Predicting Varieties: Partial Orderings in English Stress Assignment*

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Abstract

The goal of this paper is twofold: (1) to review various behaviors of Class 1 suffixes with regard to stress assignment in English; and (2) to argue that the partial ordering theory -- a version of OT proposed by Anttila (2002), etc. -- properly accounts for such abundance among suffixes, predicting all and only the variation observed here. Each suffix turns out to be classified as having one of five stress patterns, all of which can be characterized by partial rankings of five general constraints. No other patterns than these five are predicted to arise because some of the constraint interactions do not produce any phonological consequence. A pilot survey on actual frequency of each pattern among suffixes is also conducted, and the result shows that the proportion of each pattern roughly corresponds to the proportion predicted by the present analysis, suggesting its appropriateness.

1 Introduction

It is widely known that English suffixes should be divided into two "classes" according to whether or not they are subject to phonological phenomena, and such classhood has been captured in the literature in various theoretical ways (cf. Chomsky and Halle (1968), Siegel (1974), Allen (1978), Kiparsky (1982), etc.). Suffixes in (1a) are examples of typical Class 1 suffixes, taken from SPE and various studies, which are stress-shifting. Those in (1b), on the other hand, are stress-neutral (i.e. Class 2).

(1) a. Class 1 suffixes:
-ity, -ion, -(i)an, -al, -ous, -ant/-ent, -ory, -ary, -ic, -id, -ive,-ate, -ify, etc.

b. Class 2 suffixes:
-like, -able, -hood, -ness, -ment, -ist, -ism, -ish, -ly, -wise, -ing, -ed, etc.

A closer investigation, however, reveals much more than such a simple dichotomy among English suffixes: varieties exist even among suffixes belonging to the same "Class 1" with regard to several properties in stress assignment. We will observe such various behaviors in Section 2.

As it happens, the different behavior of suffixes has been tacitly analyzed in previous rule-based studies. In such studies, some suffixes are individually specified with a special rule which applies only to the relevant suffix, or are simply treated as 'exceptions.' Both of these analyses, needless to say, lacks generality and theoretical elegance. A recent approach called the partial

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ordering theory, proposed by Anttila and Cho (1998) and Anttila (2002), gives us a clue to solve this problem. Based on Optimality Theory (cf. Prince and Smolensky (1993)), this is a restrictive version of the reranking (or cophonology) theories of constraints (cf. Itô and Mester (1995), Inkelas (1998), Orgun (1998), etc.). As we will see in section 3, this theory elegantly accounts for the diversity among English suffixes, without weakening theoretical consistency and having recourse to ad hoc devices. Furthermore, it is predicted that all and only the patterns observed in this paper will be produced in the interaction of the relevant constraints.

The present analysis raises a further issue: does theoretical prediction correspond to the actual frequency? In Section 4, I will point out how the present analysis makes prediction for each pattern and compare it with the result of a pilot study. The result suggests that the present analysis makes good prediction as to the actual frequency, though not perfect. Section 5 concludes the paper.

2 Specific Behaviors of Class 1 Suffixes in Stress Assignment

2.1 Sensitivity to Extrametricality

Since Hayes (1980, 1982), it is widely assumed in metrical theory that the final syllable of English words tends to be extrametrical, as summarized in (2).[1]

(2) a. Rhyme → [+ ex] / __ $]_{N}$
b. $[X]_{Suffix}$ → [+ ex] / __ $]_{Adj}$
c. [+cons] → [+ ex] / __ $]_{word}$ (cf. Hayes (1980, 1982))

As formalized in (2a) and (2b), the final syllable of nouns (i.e. both suffixed and unsuffixed, the latter of which is obviously beyond the scope of this paper) and derived adjectives (i.e. only suffixed) should be extrametrical, which is true as exemplified in (3). Words in (3a) are suffixed nouns, and those in (3b) suffixed adjectives.

(3) a. pub(líci)<ty> com(múni)<on> A(méri)<can>
b. (nátu)<ral> (húmo)<rous> (dómi)<nant> (áddi)<tive>

Since trochaic feet are constructed from right to left in English, the primary stress falls on the antepenultimate syllable. Note that the penultimate syllable is light in the words in (3) and thus should be the dependent of a foot. Verbal suffixes are considered in the next subsection, because they do not undergo extrametricality but stress retraction, usually containing a diphthong.

There are, however, several suffixes which do not conform to the prediction.

(4) exceptions to extrametricality:
a. -ic: alco(hóli)<c> a(tómi)<c> ti(táni)<c> sym(phóni)<c>
b. -id: pel(lúci)<d> in(trépi)<d> in(sípi)<d>

Adjective-forming suffixes *–ic* and *-id* do not undergo suffix extrametricality (2b), although they do undergo consonant extrametricality (2c), which vacuously applies to normal nouns and

[1] Burzio (1994) explores a different approach to this fact, in which the final syllable is assumed to be metrified in a trisyllabic foot. I will not follow his approach because such feet are not universally observed and thus it is difficult to derive them from interactions of universal constraints.

adjectives as well. Hence, words with these suffixes have primary stress on the penultimate syllable, even though it is light.

These suffixes are often treated simply as exceptions to extrametricality. In any case, we have to recognize two distinct groupings, one for suffixes which undergo extrametricality, and the other for those which do not.

2.2 Sensitivity to Stress Retraction

In English, the rightmost stress usually becomes primary, as we saw in (3) and (4). When it is on the final syllable, however, the primary stress is 'retracted' leftward, as exemplified in (5).

(5) oríginàte, syllábifỳ, álkanòid, mágnetìte, sécretàry, inhíbitòry

This happens particularly when the final syllable contains a long vowel or a diphthong, which do not undergo extrametricality as analyzed by Halle and Vergnaud.[2]

The words in (6), however, are exceptions to Stress Retraction, in that they have primary stress on the final syllable.

(6) 'exceptions' to Stress Retraction
- a. Jàpanése, Chìnése, Viètnamése, Pòrtuguése, jòurnalése
- b. ènginéer, vòluntéer, pìonéer, mòuntainéer, àuctionéer, pùppetéer
- c. àrabésque, Ròmanésque, pìcarésque, pìcturésque, gròtésque
- d. nòvelétte, kìtchenétte, màrionétte, màisonétte, cìgarétte

As in the case of the non-extrametrical suffixes seen in the previous section, the suffixes in (6) must also be specified in some way or another so that they are immune from Stress Retraction. That is, we have to recognize two groupings of suffixes; one for those which undergo Stress Retraction and the other for those which do not.

2.3 Strong vs. Weak Retractions

Moreover, there is a distinction among the words which undergo Stress Retraction; that is, while some undergo Strong Retraction, others undergo Weak Retraction (cf. Liberman and Prince (1977)). In words which undergo Strong Retraction, stress occurs exactly two syllables away from the suffix. That is, the weight of the intervening syllable is irrelevant. (7a) contains words which have a light syllable to the left of the verbal suffix *-ate*, while (7b) contains words in which the preceding syllable is heavy. In either case, primary stress is two syllables away from the suffix. The words in (8) are further examples which have a heavy penultimate syllable.

