A Phonetically Based Account of English Reduplication

Miyeon Ahn
(Seoul National University)

Ahn, Miyeon. 2005. A Phonetically Based Account of English Reduplication. *SNU Working Papers in English Language and Linguistics* 4, 73-93. The purpose of paper is to explore English reduplication within the framework of Optimality Theory (OT, Prince and Smolensky 1993). It is claimed in this paper that perception plays a role in motivating constraints and the perceptually motivated constraints account for the phonological process, reduplication. Focusing on English reduplication, this paper investigates how perception operates to motivate reduplication-related constraints. In doing so, constraints of MAXIMIZE OBSTRUENCY and MAXIMIZE DISTANCE, which result in perceptual distinctiveness, are proposed. Perceptually based theoretical accounts advanced in this paper are supported by statistical data analysis. And this paper claims that English reduplication operates to maintain the perceptual salience maximally. Finally, this paper demonstrates with the concrete data set of English that reduplication is a process to enhance perceptual distinctiveness maximally and that the perception-based constraints are necessary and valid in OT. **(Seoul National University)**

Keywords: Optimality Theory, reduplication, perception, constraints, perceptual distinctiveness, phonological contrasts

1. Introduction

There have been several attempts to account for the widespread range of phonological phenomena with phonetically-driven theories. In these phonetically-driven accounts, the most dominant concept is *perception*. Perception is said to be "the process of receiving and decoding speech input" (Crystal 1997). It suggests that segments preferentially occur "where they can be best heard" (Hayes 1997) and where they can be best produced. In other words, there are perceived or produced segments which can be best realized when they avoid any possibilities of confusion.

It is postulated that a speaker partially understands "the physical

conditions under which speech is produced and perceived" (Hayes et al. 2004). The postulation is known as 'phonetic knowledge' (Kingston and Diehl 1994). I hypothesize that phonological constraints are based on this phonetic knowledge. Some of the knowledge actually is developed into constraints. The attempts to apply the phonetically based constraints to explain phonological processes can be called phonetically-driven accounts.

Wright (2004) explains that several phonological processes can be motivated by phonetic factors, such as perceptual cues and ease. Following his explanation, I claim that perceptually motivated constraints can play an important role in explaining phonological phenomena. I claim that perceptual factors not only define the type of reduplication but also identify the format of reduplicants. Proposing two perceptually based constraints, I claim that reduplicants have a strong tendency to maximize perceptual distinctiveness.

2. Preliminaries

2.1 Discussion of reduplication

OT was developed into *Correspondence Theory* by McCarthy and Prince (1995). The development of the theory enabled us to explain reduplication in a simpler way. The output forms of reduplication are called reduplicative words.[1] They have two parts: a base and a reduplicant, a total or partial copy of the base. The definitions given by McCarthy and Prince (1995) are as follows:

(1) Definitions of reduplicant and base

The 'reduplicant' is the string of segments that is the phonological realization of some reduplicative morpheme RED(uplicant). The 'base' is the output string of segments to which the reduplicant is attached.

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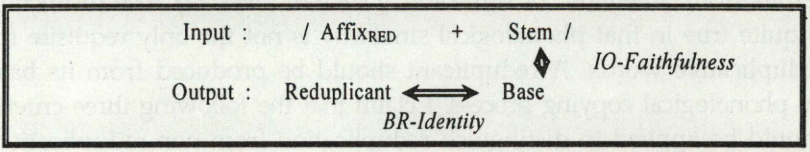
1) The choice of the nomenclature among similar terms is necessary. The usage of the term to refer to reduplicative words was not clearly defined. According to Minkova (2002), while 'reduplicative compounds' was used by Jespersen (1942), 'pseudo-compounds' was used by Marchand (1969). I will use the term 'reduplicative words', or 'reduplicatives' for short in line with Minkova (2002) since it is more widely used.

According to Correspondence Theory, the input of reduplication, a lexical representation, is a combination of *RED and stem* and the output, a surface representation, consists of *reduplicant and base*. The base of the output is faithful to the stem of the input, and this relationship is captured by I(nput)-O(utput) Faithfulness. The concept of identity between base and reduplicant is needed, which is called B(ase)-R(eduplicant) Identity. What McCarthy and Prince call the "*Basic Model*" is depicted in (2).

