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PHONOLOGY OF ACEHNESE REDUPLICATION: APPLYING OPTIMALITY THEORY

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Abstract
Reduplication in Acehnese serves many functions, such as plurality, reciprocity, emphasis, continuity, and repetitions. This word formation process has been previously analyzed in terms of morphology and phonology. The present study aimed to discover the constraint ordering of reduplication to determine the rules that govern each pattern of reduplication in the language. The study employed Correspondence Theory under the umbrella of Optimality Theory, focusing on total and partial reduplication, leaving out rhyming reduplication due to framework limitation. The results show that all patterns of reduplication in Acehnese follow regular application where well-formedness proceeds faithfulness (MAX-IO) and precedes reduplicative identity (MAX-BR). The well-formedness for total reduplication only includes the constraint of the complex nucleus, where a final diphthong in the base changes to a monophthong in the reduplicant. For partial reduplication, the constraint for well-formedness is that the syllable should be open, preceded by a reduplicant size of no more than one syllable, and alignment (either left for reduplicating prefixes or right for reduplicating suffixes). In addition, the well-formedness is proceeded by no insertion (DEP-BR). This study indicates the need to establish a ranking of constraints that govern the phonology of Acehnese outside the context of reduplication, which is a suggestion for future studies.

Keywords: Acehnese, correspondence theory, optimality theory, phonology of reduplication

Introduction
Acehnese is a primary language spoken in the Aceh province, which is one of the provinces in Indonesia. The language is now rarely found in formal writing, but it is often used in text messages and social media posts and comments. Yusuf, Fata, Aziz, Surya, and Pillai (2022) assert that this language shares a close relationship with Chamic, an Austronesian language that has its roots in Cambodia and Vietnam. Mid-vowels and diphthongs in the two languages are similar, indicating that they are both descended from Proto-Aceh-Chamic. Reduplication is a common word formation in the language, similar to its neighboring languages (Aziz & Nolikasari, 2020; Inkelas & Downing, 2015; Mulyani, Deliana, & Nasution, 2021)

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Al Mahmoud (2014) defines reduplication as a morphological process in which all or a portion of a base is copied and reattached to the base. The availability of nearly all lexical items for use in reduplicated forms to allude to repetition, plurality, mutuality, and other purposes illustrates the richness of reduplication in Acehnese. Many words in Acehnese, in addition to those that can be reduplicated, only exist in reduplicated form. This suggests that reduplication patterns in Acehnese, including total reduplication, partial reduplication, and lexicalized reduplication, are incredibly rich (Mustafa, 2022b). Common reduplication and rhythmic reduplication are both present in each of these patterns, and the majority of the lexicalized reduplications are onomatopoeia, which has been the subject of another study by Muliawati and Yusnida (2019).

Reduplication has been discussed in previous works on Acehnese. Durie (1985) gives a brief overview of Acehnese reduplication, including some instances from his work on Acehnese grammar, and acknowledges that words can be reduplicated entirely or partly. A similar conclusion was made by others (e.g., Devi, Yakob, & Effendi, 2020). Muliawati and Yusnida (2019) discovered that onomatopoeic words are commonly fully and partially reduplicated. Mustafa (2022a) shows that reduplication in Acehnese can be analyzed using Morphological Doubling Theory (MDT) and C-V skeleta. However, Optimality Theory, which is commonly used to analyze reduplication from a phonological point of view, has not been applied in the analysis of Acehnese reduplication. Therefore, the present study is intended to fill this gap in the literature on Acehnese reduplication. The result of this study shows a ranking of constraints that determines the phonology of Acehnese in the context of reduplication.

Literature Review

This study deals with Acehnese reduplication from a phonology point of view, utilizing Optimality Theory. Therefore, the section begins with introducing Acehnese phonology based on what previous studies have revealed. Then, the literature related to Acehnese reduplication is presented and argued, followed by introducing Optimality Theory and how previous studies used it to analyze reduplication. Finally, the section concludes with a summary of the literature review to show the gap addressed in the present study.

