

Internal Reduplication in Māori: Harmonic Serialism vs. Parallel OT*

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Abstract

Harlow (1991) によってマオリ語の畳語形成 (reduplication) は記述・一般化され、複数の畳語パターンが存在することが明らかにされた。その後 Meyerhoff and Reynolds (1996) によって最適性理論に基づいた理論分析が行われたが、Harlow (1991) でパターン2と呼ばれていた畳語パターンに関しては、他のパターンに比べ例が少ないという理由で理論分析が見送られていた。本研究ではこのパターン2に対して、GEN と EVAL に関する想定が異なる2つの最適性理論の枠組み(並列型最適性理論 (Parallel Optimality Theory) と調和的直列理論 (Harmonic Serialism)) による理論分析を試みる。その際に調和的直列理論はこの畳語パターンを正しく予測できるが、並列型最適性理論では捉えられないことを明らかにする。この予測の差は GEN に関する両者の想定の違いに起因する。本研究の意義は、マオリ語の畳語形成が並列型の最適性理論よりも調和的直列理論の方が優れている証拠になることを明らかにした点にある。

Key Words: reduplication, Harmonic Serialism, Parallel OT

1. Introduction

Reduplication is a morphological process in which the form of an affix copies in whole or in part phonological characteristics of the root. Roughly speaking, this morphological process can be divided into two types: total reduplication and partial reduplication. The former process copies a root totally, whereas the latter process copies a root partially. For instance, the former type is observed in English and Japanese, and the latter is observed in Agta and Samoan:

(1) Reduplicative pattern

a. Total reduplication

English: *bye* → *bye-bye* *night* → *night-night*

Japanese: *ie* ‘house’ → *ie-ie* ‘houses’ *yama* ‘mountain’ → *yama-yama* ‘mountains’

b. Partial reduplication

Agta: *takki* ‘leg’ → *tak-takki* ‘legs’ *pusa* ‘cat’ → *pus-pusa* ‘cats’

Samoa: *alofa* ‘she loves’ → *a-lo-lofa* ‘they love’ *tamaloa* ‘man’ → *tama-lo-loa* ‘men’

This morphological strategy is widely adopted in Malayo-Polynesian languages to form plurals and to emphasize the meaning of the root. Māori, belonging to Malayo-Polynesian languages, also has this strategy for derivation and inflection (Biggs 1961: 28-29, Harlow 1991, Bauer 1993: 525-528, Meyerhoff and Reynolds 1996, Keegan 2005 and Harlow 2007: 127-128). Māori has both the two types of reduplication:

(2) Māori reduplication

i. Total reduplication

hui ‘meet, gather’ → *hui-hui* ‘gather’ *wera* ‘hot’ → *wera-wera* ‘somewhat hot’

ii. Partial reduplication

nui ‘big’ → *nu-nui* ‘big’ *anga* ‘respect’ → *anga-nga* ‘respect’

These reduplications were described and generalized by Harlow (1991). He generalized that there are several different reduplicative patterns in the Māori grammar.

The aim of this paper is to demonstrate that one of the Māori partial reduplicative patterns can be captured by the theoretical framework of Harmonic Serialism (HS) but cannot be captured by Parallel Optimality Theory (POT). More specifically, it will be shown that the former framework has a ranking of well-attested constraints that maps an input to the correct output form, but the latter framework does not. This article is devoted to arguing that Māori prosodic morphology supports HS rather than POT.

The organization of this paper is as follows. In §2, we will review the basic assumptions about the phonological theories. In §3, we will survey the generalization about the Māori reduplicative patterns. In §4, it will be demonstrated that one of the reduplicative patterns cannot be captured by POT but can be captured by HS. In §5, we will summarize this paper.

2. Basic assumptions

2.1 Harmonic Serialism (HS) vs. Parallel Optimality Theory (POT)

HS and POT are variants of Optimality Theory (OT). Their main difference is attributed to their assumptions about two components of the OT grammar: the GEN and the EVAL. The assumptive differences may lead to different empirical and formal consequences. Recently, it has been demonstrated that HS can yield a factorial typology and capture opaque phenomena better

than POT (McCarthy 2010, Pruitt 2008, Elfner 2009, Kimper 2011, Tanaka 2013 among others).