(7) a. certíficàte, commúnicàte, invéstigàte, apprópriàte, manípulàte
    b. désignàte, démonstràte, cónfiscàte, législàte, cóntemplàte

(8) sátisfỳ, récognìze, ánecdòte, ásymptòte, Afghánistàn, Pákistàn

[2] Weak Retraction, which we will discuss in the next section, is analyzed as a result of extrametricality by Hayes (1982): because of extrametricality, the suffixes have secondary stress, but not primary one. In this paper, I will follow Halle and Vergnaud and regard retraction as different from extrametricality, because the driving force of retraction should be distinct from that of extrametricality, as we will discuss in Section 3.

On the other hand, in words which undergo Weak Retraction, primary stress occurs one or two syllables away from the suffix, depending on the weight of the preceding syllable of the suffix. That is, if the preceding syllable of the suffix is heavy, as in (9b) and (10b), primary stress is retracted onto that syllable. If it is not, as in (9a) and (10a), primary stress is retracted two syllables away from the suffix.[3]

(9) a. álkanòid, hóminòid, pyrámidòid, crýstallòid, tentáculòid, sólenòid
b. ellípsòid, mollúscòid, cylíndròid, salamándròid, aráchnòid

(10) a. mágnetìte, dýnamìte, sécretàry, inhíbitòry, admónitòry[4]
b. stalágmìte, gelígnìte,[5] eleméntary, perfúnctory, refectory

These data suggest that each suffix must somehow be grouped into one of the two retraction types, if it undergoes retraction.

2.4 Summary

In sum, from the various patterns in stress assignment it is clear that there are several distinctions among English Class 1 suffixes. That is, in addition to the well-established dual classhood, it is necessary to make the following five distinctions among Class 1 suffixes:

(11) a. extrametrical suffixes; -ity, -ion, -(i)an, -al, -ous, -ive, etc. (= (3))
b. non-extrametrical suffixes; -ic, -id, etc. (= (4))
c. non-retracting suffxes; -ese, -eer, -esque, -ette, etc. (= (6))
d. strongly retracted suffixes; -ate, -(i)fy, -ize, etc. (= (7), (8))
e. weakly retracted suffixes; -oid, -ite, -ary, -ory, etc. (= (9), (10))

Although there might be further minor distinctions (cf. Zamma (2002)), these are the core distinctions among English suffixes in as much as they form clear categories for stress assignment purposes. Having established such core distinctions, let us start theoretical discussion in the next section.

3. A Partial Ordering Analysis

In this section, we will consider (i) how the emergence of each of the patterns in (11) can be analyzed; (ii) how we can account for the fact that there are such varieties; and (iii) how we can predict that all but only these patterns could arise. As I have mentioned earlier, the partial ordering theory -- a version of Optimality Theory -- gives us an elegant way of analyzing these issues.

[3] The final *y* in *-ory* and *-ary* is considered to be a glide, as is widely assmed since SPE and Liberman and Prince (1977).

[4] *-ary* and *–ory* appear without stress in British pronunciation, which may suggest that they are becoming usual extrametrical suffixes.

[5] *-ite* is becoming a Strong Retraction suffix in British English, according to Wells (2000); e.g. *stálagmìte*, *gélignìte*, etc.

3.1 Constraints

Let us first identify the constraints necessary to make the distinctions observed in (11). For the extrametrical/non-extrametrical distinction, the following two constraints are responsible:

(12) a. **Align-R**: Primary stress should be right-aligned.
     b. **Extrametricality (EM)**: The final syllable is extrametrical
(13) a. extrametrical: **EM** » **Align-R**
     b. non-extrametrical: **Align-R** » **EM**

(12a) is a constraint which requires the primary stress to appear as rightmost as possible. If it is ranked above a constraint which requires extrametricality (12b), as in (13b), the non-extrametrical pattern will be produced. In the reverse ranking (13a), on the other hand, the extrametrical pattern emerges.

Extrametricality is often attributed to a constraint called **Nonfinality** (cf. Prince and Smolensky (1993), Hammond (1999), Pater (2000), etc). Although labelling of the constraint itself is a trivial matter, it is necessary to assume two distinct constraints, one of which is responsible for extrametricality and the other for stress retraction. Note that an extrametrical syllable is completely kicked out from a foot, while the final syllable under stress retraction has secondary stress, being metrified. Moreover, such complete exclusion of syllable (or mora) from metrical feet is observed in various languages and can be regarded as a universal property of word edge (cf. Hayes (1980), among others). I will thus employ here the constraint in (12b) for extrametricality, and spare **Nonfinality** for stress retraction.

Ranking of **Nonfinality**, whose definition is in (14), with respect to **Align-R** produces the difference in sensitivity to stress retraction. If **Nonfinality** is ranked higher than **Align-R** (15a), primary stress is retracted leftward. In the reverse ranking (15b), retraction does not occur.

(14) **Nonfinality (NonFin)**: Primary stress does not fall on the final syllable.
(15) a. retracting: **Nonfinality** » **Align-R**
     b. non-retracting: **Align-R** » **Nonfinality**

Note, as I have just mentioned above, that **Nonfinality** just prohibits the final syllable from having primary stress, but not secondary one. In other words, it tolerates a pattern in which the final syllable is metrified, contra **Extrametricality**.

As we have seen in the previous section, there is a distinction among stress retraction: strong vs. weak. In Strong Retraction, primary stress appears strictly two syllable ahead of the final syllable, which has secondary stress. Strong Retraction, in other words, strictly prohibits two adjacent stresses, sometimes creating a stressless heavy syllable. This indicates that a ban on stress clash (16a) is more highly respected than a ban on stressless heavy syllable (16b). This relationship can be expressed in the ranking in (17a):

(16) a. ***Clash**: Stresses should not be on adjacent syllables.
     b. **Weight-to-Stress Principle (WSP)**: A heavy syllable should be stressed.
(17) a. Strong Retraction: ***Clash** » **WSP**
     b. Weak Retraction: **WSP** » ***Clash**

In Weak Retraction, on the other hand, the case is to the reverse: primary stress is retracted onto the preceding heavy syllable of the suffix, tolerating stress clash. Thus, the constraint ranking for the Weak Retraction suffixes should be as in (17b).

In addition, there is another characteristic ranking for strong/weak distinction on retraction. Consider the ranking below:

(18) a. Strong Retraction: ***Clash** » **Align-R**
b. Weak Retraction: **Align-R** » ***Clash**

The ranking in (18a) produces a pattern which avoids stress clash by placing the primary stress far from the right edge. As Strong Retraction always skips the penultimate syllable incurring one more violation of **Align-R** than Weak Retraction would do, (18a) is another ranking for this type of retraction. Conversely, preferrence of right-alignment over stress clash in the ranking in (18b) leads to Weak Retraction.

Let us finally summarize the constraints necessary in analyzing various types of suffixes in (11). We need the following five constraints, most of which are well-established in OT literature.

(19) a. **Align-R**: Primary stress should be right-aligned.
b. **Extrametricality (EM)**: The final syllable is extrametrical.
c. **Nonfinality (NonFin)**: Primary stress does not fall on the final syllable.
d. ***Clash**: Stresses should not be on adjacent syllables.
e. **Weight-to-Stress Principle (WSP)**: A heavy syllable should be stressed.