The phonology of Acehnese

Regarding phonetics, Acehnese has 21 consonants without labiodental, dental, post-alveolar, retroflex, palatal, ovular, and pharyngeal consonants. Palatal consonants in Acehnese are so fronted that Asyik (1987) considers them alveopalatal, although Durie (1985) analyzes them as palatal consonants. Furthermore, vowels in Acehnese are divided into oral and nasal vowels (Yusuf & Pillai, 2016). There are ten oral and seven nasal vowels, and nasal vowels correspond to all oral vowels except for high-mid vowels. Acehnese has more central vowels than other vowels, with only one low vowel for both oral and nasal. Besides the above ten vowels, there are eighteen diphthongs in Acehnese, twelve of which are oral (Yusuf & Pillai, 2013). This is considered a vast number of diphthongs for a world's language. Like monophthongs, Acehnese has more oral than nasal diphthongs. Surprisingly, [au], which occurs in many of the world's languages, does not exist in Acehnese. Some diphthongs in Acehnese end

with [ə] and others with [i], and both types of diphthongs exist in oral and nasal diphthongs. In terms of word formation, Asyik (1987) states that Acehnese uses affixes to form verbs, nouns, and adjectives. A noun is formed from a verb by the infix *-ɯn-*, and the prefix *buraŋka-* can be attached to certain types of words for this purpose. A verb can be formed from nouns and adjectives by adding prefixes *mũ-*, *pɯ-*, *tɯ-*, *tu-*, infix *-ɯm-*, and a pronominal pronoun. Finally, adjectives can derive from nouns, verbs, and *tu*-affixed words by attaching affixes *mũ-* and *tɯ-*. These word formations are motivated by grammatical requirements to change the syntactic category. Another word formation process in Acehnese is not related to grammar, but it is motivated merely by semantic requirement, i.e., reduplication (Mustafa, 2022a).

Reduplication in Acehnese

There are currently only few publications related to reduplication in Acehnese. The publications that address reduplication can be found in Asyik (1987) and Durie (1985). Due to the primary emphasis on Acehnese grammar in both of these works, the discussion on reduplication is not as thorough. Reduplication was examined in grammar by Asyik (1987), including mandatory reduplication, reduplication as plural marking, and grammaticality in reduplication, or when reduplication is permitted in a sentence. Meanwhile, Durie (1985) discusses reduplication in a section of his work, focusing on patterns and semantic functions of Acehnese reduplications. More recent studies related to Acehnese reduplication have been conducted by Mustafa (2022a) and Mustafa (2022b), focusing on patterns of reduplications and analyzing them morphologically.

Reduplication in Acehnese often occurs in two main patterns, namely total and partial reduplications, with rhyming reduplication as an additional pattern (Mustafa, 2022a). Both total and partial reduplication are considered pure reduplication. Many word classes, including nouns, verbs, adjectives, pronouns, adverbs, numerals, and articles, can be subjected to total reduplication. Mustafa (2022b) found that many reduplicated words in Acehnese can be affixed, and some are only found in the affixed form. Affixed reduplication can be used with nouns, verbs, adjectives, pronouns, adverbs, and numbers (Ali et al., 1984). A reduplicant also occurs in a vowel shift in phonological reduplication, also referred to as rhyming reduplication.

In addition to patterns of reduplication, Ali et al. (1984) reveal the functions of reduplication in Acehnese. These functions include plural markings, emphases, repetitions, protracted actions, reciprocities, and collective and distributive meanings. Reduplication can also mean "somewhat," as in *meuneuputeh-puteh* (from *puteh* ‘white), which means "whitish." In addition, reduplication in Acehnese does not modify the word class of a word, but adding affixes to reduplicated words sometimes does (Mustafa, 2022b). Additionally, reduplicated words retain their stylish meaning in Acehnese since reduplication does not alter the tone or style of the language.