Now, let us review their difference more in detail. First of all, we review their assumptions about the GEN. The GEN is a component of the OT grammar. In particular, it is a function that generates a set of output candidates for a certain input and submits the set to the EVAL. HS and POT have different assumptions about the ability of the GEN. The GEN of POT has a property called *Freedom of Analysis*. It is free to generate any conceivable output candidates. That is, it can apply any changes (deletion, insertion and alternation) to an input to produce the candidate set. On the other hand, the GEN of HS is limited in that it can apply only one minimal change at a time. More specifically, the GEN of HS is allowed to apply either one deletion, one insertion or one alternation at each step. This property is called *Gradualness*. In sum, the GEN of POT is not limited in the way of generating the candidate set, but the GEN of HS is limited. Hence, the output candidates can differ in any number of ways from the input in POT, whereas the output candidates can differ by one change from the input in HS.

Next, let us review their assumptions about the EVAL, which is a component of the OT grammar that evaluates output candidates with respect to a constraint hierarchy. The EVAL of POT assesses the harmony of output candidates and selects the optimal candidate *as the output form*. That is, it determines the output form at one step. On the other hand, the EVAL of HS assesses the harmony of output candidates and selects the optimal candidate *as the new input*. Then, it passes back the new input to the GEN until there is convergence, when the optimal candidate is identical to the most recent input to the GEN. That is, it may determine the output form through some steps. To sum up, POT is a parallel mapping theory in that there is only one step that maps an input to an output directly, whereas HS is a serial mapping theory in that there may be a sequence of steps in which there are intermediate representations:

(3) Schemes of POT and HS¹

- i. POT: /Input/ → (GEN) → Candidate Set {Input + Candidates that differ in any number of ways from Input} → (EVAL) → [Optimal Form (= Output)]
- ii. HS: /Input/ → (GEN) → Candidate Set {Input + Candidates that differ minimally from the input} → (EVAL) → <Optimal form (=New Input A)> → (GEN) → Candidate Set [New Input A + Candidates that differ minimally from the new input] → (EVAL) → <Optimal form (=New Input B)> → ... → [Optimal form (= Output)]

To take an example, an input /tutu/ is evaluated in the phonological grammar of Japanese as follows. In POT, it is mapped to the output form [tsutsu] directly, since the GEN of POT can apply any changes to the input and the EVAL selects the optimum as the output form. On the other hand,

in HS, it is mapped to the output form [tsutsu] via the intermediate representation <tsutu>, since the GEN of HS can apply only one change (i.e. single affrication) and the EVAL of HS selects an optimal form and feeds it back into the GEN as a new input until the convergence. Note that this derivation shows steady harmonic improvement, which follows from the basic assumption of HS:

(4) Difference of /tutu/ evaluation between POT and HS


i. Constraints

*tu: Assign a violation mark for every marked string [tu].

IDENT-IO: Assign a violation mark for every element in an output (O) that has a different feature value from an input (I).

ii. Demonstration

a. POT: /tutu/ → [tsutsu]

Input: /tutu/	*tu	IDENT-IO	Operation
a. tutu	**!		“no operation”
b. tsutu	*!	*	“single affrication”
c.  tsutsu		**	“double affrication”

b. HS: /tutu/ → <tsutu>² → [tsutsu]

1st Iteration “affrication”

Input: /tutu/	*tu	IDENT-IO	Operation
a. tutu	**!		“no operation”
b. tsutu	*	*	“single affrication”

2nd Iteration “affrication”

Input: <tsutu>	*tu	IDENT-IO	Operation
a. tsutu	*!		“no operation”
b. tsutsu		*	“single affrication”

3rd Iteration “converge”

Input: <tsutsu>	*tu	IDENT-IO	Operation
a. tsutsu			“no operation”

Output: <tsutsu>

In this section, we have reviewed the difference between POT and HS. Then, it was pointed out that their differences are attributed to their assumptions about the GEN and the EVAL. In §4, it will be demonstrated that these different assumptions enable HS to capture the Māori reduplicative pattern which POT does not capture when the same constraints are employed.

2.2 Additional assumptions

In this sub-section, we will review well-attested OT constraints that are related to reduplicative formation. First of all, let us review a markedness constraint that determines which part of the stem the reduplicative affix copies. Marantz (1982) found that the original and copied phonological contents tend to be adjacent across languages. That is, a reduplicative affix copies the left strings of the stem when it is a prefix, and a reduplicative affix copies the right strings of the stem when it is a suffix. This generalization is called Marantz' Generalization, and it has been adopted as a markedness constraint, e.g. LOCALITY (Nelson 2005), ADJACENCY (Lunden 2006) and COPY-LOCALLY (McCarthy et al. 2011). In this paper, we will employ the last one:

(5) COPY-LOCALLY (McCarthy et al. 2011)

To a candidate, assign as many violation marks as there are *Xs* intervening between the original *X* string and its copy.

