

Syllable and Consonant Assimilation in English*

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The goal of this paper is a straightforward one. That is to demonstrate and give evidence to the proposal that nasal and voicing assimilations and their cognate processes are regulated by syllable structures of the concerned sequences. This approach turns out to be plausible in some respects. First, in the case of nasal assimilation it is possible to describe it in terms of a single rule schema and cope with the difficulties derived from the previous foot-based analyses. Second, for the explanation of voicing agreement, we can offer a phonological account, rejecting the morphological accounts of Mascaró (1987) and others. In this case it proves that reduction parameter is positive in earlier lexical levels to provide a coherent description of voicing assimilation in English.

0. Introduction

In this paper I attempt to examine a couple of processes of consonantal assimilation in English, most of which were already covered in the previous literature. One of the reasons to come back to this well-known topic is that it is desirable to review this problem as the emergence of Nonlinear phonology and Underspecification theory. It does not follow that this is the first attempt to treat the consonantal assimilatory processes with the current view of phonological research. Among others, Borowsky (1986), Mascaró (1987) already challenged this problem, making use of current resources of phonological researches or opening the new way to further research.

In what follows I will try to demonstrate the fact that Nasal Assimilation and Voicing Assimilation in English crucially refer to syllable structures of a sequence at stake.

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1. Assumptions

For the background for the explication of the consonant assimilatory processes in English, I presume the following expertise in current phonological research. First, I adopt Myers's (1991b) notion of the Strong Domain Hypothesis as a constraint on the rule application in the lexical phonology. Myers introduced this notion as an alternative to the Structure Preservation (Kiparsky 1985) in the following way:

(1) The Strong Domain Hypothesis

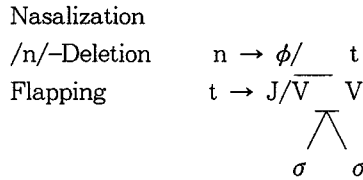
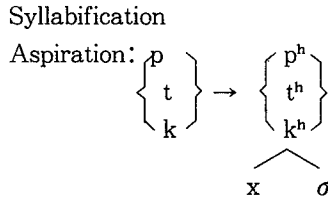
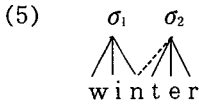
- a. All rules or constraints are available at the earliest level of the phonology.
- b. Rules or constraints cease to apply, but may not begin to apply at a later level by stipulation.

Second, for the base of word formation in the lexical domain, I assume that not simply words, but also stems are entitled to be its input (cf. Scalise 1984). In other words, I will reject Aronoff's (1976) word-based theory of word formation.

Third, I accept the basic tenet on feature specifications at the underlying representations that lexical entries should not contain predictable specifications. This idea leads to underspecification of a feature at the underlying level. In particular, I interpret the notion of underspecification in a comprehensive way so that both context-sensitive underspecification (Ao 1991) as well as the ordinary context-free underspecification (Archangeli 1984) will be considered in our discussion on English phonology.

2. The Algorithm of Ambisyllabification

Even though Kahn's (1976) project on ambisyllabification proves to be valid for eliminating not a few inadequate formulations of phonological rules, e.g., conjunction of consonant and word boundary, it is also true that there are some serious problems in this syllable theory. First, note the syllable structures of the following, built by Kahnian basic syllable assignment rules.

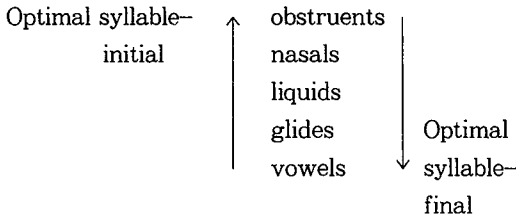


For these reasons, I propose that ambisyllabification is governed by some universal principles as well as by language-specific property, stress pattern in this case. For this purpose I introduce a couple of (quasi-)universal principles:

(6) a. The Sonority Sequencing Principle (Clements 1990)

Between any member of a syllable and the syllable peak, only sounds of higher sonority rank are permitted.

b. The Syllable Contact Law (Clements 1990, Hooper 1976)