In conclusion, works on reduplication in Acehnese have focused on the patterns and meaning, such as in Asyik (1987) and Durie (1985). In both works, the reduplication was analyzed descriptively based on the framework of C-V skeleta. In addition, Mustafa (2022a) employed Morphological Doubling Theory

to analyze the patterns of reduplication in this language with little success for a certain type of reduplication. Therefore, Optimality Theory was suggested to be used in Acehnese reduplication analysis.

Optimality theory (OT)

Introduced in the early 1990s, Optimality Theory (OT) has become well-accepted among phonologists and is now widely used in linguistic analyses, including studies on reduplication. OT is based on constraints, which are ranked based on the number of constraint violations. Violation of lower-ranked constraints is acceptable in preventing violation of higher-ranking constraints (Prince & Smolensky, 2004). A candidate that only violates the lowest constraint emerges as an output in a language. The theory developed within the OT to deal with reduplication is called Correspondence Theory. Unlike the C-V skeleta, which regards reduplication as a sort of affixation that is entirely specified for segmental content, Correspondence Theory suggests that the segmental content of reduplication is copied from the reduplicated stem (Downing & Inkelas, 2015). This theory suggests that the patterns of reduplication are the results of interaction between three types of constraint in OT. According to McCarthy and Prince (2017), those constraints are faithfulness constraints, well-formedness constraints, and base-reduplicant (BR)-identity.

Faithfulness constraints require lexical forms and surface forms to be as close as possible, if not identical (Prince & Smolensky, 2004). Underlyingly, the reduplicant is an empty morpheme, and its surface form (output) depends on the base form (input). This theory, which involves correspondence between base and reduplicant, is called the Basic Model (McCarthy & Prince, 1995). It is a simplified model of total reduplication, which involves correspondence between stem and base as well as stem and reduplicant in addition to base and reduplicant. McCarthy and Prince (2017) conclude that the input faithfulness constraint (IO-Faithfulness) in reduplication requires the output to preserve the stem's input specifications, resulting in BR-Identity. In eliminating ill-formed candidates, these correspondence constraints interact with other faithfulness constraints and well-formedness constraints, e.g., MAX-IO, IDENT-IO, NO-CODA, and *COMPLEX. Kager (1999) identifies the following correspondence constraints:

Correspondence constraints in reduplication:

a) Maximality (MAX-BR): Every element in B has a correspondent in R, such that B is the base and R is reduplicant.
b) Dependence (DEP-BR): Every element in R has a correspondent in B, such that B is the base and R is reduplicant.
c) Identity (IDENT-BR[F]): corresponding segments in R must be identical concerning the feature(s) in F.

The present study

Previous studies have covered reduplications in earlier publications on Acehnese. Words in Acehnese can be replicated wholly or partially (Devi et al., 2021; Mustafa, 2022b). For example, Muliawati and Yusnida (2019) found that

onomatopoeic words frequently duplicate totally and partially. As Mustafa (2022a) demonstrates, reduplication in Acehnese can be examined using C-V skeleta and the Morphological Doubling Theory (MDT). However, not all instances of reduplication can be analyzed morphologically using MDT or phonologically using C-V skeletal. According to Sande (2021) and Musa and Altakhaineh (2015), a more advanced phonological analysis, such as Optimality Theory, can explain the output in the reduplicants more comprehensively. Therefore, the present study aims to analyze the patterns of reduplication in Acehnese using Optimality Theory proposed by Prince and Smolensky (2004) to find out the constraints and their orders. The results of this study contribute to the establishment of constraint rankings in Acehnese word formation, which can serve as a reference for the use of Optimality Theory in analyzing the phonology of Acehnese.

Method

The data for this qualitative research was collected from *hikayat*, a type of literary work in Acehnese. These literary works have been used by other researchers in linguistic studies (e.g., Aziz, Yusuf, Mustafa, & Munawarah, 2020; Mustafa, 2022b, 2022a). It was written in the form of poems, and it was usually read with a specific monotonous melody. The data were collected from nine *hikayats* published between 1961 and 1995. These dates are predicted, and the exact dates of their writing remain unknown because many *hikayats* were passed down from one generation to the next without any authorship or publication details.