For instance, this constraint assigns violation marks as follows. It assigns as many violation marks as *Xs* that do not stand at the right edge when a reduplicative affix precedes a root and it assigns as many violation marks as *Xs* that do not stand at the left edge when a reduplicative affix follows a root. Note that RED means a reduplicative affix, and the underlined part indicates a copied part:

(6) Assignment of violation marks for a prefix and a suffix

a. RED as a prefix

RED-ABCD	COPY-LOC
a. <u>AB</u> -ABCD	
b. <u>CD</u> -ABCD	AB
c. <u>D</u> -ABCD	ABC

b. RED as a suffix

ABCD-RED	COPY-LOC
a. ABCD- <u>CD</u>	
b. ABCD- <u>AB</u>	CD
c. ABCD- <u>A</u>	BCD

How about an internal reduplicative affix? According to the definition in (5), it does not assign any violation marks for every candidate that copies the strings that stand immediately on the right side, the left side and both sides. Hence, we assume that it assigns violation marks for every candidate that copies the strings that stand non-immediately on the right side and the left side:

(7) Assignment of violation mark for an infix

AB-RED-CD	COPY-LOC
a. AB- <u>B</u> -CD	
b. AB- <u>BC</u> -CD	

Copied part
 immediately left
 immediately left and right

c.	AB- <u>C</u> -CD		immediately right
d.	AB- <u>A</u> -CD	B	non-immediately left
e.	AB- <u>D</u> -CD	C	non-immediately right

Next, let us review a constraint that determines the length of a copied part. In this paper, we adopt an alignment constraint $MCAT = PCAT$. This constraint template was proposed by McCarthy and Prince (1993: 146):

(8) Constraint schema for alignment constraints

$MCAT = PCAT$

where $Mcat = \text{Morphological Category} = \text{Prefix, Suffix, RED, Root, Stem, LexWd, etc.}$

$Pcat = \text{Prosodic Category} = \text{Mora, Syllable (type), Foot (type), PrWd (type), etc.}$

For instance, $RED = \sigma$ requires a reduplicative part to be monosyllabic, and $RED = Ft_{\sigma}$ requires a reduplicative part to be disyllabic. These constraints interact with a faithfulness constraint $MAX-BR$ to determine the length of a reduplicative part in Ilokano and Manam respectively:

(9) Length-determination of a copied part

i. Constraints

$RED = \sigma$: Assign a violation mark for every reduplicative part that is not monosyllabic.

$RED = Ft_{\sigma}$: Assign a violation mark for every reduplicative part that is not disyllabic.

$MAX-BR$: Assign a violation mark for every element in B (base) that does not have a correspondent in R (reduplicative part).

ii. Demonstration

a. Ilokano

Base: /si-RED-buner/	$RED = \sigma$	MAX
a. si- <u>bu</u> -buner		neŋ
b. si- <u>buner</u> -buner	*!	

b. Manam

Base: /salaga-RED/	$RED = Ft$	MAX
a. salaga- <u>ga</u>	*!	sala
b. salaga- <u>laga</u>		sa
c. salaga- <u>salaga</u>	*!	

Finally, let us review a constraint that determines where an infix is inserted. In this study, we will employ a family of well-formedness constraints Generalized Phonological Subcategorization (GSS) as a circumscriptive constraint. This constraint family was originally proposed by McCarthy and Prince (1993: 34), and it was revised by Yu (2003: 60). In this paper, we will follow the proposal by Yu (2003). This constraint family obeys the following schema:

(10) Generalized Phonological Subcategorization (Yu 2003: 60)

ALIGN (Cat1, Edge1, Cat2, Edge2) = def

\forall Cat1 \exists Cat2 such that Edge1 of Cat1 and Edge2 of Cat2 coincide.

Where Cat1 \in MorphCat {morphemes, morph}

Cat2 \in PhonCat {ProsCat, C, V}

Edge1, Edge2 \in {Right, Left}

As defined in (10), this constraint family requires a designated edge of a morphological category Cat1 to coincide with a designated edge of a phonological category Cat2. Yu (2003: 5) termed ‘pivot’ the phonological unit to which an affix attaches, and generalized over 101 languages that there are only seven pivots: first consonant, first vowel, final syllable, final vowel, stressed syllable, stressed foot and stressed vowel. Let us consider as an example the case that the pivot is the first vowel, i.e. the infix is inserted after the first vowel. This pattern of infixation is observed in Alabama, Quileute, Miskito, Yuma, and Dakota (Yu 2003: 25-32), and it can be predicted by ALIGN (L, Affix, R, V₁). Dakota infixation can be captured by this alignment constraint as follows:

(11) Dakota infixation: paxta \rightarrow pa-wa-xta

i. Constraint

ALIGN (L, Affix, R, V₁): Assign a violation mark for every affix that does not stand immediately after the initial vowel.

ii. Demonstration

/paxta/ + /wa/	ALIGN (L, Affix, R, V ₁)
a. wa-paxta	*!
b. pa-wa-xta	
c. paxta-wa	*!