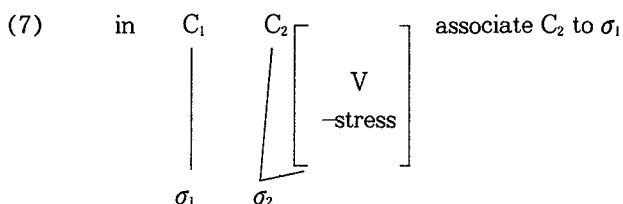


c. The Sonority Scale¹

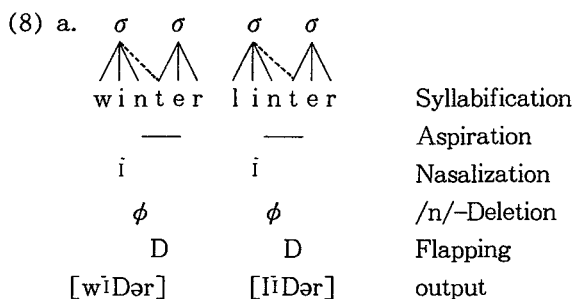
stop	fricative	nasal	l	r	glide	vowel
1	2	3	4	5	6	7

¹The universality of the sonority scale (6c) is strongly challenged by plenty of language-specific variations. For the discussion on this problem, refer to Hankamer & Aissen (1974).

The principle (6a) and (6b) are concerned with ensuring that the sonority profile should be falling at the rhyme position and rising at the onset position in unmarked cases. Given these universal principles, we are in a position to eliminate Kan's stipulation to ambisyllabification that CCo should not be a member of universally prohibited clusters. For the present, I propose that rule (3b) should be revised into (7):²



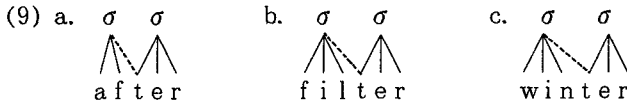
The significant difference between (3b) and (7) lies in the fact that the formulation (7) predicts the ambisyllabic segment is not C₁, but C₂ and the syllable associations are governed by the universal principles of Sonority Sequencing Principle and Syllable Contact Law. This revised formulation of ambisyllabification is beneficial to eliminate the problem arising in the derivation (5). Consider the following derivation:



Due to the ambisyllabicity of the segment /t/ guaranteed by the formulation (7), the derivation (8) turns out to be successful to account for flapping in English.

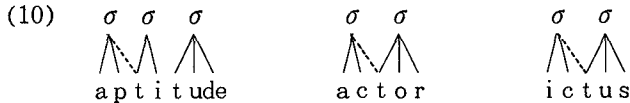
In addition this analysis is supported by showing that we can remove the ill-formed syllable types shown in (4), as illustrated in the following:

² I send my deep appreciation to Suk-Guen Kang for his helpful comment for the elaboration of ambisyllabification rule.



That is, the configurations in (7) overcome the problem of the violation of the Sonority Sequencing Principle incurring in (4).

For the elaboration of the rule (7), let us consider further data in English. According to Selkirk's (1982) observation, the aspiration of the segment /t/ in words like *aptitude*, *actor*, *ictus* occurs under only slow or staccato speech. Otherwise the process normally blocked. What it means is that the segment /t/ is ambisyllabic as demonstrated in the following:



Since in (10) the ambisyllabicity of /t/ is allowed, even though this connivance results in violation of the principle (6a)—a sonority plateau at the rhyme position, it is necessary to adduce a condition to rule (7) to the effect that sonority plateau is not disallowed in the rhyme position.

In the following sections, I will try to show that some major processes of consonant assimilation in English should be analyzed as referring to syllable structures, particularly ambisyllabicity of a segment.

