syllable-final tap in (21a-c) militate against it despite the rare coda cluster sonorant consonant plus tap. The reason why the Maximum Coda Principle has the priority over the Stressed Syllable Law stems from the account that the less sonorous tap than the lateral and nasals and other sonorant consonants render the Maximum Coda Principle applicable due to the satisfaction of the Sonority Sequencing Principle.

4.3. Less sonorous segments preceding syllabic consonants

The Sonority Sequencing Principle specifies that sonority scale decreases between two syllabic nuclei due to the larger sonority of them. In parallel, when a segment precedes a syllabic consonant, the preceding segment must be less sonorous than the syllabic consonant in view of the principle. In the following examples, each of the syllabic one is more sonorous than the preceding one by the degree of one (cf. 2):

(22) a. even b. final
[ˈiːvn̩] [ˈfaɪnl̩]

By way of comparison, the following syllabic consonants are much rarer or never: the syllabic nasal preceded by the lateral and the syllabic lateral preceded by the central approximant of /r/ (cf. Wells 2008), both of the syllabic consonants, if implemented, being less sonorous than the preceding ones by the distance of one:

(23) a. sullen b. laurel
[ˈsʌlən] *[ˈsʌln̩] [ˈlɔːrəl] *[ˈlɔːrl̩]

The words in (23) have underlying schwa plus a nonsyllabic consonant like those in (22), but the syllabic consonant formation is inapplicable. As argued in section 4.1., syllabic nuclei are grounded in higher degree of sonority. In principle, the ban on the syllabic consonant formations in (23) is accounted for by stating that even if satisfied, they are counted as worse patterns on the basis of the sonority demotion (i.e. /l/ > /n/, /r/ > /l/).

The only one kind of exception is a sequence of two syllabic consonants, but there is the difference between nonsyllabic and syllabic consonants. It leads to different syllabic analysis: for the former, syllable margin and for the latter, syllable nucleus. Due to the explicit syllable break, the more sonorous preceding [r̩] relative to the following [n̩] is irrelevant to the analysis of the sonority at issue:

(24) reference
[ˈrefr̩n̩s]

Now examine the cases in which the tap precedes a syllabic consonant. Following the tap, AmE speakers pronounce syllabic [l] and syllabic [m], instead of the corresponding form with schwa:[6]

(25) a. little b. bottle
[ˈlɪɾl̩] [ˈbɑɾl̩]

(26) atom
[ˈæɾm̩]

In these cases, if the taps have the sonority scale as Rhotic in the general ranking, the syllabic [l] and the syllabic [m] would not be pronounced in view of the syllable theory mentioned above. There exists no or almost no example where a preceding consonant, in either the onset or the coda, has larger sonority scale than the following syllabic consonant. The sequence tap plus syllabic [l] or [m] does not represent much rarer cases, but AmE speakers tend to pronounce them. Provided the taps are less sonorous than the lateral and nasals, the syllabic consonants in (25) and (26) function as the nuclei.

4.4. The phonotactic constraint on triconsonants

When dividing consonants into obstruents and sonorant consonants on the basis of the sonority in broad terms, three types of diconsonatal clusters become possible: an obstruent plus a sonorant consonant (e.g. /pr/), an obstruent plus an obstruent (e.g. /st/) and a sonorant consonant plus a sonorant consonant (e.g. /mj/). Sequences of two sonorant consonants have a marked status (e.g. McMahon 1990: 221). The markedness is accounted for by the OCP, the ban on adjacent similar elements, and the sonority, with an obstruent plus a sonorant consonant highly valued. Instead of both of them, a cluster is grounded in articulatory phonetics. The marked cluster rhotic plus coronal glide (i.e. /rj/) stems from incompatible articulation and durational difference (Hall 2003, 2004). In AmE there exist three tautosyllabic clusters that consist of two sonorant consonants:

(27) a. onset /mj/ (e.g. music)

b. coda /lm/ (e.g. film), /ln/ (e.g. kiln)

The disonorants in (27) are thought of as marked clusters. First, only some everyday words include them. Second, in the diachronic view, the coda /lm/ appeared in Middle English and the other two sequences in Modern English (cf. Nakao 1985: 462-464). By contrast, the clusters such as /pl, kr, sp/ have the diachronic stability in English and have more causations for the relative unmarkedness. Third, they have crosslinguistically limited occurrences.

Assuming the markedness of the diconsonantal sonorants, partly because of the sonority, I predict that PDE has no sequence within a morpheme that consists of three sonorant consonants, although the clusters across the boundary of either a morpheme or a word appear (e.g. fi<u>lmm</u>aker, sou<u>l mu</u>sic). Both onset and coda clusters lack them and it is an impossible phonotactic pattern that a syllabic consonant is preceded and followed by a sonorant consonant within a morpheme.