Now we can answer the first question raised at the beginning of this section. Each of the patterns in English accentuation can be analyzed as arising from interactions among these constraints: extrametrical patterns from the ranking in (13a); non-extrametrical patterns from (13b); non-retracting patterns from (15b); Strong Retraction patterns from (17a) and (18a); and Weak Retraction patterns from (17b) and (18b).

Of course, more constraints other than those in (19) are operating in English stress assignment, such as:

(20) a. **LX≈PR**: Content words should be prosodically analyzed (i.e. have stress).
b. **Troch**: Construct trochaic (i.e. left-headed) feet.
c. **FootBinarity**: Feet must be binary (i.e. no degenerate foot *('L)).
d. **Extrasyllabicity**: The final consonant is extrasyllabic.
e. **Parse-σ**: Syllables should be incorporated into feet.

These constraints are also well-established in OT literature (except for (20d), which, however, seems operating in several languages according to Hayes (1980)). (20a) requires any content word to have stress, which is obviously never violated in English and must be top-ranked. (20b) is a constraint which guarantees that feet constructed in English are trochaic, or left-headed, while (20c) sets their size as bisyllabic, or at least bimoraic (i.e. heavy monosyllable). Taken together, they produce trochaic feet (i.e. ('LL), ('HL) or ('H)) but not a degenerate foot (i.e. *('L)). Depending on the ranking of **WSP**, ('LH) and ('HH) are also possible, as in the case of Strong Retraction. As this trochaic pattern (i.e. left headedness and binarity restriction) is consistent in English, (20b) and (20c) can also be regarded as ranked in considerably a higher position in the constraint hierarchy. (20d) is also ranked higher so that extrasyllabicity effect is guaranteed widely (cf. Hayes (1980)), but should be ranked lower than (20a) (i.e. **LX≈PR** »

Extrasyllabicity), given the fact that monosyllabic content words always have stress (e.g. *hít*). These constraints, however, are all ranked higher than those in (19) and these two groups rarely interact with each other.[6] I will hence omit them in the discussion below unless necessary.

The constraint in (20e), on the other hand, is often violated in English, as some syllables are left unparsed in order to satisfy some of the constraints in (19). It is thus ranked lower than any of the constraints in (19), and I will also omit this constraint in the following discussion.

3.2 Partial Ordering Theory and Fixed Rankings in English

Now that we have identified the constraints necessary to analyze the variation in English, let us move on to an analysis in the framework of partial ordering theory (cf. Anttila and Cho (1998), Anttila (2002)). The theory is based on the two general assumptions given below:

(21) Partial Ordering Theory (Anttila (2002: 21))

a. Grammars are partial orderings of optimality-theoretic constraints.

b. Subregularity Integration: The partial orders within a language are the possible subregularities (declensions, lexical exceptions, etc.) in that language.

In other words, this theory suggests that the 'core' of the grammar of a language is only partially determined. The remaining undetermined parts are fixed differently depending on the subgroup of the language. Consider a hypothetical language *L* below as an example.

(22) A grammar lattice (Anttila (2002: 21))

Ø
{ABC, ACB, BAC, BCA, CAB, CBA}
(Universal Grammar)

A » B
{ABC, ACB, CAB}
(Language *L*)

A » B A » C {ABC, ACB} (Subgrammar 1)	A » B C » B {ACB, CAB} (Subgrammar 2)

A » B A » C B » C {ABC} (Subgrammar 3)	A » B C » B A » C {ACB} (Subgrammar 4)	A » B C » B C » A {CAB} (Subgrammar 5)

Given three constraints A, B, and C in universal grammar, the core grammar of the language *L* is only determined as A » B, and the remaining rankings among them are determined in

[6] **Extrasyllabicity** seems sometimes overridden by **Align-R**, as several suffixes seem to syllabify the final consonant to put a stress on the resulting final heavy syllable. See Section 4.

subgrammars 1 through 5. These different rankings lead to different bahaviors among various groupings in the language, such as parts of speech, word classes, inflectional forms, etc.

Let us then move back to the English case at hand. As we have discussed, the general constraints in (20a-d) are considered to be ranked in fairly a high position in the ranking, as they are almost always respected in English. The constraint in (20e), on the other hand, should be ranked in lower position, as it is often violated. These basic rankings are regarded as the core rankings of English in terms of the partial ordering theory. Although it is highly possible that there are rankings among the constraints in (20a-d) (e.g. **LX≈PR** » **Extrasyllabicity** as I have mentioned in the last section), I will just assume that they as a whole are higher ranked and I will not discuss about them any further, because it is the partial rankings that produce the variety in English accentuation -- the target of the present paper.

There are several more fixed rankings which I should mention here. The first of them is the one between **EM** and **WSP**. To be precise, it is a variant of **WSP** which interacts with **EM** in the word-final position. Recall that the weight of the rightmost heavy syllable (especially with a long vowel or a diphthong, as we will discuss shortly) is always respected and attracts a stress, whether it is primary or secondary. This is why most metrical analyses of English in derivational theory assume right-to-left metrification. Heavy syllables in other positions, on the other hand, can be stressless, as is obvious in Strong Retraction. From this observation, it is reasonable to assume a distinct constraint of **WSP** which is specialized to the rightmost position, as below:[7]

(23) **WSP#**: The rightmost heavy syllable should be stressed.

If this constraint were absent, we would predict an unattested pattern in English. Compare a hypothetical case of Strong Retraction, with the ranking ***Clash** » **WSP** (cf. (17a)).

(24)

HHHH	***Clash**	**WSP**
('H)('HH)('H)	*!	*
☞ ('HH)('HH)		**

This ranking would predict an unusual stress pattern, in which Strong Retraction is suppressed only when usual metrification would otherwise produce stress clash. Note also that the optimal pattern in (24) also satisfies **Nonfinality**, which is the driving force of retraction. A pattern like this, however, never happens in English. It is thus necessary to guarantee that the final heavy syllable always has some degree of stress, by ranking (23) higher than other stress assignment constraints.

As I hinted above, it is a heavy syllable with a long vowel that is always stressed, exempt from extrametricality (cf. Hayes (1980:151)). That is, a final syllable with a rhyme VV(C) always has a stress, either primary or secondary, while one with VC(C) can be stressless (recall that the final consonant is extrasyllabic), despite the fact that both rhymes are normally regarded as constituting a heavy syllable. This fact can be regarded as a consequence of the following fixed ranking in English, dividing **WSP#** according to the rhyme structure (cf. Hammond (1999:265)):[8]

[7] The existence of this constraint might be due to the fact that word-final position is more prominent than other positions, as Beckman (1998) argues. However, we cannot replace this with a positional faithfulness constraint, because stress is regarded as absent in the input.

[8] Hammond uses **Nonfinality** instead of **EM**, to which I do not attribute extrametricality for the reason

(25) **WSP(VV)#** » **EM**

WSP(VC)#, on the other hand, does not seem to have a fixed ranking with respect to **EM**, because suffixes with this rhyme structure can be either extrametrical or stressed, as we will see below. In other words, the ranking between **WSP(VC)#** and **EM** is not fixed and thus they can be ranked in either of the following ways:

(26) a. **EM** » **WSP(VC)#**
b. **WSP(VC)#** » **EM**

Moreover, the fact that VV(C) is always stressed while VC(C) can be extrametrical suggest that **WSP(VV)#** is consistently ranked higher than **WSP(VC)#**.[9]

(27) **WSP(VV)#** » **WSP(VC)#**

Taken together, these partial rankings produce the following two rankings:

(28) a. **WSP(VV)#** » **EM** » **WSP(VC)#**
b. **WSP(VV)#** » **WSP(VC)#** » **EM**

These rankings elegantly account for the assymetry between the rhymes with VV(C) and VC(C): suffixes with VV(C) are always stressed but those with VC(C) vary. The difference can be attributed to the two rankings in (28), by which some suffixes with VC(C) are assigned with the ranking in (28a) to undergo extrametricality, while others are assigned with (28b). Recall that Hayes (1980) had to propose a "purely lexical solution (p.152)" to this problem.