In this section, we have reviewed the definitions of the three well-attested markedness constraints (COPY-LOCALLY, RED = Ft_{σσ} and ALIGN (L, Affix, R, V₁)) and one faithfulness constraint (MAX-BR). In §4, it will be shown that these constraints play important roles in capturing the Māori reduplication.

3. Generalization of Māori reduplication

It is, now, time to review the generalization of the Māori reduplication. In this study, we will follow the generalization by Harlow (1991, 2007: 127-129) and Bauer (1993: 525-528), according

to whom, there are several different reduplicative patterns in the Māori grammar. More specifically, the Māori reduplicative pattern can be divided mainly into two types: total reduplication and partial reduplication. Moreover, partial reduplication can be divided into two sub-categories: partial reduplication for a disyllabic stem and partial reduplication for a trisyllabic stem. Here, we would like to pick up only the partial reduplicative pattern for a trisyllabic stem:

(12) Partial reduplication for a trisyllabic stem in Māori

a. reduplication of the first syllable: $\sigma_1\sigma_2\sigma_3 \rightarrow \underline{\sigma_1}\text{-}\sigma_1\sigma_2\sigma_3$

hoia ‘annoyed’ \rightarrow *ho-hoia* ‘annoyance’

kopuu ‘blistered’ \rightarrow *ko-kopuu* ‘type of gravel’

b. reduplication of the first two syllables with dissimilation of the repeated consonants in

$\sigma_1\sigma_1: \sigma_1\sigma_2\sigma_3 \rightarrow \sigma_1\text{-}\underline{\sigma_1}\underline{\sigma_2}\text{-}\sigma_2\sigma_3$

pakini ‘nip’ \rightarrow *pa-aki-kini* ‘pain’

monehu \rightarrow *mo-one-nehu* both meaning ‘indistinct’

c. reduplication of the first two syllables: $\sigma_1\sigma_2\sigma_3 \rightarrow \underline{\sigma_1}\underline{\sigma_2}\text{-}\sigma_1\sigma_2\sigma_3$

takai ‘wrap up’ \rightarrow *taka-takai* ‘wind round’

tapahi ‘cut’ \rightarrow *tapa-tapahi* ‘cut into pieces’

Harlow (1991) assumed that it is lexically determined which reduplicative strategy is applied to a base word. That is, a base word is associated with a reduplicative pattern in the lexicon. This information is idiosyncratic, but not systematic. This assumption is also followed by Meyerhoff and Reynolds (1996). We will also follow the assumption that the information about the reduplicative pattern is specified in the lexicon. That is, we assume that several co-phonologies exist in Māori phonology and each lexical item is associated with one of them.

Meyerhoff and Reynolds (1996) analyzed the Māori reduplicative patterns theoretically in the framework of POT. Certainly, their analysis successfully captured them, but they ignored the reduplicative pattern (12b) because the reduplicative pattern is rarer than the other patterns. Hence, it remains unclear whether the reduplicative pattern (12b) can be predicted by well-attested constraints in the OT framework. In the next section, we will attempt to theoretically analyze the co-phonology associated with the reduplicative pattern (12b) in the two OT frameworks of POT and HS, and demonstrate that it cannot be captured by POT, but it can be captured neatly by HS.

Before proceeding to the theoretical analysis of the partial reduplicative pattern (12b), we would like to examine its generalization more in detail. As noted above, this reduplicative pattern is the case that the first two syllables of a base are copied and the consonant dissimilation occurs. More specifically, we can regard this reduplicative pattern as consisting of the following three

linguistic operations: (i) the copy of the first two syllables (ii) the movement of the copied string (i.e. the reduplicative affix) after the first vowel, and (iii) the consonantal dissimilation of the first two syllables. These three linguistic operations can be summarized as follows:

(13) Three linguistic operations of the reduplicative pattern in (12b)

Input:	RED + /pakini/	RED + /monehu/
<i>Copy</i>	<pa <u>ki</u> -pakini>	<mo <u>ne</u> -monehu>
<i>Movement</i>	<pa- <u>pa</u> ki-kini>	<mo- <u>mo</u> ne-nehu>
<i>Dissimilation</i>	<pa- <u>a</u> ki-kini>	<mo- <u>o</u> ne-nehu>
Output:	[pa- <u>a</u> ki-kini]	[mo- <u>o</u> ne-nehu]