3. Nasal Assimilation in English

3.1. Problems of Borowsky's (1986) Analysis

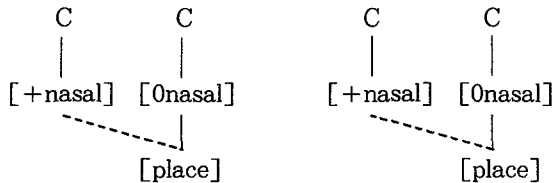
Consider the following examples³:

³ It is of no doubt that the phonetic representations of the nasal consonants in (11a) are not one and only ones in diverse English accents. For example, we can easily encounter the variations between [n] and [ŋ] in the examples such as *concord*, *concourse*, *concrete*, *Congreve*, *concupine*, *conclave* (cf. Kenyon & Knott 1953). However, what matters at this point is that the regular phonetic value of the nasal consonants posited at this point is that the regular phonetic value of the nasal consonants posited at the environments similar to the examples in (11b) never, at least in phonological sense, give rise to phonetic variations. For instance, the regular value of the nasal in *congressional*, distinct from that of *congress* is fixed as [n]. The alternation of [ŋ]/[n] in *congress/congressional* should be understood in this type of rather simplified interpretation of phonetic data.

- (11) a. i[m]potent b. i[n]clude c. u[n]palatable
 i[n]tolerable e[n]quire u[n]broken
 co[ŋ]gress co[n]gressional u[n]clad
 co[ŋ]cord co[n]cur u[n]godly

In English a nasal consonant tends to assimilate its place node to that of the following consonant as seen (11a). Yet this process is blocked in the examples in (11b, c). The distinction between (11a) and (11c) is easily accountable in the mechanism of level-ordering in lexical phonology and morphology. That is, if we assume that the domain of Nasal Assimilation confines to level 1 and the suffixes *in-* and *un-* undergo morphological processes at level 1 and level 2, respectively, we can account for the blocking of the phonological process in the case of (11c). Here the problem is how to distinguish (11a) and (11b). For the account of the phonological process occurring in (11), Borowsky adopted the traditional approach like Kiparsky (1979) in that she relied upon the foot structure of the sequence. Note the following formulation of nasal assimilation presented by Borowsky:

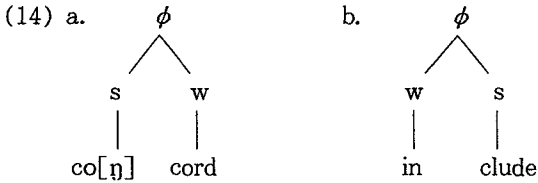
- (12) a. Nasal assimilation 1 b. Nasal Assimilation 2 (in the foot)



The category 'foot' appears to be beneficial to distinguish between the prosodic structures in (11a) and (11b), as shown in (13).

- (13) a. (co[ŋ]cord)ϕ b. i[n] (clude)ϕ
 (co[ŋ]gress)ϕ e[n] (quire)ϕ

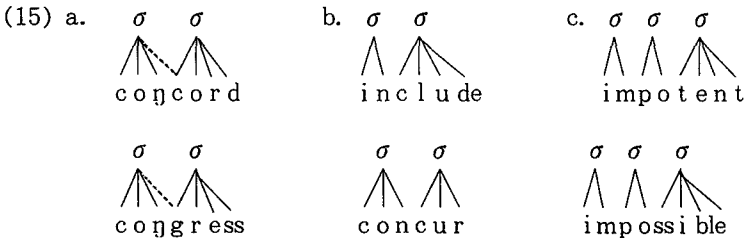
However, this type of analysis is easily subject to criticism. First of all, it is undeniable that the notion of foot is distorted in (13). According to our usual sense of prosodic structures, the metrical structures of (13a) and (13b) are not distinguishable, as demonstrated in the following:



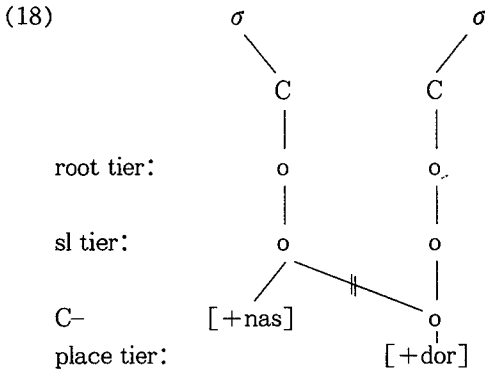
Additionally, doubling of the same type of rules is undesirable, where the only application domain of a rule is differentiated. Other things being equal, a unitary type of rule formulation is expected.