(2) Basic Model



This model tells us that reduplication is caused by three constraints: IO-faithfulness constraints, BR-identity constraints and markedness constraints. McCarthy and Prince (1995) define correspondence as paraphrased in (3):

(3) Correspondence

Given two strings S_1 and S_2, related to one another as input-output, base-reduplicant, etc., *correspondence* is a relation $\mathcal{R}$ from the elements of S_1 to those of S_2. Elements $\alpha \in S_1$ and $\beta \in S_2$ are referred to as *correspondents* of one another when $\alpha \ \mathcal{R} \ \beta$.

Following the above definition, correspondence can be defined as a relation between elements in two strings: S_1, and S_2. Therefore, it can be said that both relationships, I-O and B-R, come under correspondence.

Reduplication is obtained by repeating the base *in total* or *in part*. As one can guess from the name, *total reduplication* refers to an identical copy of the string of components in whole, while *partial reduplication* requires only a part of the string.[2] Note that whether the process is

2) While the use of the term partial reduplication has currency among linguists, that of total reduplication varies among full and total (Yip 1998, 2000, Kager 1999), complete (Schiering 2004) and copy (Minkova 2002). Although what the words intend is almost the same, to avoid confusion and to maintain coherence, the terms of total and partial reduplication will be used.

partial or total, both are included in reduplication.

2.2 Definition of reduplication

There are items which seem to be reduplicative words but actually are not. I will filter out the pseudo-reduplicative words by suggesting three criteria, confining the scope of this study to a set of words.

There have been some attempts to define reduplicative words. The main point is to distinguish "accidental similarity" from similarity that results from "intention" of some sort (Dienhart 1999: 11). The distinction is quite true in that phonological similarity is not the only requisite for reduplicative words. A reduplicant should be produced from its base by phonological copying process. I claim that the following three criteria should be applied to distinguish reduplication from non-reduplication.

The first plausible criterion is given by Minkova (2002). In her analysis, Minkova argues that Syntactic Compounds (SCs) in which one part clearly modifies the other must be excluded. Items such as *toy boy* and *six socks* are excluded by this criterion. For example, both *hurly-burly* and *six socks* show differences in the onsets of each component. However, while *six* is the syntactic modifier of *socks* in *six socks*, *hurly* is not in *hurly-burly*. So, *hurly-burly* is a reduplicative word but *six socks* is not. Therefore, it can be said that *hurly-burly* is a legitimate candidate of reduplication but *six socks* is not.

The second and third criteria are devised by Dienhart (1999). They are *The Single Phone Condition* (SPC) and *The Affix Condition* (AC) respectively. The conditions are defined as follows:

(4) a. Single Phone Condition (SPC) :

This condition denies membership to monomorphemic constructions of the form CVCV, where the "Reduplication" involves only a single phone. The repeated phone can be either C or V.

b. Affix Condition (AC) :

This condition denies membership to any polymorphemic construction consisting of an affix and a root, where the form of the affix is not conditioned by the phonological makeup of the root.

(Dienhart 1999: 12)

SPC is based on the generalization that "the longer the base, the less likely it is that the phonological similarity between the base and the reduplicant is accidental" (Dienhart 1999: 11). So the words where the base is monosyllabic are excluded in most cases. Unlike Dienhart, clipped words, accidentally sharing the same vowels such as *sci-fi*, are filtered out by this criterion. *Sci-fi* is not a reduplicative since *fi* is not copied from *sci*. Reduplicants of reduplicatives are modified from their bases.

AC is concerned with words like *dismiss, undone* and *lowly*. Their affixes are just "phonologically similar to their roots" and those are not reduplicative words. These affixed words should be excluded by AC. In short, it can be said that both SPC and AC filter out unintentionally similar sequences.

According to these three criteria pseudo-reduplicative words, where there is no phonological relation between the base and its reduplicant in a linguistic sense, should be excluded from a data set.

2.3 Classification of reduplication

According to Minkova (2002) analysis, there are three types of productive reduplication in English. She classifies reduplicative words into three types following Jespersen (1942, 1965: 174) and Dienhart (1999).