At the first linguistic operation *Copy*, the reduplicative affix copies the first two syllables: RED + C₁V₁C₂V₂C₃V₃ → C₁V₁C₂V₂-C₁V₁C₂V₂C₃V₃. At the next linguistic operation *Movement*, the copied part (i.e. the reduplicative affix) moves after the first vowel: C₁V₁C₂V₂-C₁V₁C₂V₂C₃V₃ → C₁V₁-C₁V₁C₂V₂-C₂V₂C₃V₃. At the final linguistic operation *Dissimilation*, the first two identical syllables dissimilate, and the second consonant C₁ is deleted for the second verb V₁ to be incorporated to the preceding syllable as the second V slot: C₁V₁-C₁V₁C₂V₂-C₂V₂C₃V₃ → C₁V₁-V₁C₂V₂-C₂V₂C₃V₃.

As will be seen in the next section, the first two operations (i.e. *Copy* and *Movement*) can be ensured by the well-attested constraints reviewed in §2. However, it is necessary for us to introduce another constraint to ensure the final operation *Dissimilation*. Here, we would like to postulate the following constraint *#C₁V₁C₁V₁:

(14) *#C₁V₁C₁V₁

Assign a violation mark for every candidate in which the first two syllables are identical.

This constraint may look ad hoc, but it is definitely supported by both the internal and external evidence. That is, we can find various phonological phenomena within and outside Māori in which the first two identical syllables are avoided. As for the internal evidence, Harlow (1991) clarified that C₁V₁C₁V₁ is also avoided in other phenomena³ within Māori. As one example, let us review total reduplication for a trisyllabic stem. In this reduplication, C₁V₁C₂V₂C₃V₃ is reduplicated to C₁V₁-V₁C₂V₂C₃V₃-C₂V₂C₃V₃, e.g. *pakaru* ‘broken’ → *pa-akarū-karu* ‘break in pieces.’ As with the partial reduplicative pattern (12b), the first two identical syllables dissimilate and they lose the second consonant to avoid the two adjacent identical syllables. As noted here, it is common within Māori to avoid two adjacent identical syllables. The external evidence comes

from Besnier (2000: 618). He proposed that two identical syllables were avoided in Tuvaluan, and thus some words dissimilated the two successive identical syllables diachronically: *vavae* → *vvae* and *mamao* → *mmao*. These words deleted the first vowel to avoid two adjacent identical syllables. In this way, it is common in other languages to avoid two adjacent identical syllables. On the basis of the above evidence, we will employ the markedness constraint $*\#C_1V_1C_1V_1$ in the theoretical analyses in the next section.

4. Theoretical analyses

Now, we attempt to analyze the Māori reduplicative pattern (12b) in the two OT frameworks, i.e. HS and POT. It will turn out that HS is better at capturing this reduplication than POT. More specifically, it will be demonstrated that HS has a ranking that maps an input (e.g. *monehu*) to the intended winner (e.g. *mo-one-nehu*), whereas POT has no ranking. Note that we will employ the same set of constraints (i.e. COPY-LOCALLY, RED=Ft_σ, ALIGN (L, Affix, R, V₁), $*\#C_1V_1C_1V_1$ and MAX-BR) in the two theoretical frameworks. They were all reviewed in the last two sections.

4.1 Harmonic Serialism

In this sub-section, it will be demonstrated that HS can handle the Māori reduplicative pattern (12b). In particular, it will be shown that there is a ranking that can map an input (e.g. *monehu*) to the intended winner (e.g. *mo-one-nehu*) correctly in HS.

First of all, we assume that the step-by-step trajectory in (13) exists in the derivation: the reduplicative affix copies the adjacent two syllables at the first iteration, e.g. *mone-monehu*; the copied part (i.e. the reduplicative affix) moves after the first vowel at the second iteration, e.g. *mo-mone-nehu*; the first two identical syllables dissimilate and the second consonant is deleted at the third iteration, e.g. *mo-one-nehu*; the derivation reaches the convergence at the fourth iteration:

(15) Trajectory to the intended winner		
UR:	/RED + monehu/	<i>Operation</i> ⁴
1 st Iteration:	< <u>mone</u> -monehu>	“copy of one phonological unit (= Ft _σ ⁵)”
2 nd Iteration:	<mo- <u>mone</u> -nehu>	“movement of one constituent (= RED)”
3 rd Iteration:	<mo- <u>one</u> -nehu>	“deletion of one segment”
4 th Iteration:	<mo- <u>one</u> -nehu>	“no operation” = convergence
SR:	[mo- <u>one</u> -nehu]	


If we assume that the derivation proceeds as in (15), HS can neatly capture the reduplicative pattern. Now, we will demonstrate how HS can capture this trajectory with a certain single

ranking.