The data were the reduplicated words obtained from the *hikayats*. An educated native speaker of Acehnese who is familiar with Acehnese vocabulary, including archaic words, carried out the data extraction. The researcher and an expert in Acehnese language determined the meaning of each reduplicated word. The extracted reduplicated words were recorded together with their definitions and their locations in the *hikayats*, including pages and lines in order that they can be confirmed and validated.

Finally, the data was analyzed using a qualitative data analysis procedure given by Wellington (2015, pp. 260-264), i.e., “dividing up the data, taking the data apart, picking and filtering the data, classifying the data, and categorizing the data." The data for this study was separated into reduplicated patterns. Total reduplications and partial reduplications were the two main categories into which the patterns were separated. The types of reduplication involved in each category were carefully examined. The reduplications with a common characteristic were grouped into additional, less general groups once all types of reduplication in each category had been classified.

Finally, the primary analysis was employed, i.e., using the Optimality Theory. The primary step was to find the constraints of Acehnese reduplications and determine their ranking using the framework proposed by McCarthy and Prince (2017), where the MAX-BR or IDENT-BR ranks first, and the MAX-IO or IDENT-IO ranks last. The phonology rules, or well-formedness, come between these two constraints, which were determined by analyzing the phonological rules of the language based on previous studies. Each pattern of reduplication was analyzed separately, where open and closed syllables were also analyzed in

isolation. Rhythmic reduplication, which is frequent in Acehnese based on a previous study by Mustafa (2022b), was excluded from the analyses because OT has not addressed this type of reduplication. The rhythm that can be analyzed in the context of OT is still limited to rhythm resulting from pause (Ishikawa & Miyakoda, 2015) and stress pattern (Kentner, 2017). A case of consonant alteration has been presented by Soohani, Ahangar, and Van Oostendorp (2016); however, this is rare in Acehnese compared to vowel 'disidenticalization,' which is under-explored in literature.

Findings and Discussion

The main objective of this study is to present the analysis of Acehnese reduplication using Optimality Theory (OT). The analyses are presented for each pattern of reduplication. Therefore, the patterns of reduplication in Acehnese need to be established before OT analysis. Based on the data, the patterns of reduplication that appear in the nine *hikayats* are presented in Table 1.

Table 1. Patterns of reduplication in Acehnese

Patterns of reduplication	Number of tokens	Percentage
Total reduplication	314	85%
Partial reduplication	9	3%
Rhyming reduplication (total)	23	6%
Rhyming reduplication (partial)	22	6%

Table 1 shows that total reduplication dominates the patterns of reduplication in Acehnese, with partial reduplication mostly occurring as rhyming reduplication. Regular partial reduplication is the least found reduplication pattern in Acehnese. The results in Table 1 imitate the patterns of reduplication found by (Mustafa, 2022b), although he also presented another pattern of reduplication, i.e., lexicalized reduplication. This pattern will not be discussed here because the input and reduplicated form cannot be determined. Each pattern in Table 1 is analyzed, and the results of the analyses with OT are presented in the following subsections.

Total reduplication

Total reduplication in Acehnese is very straightforward because the reduplicant is generally identical to the stem. This is the characteristic of reduplication in Austronesian languages such as Hawaiian (Alderete & MacMillan, 2015), Papapana (Smith, 2016), Isbukun Bunun (Lin, 2019), and Palembang (Alsamadani & Taibah, 2019), as well as other language families such as Indo-European languages (Rácová & Samko, 2015; Yates & Zukoff, 2018). Acehnese allows open and closed syllables, and no coda deletion has been found in reduplicants. Therefore, NO-CODA, with the open syllable, is ranked in the very lowest part of the hierarchy. For this reason, NO-CODA is not included in the analysis of total reduplication because it does not have any effect on this construction. The MAX-BR, by which every element in the base has a correspondence in the reduplicant (Lin, 2018), is the reduplicative identity constraint. In addition, the stem in reduplication always appears in full without any deletion or assimilation. In other words, the stem in reduplication is not

affected by either the reduplicant or the reduplication. Therefore, MAX-IO, whereby input segments must have corresponding outputs (no deletion in the base), dominates other constraints.