(5) Three types of reduplication in English

Type 1 : Total reduplication	(*tut-tut*)
Type 2 : Rhyme reduplication	(*hocus-pocus*)
Type 3 : Ablaut reduplication	(*riff-raff*)

The three types are classified by their forms. This classification is distinguished from that of Park in that total reduplication is added and reduplicatives are grouped by their forms. While perfect identity is required in type 1, either consonants or vowels can be altered in type 2 and 3. Unlike Park's analysis, *hocus-pocus* and *higgledy-piggledy* can be congregated in a single group as type 2, and *fiddle-faddle* is distinguished from *hocus-pocus* as type 3. Since the changes of both consonants and vowels are addressed, the classification seems well organized.

A reduplicant is a complete copy of its base in type 1. Totally

reduplicated words are often seen in imitative words. They include onomatopoeia such as animal noise and sounds made by instruments. For instance, *baa-baa*, the cry of a sheep or lamb or *chip-chip*, the sound of an ax, are such imitative words. It can be said that similarity triggering constraints are activated in this type of reduplication.

Minkova (2002) mentions that, historically, rhyme reduplication was produced after total reduplication. As the name says, only the nucleus and coda of a base (sometimes including the following syllables) are copied. About ablaut reduplication, Minkova tenably suggests that it appears long after total and rhyme reduplication.[3] Only the onset is copied in ablaut reduplication and this type of reduplication has the lowest productivity out of the three.

2.4 Main points at issue

I previously stated that the main point of this paper is the perceptual account of reduplication. We can raise two questions about perceptual accounts. First, can reduplication be accounted for by perceptual factors? Second, what does the perceptual account of reduplication look like, if that is possible to determine? Throughout the paper, I address each of the questions, introducing related constraints and offering data analysis to support my claims. Given that all those perceptually motivated constraints correctly operate to produce optimal outputs, one can conclude that the perceptual account of reduplication is possible.

Speakers have a specific modification based on two factors when they produce reduplicative patterns.[4] Unlike assimilation, the first factor is keeping proper similarity. Perfect similarity is required only in total reduplication, while non-identity of base and reduplicant is the key to partial reduplication. This factor leads us to the idea that not only similarity triggering constraints but also similarity avoidance triggering

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3) Minkova applies the term 'ablaut' to reduplication which changes its vowel in the process. The ablaut here must be distinguished from Old English verbs' vowel shift. Usage of the term, ablaut, is somehow modeled on Indo-European ablaut, which simply replaces the vowel of a base. The term ablaut is used to indicate a type of reduplication in this paper.

4) Steriade (2001) suggests the factors based on place assimilation. The two factors are "perceived similarity to the original form and optimized articulation".

constraints are required. The second factor is that the output should be optimized. What Steriade calls 'phonotactic improvement' means in reduplication that a reduplicant should be better than its base in perception, in markedness, and in structure. Syllable structure healing of the process or unmarked structure production after the process can be seen as phonotactic improvements.

Consequently, two assumptions can be made: first, speakers produce reduplication controlling the balance of identity and non-identity. Second, what the speakers produce are structures that have improved on their originals. It follows that the balance of identity and non-identity evaluates "the distance in perceptual space" (Steriade 2001: 18) between base and its reduplicant. Thus, it can be said that a perceptually based analysis of reduplication requires the two assumptions.

Yip (1995) has mentioned that reduplicative words result from "a tension between two constraints, one requiring repetition (reduplication) and one banning repetition (identity-avoidance)".[5] The central theme of this paper is to figure out the similarity triggering constraints and similarity avoidance constraints, and their tension. Of course, the constraints are based on perception. In the next chapter, I will suggest theoretic accounts of reduplication. The analysis of reduplicative patterns in English will offer evidence for functionally motivated constraints.

3. Perceptually based theoretic account

English partial reduplication undergoes the segmental change either of consonants or of vowels. It might be alleged that the segmental change is lexically encoded. Lexically encoded changes mean that every single word undergoes a different and individual reduplication process. The changes displays a lack of generalization and so no principles can be found. However, a close observation of reduplicatives nullifies the allegation.