Since **WSP(VV)#** is never violated and **WSP(VC)#** can be violated only by **EM**, these two constraints are ranked in a fairly high position in the constraint hierarchy. This fact can be expressed in the following partial rankings:[10]

(29) a.

WSP(VV)# » WSP(VC)#	**WSP(VV)# » Align-R**	**WSP(VV)# » *Clash**
WSP(VV)# » EM	**WSP(VV)# » NonFin**	**WSP(VV)# » WSP**

b.

WSP(VC)# » Align-R	**WSP(VC)# » *Clash**
WSP(VC)# » NonFin	**WSP(VC)# » WSP**

To spare the space, I will omit most of these fixed rankings from the following discussion. Note here just that only **EM** can be ranked higher than **WSP(VC)#**, to produce the ranking in (28a).

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mentioned above. In the course of discussion, he abolishes the idea of dividing **WSP** according to the rhyme structure and develops new approach, which I also do not follow since it is beyond the scope of this paper and division of **WSP** is suffice here. In addition, he does not restrict the division to word-final position.

[9] This ranking might be a specialized version of a universal ranking **WSP(VV)** » **WSP(VC)**, as it is observed in some languages that syllables with VC are regarded as light while ones with VV are always counted as heavy (cf. Hayes (1995:121)). In recent analyses in OT, however, attempts have been made to derive this fact from interactions of other constraints (e.g. Morén (2000) and Crowhurst and Micheal (to appear)). I am grateful to Moira Yip and Nina Topintzi for directing my attention to this issue.

[10] Among these partial rankings, **WSP(VV)#** » **WSP** and **WSP(VC)#** » **WSP** arise from Panini's theorem: more specific ones should be ranked higher than general ones in the hierarchy.

The last fixed ranking we should discuss here is the one between ***Clash** and **EM**. Ranking among these constraints would determine whether or not stress clash is strongly avoided enough to tolerate metrification of the final syllable. That is, with the ranking ***Clash** »**EM**, it is predicted that extrametricality is suppressed only when stress clash would otherwise occur. As the degenerate foot (L) is never produced due to high ranking of **FootBinarity** (20c), the only situation where ***Clash** would be violated in extrametrical words is when the last sequence of the word is either ('H)('H)<σ> or ('H)('σL)<σ>. The former of them is nonetheless violated if the sequence is parsed as ('H)('Hσ) by metrifying the final syllable, and thus never wins against a candidate which satisfies **EM**. In the latter case on the other hand, it might be possible to construct a structure like ('Hσ)('Lσ) in order to avoid ***Clash** violation. Consider hypothetical cases of the structures with LLL and HLLL.

(30) a.

LLL	***Clash**	**EM**
☞ ('LL)<L>		
L('LL)		*!

b.

HLLL	***Clash**	**EM**
('H)('LL)<L>	*!	
☞ ('HL)('LL)		*

As shown in (30), suffixes with this ranking would show a pattern in which regular extrametrical pattern is suppressed only when stress clash might otherwise occur, but nowhere else. In fact, however, no example of suffixes with such a pattern can be found in English. We can thus conclude that the ranking between them is fixed in English as in (31).

(31) **EM** » ***Clash**

Now we can answer the second question: why are there such varieties among suffixes? It is because some parts of the constraint rankings are left unfixed in the lexicon of English, but are determined depending on the suffixes. Of course, some 'core' rankings are fixed in the entire lexicon of English, so that even these various patterns are given 'English-ness', distinct from other languages. Such core rankings include: (29), (31), as well as (20a-d) » (19) » (20e).

3.3 Possible Constraint Interactions and Possible Patterns

Assuming that we have five constraints in (19) for subgrammars in English which can be freely ranked depending on the suffix (the constraints in (20) and varieties of **WSP#** are not considered in suffixal variation), there are logically 5! = 120 rankings among them. As one of the partial rankings is fixed as in (31), the total possible rankings are 120 / 2 = 60, all of which are listed below. In (32), the more left a constraint appears, the higher it is ranked in the hierarchy (the rightmost four columns are discussed later):

(32) possible rankings

						(35b)	(35c)	SR	WR
1	Align-R	EM	NonFin	*Clash	WSP	√	√		A>C
2	Align-R	EM	NonFin	WSP	*Clash	√	√		A>C
3	Align-R	EM	*Clash	NonFin	WSP	√	√		A>C
4	Align-R	EM	*Clash	WSP	NonFin	√	√		A>C
5	Align-R	EM	WSP	NonFin	*Clash	√	√		A>C
6	Align-R	EM	WSP	*Clash	NonFin	√	√		A>C
7	Align-R	NonFin	EM	*Clash	WSP	√	√		A>C
8	Align-R	NonFin	EM	WSP	*Clash	√	√		A>C
9	Align-R	NonFin	WSP	EM	*Clash	√	√		A>C
10	Align-R	WSP	EM	NonFin	*Clash	√	√		A>C
11	Align-R	WSP	EM	*Clash	NonFin	√	√		A>C
12	Align-R	WSP	NonFin	EM	*Clash	√	√		A>C
13	EM	Align-R	NonFin	*Clash	WSP		√		A>C
14	EM	Align-R	NonFin	WSP	*Clash		√		A>C
15	EM	Align-R	*Clash	NonFin	WSP		√		A>C
16	EM	Align-R	*Clash	WSP	NonFin		√		A>C
17	EM	Align-R	WSP	NonFin	*Clash		√		A>C
18	EM	Align-R	WSP	*Clash	NonFin		√		A>C
19	EM	NonFin	Align-R	*Clash	WSP				A>C
20	EM	NonFin	Align-R	WSP	*Clash				A>C
21	EM	NonFin	*Clash	Align-R	WSP			C>A	
22	EM	NonFin	*Clash	WSP	Align-R			C>W	
23	EM	NonFin	WSP	Align-R	*Clash				W>C
24	EM	NonFin	WSP	*Clash	Align-R				W>C
25	EM	*Clash	Align-R	NonFin	WSP		√	C>A	
26	EM	*Clash	Align-R	WSP	NonFin		√	C>A	
27	EM	*Clash	NonFin	Align-R	WSP			C>A	
28	EM	*Clash	NonFin	WSP	Align-R			C>W	
29	EM	*Clash	WSP	Align-R	NonFin		√	C>W	
30	EM	*Clash	WSP	NonFin	Align-R			C>W	
31	EM	WSP	Align-R	NonFin	*Clash		√		W>C
32	EM	WSP	Align-R	*Clash	NonFin		√		W>C
33	EM	WSP	NonFin	Align-R	*Clash				W>C
34	EM	WSP	NonFin	*Clash	Align-R				W>C
35	EM	WSP	*Clash	Align-R	NonFin		√		W>C
36	EM	WSP	*Clash	NonFin	Align-R				W>C
37	NonFin	Align-R	EM	*Clash	WSP	√			A>C
38	NonFin	Align-R	EM	WSP	*Clash	√			A>C
39	NonFin	Align-R	WSP	EM	*Clash	√			A>C