Then, look at the following phonetic descriptions in (28). At first glance, the underlined segments consist of the sequence of the three sonorant consonants due to the alveolar nasal plus the tap plus, after the syllable break, the syllabic [r]:

(28) a. ce<u>nter</u> b. i<u>nter</u>national
[nɾ.r̩] [nɾ.r̩]

It seems to be true that AmE does not have other case of the sequence of three sonorant consonants within a morpheme. This phonotactic constraint (i.e. the one banning the clusters, say, like /mlj/ and [nl̩m]) is posited in AmE and other varieties of English and, like diconsonantal sonorants, has the motivation of sonority. Both of the sequences shown above are made impossible due to the close distance of the sonority. The large difference of sonority in both cases makes the profiles allowed (e.g. [stj]upid, ta[bl̩z]). When the number of sonorant consonants changes from three into two, legal sequences also appear: a[mj]usement, fi[nl̩]. To put it simply, my supposition is the following order of sonority: Vowel > Sonorant Consonant > Tap > Obstruent. In this view, the underlined segments in (28) consist of a sonorant consonant plus the tap plus a syllabic sonorant consonant, but not the sequence of three sonorant consonants. The pronunciations become legal due to the fact that the AmE tap has the lower sonority value than the lateral and nasals and differs from sonorant consonants in terms of the sonority scale.

5. The larger sonority value than obstruents

5.1. The Syllable Contact Law

One of the reasons for the more sonorous tap than obstruents stems from the Syllable Contact Law. The definition, slightly different from the earlier version, is cited from Murray (2000: 222):

(29) <u>the Syllable Contact Law</u>
The preference for a string … σ_x σ_y … increases as the right edge sonority of σ_x increases and the left edge sonority of σ_y decreases.

In order to discuss the issue of whether a syllable contact is better or worse, look at the following examples (Although English syllabifications are well-known for the inconsistency, those in the following do not become controversial):

(30) a. cowboy b. construction
[ˈkæ<u>w.b</u>ɔy] [kənˈstrʌ<u>k.ʃ</u>n̩]

(30a) represents better contact and (30b) worse one. The semivowel /w/ is much more sonorous than the voiced stop /b/ by the degree of six. The voiceless stop /k/ is less sonorous than the voiceless fricative /ʃ/ by the degree of two. (See the general hierarchy in 2.) Other things being equal, the satisfaction of the Syllable Contact Law renders a segment at issue have better profile than the violation of it.

With regard to the Syllable Contact Law, the AmE tap represents the preceding syllable-final. When we cope with the following syllable-initial, segments across word-boundary originate in irrelevant environment and therefore cases without word-boundary should be dealt with. As demonstrated in (31), the following syllable-initial contains unstressed high front tense vowel, ‘r’-colored schwa, syllabic [r], syllabic [l], syllabic [m] and, possibly, the corresponding form with (‘r’-colored for 31c) schwa of each syllabic consonant:

(31) a. daddy b. better c. center d. little e. atom
['dæɾ.i] ['beɾ.ə] ['senɾ.r̩] ['lɪɾl̩] ['æɾm̩]

Given one of the syllable-based generalizations, onset-initial alveolar stops turn into the rhyme-final tap (Kahn 1980, Selkirk 1982 and others in this line of research). In the case of the former, the preceding syllable-final is occupied by a vowel or by a sonorant consonant and the following syllable-initial by an alveolar stop. In the case of the latter, the tap becomes the preceding one and a vowel with low sonority or a syllabic sonorant consonant the following one. Generally speaking, coda-final tends to be more sonorous than onset-initial. If, like my assumption, the AmE tap is between nasals and voiced fricatives in terms of the sonority, it is less sonorous than the following syllable-initial by the degree between one (the syllabic nasal in 31e) and seven (the high peripheral vowel in 31a). This implies, more or less, the violation of the Syllable Contact Law, but such violations are likely to happen in AmE:

(32) a. erudite b. topmost c. footlight d. aqua
[r.j] [p.m] [ʔ.l] [k.w]

In the order of (32a, b, c, d) the preceding syllable-final is less sonorous than the following syllable-initial by the degree of one, four, five and seven in the general ranking in (2), respectively. The examples like above lead me to claim that the lesser sonority of the preceding syllable-final than the following syllable-initial is permitted, but that the smaller sonority value of the former is, at most, seven in the general ranking. It is taken into account that in contrast to the highly common case of the less sonorous tap than the following syllable-initial [i] by the degree of seven, as in the words *city*, *pity* and *daddy*, the following violations of the Syllable

Contact Law by the distance of eight do not happen and are, at the least, very rare: voiceless fricative – mid central vowel, nasal – low vowel. If the tap is less sonorous than voiced fricatives, contrary to my assumption, it means a crucial violation of the Syllable Contact Law and the lesser sonority scale does not work. That is why the AmE tap has the sonority between nasals and voiced fricatives.