The distribution of reduplicant consonants does not allow every consonantal segment. Instead, it is roughly restricted to a set of consonants. The distribution of reduplicant vowels is even more severely restricted. The number of vowels permitted in a reduplicant position

5) Yip calls the constructions such as reduplicative words as echo words in her analysis.

is seldom more than one. The fact that the segmental distribution of a reduplicant is restricted to a fixed set implies that phonological generalization exists. The phonological generalization will lead a few of noticeable English reduplication tendencies.

To prove the validity of the generalization, I collate English reduplicatives data. I argue that the choice of a segment out of a fixed set operates to balance similarity and similarity avoidance. The similarity between bases and reduplicants are required since reduplicants are copied form from their bases. At the same time, the phonological contrasts between bases and reduplicants should be maximized. I argue that the contrasts are shown maximally either by increasing obstruency of consonantal segments or by expanding the distance of vowel segments between bases and reduplicants. I will suggest a constraints ranking hierarchy that deals with the phonological contrasts in detail. The hierarchy will be verified with concrete data analysis.

3.1 Rhyme reduplication

3.1.1 Patterns of rhyme reduplication

In rhyme reduplication, GROUP 1, the rhyme is repeated while the onsets of two components are not alike. Note that examples of rhyme reduplication are subdivided into (6a) and (6b).

(6) GROUP 1 (G1)

: a. *abba dabba, airy-fairy, ambler gambler, anglo-banglo, argey-bargey, argle-bargle, eensy-weensy, even-steven icky-wicky, itsy-bitsy, okey-dokey, ooey-gooey, ooly-drooly,* etc.

b. *beddie-weddie, big-wig, Billie Sallie, Bizzy-lizzy, boogie-woogie, bowwow, boz-woz, brain drain, bunnie wunnie, mucluc, mumbo-jumbo, musty-fusty, nasty-wasty, wobbly-pobbly, woodoo, yock dock,* etc.

G1 shows a pattern of $C_iV_1(C_2)(V)(C)$-$C_jV_1(C_2)(V)(C)$. The number of base-syllables varies among words. It should be noted that the total number of syllables of a base and its reduplicant is always same, which is an important point for English reduplication. The first consonant of C_i is possibly nullified and C_j is encoded following a tendency discussed

below.

Focusing on the concept of obstruency, it is observed that the initial segments of bases may be either stops or non-stops. Stop sounds are known as the most obstruent ones, while non-stops are less obstruent. I argue that the initial consonantal segments of bases experience the two following changes: i) initial stop sounds become non-stops; ii) initial non-stop sounds become stops. The alternation of consonants results from the obstruent degree. A obstruent segment, a stop sound, can show maximal phonological contrasts to a non-obstruent segment. In other words, to be altered to the counter set is the way to maximize contrasts for stop sounds. Therefore, it should be noted that initial stop sounds seldom alter the other stop sounds. Similarity can be avoided by the alternation.

3.1.2 Rhyme reduplication constraints

In English partial reduplication, the difference of segments occurs in the first syllable only. The first syllables of base and its reduplicant are never identical in rhyme and ablaut reduplication. On the other hand, the segments of second and third syllables are never altered. This property of English reduplication results in the following constraint.

(7) *REPEAT (σ[_) : The first syllables have either different onsets or different rhymes.

The constraint in (7) plays a role in distinguishing partial reduplicants from total reduplicants. In English, a reduplicative word is never formed by the repetition of the final syllable such as **humpty-humpdy* or **humty-humta*. So, everytime the first syllable is identical, it will produce totally identical sets. Therefore, it can be said that the constraint of *REPEAT (σ[_) excludes the totally copied reduplicant.

Yip (2000) argues that reduplication is forced by constraints that require repetition. The constraints were ECHO and REPEAT in Yip (1993) and they are replaced by the following two constraints:

(8) ALLITERATE and RHYME

a. ALLITERATE : Output must contain at least one pair of adjacent syllables with identical onsets.

b. RHYME : Output must contain at least one pair of adjacent syllables with identical rhymes.
(Yip 2000: 8)

The two constraints fit well to analyze Chinese data (Yip 2000) when total reduplicative constructions are not more than two syllables (ex. *hip-hop*) or when only the first syllable is copied and suffixed (ex. *ka-kata*) in the other languages. However, more than two syllables are frequently seen (ex. *okey-dokey*) in English and total syllable numbers of base and its reduplicant are always the same in English reduplication.