At the first step, a candidate whose reduplicative affix is filled with the adjacent two syllables beats every other possible candidate. The tableau in (16) shows this step and indicates which ranking is required to ensure this outcome. Note that we adopt a combination tableau (McCarthy 2008: 46-48) for the ranking argument from here on. The following ranking tells us that it is necessary for RED=Ft_{σσ} and COPY-LOCALLY to dominate ALIGN (L, Affix, R, V₁) and MAX-BR in that the latter constraints may favor the wrong forms in (16a) and (16b). It remains unclear from this step where *# C₁V₁C₁V₁ is located, because it does not interact with any other constraints:

(16) Ranking argument for the 1st iteration


RED=Ft_{σσ}, COPY-LOCALLY >> ALIGN (L, Affix, R, V₁), MAX-BR

/RED + monehu/	RED=Ft	LOC	ALIGN	MAX	Operation
a. RED-monehu	*W		*	L	“no operation”
b. mo-RED-nehu	*W		L	L	“movement”
c.  mone-monehu			*	hu	“copy”
d. <u>nehu</u> -monehu		mo W	*	mo	“copy”

At the second iteration, a form in which the reduplicative affix moves after the first vowel of BASE wins over its competitors. As indicated in the following combination tableau, the ranking [ALIGN (L, Affix, R, V₁) >> *#C₁V₁C₁V₁] is required to ensure the intended outcome, because the opposite order favors the wrong forms in (17a) and (17c).

(17) Ranking argument for the 2nd iteration

ALIGN (L, Affix, R, V₁) >> *#C₁V₁C₁V₁

<u>mone</u> -monehu	ALIGN	*#CVCV	Operation
a. <u>mone</u> -monehu	*W	L	“no operation”
b.  mo- <u>mone</u> -nehu		*	“movement”
c. mone- <u>mone</u> -hu	*W	L	“movement”

The third iteration requires that a candidate that is affected by the dissimilation of the first two syllables beats every other candidate. This derivation requires *#C₁V₁C₁V₁ to dominate MAX-BR, because the opposite order favors the wrong form in (18a):

(18) Ranking argument for the 3rd iteration

*#C₁V₁C₁V₁ >> MAX-BR

mo- <u>mone</u> -nehu	*#CVCV	MAX	<i>Operation</i>
a. mo- <u>mone</u> -nehu	*W	hu L	“no operation”
b. ↗ mo- <u>one</u> -nehu		m, hu	“dissimilation”

At the forth iteration, the derivation reaches the convergence. In other words, the optimal form is identical to the most recent input to the GEN. This derivation is ensured by the ranking [RED=Ft_{σσ} >> MAX-BR]:

(19) Ranking argument for the 4th iteration

RED=Ft_{σσ} >> MAX-BR

mo- <u>one</u> -nehu	RED=Ft	MAX	<i>Operation</i>
a. ↗ mo- <u>one</u> -nehu		m, hu	“no operation”
b. mo- <u>oneu</u> -nehu	*W	m, h L	“insertion”

To recap, the summary tableau is as follows. It demonstrates that HS neatly captures the Māori reduplicative pattern (12b) if we postulate the harmonically-improving trajectory in (15). That is, the full derivation can be captured by the single ranking [RED=Ft_{σσ}, COPY-LOCALLY >> ALIGN (L, Affix, R, V₁) >> *# C₁V₁C₁V₁ >> MAX-BR]. In this sub-section, we have argued that there is a single ranking that can map an input to the intended winner in HS:

(20) Summary tableau for the trajectory in (15)

/RED-monehu/	RED=Ft	LOC	ALIGN	*#CVCV	MAX	<i>Operation</i>
1st Iteration						
a. RED-monehu	*W		*		L	“no operation”
b. mo-RED-nehu	*W		L		L	“movement”
c. ↗ <u>mone</u> -monehu			*		hu	“copy”
d. <u>nehu</u> -monehu		mo W	*		mo	“copy”
2nd Iteration						
e. <u>mone</u> -monehu			*W	L	hu	“no operation”
f. ↗ mo- <u>mone</u> -nehu				*	hu	“movement”
g. mone- <u>mone</u> -hu			*W	L	hu	“movement”
3rd Iteration						
h. mo- <u>mone</u> -nehu				*W	hu L	“no operation”
i. ↗ mo- <u>one</u> -nehu					m, hu	“dissimilation”

4th Iteration						
j.	☞ mo- <u>one</u> -nehu					m, hu “no operation”
k.	mo- <u>oneu</u> -nehu	*W				m, h L “insertion”

Output: mo-one-nehu

4.2 Parallel Optimality Theory (POT)

Next, let us analyze the Māori reduplicative pattern (12b) theoretically in the framework of POT. It will be demonstrated that it cannot handle this reduplicative pattern, i.e. it does not have any ranking of the above constraints to ensure that an input is mapped to the intended winner.