3.2. Syllable Sensitivity

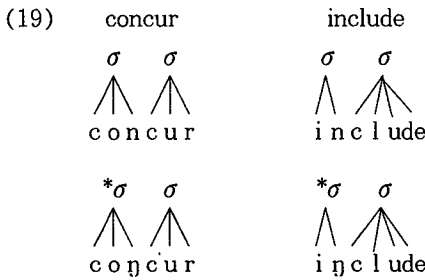
In the preceding section we pointed out the problem of the approach based on foot structure to account for nasal assimilation in English. In this section I will show that it is more appropriate to examine the process in terms of syllable structure when we depend upon the ambisyllabification algorithm (7). Consider the following syllable structures.



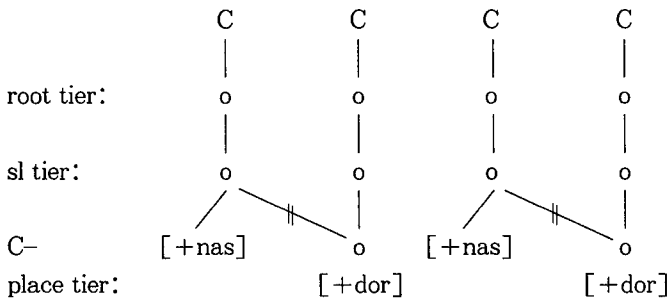
The syllable structures illustrated in (15a) and (15b) make clear the difference between them: in the former case the NC cluster are tautosyllabic, whereas in the latter case the cluster is heterosyllabic. This fact leads us to conclude that what matters in nasal assimilation in English is syllable structure rather than its superordinate category foot. On the other hand, the string adjacency between nasal and following obstruents is a necessary and sufficient condition in the other case, as seen in (15c). Thus, it comes to be possible to collapse Borowsky's two types of rules into a single schema (16).



Now, with this adducing rule (18) we are in a position to derive well-formed outputs in the following way.



Rule (16)



Rule (18)

n n

co[n]cur i[n]clude

Default Rule
 :[]→[+cor]
 output

3.3. The Side Effect

In the preceding section we have tried to account for nasal assimilation in terms of syllable structures. In this section I will demonstrate that another phonological process involving NC clusters, *g/b*-Deletion is governed by syllable boundaries. If this type of analysis is right, this phonological process lends support to our approach based on syllable rather than foot.





Note the following examples, in which after undergoing nasal assimilation (16), the trigger of the rule segment /g/ deleted in (20a) in contrast with(20b).

- | | | | |
|---------|-------------------|----|-------------------|
| (20) a. | angma[æŋmə] | b. | finger[fɪŋgə] |
| | tungsten[tʌŋstən] | | anger[æŋgə] |
| | long[lɔŋ] | | longer[lɔŋgə] |
| | strong[strɔŋ] | | stronger[strɔŋgə] |

Likewise, segment /b/ undergoes deletion in the following examples in (21a) unlike (21b).

- | | | | |
|---------|--------------|----|--------------------|
| (21) a. | bomb[bʌm] | b. | bombard[bʌmbəd] |
| | crumb[krʌm] | | crumble[krʌmbəl] |
| | grum[grʌm] | | grumble[grʌmbəl] |
| | scram[skræm] | | scramble[skræmbəl] |

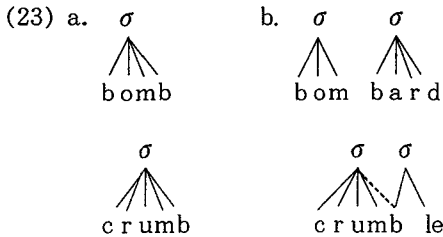
In the examples given above, when we resort to the syllable structures, the distinction between (20a) and (20b) emerges in a clear way. Consider the following illustration:

- | | | | |
|---------|---|----|---|
| (22) a. | σ σ | b. | σ σ |
| |  | |  |
| | a n g m a | | f i n g e r |
| | σ | | σ σ |
| |  | |  |
| | l o n g | | l o n g e r |

The configurations given in (22) pinpoint the environments where /g/-Deletion occurs, i.e., /g/ deletes on the condition that /g/ is not ambisyllabic. This type of analysis is supported by universal syllable

inventory. It is well known that consonants posited at the onset position are comparatively resistant to deletion, otherwise the unmarked syllable type CV is enforced to change into more marked type V or VC type of syllable. However, it is a rather unusual process.