In addition to the above constraints, the monopthongization should also be accounted for. Al-Harbi (2003) proposes some syllable structure constraints for Acehnese syllabification, and one of them is *COMPLEX^{NUC}, i.e., only one segment may associate with the nucleus. For the monopthongization in reduplicant to pass the MAX-BR constraint, *COMPLEX^{NUC} should dominate MAX-BR to satisfy the emergence of the unmarked in reduplication, i.e., the order of ranking is faithfulness ⩾ Well-formedness ⩾ Reduplicative identity. In this case, MAX-IO is categorized into faithfulness constraint, *COMPLEX^{NUC} is a well-formedness constraint, and MAX-BR is a reduplicative identity. In short, the ranking of constraints can be concluded in (1).

(1) Ranking of constraints for total reduplication constraint
MAX-IO ⩾ *COMPLEX^{NUC} ⩾ MAX-BR

The ranking in (1) is applied to the reduplicated words ending in a closed syllable, i.e., *mãseŋ-mãseŋ* 'each' shown in Tableau 2, and to the reduplicated words ending in a diphthong, i.e., *manɔ̃-manɔ̃ə* 'to take a bath (more than once)' presented in Tableau 1 to confirm the ranking.

Tableau 1. Acehnese total reduplication for words ending in closed syllable

	RED + mãseŋ	MAX-IO	*COMPLEX^{NUC}	MAX-BR
☞a.	mãseŋ - mãseŋ			
b.	mãse - mãseŋ			*!
c.	mãs - mãseŋ			*!*
d.	mã - mãseŋ			*!**
e.	seŋ - mãseŋ			*!*
f.	mãse - mãse	*!		

Tableau 2. Acehnese total reduplication for words ending in diphthong

	RED + mãnɔ̃ə	MAX-IO	*COMPLEX^{NUC}	MAX-BR
a.	**mãnɔ̃ɔ̃**-mãnɔ̃ə	**!		
☞b.	**mãnɔ̃**-mãnɔ̃ə	*		*
c.	**mãn**-mãnɔ̃ə	*		**!
d.	**mã**-mãnɔ̃ə	*		**!*
e.	**mãnɔ̃**-mãnɔ̃	!*		

Most candidates in Tableau 1 violate MAX-BR and one candidate (f), in which the stem changes, violates MAX-IO, which is always fatal in reduplication. *COMPLEX^{NUC} is not violated because there is no candidate with the nucleus of more than one vowel. The winning candidate **mãseŋ** - mãseŋ is the perfect candidate because it does not violate any constraint in total reduplication.

For reduplicated words whose base ends with a diphthong, as presented in Tableau 2, all candidates violate *COMPLEX^{NUC} at least once after surviving the faithfulness constraint MAX-IO. However, candidate (a) violates the

*COMPLEX^{NUC} constraint twice, which is a fatal violation. The violation of *COMPLEX^{NUC} twice results in the elimination of candidate (a). Most of the surviving candidates are eliminated by reduplicative identity schema MAX-BR. The ranking of constraints in Tableau 2 confirms that the ranking in (1) governs the total reduplication in Acehnese. The elimination process is completed by three constraints, i.e., MAX-IO, *COMPLEX^{NUC}, and MAX-BR, with the ranking of MAX-IO ⩥ *COMPLEX^{NUC} ⩥ MAX-BR. Therefore, the emergence of the unmarked in Acehnese total reduplication supports the schema of the emergence of the unmarked in (2) always applies in the reduplicant as also found in Tamil (Ramasamy, 2020), although the language as a whole violates it. In other languages, such as Abui and Kurdish, diphthongs are retailed in the reduplicant (Klamer & Saad, 2020; Yeganeh & Jahanfar, 2018). On the other hand, Sanskrit simplifies complex onset in a reduplicant (Inkelas, 2014).