First of all, let us apply the same ranking as the HS approach: RED=Ft_σ, COPY-LOCALLY >> ALIGN (L, Affix, R, V₁) >> *#C₁V₁C₁V₁ >> MAX-BR. Unfortunately, it predicts a wrong winner *mo-nehu-nehu* under this ranking in POT. Attentive readers may realize that the reduplicative pattern (12b) cannot be predicted by any ranking of these constraints in POT, because the intended winner *mo-one-nehu* is harmonically bounded by another candidate *mo-nehu-nehu*. In other words, the set of violation marks for *mo-one-nehu* is a subset of *mo-nehu-nehu*, and thus it is meaningless to rerank these constraints:

(21) Wrong prediction in POT

Base: RED + monehu	RED=Ft	LOC	ALIGN	*#CVCV	MAX
a. <u>mone</u> -monehu			*!		hu
b. <u>mo</u> -monehu	*!		*	*	nehu
c. mo- <u>mone</u> -nehu				*!	hu
d. ☹ ⁶ mo- <u>one</u> -nehu					m, hu!
e. mo- <u>mo</u> -nehu	*!			*	nehu
f. ☹ ⁶ mo- <u>nehu</u> -nehu					mo
g. mo- <u>hu</u> -nehu	*!	ne			mone

When no ranking of certain constraints can induce the intended winner to win, all we can do is to introduce a new constraint that breaks the bounding relation by favoring the intended winner over the intended losers. Thus, I will attempt to find such a constraint here. Actually, the intended winner can be predicted in POT, if we employ ANCHOR-L instead of COPY-LOCALLY:

(22) Theoretical analysis with ANCHOR-L in POT

i. Definition of ANCHOR-L

ANCHOR-L: Assign a violation mark for every candidate in which the leftmost syllable of R (reduplicative part) does not correspond to the leftmost syllable of B (base).

ii. Demonstration:

RED=Ft_σ, ANCHOR-L, ALIGN (L, Affix, R, V₁), *# C₁V₁C₁V₁>> MAX-BR

RED + monehu	RED=Ft	ANCH-L	ALIGN	*#CVCV	MAX
a. <u>mone</u> -monehu			*W		hu L
b. <u>mo</u> -monehu	*W		*W	*W	nehu W
c. mo- <u>mone</u> -nehu				*W	hu L
d. mo- <u>one</u> -nehu					m, hu
e. mo- <u>mo</u> -nehu	*W			*W	nehu W
f. mo- <u>nehu</u> -nehu		*W			mo L
g. mo- <u>monehu</u> -nehu	*W				L

However, this analysis causes a serious problem to the factorial typology, because ANCHOR constraints may generate unattested reduplicative patterns. As was seen in §2.2, Marantz' generalization claimed that copying normally proceeds from left to right in prefixes and from right to left in suffixes. That is, there are no reduplicative patterns in which the original parts and its copied part are not adjacent. The ANCHOR constraints may generate not only the attested reduplicative patterns but also the unattested reduplicative patterns:

(23) Prediction by ANCHOR constraints

ANCHOR-L × RED=prefix → attested pattern (AB-ABCD)

ANCHOR-R × RED=prefix → *unattested pattern (CD-ABCD)

ANCHOR-R × RED=suffix → attested pattern (ABCD-CD)

ANCHOR-L × RED=suffix → *unattested pattern (ABCD-AB)

On the other hand, the prediction by COPY-LOCALLY neatly fits the factorial typology. That is, it can make sure that the original parts and its copied parts are always adjacent:

(24) Prediction by COPY-LOCALLY

COPY-LOC × RED=Prefix: attested pattern (AB-ABCD)

COPY-LOC × RED=Suffix: attested pattern (ABCD-CD)

From the typological perspective, we have to stick to COPY-LOCALLY. (The problems of the ANCHOR constraints are discussed more in detail in Nelson (2005) and Lunden (2006).) However,

POT cannot predict the Māori reduplicative pattern in (12b) by employing the well-attested constraint COPY-LOCALLY.

In this sub-section, it was demonstrated that POT has no ranking of the well-attested constraints that can correctly capture the reduplicative pattern in (12b). In addition, we have seen that it is possible for POT to capture the reduplicative pattern, only if we employ the problematic and controversial constraint ANCHOR-L instead of the well-attested constraint COPY-LOCALLY.