Similarly, syllabification itself of (21) accounts for /b/-Deletion as shown in (23).



In our account the blocking of the application of /b/-Deletion in (23b) is due to the ambisyllabicity or the position at the onset. In this way we can show that ambisyllabicity plays a significant role in the explication of nasal assimilation and its corollary phenomena.

4. Voicing Assimilation

4.1. Mascaró's (1987) Parametric Approach

Among the previous accounts for the voicing assimilation in English, Mascaró's parametric approach calls our particular attention. Although other accounts such as Kiparsky (1985), Mohanan (1991), Halle & Mohanan (1985), and Borowsky (1986) tried to handle this phonological phenomena, it is of no doubt that most of them fail to provide a full-fledged explication for it. Moreover, another distinction of Mascaró is that he attempts to offer a universal explanation for the operations involving the feature [voice]. In this respect, it makes sense to adopt Mascaró's parametric approach to voicing assimilation in English.

Mascaró postulates two types of parameter in the account for the operations involving [voice], possibly place features.

(24) Mascaró's Parameters

- a. Reduction (delinking or deassociation)

b. Spreading

At this point some comments on the nature of parametric approach in phonology are in order. The autosegmental spreading requires a precedent operation of delinking or deassociation of an association line to ensure the accompanying operation of spreading. In this case, by the definition of parameter, each language is privileged to choose or reject both or either of them.

4.2. Determination of Parameters for English

Mascaró argues that the reduction parameter with respect to the feature [voice] is negative in English on the basis of the following examples:

- | | | |
|------|--------------|------------|
| (25) | A[zt]ec | Na[ɣv]ille |
| | Ha[psb]urg | Ma[kv]eagh |
| | A[fg]anistan | Ru[tg]ers |

The emergence of a bunch of counterexamples illustrated in (25) seems to lead us to conclude that the parameter of delinking of [voice] is negative in English. Actually, Mascaró (pp. 44–46) argues that parameter of reduction is negative in English and allows assimilation by spreading of [voice] occurring in the following cases.

- | | | | | |
|------|------------|--------|--------|----------|
| (26) | 3rd sg. | hits | sheds | chooses |
| | Genitive | Pat's | Fred's | George's |
| | contracted | Pat's | Fred's | George's |
| | preterit | passed | banged | padded |

Spreading of voicing from the stem-final consonant to the (quasi)-suffixes is warranted by the manipulation of application stages of redundancy rules.

4.3. Allomorphy Rule or Phonological Rule?

If we assume that the reduction parameter for [voice] is negative in English, as Mascaró argues, how can we explain the voicing assimilation in the following:

- | | | | |
|---------|--|----|----------------|
| (27) a. | A dialectal variation | b. | |
| | width[<i>wɪdθ</i>]/[<i>wɪtθ</i>] | | five/fifth |
| | breadth[<i>brɛdθ</i>]/[<i>brɛtθ</i>] | | twelve/twelfth |
| | midst[<i>mɪdθ</i>]/[<i>mɪtθ</i>] | | leave/left |

For the explication of the examples given in (27), Mascaró argues that those examples do not constitute positive evidence for the phonological voicing assimilation. First of all, the voicing assimilation in (27a) shows dialectal variation, which shows its status as a regular phonological rule is shaky. In addition, the apparent phonological process in (27b) is observed only in extremely limited examples. In this sense, Mascaró concludes that the voicing assimilation in (27) is not a phonological operation, but a marginal allomorphic process.⁴ In other words, it is likely that voicing assimilation in English is relevant to a few morphemes.