5.2. The ban on tapping

Like other allophones, the AmE tap has some restrictions for the occurrence. One of them specifies preceding segments. (Other restrictions contain stressed or unstressed syllables, the onset or the coda and the following segments). The tap is preceded by either a vowel, as in (33), or a vowel plus a sonorant consonant, as in (34), but not by a vowel plus an obstruent, as in (35). Despite the same phonological environments preceded by a stressed syllable and followed by an unstressed vowel, those in (35) is pronounced as the corresponding voiced stops and not replaced by the tap, as Wells (2008) describes (see also the papers on syllabic analyses in the second paragraph in section 4.2.):

(33) a. little b. bottle c. city
[ˈlɪɾ.l̩] [ˈbɑɾ.l̩] [ˈsɪɾ.i]

(34) a. center b. guilty c. party
[ˈsenɾ.ɹ̩] [ˈɡɪlɾ.i] [ˈpɑːrɾ.i]

(35) a. actor b. laughter c. loved Ann d. bathed in
[ˈæktə] [ˈlæftə] [lʌvd] [beɪðd]
*[ˈækɾə] *[ˈlæfɾə] *[lʌvɾ] *[beɪðɾ]

Syllabic analyses state that the allophonic tap is restricted within the coda-final (cf. the literature in the first paragraph in section 4.2.). On the basis of the sonority hierarchy suggested in this paper, those in (33) and (34) satisfy the Sonority Sequencing Principle and the Maximum Coda Principle is applied to the ones in (34). (The latter is meant to apply to more than one consonant.) Conversely, if the tap is phonetically implemented, the coda taps in (35) violate it owing to the larger sonority than obstruents. The Maximum Coda Principle is one of the characteristics for PDE syllabifications, but the occurrence of the tapping in (35) makes the principle unworkable. The reason why the violation of the principle is blocked in (35) is that such syllable-edge segments occur within coronal obstruents, which have a different status from the tap.

6. Conclusion

The phenomenon that AmE tap has lesser sonority value than the lateral and nasals presents a different case from that in previous research. With respect to accountable evidence, this paper has suggested four pieces on the less sonorous tap than the lateral and nasals and two pieces on the more sonorous tap than obstreunts. All of the six pieces relate AmE taps to the phenomena relevant to sonority such as the Nucleus Constraint, sonority-based maximum syllabifications, the Sonority Sequencing Principle and the Syllable Contact Law. They, in fact, correspond to the phonetic facts and the phonological phenomena, both of which converge to support my view.

Footnote

1 Both consonant lenition and consonant weakening refer to the identical sound patterns from effortful to effortless ones. The AmE tapping corresponds to the generalization due to the fact that the tap has limited air turbulence relative to the alveolar stops. They are not grounded in sonority promotion, a phonological one, since the consonant lenition, say, from a voiced fricative to a nasal does not occur.

2 According to Oda (2008b), the sonority conversion happens not only within sonorant consonants but also between vowels. In the general ranking in (3), Mid Central Vowel has lesser sonority value than High Peripheral Vowel. However, PDE has the following language-specific ranking on them:

(i) <u>Present-Day English</u>

/ʌ/ (TURNED V, a mid central vowel) > High Peripheral Vowel
> (other segments of) Mid Central Vowel

On the one hand, it is worth noting that the sonority conversion takes places in the cases other than those in the sense of Hankamer and Aissen. On the other hand, I observe that such less common cases do not have a very wide distribution.

3 This is based on my judgment in Japanese sounds, which have both the tap and the voiced coronal stop.

4 The constraint in (10) does not mean a Prince and Smolensky's (2004) finding, but constitutes one of the general syllable theories. In this line of research, see Vennemann (1988), Clements (1990) and some others.

5 Jensen's (2000) prosodic approach is partly based on foot-initial and non-foot-initial positions. While the former undergoes strengthening processes,

the latter weakening processes. For the cases in which syllabic analyses do not make sense, see the following examples for the AmE tap:

(ii) a. go t̠o b. see you t̠omorrow

[ɾ] [ɾ]

Contrary to the syllable-based generalization, both of the taps in (ia, b) represent the onset taps, not coda ones unlike the Kahn's (1980) and other scholars' definitions. Instead, the prosodic approach specifies that they occur in non-foot-initial positions due to the fact that *go* is stressed, while *to* is unstressed and that *see* is stressed, while *you* and the first syllable of *tomorrow* is unstressed.

[6] Although Wells (1982) does not consider the syllabic [m] in (26) to be implemented, Jensen (2000) has the positive idea for the phonetic implementation. I observe that this is one of the rather new types of PDE syllabic consonants. The tap plus syllabic [r] also represents a pronounceable case, but syllabic [n] following the tap does not. In the environment of /t/ plus syllabic [n], the /t/ is replaced by the glottal stop, not by the tap.

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