4.3 Comparison

Now, it is time to examine more in detail why HS can capture the reduplicative pattern with well-attested constraints, but POT cannot. The answer comes from their theoretical assumptions about the GEN.

As was reviewed in §2.1, the GEN of POT has a property called *Freedom of Analysis*. Because of this property, the candidate set is unlimited and infinite. It includes the input to the GEN and forms that differ in any number of ways from the input. In particular, it includes simultaneously the intended winner *mo-one-nehu* and the wrong form that harmonically bounds the intended winner *mo-nehu-nehu* (Both the forms equally satisfy all the markedness constraints but the latter satisfies MAX-BT better than the former.). This is why, POT cannot do without predicting that *mo-nehu-nehu* is more harmonic than *mo-one-nehu* under any rankings, and thus there is no ranking that correctly maps an input *monehu* to the intended winner *mo-one-nehu*.

(25) Wrong prediction by POT

Base: RED + monehu	RED=Ft	LOC	ALIGN	*#CVCV	MAX
a. ⊗ mo-one- <u>nehu</u>					m, hu!
b. ● mo- <u>nehu</u> - <u>nehu</u>					mo

On the other hand, the wrong prediction does not occur in HS. As was reviewed in §2.1, the GEN of HS has a property called *Gradualness*. Because of this property, the candidate set is limited and finite. It includes the input to the GEN and forms that differ by one change from the input. Hence, the candidate set cannot include the intended winner *mo-one-nehu* and the problematic form for POT *mo-nehu-nehu* simultaneously, if we postulate the ranking that ensures that a reduplicative affix copies the first two syllables of a base at the first iteration. The reason is that the copied syllables $\sigma_1\sigma_2$ cannot be changed to $\sigma_2\sigma_3$ at the later steps. Changing the copied syllables involves both the deletion and the insertion (e.g. *mone* → *one* “m-deletion” → *ne* “o-deletion” → *neu* “u-insertion” → *nehu* “h-insertion” or *mone* → *moneu* “u-insertion” → *monehu* “h-insertion” → *onehu* “m-deletion” → *nehu* “o-deletion”) and the intermediate

representations (*ne*, *neu*, *moneu*, *monehu*, *onehu*) incur serious violations of either or both of the two undominated constraints RED= $F_{t\sigma}$ and COPY-LOCALLY.

In sum, POT cannot do without evaluating the intended winner *mo-one-nehu* and the wrong form *mo-nehu-nehu* simultaneously, and thus it has no ranking that can capture this reduplicative pattern. On the other hand, HS does not evaluate the two forms simultaneously given that a reduplicative affix copies the first two syllables of a base at the first iteration, and thus the wrong prediction does not occur.

5. Summary

In this paper, we have considered the theoretical analyses of the Māori reduplicative pattern in (12b), after reviewing the two OT frameworks, HS and POT. Then, it was demonstrated that HS is better at capturing this reduplicative pattern than POT, because the former has a ranking of the well-attested constraints that maps an input to the intended winner whereas the latter does not. The difference is caused by their different assumptions about the GEN. The significance of this paper is to clarify that the Māori prosodic morphology presents an interesting argument in favor of the serial view rather than the parallel view.

Notes

* The earlier version of this paper was presented at the 10th meeting of Phonology Festa. I deeply appreciate all the comments from the audiences. Besides, I wish to thank Professor Shin-ichi Tanaka, Clemens Poppe, Chuyu Tikiu Huang and two anonymous reviewers. This study was supported by JSPS KAKENHI Grant Number 26-2350.

¹ Note that each symbol conventionally means the followings: // is an underlying representation or an input; <> is an intermediate representation; [] is a surface representation or an output.

² One might realize that <tutsu> is also a possible intermediate representation. Further investigation is required for whether <tsutu> or <tutsu> is more appropriate as an intermediate representation.

³ The main proposal of Harlow (1991) is that C_1VC_1V is avoided in reduplication, passive formation and allomorphs of *motu* ‘island,’ *ngāiti* ‘tribal prefix’ and *whaka* ‘causative.’

⁴ As was reviewed in §2.1, an operation at each step must be minimal in HS. We assume that “one copy of one phonological unit (=F t_{σ})” and “one movement of one constituent (=RED)” are minimal operations, because these operations are regarded as one operation (i.e. one copy or one movement) on one category (i.e. one foot or one reduplicative affix). Actually, the former operation is regarded as a minimal operation in McCarthy et al. (2011) as well.

⁵ Māori feet are usually disyllabic, i.e. F t_{σ} . The interested reader should refer to Hashimoto (2015).

⁶ ☉ means “an intended winner.” ☹ means “a wrong winner.”

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