However, when we closely examine the examples in English, we can find that this claim meets serious difficulties. Above all, the number of morphemes undergoing voicing assimilation is not a few. Note the following:

- | | | | |
|---------|--------------|----|----------------|
| (28) a. | loze/lost | b. | knife/knives |
| | leave/left | | mouth/mouths |
| | cleave/cleft | | path/paths |
| | deave/defit | | wreath/wreaths |

In these cases, if we insist on the allomorphic approach to the phenomena, it outrightly contradicts the definition of the rule of allomorphy: a rule which only applies to certain morphemes in the immediate environment of certain other morphemes (Aronoff 1976: 116). However, we can see wide-ranging types of morphemes are involved in the apparent voicing assimilation: verb, noun stems, numerals, suffixes like preterit /-t/, plural /-z/. In this respect, we expect a phonological explanation for the phenomena.

Moreover, the examples given in (25) do not lend support to the allomorphic explanation. When we consider that the reduction of a feature is a sort of structure changing operation, it is natural to consider that the

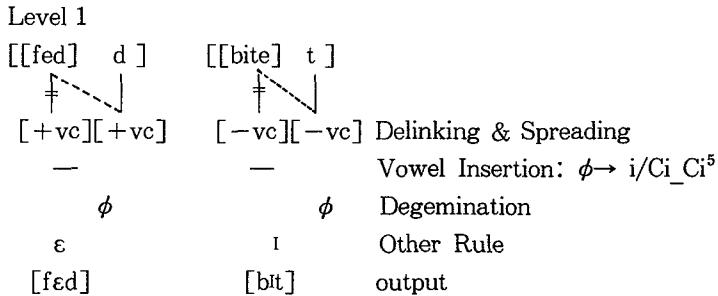
⁴A similar argument in favor of allomorphic explanation was introduced by Cho (1992).

reduction is subject to the Strict Cycle Condition. This condition requires that a structural changing operation is permitted only in the derived environments, as defined by Kiparsky (1982). However, in the case of (25) all the examples are non-derived proper nouns. Thus, we can conclude that the blocking of voicing assimilation in (25) stems from the effect of the Strict Cycle Condition.

More compelling evidence for the phonological approach to voicing assimilation stems from the following examples. When we assume the Strong Domain Hypothesis, as stated in section 1, the phonological explanation for voicing assimilation in English comes up with a successful result.

- (29) feed/fed bite/bit
 hide/hid cut/cut
 lead/led knit/knit
 read/read hit/hit

- (30) a. fed b. bit



The crucial point in derivation (30) is that vowel insertion allowed freely in the examples such as *padded*, *treated*, *buses*, *catches* is blocked in this case. In our analysis the prior application of voicing assimilation bleeds the application of the the rule. The blocking is warranted by the universal well-formedness condition of line crossing. The prevalence of data behaving in a similar way supports our phonological approach.

⁵When we invoke the effect of the Obligatory Contour Principle as a rule trigger (Yip: 1988), we can eliminate the structural description of the rule.

4.4. Relevance of Syllable

In the preceding section, I tried to show that the delinking of the feature [voice] is affirmative in English. If so, how can we account for the seemingly counterexamples to the phenomena in the following examples? Consider the illustration (31d).

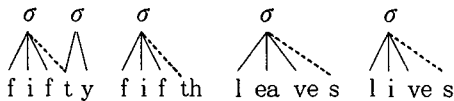
- (31) *abhor* *absess*
absissa *absent*
absurd *absolute*
abskond *abstact*
adhere *obstacle*
adhibit *obsolete*

The clue to the resolution for the problem can be found in the syllable structures of the sequences of the italicized parts. Consider the syllabification given in (32).

- (32)
- | | | | | | | | |
|----------|----------|----------|----------|----------|----------|----------|----------|
| σ | σ | σ | σ | σ | σ | σ | σ |
| \wedge | \wedge | \wedge | \wedge | \wedge | \wedge | \wedge | \wedge |
| a | b | a | b | a | d | a | b |
| h | h | s | s | h | s | c | o |
| o | r | e | s | e | s | n | d |

The illustration of syllable structures in (32) demonstrate that the consonant sequences at stake straddle two heterogeneous syllables. In this case, the sonority profile of the sequences disallows the application of ambisyllabification rule (7). Seeing that situation, let us turn our attention to the syllable structures of the following where voicing assimilation regularly occurs.