40	NonFin	EM	Align-R	*Clash	WSP				A>C
41	NonFin	EM	Align-R	WSP	*Clash				A>C
42	NonFin	EM	*Clash	Align-R	WSP			C>A	
43	NonFin	EM	*Clash	WSP	Align-R			C>W	
44	NonFin	EM	WSP	Align-R	*Clash				W>C
45	NonFin	EM	WSP	*Clash	Align-R				W>C
46	NonFin	WSP	Align-R	EM	*Clash	√			W>C
47	NonFin	WSP	EM	Align-R	*Clash				W>C
48	NonFin	WSP	EM	*Clash	Align-R				W>C
49	WSP	Align-R	EM	NonFin	*Clash	√	√		W>C
50	WSP	Align-R	EM	*Clash	NonFin	√	√		W>C
51	WSP	Align-R	NonFin	EM	*Clash	√	√		W>C
52	WSP	EM	Align-R	NonFin	*Clash		√		W>C
53	WSP	EM	Align-R	*Clash	NonFin		√		W>C
54	WSP	EM	NonFin	Align-R	*Clash				W>C
55	WSP	EM	NonFin	*Clash	Align-R				W>C
56	WSP	EM	*Clash	Align-R	NonFin		√		W>C
57	WSP	EM	*Clash	NonFin	Align-R				W>C
58	WSP	NonFin	Align-R	EM	*Clash	√			W>C
59	WSP	NonFin	EM	Align-R	*Clash				W>C
60	WSP	NonFin	EM	*Clash	Align-R				W>C

In what follows, I will consider the third question: why do the rankings above produce all and only the patterns we observed in (11)? As we will see, only the five patterns emerge from these 60 possible rankings.

First, let us consider how many interactions are possible among the five constraints established in Section 3.1.

(33) possible interactions of constraints

Align-R vs. EM
Align-R vs. NonFin   EM vs. NonFin
Align-R vs. *Clash   EM vs. *Clash   NonFin vs. *Clash
Align-R vs. WSP   EM vs. WSP   NonFin vs. WSP   *Clash vs. WSP

Among these ten possible interactions, those referred above as the determinant rankings for each of the phonological properties are the following four:

(34) a. extrametrical/non-extrametrical: **Align-R** vs. **EM**
b. retracting/non-retracting: **Align-R** vs. **Nonfinality**
c. strong/weak retraction: ***Clash** vs. **WSP** and **Align-R** vs. ***Clash**

In addition to these, the ranking between **EM** and ***Clash** is fixed as in (30). Thus, five interactions in (33) remain left unmentioned. Interestingly enogh, none of the remaining interactions produce any phonological consequences. Let us consider each of them.

Align-R vs. **WSP**:
Ranking among these constraints would determine whether or not right-alignment is strongly required enough to tolerate a stressless heavy syllable. Such a situation would arise in foot structures such as: H(σL)#, (LH)#, and H(H)#. These structures, however, do not have to be constructed, as structures which satisfy both of the constraints are always possible, by constructing a foot (H); i.e. (H)(σL)#, L(H)#, and (H)(H)#.

EM vs. **NonFin**:
Ranking among these constraints would determine whether or not extrametricality is strongly required enough to tolerate final stress. Obviously, such a case is contradictory and does not arise, because if a word obeys **EM**, the word does not have final stress. Recall also that **EM** is independently necessary from **NonFin**, which forces stress retraction, in order for a syllable to be completely kicked out from a foot. Note that non-extrametrical structures like ('σσ)# satisfy **NonFin**.

EM vs. **WSP**
WSP here is a general constraint, which applies to all the heavy syllables irrespective of its position in the word. Since extrametricality, which concerns only the final syllable, is determined by higher-ranked constraint **WSP#** with respect to **EM**, the ranking of the general **WSP** with respect to **EM** is irrelevant and produces no phonological effect. On the quantity-sensitivity of non-final heavy syllables, on the other hand, the ranking in question also has no effect, since it is always possible to satisfy both of the constraints at one time; e.g. X(H)<Y>.

NonFin vs. ***Clash**:
Ranking among these constraints would determine whether or not stress clash is strongly avoided enough to tolerate final stress. Given that primary stress is 'retracted' onto a syllable which would have secondary stress without the retraction, stress clash would occur between the secondary stress and the final primary stress even if the primary stress is not retracted; that is, the word would violate ***Clash** whether or not it satisfies **NonFin**. For example, stresses clash in ('H)('H) and ('H)('σσ)('H) irrespective of the place of the primary stress.

NonFin vs. **WSP**:
Ranking among these constraints would determine whether or not quantity-sensitivity is strongly required enough to tolerate final stress. Note, however, **Nonfinality** as we defined it prohibits final primary stress but does allow final secondary stress. In other words, it is possible to satisfy both of the constraints at the same time by assigning a secondary stress to the final heavy syllable.

In sum, all of the constraint interactions above do not produce any phonological effect, and thus can be ignored in considering the possible phonological patterns produced by the five constraints. In other words, it is only the four interactions in (34) that have phonological consequences, which further lead to the five distinct patterns in (11). Now we can answer the third question halfway: only the five patterns can emerge because some of the constraint interactions have no phonological consequence.

3.4 Possible Patterns and the Rhyme Structure

Let us finally consider the remaining half of the third question: how do each of the five patterns arise from the 60 possible rankings in (32)? In other words, which rankings in (32) produce which patterns?

Let us first recall the defining rankings for each pattern we established in Section 3.1. I will summarize relevant partial rankings below:

(35) a. extrametrical: **EM** » **Align-R**
b. non-extrametrical: **Align-R** » **EM**
c. non-retracting: **Align-R** » **Nonfinality**
d. Strong Retraction: **Nonfinality** » **Align-R** PLUS
either ***Clash** » **WSP** or ***Clash** » **Align-R**
e. Weak Retraction: **Nonfinality** » **Align-R** PLUS
either **WSP** » ***Clash** or **Align-R** » ***Clash**

Retraction suffixes should have at least two rankings as shown in (35d) and (35e), one of which serves as the driving force of retraction (i.e. **NonFin** » **Align-R**), and the other of which determines the type of retraction. As for the two characteristic rankings for the latter (i.e. those written in the second line in (35d and e)), the one found in higher position determines the pattern. Suppose, for example, a suffix has such a ranking as **WSP** » ***Clash** » **Align-R**, where the ranking of the first two constraints is the one in (35e) while that of the last two is the one in (35d). (Primary stress is assumed on the second and first syllables in the first and second candidates respectively, due to higher-ranked **NonFin** for retracting suffixes than **Align-R**.)

(36)

HHH	WSP	*Clash	Align-R
☞ ('H)('H)('H)		**	*
('HH)('H)	*!		**

It is a Weak Retraction pattern that is produced with this ranking, because the highermost **WSP** requires a stress on the penultimate syllable, tolerating stress clash. In other words, it is the highest constraint among the three that determines the type of retraction.