Since no part of base is deleted or suffixed in English reduplicants as in *ka-kata*, we can say that English reduplication is produced through the use of a consonant or a vowel change after a totally copied process. According to this property of English reduplication, ALLITERATE can be applied to data such as *riff-raff* but not *pincum-pancum* since the consonant of the adjacent syllables are not identical. Likewise, Yip's RHYME excludes *okey-dokey* since the condition "one pair of adjacent syllables with identical rhymes" is not satisfied. Therefore, the elaboration of the constraints is necessary for English data analysis. Keeping the property of English data in mind, we can revise them such as the following:

(9) ALLITERATE and RHYME (revised)
a. ALLITERATE : Output must contain corresponding syllables with identical onsets.
b. RHYME : Output must contain corresponding syllables with identical rhymes.

The revised constraints are different from those of Yip in that they control more than a specific consonant or vowel; they require the remaining part of the syllable to be totally identical. Tightly elaborated constraints, such as above, evaluate *pincum-pancum* and *okey-dokey* correctly.

There is a tendency related to GROUP 1, which is concerned with the universal segment hierarchy.[6] Rhyme reduplication is related to consonantal markedness hierarchy. The markedness of a segment

6) There are tendencies concerned with syllable inventory. In this paper, I deal with segment-sensitive tendencies only.

requires two dimensions to be considered. One is manner and the other is place. I claim that rhyme reduplication is related to place markedness (PM), which is Consonant Place Hierarchy. The Consonant Place Hierarchy is shown in (10).

(10) Consonant Place Hierarchy

coronal	labial, dorsal
unmarked ←	→ marked

It is commonly held that both labial and dorsal sounds are more marked than coronal sounds in English.[7] According to the markedness shown above, markedness constraints are suggested. The PM constraints and their hierarchy can be formalized as follows:

(11) PM constraints

a. *[DORSAL]P : Consonants cannot be dorsals.
*[CORONAL]P : Consonants cannot be coronals.
*[LABIAL]P : Consonants cannot be labials.

b. *[LABIAL]P, *[DORSAL]P » *[CORONAL]P

I argue that a morphological unit such as reduplicant is formed for increasing obstruency in rhyme reduplication, which is caused by phonological contrasts. Less obstruent sounds of a base are modified to more obstruent ones by this morphological operation. This tendency is translated into the following constraint.

(12) MAXIMIZE OBSTRUENCY : Obstruency is maximally increased in reduplication.

The above constraint says perceptual distinctiveness is required in

7) According to Hume's (2003), the markedness ranking of place in articulation is still controversial. Even though she argues that there are some reasons for labial sounds to be unmarked, most phonologists assume that coronal sounds are unmarked. I take most phonologists' assumption in this paper. See Kean (1992), Prince and Smolensky (1993) and Hume (1996) for evidence of coronal unmarkedness, Trigo (1988) for dorsal unmarkedness and Rice (1996) for both coronal and dorsal unmarkedness. See Lombardi (1991) for laryngeal unmarkedness.

reduplication by the way of phonological contrasts. The degree of obstruency is compatible with the manner of each sound. It is highest in obstruents such as stops or fricatives while it is low in sonorants such as nasals or approximants. So, a sonorant-obstruent set shows more contrast than a sonorant-sonorant or obstruent-obstruent set.

A tableau can be formulated by the above constraints as in (13).

(13) *REPEAT(σ[_) » RHYME » PM, MAXIMIZE OBSTRUENCY » ALLITERATE

	*REPEAT(σ[_)	RHYME	PM	MAXIMIZE OBSTRUENCY	ALLITERATE
☞ i. fuddy duddy			*		*
ii. fuddy nuddy			*	* !	*
iii. fuddy puddy			* ! *		*
iii. fuddy fuddy	* !		**	*	
iv. fuddy faddy		* !	**	*	
v. fuddy daddy		* !	*		*

The PM constraint incurs violations whenever the place of reduplicants is more marked than that of bases. In the above tableau, /f/, labial, is more marked than /d/, coronal in (21i). /n/ in (21ii) is also a coronal sound such as /d/, but it fails to be the optimal output since it is less obstruent than /d/.