(2) Emergence of the unmarked in Acehnese total reduplication

Schema	Faithfulness	⩥	Well-formedness	⩥ Reduplicative identity
Instantiation	MAX-IO	⩥	*COMPLEX^{NUC}	⩥ MAX-BR

Partial reduplication

Partial reduplication in Acehnese is divided into two categories: reduplicating prefixes and reduplicating suffixes (Mustafa, 2022a). The OT analysis for the two categories cannot be combined. Lin (2015) proposes an approach to analyzing partial reduplication, which involves *alignment*. In more general word formation, alignment is expressed as ALIGN, i.e., the edge of the Grammatical Word coincides with the edge of the Prosodic Word (PrWd). In reduplication, the ALIGN is more specific, depending on whether it is used to analyze reduplicating prefixes or suffixes.

Reduplicating prefix

Reduplicating prefix is characterized by the reduplication in which the reduplicant is on the left of the stem, e.g., *mã-mãndum* ‘all EMP.’ In *mã-mãndum*, it is evident that the reduplicant *mã* is copied from the first syllable for the stem *mãndum* ‘all.’ Therefore, one of the constraints for reduplicating prefixes should rule this reduplicant position. Such a rule, proposed by Lin (2015), is presented in (3).

(3) ALIGN-RED-L
The left edge of the reduplicant coincides with the left edge of PrWd.

In addition to the constraint in (3), to form partial reduplication in Acehnese, only the first syllable of the stem is copied. Ate (2021) uses the syllable restriction constraint, which can be presented in (4), to explain the prevention of more than one syllable occurring in the reduplicant. In Acehnese, this constraint prevents reduplicated words like **mãndum-mãndum* from surviving EVAL.

(4) RED ≤ σ
Reduplicant must not be longer than one syllable.

In total reduplication, NO-CODA was found not to be a significant constraint. However, this is not the case with the partial reduplicating affix. The reduplicant does not contain all segments of the first syllable in the stem. The syllable in the reduplicant is always open. Therefore, NO-CODA prevents the reduplicated word **mãn-mãndum* from appearing in the surface form. On the other hand, reduplicative identity MAX-BR is the most dominant constraint in partial reduplication because, in addition to the order in emergence of the unmarked, the reduplicant syllabus is single, and most stems that undergo this kind of partial reduplication are disyllabic. Tableau 3 shows the order of the constraints described above.

Tableau 3. Reduplicating prefixes with closed-syllable base in Acehnese

	RED + mãndum	MAX-IO	ALIGN-RED-L	RED ≤ σ	NO-CODA	MAX-BR
a.	**mãndum**-mãndum			*!	****	
b.	**mãndu**-mãndum			*!	***	***
c.	mãndum-**du**		*!		**	***
d.	**mãn**-mãndum				***!	****
e.	**mãn**-mãndu	*!				
☞ f.	**mã**-mãndum				**	****

Tableau 4. Reduplicating prefixes with open-syllable base in Acehnese

	RED + ʃɛdara	MAX-IO	ALIGN-RED-L	RED ≤ σ	NO-CODA	MAX-BR
a.	**ʃɛdara**-ʃɛdara			**!		
b.	**ʃɛda**-ʃɛdara			*!		**
c.	ʃɛdara-**dara**		*!	*		**
d.	ʃɛdara-**ra**		*!			****
e.	**ʃɛ**-ʃɛdar	*!				
☞ f.	**ʃɛ**-ʃɛdara					****
g.	ʃɛdara-**dar**		*!		*	***