Now that the defining rankings for each pattern is clear, let us next observe in (32) which of them are contained in each ranking. In the righmost four columns in (32), properties of extrametricality (35b) and insensitivity to retraction (35c) are checked when their characteristic rankings are found, and the highest decisive ranking for Strong Retraction (SR) or Weak Retraction (WR) is noted (e.g., A>C stands for **Align-R** dominates ***Clash**).

Since a characteristic ranking of a phonological property is only a part of one whole ranking, it is possible that one ranking has several properties. For example, the ranking in (32-1) has properties of extrametricality and unsubjectivity to retraction, as well as a part of the properties of Weak Retraction. This does not mean that the same suffix can be both extrametrical and non-retracting, but that both of the types can arise from this single ranking. Note that stress retraction only takes place when the final syllable is heavy, because a light syllable is either extrametrical or the dependent of a foot. Conversely, a heavy syllable cannot be the dependent of a foot, and thus it cannot be non-extrametrical. In other words, it depends on the structure of the final syllable the suffix creates (after extrasyllabicity) which of the properties would take effect. For example, the word assigned the ranking in (32-1) is non-extrametrical when the final syllable is light, while it is non-retracting when it is heavy. In addition, the property of retraction type has no effect when the suffix is non-retracting; for example, the property of Weak Retraction is not realized in (32-1) because it has a non-retracting property.

In (37), I show which pattern will arise depending on the syllable structure in each ranking in (32), where EM stands for 'extrametrical' and R for 'retracting':

(37) possible rankings

	(35b)	(35c)	SR	WR	L	H(VV)	H(VC)
1	√	√		A>C	non-EM	non-R	non-R
2	√	√		A>C	non-EM	non-R	non-R
3	√	√		A>C	non-EM	non-R	non-R
4	√	√		A>C	non-EM	non-R	non-R
5	√	√		A>C	non-EM	non-R	non-R
6	√	√		A>C	non-EM	non-R	non-R
7	√	√		A>C	non-EM	non-R	non-R
8	√	√		A>C	non-EM	non-R	non-R
9	√	√		A>C	non-EM	non-R	non-R
10	√	√		A>C	non-EM	non-R	non-R
11	√	√		A>C	non-EM	non-R	non-R
12	√	√		A>C	non-EM	non-R	non-R
13		√		A>C	EM	non-R	EM/non-R
14		√		A>C	EM	non-R	EM/non-R
15		√		A>C	EM	non-R	EM/non-R
16		√		A>C	EM	non-R	EM/non-R
17		√		A>C	EM	non-R	EM/non-R
18		√		A>C	EM	non-R	EM/non-R
19				A>C	EM	WR	EM/WR
20				A>C	EM	WR	EM/WR
21			C>A		EM	SR	EM/SR
22			C>W		EM	SR	EM/SR
23				W>C	EM	WR	EM/WR
24				W>C	EM	WR	EM/WR
25		√	C>A		EM	non-R	EM/non-R
26		√	C>A		EM	non-R	EM/non-R
27			C>A		EM	SR	EM/SR
28			C>W		EM	SR	EM/SR
29		√	C>W		EM	non-R	EM/non-R
30			C>W		EM	SR	EM/SR
31		√		W>C	EM	non-R	EM/non-R
32		√		W>C	EM	non-R	EM/non-R
33				W>C	EM	WR	EM/WR

34				W>C	EM	WR	EM/WR
35		√		W>C	EM	non-R	EM/non-R
36				W>C	EM	WR	EM/WR
37	√			A>C	non-EM	WR	WR
38	√			A>C	non-EM	WR	WR
39	√			A>C	non-EM	WR	WR
40				A>C	EM	WR	WR
41				A>C	EM	WR	WR
42			C>A		EM	SR	SR
43			C>W		EM	SR	SR
44				W>C	EM	WR	WR
45				W>C	EM	WR	WR
46	√			W>C	non-EM	WR	WR
47				W>C	EM	WR	WR
48				W>C	EM	WR	WR
49	√	√		W>C	non-EM	non-R	non-R
50	√	√		W>C	non-EM	non-R	non-R
51	√	√		W>C	non-EM	non-R	non-R
52		√		W>C	EM	non-R	non-R
53		√		W>C	EM	non-R	non-R
54				W>C	EM	WR	WR
55				W>C	EM	WR	WR
56		√		W>C	EM	non-R	non-R
57				W>C	EM	WR	WR
58	√			W>C	non-EM	WR	WR
59				W>C	EM	WR	WR
60				W>C	EM	WR	WR

When the syllable is light, the pattern is simple: it is non-extrametrical if the column of (35b) is checked, whereas it is extrametrical if not. When the relevant syllable is heavy, on the other hand, the pattern is determined depending on its rhyme structure. Recall the difference in extrametricality between the rhymes VV(C) and VC(C), which we discussed above. In the case of a VV rhyme, which can never be extrametrical, the pattern will be non-retracting when the particular whole ranking has the characteristic partial ranking (i.e. the column of (35c) is checked), while the pattern will be retracting when the whole ranking does not have such a partial ranking, with the retraction type indicated in third or fourth columns. The case of a VC(C) rhyme is similar to that of a VV(C), except that it can be extrametrical when **EM** is ranked in a fairly high position. Since the omitted **WSP(VC)#** is usually ranked higher than all the constraints in (32) (recall (29b)), extrametrical ranking is only possible when **EM** is ranked highest among these five constraints; that is, in rankings 13 to 36 in (32). In (37), therefore, two possible patterns are shown in those rankings.

Each of the five patterns observed in English suffixes, then, can be analyzed as emerging from some of the rankings in (32):

(38)

	rankings in (32)
extrametrical	L: 13-36, 40-45, 47-48, 52-57, 59-60; H(VC):13-36
non-extrametrical	L: 1-12, 37-39, 46, 49-51, 58
non-retracting	H: 1-18, 25-26, 29, 31-32, 35, 49-53, 56
Strong Retraction	H: 21-22, 27-28, 30, 42-43
Weak Retraction	H: 19-20, 23-24, 33-34, 36-41, 44-48, 54-55, 57-60

Recall also that, as we have argued, no other patterns would arise because some interactions of relevant constraints do not produce any phonological consequences. Now we can answer the third question completely: all and only the five patterns emerge from interactions among the five constraints, each arising from particular rankings in (32) as shown in (38).

What is important here is that the pattern depends on the rhyme structure that the suffix creates. In fact, the rhyme structures of the suffixes of each pattern in (11) coincide with those predicted by the theory:

(39)

extrametrical	L: -ity, -io<n>, -(i)a<n>, -a<l>, -ou<s>, -i<ve>; H(VC): -an<t>
non-extrametrical	L: -i<c>, -i<d>
non-retracting	H(VV): -e<se>, -ee<r>; H(VC): -es<que>, -et<te>[11]
Strong Retraction	H(VV): -a<te>, -(i)fy, -i<ze>
Weak Retraction	H(VV): -oi<d>, -i<te>; H(VC): -ar<y>, -or<y>

The final consonant of the suffix undergoes extrasyllabicity (due to high-ranking of (20d)) and is excluded from the structure of the final syllable. All the suffixes of each type have one of the predicted syllable structures, as underlined in (39).[12]

3.5 Summary

Summarizing the discussion so far, the present analysis provides elegant answers to the questions raised at the beginning of this section. Assuming that the 'core' grammar of a language is only partially determined with respect to constraint ranking, it naturally follows that there are variaties among some word classes in English as well as in other languages. The various behaviors among English suffixes can be analyzed as arising from the partial rankings in (35), which appear in a particular whole ranking. Only the relevant patterns are predicted to arise, because other interactions of constraints do not produce any phonological effect.