Significantly, two points can be inferred from the tableau above. First, PM should be taken seriously and so markedness plays a role in reduplicative words. Secondly, the constraint of MAXIMIZE OBSTRUENCY, which traces phonetic classification of speech sounds, evaluates stop sounds as the most preferable ones for non-stop sounds. It implies phonetically based constraints are requisite for determining optimal output in reduplication.

3.2 Ablaut reduplication

3.2.1 Pattern of ablaut reduplication

In ablaut reduplication, two initial onset consonants of base and reduplicant are the same while rhymes, especially vowels, are different from each other. The number of syllables can vary among reduplicatives. However, they share one similarity that only the first syllables are altered and the second and third syllables are totally identical. Ablaut reduplication is categorized as GROUP 2.

(14) GROUP 2 (G2)

: *A-tisket a-tasket, bibble-babble, bing-bang, blibber-blubber, hippety-hoppety, hoo-ha, jibber jabber, jig-jog, jiggety-joggety, widdle-waddle, widdy-waddy, wiggle-waggle, wingwang, zig-zag, etc.*

Examples of G2 show the pattern of $C_1V_i(C_2)(V)(C)$-$C_1V_j(C_2)(V)(C)$. According to Minkova (2002), vowels in English reduplication have two properties: i) vowels in the reduplicative word are identical in quantity and so long-short or short-long pairs are not taken; ii) in most cases, vowels in the items create a pair comprising a high front vowel and a non-high vowel as its counterpart. Therefore, it can be said that ablaut reduplication shows [+high][-high] sequence.[8)]

3.2.2 Ablaut reduplication constraints

In Minkova's (2002) analysis, a base's invariable vowel is a high front vowel in G2 and this is caused by the unmarkedness of [ɪ]. However, the markedness of a vowel must be defined in a new way. The hierarchy shown in (10) is not problematic but the hierarchy cannot be the only factor in the selection of [+high] vowels in the base.

I claim that manner markedness (MM) must be considered in the analysis of reduplication. MM is the realization of markedness in G2. Before I discuss MM in more detail, I shall briefly explain a universal hierarchy, the value of which is given in the following sonority scale.

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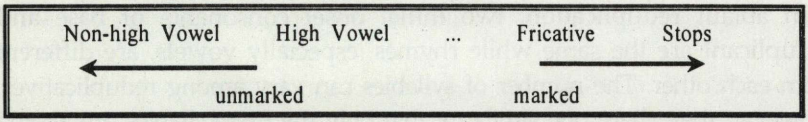
8) While Minkova separates the pairs to [ɪ-æ] and [ɪ-ɒ] as subgroups, the classification is beyond the scope of the current analysis. I take the binary feature [±high] for this paper.

See (15).

(15) Sonority Hierarchy (SH)



In this hierarchy, the most sonorous elements are assigned the highest value, and the least sonorous the lowest value (Crystal, 1997: 354). The SH matches well with MM. From the aspect of MM, non-high vowels are less marked than high vowels, and therefore a [+high][-high] sequence in ablaut reduplication conforms to the normal markedness hierarchy. The reason the high front vowel is frequent in the base can be explained in this way. More specifically, MM constraints enable us to explain examples such as *wooh-wah, crush-crash, flum-flam, flush-falsh, muxter-maxter, shuck-shack, trush-trash,* which Minkova had put aside as counter examples.

The MM can raise the following constraints:

(16) MM constraints

a. *[NONHIGH]$_M$: Vowels cannot be non-high.
*[HIGH]$_M$: Vowels cannot be high.
*[APPRO]$_M$: Vowels cannot be approximants.
*[LIQUID]$_M$: Vowels cannot be liquids.
*[FRICATIVE]$_M$: Vowels cannot be fricatives.
*[STOP]$_M$: Vowels cannot be stops.

b. *[STOP]$_M$ » *[FRICATIVE]$_M$ » *[LIQUID]$_M$ » *[APPRO]$_M$ » *[HIGH]$_M$ » *[NONHIGH]$_M$

In Flemming's (1995, 2004) analysis, the constraint MAXIMIZE CONTRAST is suggested to explain the preference. However, the constraint is modified as shown below to explain the vowel contrasts in reduplication. The constraint that reflects preference of perceptually maximized distinctiveness can be (17).