The domination of ALIGN-RED-L in Tableau 3 eliminates candidate (c), which would have overlapped the winning candidate (f) if the ALIGN-RED-L constraint had not eliminated it. If RED ≤ σ had not eliminated candidates (a) and (b), they would have been eliminated by NO-CODA constraint. Therefore, RED ≤ σ may seem insignificant for partial reduplication with a closed-syllable base. However, this does not prove that RED ≤ σ is insignificant. In Tableau 3, all syllables in the stem are closed; therefore, NO-CODA is available to eliminate candidates in (a) and (b). However, some stems which undergo partial reduplication contain open syllables, e.g., *ʃɛdara* 'relative (n.)' in Tableau 4. Without RED ≤ σ, candidate (b) in Tableau 4 would defeat candidate (f), resulting in an ill-formed reduplicated word **ʃɛda-ʃɛdara*, which is accepted in some languages like Kodi – a local language in Indonesia (Ate, 2021). Therefore, both ALIGN-RED-L and RED ≤ σ are very significant for the formation of the reduplicating prefix in Acehnese. In addition, the faithfulness constraint MAX-IO is invisible and insignificant for the given candidates in both tables. However, it is essential to eliminate reduplicated words such as**ʃɛ-ʃɛda*, which is the candidate (e) in Tableau 4. In short, the ranking for a reduplicating prefix can be formulated in (5).

(5) Ranking for reduplicating prefixes:
MAX-IO ≫ ALIGN-RED-L ≫ RED ≤ σ ≫ NO-CODA ≫ MAX-BR

Reduplicating suffix

The reduplicating suffix in Acehnese behaves differently from the reduplicating prefix. Because the reduplicant is aligned on the right edge, the ALIGN-RED-POSITION is still relevant to this reduplication after the position has been adjusted to the position of the reduplicating prefix, i.e., on the right (R). It is shown in (6) that the modification of constraint for reduplicating prefix to meet the location of reduplicant in reduplicating suffix.

(6) ALIGN-RED-R
The right edge of the reduplicant coincides with the right edge of PrWd.

Another important constraint for reduplicating suffixes is a constraint related to the syllable structure of the reduplicant. Unlike the reduplicating prefix, which does not allow closed syllables, the reduplicating suffix allows both closed and open syllables, depending on the last syllable of the stem. Therefore, the reduplicant preserves all copied segments, i.e., the segments of the last syllable in the stem. To minimize the deletion of the segment, which can result in coda deletion, a MAX-BR constraint is required. It ensures that every element of the stem has a correspondence in the reduplicant. In addition, the NO-CODA constraint is not significant for reduplicating suffixes.

The constraint that keeps the number of syllables to one is very important in analyzing reduplicating suffixes because the reduplicant only has one syllable. This constraint is RED ≤ σ, reduplication must not have more than one syllable, and violation of this constraint is fatal. In addition, the syllable structure in the reduplicant is identical to the structure of the last syllable of the base. Therefore, an insertion such as **ʔube-beʔ* for *ʔube-be* 'as big as EMP' in the reduplicant must be prevented. For that purpose, a new constraint must be introduced. The constraint which prevents this insertion/substitution is presented in (7).

(7) DEP-BR
Every element of the reduplicant has a correspondent in the base.

DEP-BR and MAX-BR have opposite functions in the hierarchy. DEP-BR prevents insertion, while MAX-BR prevents deletion. For **ʔube-beʔ* can be ruled out, insertion must outrank deletion.

Tableau 5. Reduplicating suffixes with closed-syllable base in Acehnese

	gɯnãp + **RED**	MAX-IO	ALIGN-RED-R	RED ≤ σ	DEP-BR	MAX-BR
a.	gɯnãp-**gɯnãp**			*!		
☞ b.	gɯnãp-**nãp**					**
c.	gɯnãp-**nã**					***!
d.	**gɯn**-gɯnãp		*!			**
e.	**gɯ**-gɯnãp		*!			***
f.	**nãp**-gɯnãp		*!			**
g.	nãp-**nãp**	*!				