The partial rankings for each pattern of stress assignment can be represented in the following 'grammar lattice':

[11] The final sequence of letters *tt* is regarded as underlyingly constituting a geminate.

[12] Although more thorough investigation is necessary, my pilot study suggests that –*as*<*t*> and -*is*<*m*> are the possible members of Strong Retraction type with H(VC).

(40) English grammar lattice for stress assignment

English
(20a-d) » (19) » (20e)
(29)
EM » *Clash

extrametrical	**non-extrametrical**	**retracting**	**non-retracting**
EM » Align-R	Align-R » EM	NonFin » Align-R	Align-R » NonFin

(retracting:)

Weak Retraction	**Strong Retraction**	**Weak Retraction**	**Strong Retraction**
NonFin » Align-R	NonFin » Align-R	NonFin » Align-R	NonFin » Align-R
WSP » *Clash	*Clash » WSP	Align-R » *Clash	*Clash » Align-R

Some of the rankings are fixed in all suffixed words in English, namely (i) those among unviolable constraints (20a-d) and violable ones (19), (20e); (ii) those among **WSP#**'s and **EM** (i.e. (29)); and (iii) the one between **EM** and ***Clash** (i.e. (31)). These fixed rankings are shown at the top of the diagram in (40) (and are omitted in subgrammars below that to spare space). The pattern of a suffix is first determined either by the ranking between **Align-R** and **EM** with respect to extrametricality or by the one between **Align-R** and **NonFin** with respect to subjectivity to retraction, depending on the weight of the final syllable. When it is a retracting suffix, its type (i.e. strong or weak) is further determined by the ranking either between ***Clash** and **NonFin** or between ***Clash** and **Align-R**.

4. Predictability and Actual Frequency

As we have seen, constraint rankings possible in a partial ordering analysis correctly predict the stress patterns actually observed. Looking at table (37), however, another issue arises; that is, whether it is possible to predict the actual frequency of each pattern by counting the rankings for each pattern.[13] Will the frequency coincide with the percentage predicted by the theory? Let us finally discuss this issue in this section.

The numbers of each pattern appearing in (37) are counted in (41). Take the non-extrametrical pattern with a final light syllable as an example, it can be derived in 20 rankings out of 60 possibilities, thus its percentage among all the possible patterns for this paticular syllable structure is 20/60 = 1/3 (i.e. 33.3%), as shown in the parenthesis. The numbers and percentages of all types with all syllable structure are similarly counted and calculated.

(41)

	EM	non-EM	non-R	SR	WR
L	40/60(66.7%)	20/60(33.3%)	n.a.	n.a.	n.a.
H(VV)	n.a.	n.a.	30/60(50.0%)	7/60(11.7%)	23/60(38.3%)
H(VC)	12/60(20.0%)	n.a.	24/60(40.0%)	4.5/60(7.5%)	19.5/60(32.5%)

[13] Anttila (1997) also investigates the frequency of two forms of Finnish genitive plural based on the same idea, and succeeds in making correct prediction.

As for the syllable structure H(VC), those rankings that have two possibilities are counted as half for each possiblity; that is, those numbered 13 to 36 in (37) are counted as 0.5 for 'EM' and 0.5 for either 'non-R', 'SR', or 'WR'.

Note that we do not have to make comparison of syllable structure within a stress type (i.e. within a column in (41)). This is because of the arbitrariness of a form: the syllable structure of a suffix is determined entirely arbitrarily, while stress is dependent on the shape of the suffix. I also do not take into account how many instances of words are found for a suffix: in other words, only the number of 'type' is considered, but not that of 'token'. This is because the number of token is heavily influenced by morphological conditions of the suffix such as 'productivity'. For example, suffixes like *-oid* and *-ite* have huge numbers of tokens, but their frequencies depend entirely on how much physicians and geologists find new materials.

In order to examine if the actual frequency of the stress pattern among suffixes correspond to the prediction in (41), I conducted a pilot study on relatively large number of suffixes which appear in Fudge (1984). This is a fairly comprehensive study on English suffixes and compound-forming elements (e.g. *-graph*) with regard to stress assignment, and I examined all the stress-shifting suffixes so that they can be classified into one of the five categories in (11). This re-examination was necessary because the classification of the suffixes by Fudge is different from mine and rather more complicated.[14]

In (42), the result of counting is shown in which homonymous suffixes are counted separately. This is because such suffixes sometimes show different behaviors depending on the part of speech; for example, while chemical-noun-forming *–ine* [i:n] is retracting (e.g. *glycerine*), usual-nominal *–ine* is non-retracting (e.g. *magazine*). As a pilot study, I sometimes did not find enough data to decide which category a suffix belongs to between SR and WR. In these cases, I counted 0.5 for each of two possible types.

(42) counting 1

	EM	non-EM	non-R	SR	WR	total
L	15 (71.4%)	3 (14.3%)	1 (4.8%)	1.5 (7.1%)	0.5 (2.4%)	21
H(VV)	n.a.	n.a.	16 (39.0%)	16.5 (40.2%)	8.5 (20.7%)	41
H(VC)	4 (26.7 %)	n.a.	7 (46.7 %)	1.5 (10.0%)	2.5 (16.7%)	15

Impressionally speaking, the result is not bad. Some of the cells show relatively close numbers to the prediction (e.g. extrametrical L (71.4% to 66.7%), extrametrical H(VC) (26.7% to 20.0%), non-retracting H(VC) (46.7% to 40.0%), and strongly retracted H(VC) (10.0% to 7.5%)), some are so-so (e.g. non-extrametrical L (14.3% to 33.3%), non-retracting H(VV) (39.0% to 50.0%), weakly-retracted H(VV) (20.7% to 38.3%), and weakly-retracted H(VC) (16.7% to 32.5%)), and only one of them is far more than the prediction (i.e. strongly-retracting H(VV) (40.2% to

[14] This is because Fudge categorizes the suffixes as to how far the primary stress is placed from the suffix, not from the right edge of the word, irrespective of the number of the syllable of the suffix and the presence of secondary stress on the suffix. Consequently, extrametrical suffixes (e.g. *-al*) and Weak Retraction suffixes (e.g. *-oid*) are both categorized as pre-stressed 2, i.e. placing primary stress on the second syllable preceding the suffix. Furthermore, his categorization is sometimes too descriptive. For example, *-ate* is categoried by Fudge as having a 'mixed' pattern of autostressed (i.e. non-retracting) and pre-stressed 2. It is possible, however, to analyze this suffix just as a Strong Retraction suffix since all the non-retracting examples are disyllabic (as Fudge himself notices) and can be analyzed as immune from retraction in order to avoid a degenerate foot (e.g. **(cré)(àte)*, cf. Zamma (1993)).

11.2%)). From (41) we expect for H(VV) more WR patterns than SR, but the result is to the reverse. We also find a few cases where L suffixes show non-retracting, Strong Retraction, and Weak Retraction patterns, which suggests that **Extrasyllabicity** can be violated in some marginal cases.