(17) MAXIMIZE DISTANCE : Vowels of a base and its reduplicant are maximally distant.

Since the first segment of a base is invariantly [+high] vowel, the segment of a reduplicant that shows contrasts is [-high] vowel. Even though mid vowels and low vowels share [-high] feature, low vowels are preferred to mid ones because they are maximally distant from [+high] vowels. This constraint is concerned with phonological contrasts. I suggest that the difference of vowel height between a base and its reduplicant show perceptual distinctiveness. Both sets of constraints of PM and MM, and MAXIMIZE OBSTRUENCY and MAXIMIZE DISTANCE are lexically specific constraints. Constraints which have nothing to do with the given lexicon are vacuously satisfied. It can be said that PM and MAXIMIZE OBSTRUENCY are turned "off" while the rest of the constraints are "on" in (18).[9]

Let us analysis a reduplicative word, *riff-raff*, with the above constraints. The tableau of ranked constraints would be as follows:

(18) *REPEAT(σ[_) » ALLITERATE » PM, MAXIMIZE OBSTRUENCY, MM, MAXIMIZE DISTANCE » RHYME

9) Itô and Mester (1999) suggest that only FCs "differ in the way the constraints are ranked". On the other hand, not only faithfulness constraints but also MCs can be ranked differently from the general one in Pater (2000). Following Pater, I assume that the two sets of MCs can be specified by the lexical items.

	*REPEAT (σ[ )	ALLITERATE	PM	MAXIMIZE OBSTRUENCY	MM	MAXIMIZE DISTANCE	RHYME
☞ i. riff raff [+high][-high]					*		*
ii. riff roff [+high][-high]					*	* !	*
iii. riff ruff [+high][+high]					* ! *		*
iv. riff riff [+high][+high]	* !				**		
v. riff tiff [+high][+high]		* !			**		
vi. riff taff [+high][-high]		* !			*		*

What should be noted here is this: Minkova (2002) suggests that a perceptually motivated constraint such as MAXIMIZE DISTANCE "outranks any featural identity violations that might be incurred in the reduplication". However, her suggestion is not warranted at all times. An identity triggering constraint such as RHYME is outranked by the perceptually motivated constraints but the constraint such as ALLITERATE cannot outrank them.

MAXIMIZE DISTANCE is based on Dispersion Theory (Flemming 1995, 2004). The need to avoid confusion by keeping maximized distance is suggested by phonetically driven theory. Maintaining maximal perceptual distance with structural identity, MAXIMIZE DISTANCE constraint manifests perceptual accounts of reduplication.

4. Data analysis

4.1 Vowel-sensitive tendency

The vowel-sensitive tendency is shown in ablaut reduplication. I have mentioned that the vowels of reduplicants are realized to keep maximal distance from their bases. Since most of the vowels in bases have

invariantly [+high] feature, reduplicant vowels should have a [-high] feature to be maximally distant. Three sets of vowels are found in reduplicative words.

(19) Table 1. Vowels

	[ɪ(u)-æ/ɑ]	[ɪ-ɔ/o]	[u-ɪ]	TOTAL
RAW data number	115	44	10	169
(PERCENTAGE %)	(68.0%)	(26.0%)	(5.9%)	(100%)

Maximal distance is acquired by the choice of low vowels such as [æ] or [ɑ]. It can be said that approximately two thirds of the data support the constraint of MAXIMIZE DISTANCE; even though mid vowels such as [ɔ] or [o] show distance, the choice is just 26%. This fact implies maximal distance is preferred.

The above data analysis strengthens the idea that perceptually maximal distance is derived after reduplication. As well, it supports the constraints of MAXIMIZE DISTANCE and MM, which are phonetically motivated ones. In conclusion, it draws the idea that reduplication can be accounted for by functionally motivated constraints based on perception.