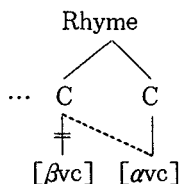
- (33) *five/fifty* *five/fifth* *leaf/leaves* *life/lives*



The configurations in (33) designate that the consonant cluster in questions are tautosyllabic by ambisyllabification or Prosodic Licensing Condition (Itô 1986). Thus, it leads us to conclude that the delinking of [voice] is operative within a syllable domain and the trigger of the operation is the

rhyme final consonant. The following formulation of delinking clarifies the process:

(34) Voicing Assimilation in English



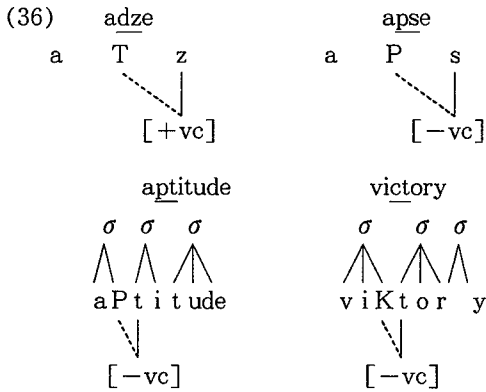
4.4. Context-Sensitive Underspecification

Aside from the phenomena of voicing assimilation enforced by rule (34), there is another kind of voicing assimilation in English. However this type of voicing should be clearly distinguished from the former type. First all, as shown in the (35), this process occur in the single-morphemic words.

(35)	<i>aptitude</i>	<i>act</i>
	<i>baptize</i>	<i>apt</i>
	<i>doctor</i>	<i>correct</i>
	<i>victory</i>	<i>script</i>
	<i>peptic</i>	<i>rapt</i>
	<i>septic</i>	<i>Egypt</i>

As in the case in (35), it is not feasible to assume regular voicing assimilation exerted by delinking of [voice] followed by spreading. This operation definitely violates the Strict Cycle Condition, and for this reason it is prohibited. Nonetheless, it is mandatory to account for the tendency of voicing agreement in the consonant clusters of (35), as tried by Kiparsky (1985).

To cope with the problem, at this point I assume that in English a consonant posited in a preconsonantal position should be analyzed to be underspecified for the feature [voice] when the consonant clusters are included in a syllable. This type of underspecification is guaranteed by the notion of Context-Sensitive Underspecification. Under this notion, let's consider the following derivations⁶:



The above derivations show that the voicing agreement in the case of (35) stems from the fact that the underspecification of preconsonantal and tautosyllabic position for the feature [voice] accompanied by the spreading of the relevant feature. Since the process of feature spreading does not result in structure changing, this analysis overcomes the effect of the Strict Cycle Condition.

4.5. Optionality of Rule Application

Let us consider the dialectal variation arising in the following examples.

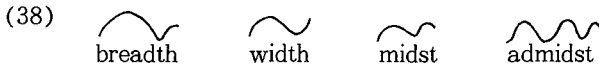
(37) breadth	[tθ~dθ]
width	[tθ~dθ]
midst	[ts~ds]
admidst	[ts~ds]

Mascaró (1987:450) attributes the optionality of the voicing agreement in (37) to the marginal allomorphic phenomena in that voicing agreement is attested only to limited dialects. Yet we can provide a genuine explanation to this problem in terms of syllable structure and sonority scale.

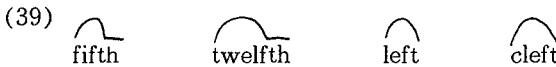
First of all, note that voicing assimilation applies obligatorily in other alternations like *five/fifth*, *twelve/twelfth*, *leave/left*, *cleave/cleft*. What is the distinction between the latter words and those in (37)? The answer is

⁶ The upper case letters denotes segments underspecified in feature [voice].