Since stress behaviors of some homonymous suffixes are almost the same, apart from minute differences such as subjectivity to vowel reduction (e.g. the vowel in adjective-forming *–ate* reduces as a result of retraction as in *private*, but not in verb-forming one as in *translate*), we might rather count these suffixes as one, not separately. In the following counting, homonymous suffixes are counted separetely only when they show different stress behaviors, as in the case of -*ine*.

(43) counting 2

	EM	non-EM	non-R	SR	WR	total
L	15 (71.4%)	3 (14.3%)	1 (4.8%)	1.5 (7.1%)	0.5 (2.4%)	21
H(VV)	n.a.	n.a.	16 (45.7%)	11.5 (32.9%)	7.5 (21.4%)	35
H(VC)	4 (26.7 %)	n.a.	7 (46.7 %)	1.5 (10.0%)	2.5 (16.7%)	15

For some reason, such homonymous suffixes all have H(VV) structure, and furthermore, most of them have the Strong Retraction pattern. Consequently this counting reduces the percentage of the most-problematic SR type with H(VV) from the one in (42), increasing at the same time those of non-retracting and WR types with H(VV). Still, the percentage of the SR type with H(VV) is far more than the prediction (32.9% to predicted 11.2%) and outweighs that of the WR type.

In sum, we can draw a tentative conclusion from this pilot study that the prediction made by the theory is correct to some extent. A more thorough investigation will alter the percentages of some cells -- deciding the type for some ambiguous cases -- but the overall proportion of each type will not change dramatically. Given that, although some stress types do not coincide perfectly, the general tendency of each pattern can be said to roughly reflect the theoretical prediction. If so, these distributional facts of each pattern provide strong support for the present analysis.

5. Conclusion

Various behaviors of English Class 1 suffixes are best analyzed within the framework of the partial ordering theory. Since it is assumed in this theory that only the 'core' of a grammar is fixed and some parts of the grammar are left unfixed in a language, it naturally follows that phonological behaviors differ from each other because of different constraint rankings depending on lexical groupings.

It is also important to note that only the variations observed in Section 2 are predicted to arise in the interaction among the proposed constraints. Unfixed rankings among several constraints may at a first glance seem undesirable when they produce too many possible rankings, but fortunately, some of the possible rankings do not produce any phonological effect at all. Thus in English, only five patterns arise from 60 possible rankings among five constraints.

Syllable structure of a suffix also plays an important role in deciding stress pattern. Because the rightmost heavy syllable is always stressed (especially when it contains a long vowel or a diphthong), suffixes with a heavy final (after extrasyllabicity) cannot be the dependent of a foot and thus can only exhibit one of retraction-concerned patterns (i.e. either non-retracting, Strong

Retraction, or Weak Retraction pattern). When the suffix ends with a light syllable, on the other hand, the pattern should be either extrametrical or non-extrametrical pattern. Crucially, actual distribution of suffixes conforms to this prediction as we saw in (39).

From the list of all the possible rankings, we are tempted to predict the proportion of each pattern depending on the syllable structure. My pilot study on a considerable number of suffixes suggests that the prediction made by the present analysis seems to correspond to the actual frequency to some degree. This fact serves as additional supporting evidence for the adequacy of the present study.

References

Allen, Margaret R. 1978 Morphological Investigations. Doctoral dissertation, University of Connecticut.

Anttila, Arto. 1997. Deriving variation from grammar: A study of Finnish genitives. In *Variation, change and phonological theory*, ed. Frans Hinkens, Roeland van Hout, and Leo Wetzels, 35-68. Amsterdam: John Benjamins.

Anttila, Arto. 2002. Morphologically conditioned phonological alternations. *Natural Language and Linguistic Theory* 20: 1-42.

Anttila, Arto and Young-mee Yu Cho. 1998. Variation and change in Optimality Theory. *Lingua* 104, 31-56.

Beckman, Jill. 1998. Positional faithfulness. Doctoral dissertation, University of Massachusetts, Amherst.

Benua, Laura. 1998. Transderivational identity: Phonological relations between words. Doctoral dissertation, University of Massachusetts, Amherst.

Burzio, Luigi. 1994. Principles of English Stress. Cambridge: Cambridge University Press.

Chomsky, Noam and Morris Halle. 1968. *Sound Pattern of English.* New York: Harper & Row.

Crowhurst, Megan and Lev Micheal. to appear. Iterative footing and prominence driven stress in Nanti (Kampa).

Fudge, Erik. 1984. English Word-Stress. London: George Allen & Unwin.

Halle, Morris and Jean-Roger Vergnaud. 1987. *An Essay on Stress*. Cambridge,Mass.: MIT Press.

Hammond, Micheal. 1999. The Phonology of English. Oxford: Oxford University Press.

Hayes, Bruce. 1980. A metrical theory of stress rules. Doctoral dissertation, MIT.

Hayes, Bruce. 1982. Extrametricality and English stress. *Linguistic Inquiry* 13:227-276.

Hayes, Bruce. 1995. Metrical stress theory: principles and case studies. Chicago: University of Chicago press.

Inkelas, Sharon. 1998. The theoretical status of morphologically conditioned phonology: a case study of dominance effects. In *Yearbook of morphology 1997*, ed. by Geert Booij and Jaap van Marle, 121-155. Dordrecht: Kluwer.

Itô, Junko and Armin Mester. 1995. The core-periphery structure of the lexicon and constraints on reranking. In *Papers in optimality theory*, ed. by Jill N. Beckman, Laura Walsh Dickey and Suzanne Urbanczyk, 181-209. UMass Occasional Papers 18. Amherst: University of Massachusetts, GLSA.

Kiparsky, Paul. 1982. Lexical phonology and morphology. In *Linguistics in themorning calm*, ed. by the Linguistic Society of Korea, 3-91. Seoul: Hanshin.

Liberman, Mark and Alan Prince. 1977. On stress and linguistic rhythm. *LinguisticInquiry* 8: 249-336.

Morén, Bruce. 2000. The puzzle of Kashmiri stress: implications for weight theory. *Phonology* 17: 365-396.

Orgun, Cemil Orphan. 1998. Cyclic and noncyclic phonological effects in a declarative grammar. In *Yearbook of Morphology 1997*, ed. by Geert Booij and Jaap van Marle, 179-218. Dordrecht: Kluwer.

Pater, Joe. 2000. Non-uniformity in English secondary stress: the role of ranked and lexically specific constraints. *Phonology* 17:2, 237-274.

Prince, Alan and Paul Smolensky. 1993. Optimality theory: Constraints interaction in generative

grammar. Ms., Rutgers University and University of Colorado.
Siegel, Dorothy. 1974. Topics in English phonology. Doctoral dissertation. MIT.
Wells, John. 2000. Longman Pronunciation Dictionary. London: Longman.
Zamma, Hideki. 1993. Stress retraction in English. *Tsukuba English Studies* 12, 21-41. University of Tsukuba.
Zamma, Hideki. 2002. Suffixes and Stress/Accent Assignment in English and Japanese: More Than a Simple Dichotomy, in *Online Proceedings of LP2002*. [available at http://www.adn.nu/~ad31175/lp2002/lp2002main.htm]

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