4.2 Consonant-sensitive tendency

Consonants of reduplication behave differently whether they are stops or non-stops. Bases starting with non-stops satisfy MAXIMIZE OBSTRUENCY when their reduplicants start with stops. On the other hand, bases starting with stops show us a slightly digressing result. Let us begin the analysis with non-stops.

(20) Table 2. Non-Stops

RAW data number	CORONAL		NON-CORONAL		TOTAL 174
	85 (48.8%)		89 (51.1%)		
(PERCENTAGE %)	STOP	NONSTOP	STOP	NONSTOP	(100%)

	62 (35.6%)	23 (13.2%)	61 (35.0%)	28 (16.0%)
	STOP		NON-STOP	
	123 (70.6%)		51 (29.3%)	

Bases starting with non-stops correctly prove the theoretical analysis in the previous chapter. In the case of non-stop consonants in bases, half of the consonants become coronals and the other half become non-coronals. However, about 70% of reduplicant consonants tend to be stops after the reduplication process. The fact that two thirds of consonants become obstruents, especially stops, reveals that reduplication is processed to satisfy MAXIMIZE OBSTRUENCY.

On the other hand, bases starting with stops go against the prediction that consonants of reduplicants all flow into obstruents. It means that stops are not always chosen in the reduplicant. See the below table.

(21) Table 3. Stops

	CORONAL		NON-CORONAL		TOTAL
RAW data number	10 (15.6%)		54 (84.3%)		
	STOP	NONSTOP	STOP	NONSTOP	
(PERCENTAGE %)	4 (6.2%)	6 (9.3%)	7 (10.9%)	47 (73.4%)	64 (100%)
	STOP		NON-STOP		
	11 (17.1%)		**53 (82.8%)**		

Bases starting with stops already have high obstruency. So, those bases cannot show maximal contrasts if the consonants of reduplicants are still obstruent sounds. Instead, the contrasts can be maximally shown only if the reduplicants start with non-obstruent sounds, *i.e.* sonorants. Around 80% of the data are altered to non-stops. It is interesting that most of non-stops are non-coronals.

Notice that most of consonants of reduplicants are non-coronals and non-stops. Stops show maximal contrasts with sonorants and, in particular, the contrasts will be the most effectively realized with glides

such as [w] and [y]. As a matter of fact, 36 items out of 47 were [w]-initial reduplicants. The change from stops to glides can show maximal contrasts.

So far, I have shown the statistical analysis of collected data. The theoretical accounts are suggested by the interaction of constraints, which are perceptually motivated. It can be said that the data prove the predicted tendencies of reduplication to be true. In sum, I conclude that reduplication is possibly accounted for by phonetic factors.

5. Conclusion

In this paper, I attempt to explain English reduplication patterns with phonetically driven constraints within the framework of OT. I assume that reduplication is produced by the tension between identity and non-identity, following Yip (1995).

Rhyme reduplication is processed to bear unmarked structure by place markedness of segments. On the other hand, ablaut reduplication is produced by manner markedness where the reduplicant is less marked than the base. In addition to the markedness related constraints, I suggest two perceptually motivated constraints. The constraints MAXIMIZE OBSTRUENCY and MAXIMIZE DISTANCE, both perceptually based, evaluate outputs where consonants or vowels of reduplicants are maximally distant from those of bases.

Based on the constraint ranking, chapter 3 deals with data analysis. Stops which are more obstruent than other segments are shown to be dominant in rhyme reduplication. Coronal sounds are the most desirable of the obstruents by the force of PM. MM constraint in ablaut reduplication forces output to become a [+high][-high] sequence. The constraint of MAXIMIZE DISTANCE operates fully to exclude mid vowels, resulting in [ɪ-æ] or [ɪ-ɑ] pattern that reveals maximal distance.

This paper, nevertheless, has proved that consonants or vowels of English reduplicative constructions have a tendency to be obstruents and to keep maximal distance and this is shown with statistic data analysis. Both rhyme and ablaut reduplication maximize perceptual distinctiveness, which results from the interaction of phonetically motivated constraints. This paper offers a contribution to support phonetically based accounts of the phonological process.

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Miyeon Ahn
myahn1@snu.ac.kr