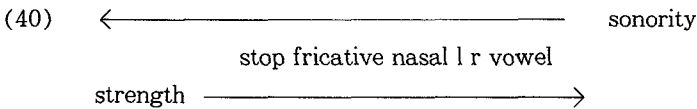
the sonority profile of the syllables. As illustrated below, the sonority profile of (37) is not optimal in terms of the Sonority Sequencing Principle.



Although the obstruent at the word-final position is incorporated into the preceding syllable by the Prosodic Licensing, the sonority profile in (38) is highly marked. This type of sonority reversal only marginally appears cross-linguistically, as pointed out by Clements (1990). In contrast, the sonority profiles in the following are less marked than those of (38). Thus the sonority plateau emerges :



Here, notice that the reversal of the sonority scale corresponds to the scale of consonant strength (Hooper 1976).

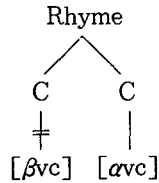


The above scale indicates that the more sonorant a segment is, the less strong it is. The strength of a segment is scaled at an universal proportion to the vulnerability of the segment to a rule. In other words, the stronger a segment is, the more resistant it is to undergoing a process.

Thus, considering the consonant strength or the sonority scale of a segment, we can provide a principled explanation for the variation of voicing assimilation in (37). The crucial factor in triggering reduction in voicing is attributable to the relative strength of the trigger compared to its target positions. That is, the optionality of devoicing stems from the fact that the strength of the trigger is not enough to impose reduction upon the preceding segment: it is weaker than the target. On the other hand, in the examples in (38) the triggering segments have the same or greater strength than the targets.

Based upon the observations, it is plausible to revise the rule schema (34) in a slight way.

(41) Voicing Assimilation in English (revised)



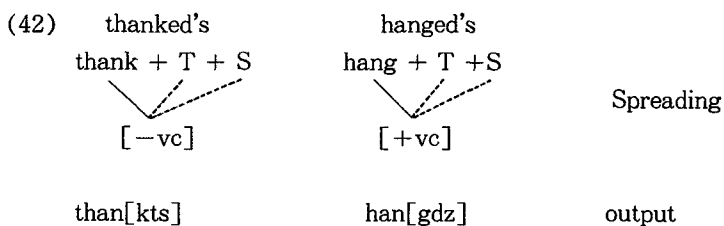
If the sonority of the trigger is greater than the target, it is optional, otherwise, obligatory

4.6. Voicing Agreement in Other Cases

The seemingly identical phenomena of voicing assimilation in the case of regular inflection and contracted forms should be dealt with from a different angle. The assimilation is characterised as automatic neutralization in that the value of voice is entirely determined by neighboring segments. For the explication of this type of voicing agreement, it is necessary to consider the base of word-formation in the lexical domain. As mentioned in the earlier part of this paper, only the base or root of a word and an independent word are allowed to be inputs to word formation. That is, inflectional or derivational affixes are excluded from the bases of the processes. This analysis leads us to differentiate the affixes from bases or stems of words with respect to morphological processes. Hence we can imagine a situation where even though a feature underspecified at the underlying representation of a stem comes to be specified by the application of a redundancy rule, the feature in question is still underspecified for the segment located in an affix.

In this vein, I assume the feature [voice] is underspecified in the case of plural, preterit, and contracted forms. The empty slots can be assumed to be filled by spreading the relevant feature from the preceding segment.

The derivations proceed in the following way:



5. Conclusion

Up to now I have attempted to show that nasal assimilation and voicing assimilation in English crucially depend upon syllable structure of the concerned sequence. In the course of analyses, I have demonstrated the following :

First, when we account for nasal assimilation in terms of syllable structure, it turns out to be possible to analyze this phenomena in a consistent way. Also, this analysis consequences in the nature of English—English does not belong to the so-called ‘Prince languages’ where geminates and nasal–consonant clusters are interconstituent sequences.

Second, the sonority value of a segment and syllable structure are heavily resorted to in the determination of the reduction of the feature [voice].

Third, the case of voicing assimilation poses interesting issues with respect to the claim that reduction is positive in some derivational and inflectional morphology.

Last, for a coherent explanation for heterogenous nature of voicing assimilation in English, both context–free and context–sensitive underspecification should be considered.

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