Tableau 6. Reduplicating suffixes with open-syllable base in Acehnese

	ʔube + **RED**	MAX-IO	ALIGN-RED-R	RED ≤ σ	DEP-BR	MAX-BR
	a. ʔube-**ʔube**			*!		
☞	b. ʔube-**be**					**
	c. ʔube-**beʔ**				*!	**
	d. **ʔub**-ʔube		*!			**
	e. **ʔu**-ʔube		*!			**
	f. be-**ʔube**	*!				
	g. ʔube-**bei**				*!	**

DEP-BR in Tableau 5 is not violated by any candidates because the reduplicated syllable is closed. In a closed syllable, no consonant can be a substitute for the coda in Acehnese because this language does not allow *COMPLEX^{CODA} at all. The deletion of a consonant in the coda, as shown in (b), which is possible in Acehnese because the NO-CODA constraint is not always violated, is prevented by the reduplicative identity constraint MAX-BR. In Tableau 6, DEP-BR is not violated by candidate (c). Unlike in reduplication with closed-syllable bases, DEP-BR is essential in eliminating ill-formed candidates in the reduplicating suffix with open-syllable bases. DEP-BR eliminates reduplicant candidates when a vowel, which creates a diphthong, is inserted, as presented in (g). Besides vowel insertion, DEP-BR also prevents the insertion of a consonant, which consequently makes the syllable closed because a closed syllable is allowed in Acehnese. Finally, Tableau 5 and Tableau 6 confirm the ranking for reduplicating suffixes, which is presented in (8).

(8) Ranking for reduplicating suffixes:
MAX-IO ⩾ ALIGN-RED-R ⩾ RED ≤ σ ⩾ DEP-BR ⩾ MAX-BR

Combined constraints for partial reduplications

The constraints and order for reduplicating prefixes and suffixes can be simplified because they follow the same rule except for the edge sync, either left edge sync for reduplicating prefixes or right edge synch for reduplicating suffixes. Therefore, the ranking of constraint for partial reduplication is represented in (9), and the application is presented in Tableau 8.

(9) Ranking for partial reduplications in Acehnese
MAX-IO ⩾ ALIGN-RED-R/L ⩾ RED ≤ σ ⩾ *CODA ⩾ DEP-BR ⩾ MAX-BR

Tableau 7. Ranking of constraints in Acehnese partial reduplication

	RED + bandum	MAX-IO	ALIGN-RED-L	RED ≤ σ	*CODA	DEP-BR	MAX-BR
	a. **bandum**-bandum			***!			
	b. **bandu**-bandum			**	***!		*
	c. **ban**-bandum				***!		***
☞	d. **ba**-bandum				**		****

	siʔat + **RED**	MAX-IO	ALIGN-RED-R	RED ≤ σ	*CODA	DEP-BR	MAX-BR
	a. siʔat-**siʔat**			**!			
☞	b. siʔat-**ʔat**				**		**
	c. siʔat-**ʔata**		*!		*	*	**
	d. siʔat-**ʔa**		*!	*	**		*

Tableau 7 shows that the constraints that tend to be fatally violated by ill-formed candidates are alignment, syllable size, and coda avoidance. Dependency is not violated due to the limited candidates that are presented in the tableau. DEP-BR commonly precedes reduplicative identity constraints in other languages, such as Saraiki, an Indo-Aryan language spoken in Pakistan (van de Weijer & Atta, 2020). In addition, Tableau 1 through Tableau 7 shows that there is no underapplication or overapplication in Acehnese reduplication, unlike languages like Lakota (Paschen, 2022).

Conclusion

The objective of this study is to find the constraints and their orders in Acehnese reduplication using Optimality Theory (OT). Based on the analyses, the study found that the constraint which governs the total reduplication in Acehnese is no complex nucleus, suggesting that the diphthong in the base is shortened in the reduplicant. For partial reduplication, the constraints for a reduplicating prefix include left edge sync (for a reduplication affix) or right edge sync (for a reduplicating suffix), one syllable reduplicant. The absence of a coda applies to all patterns of reduplication ranked higher than no insertion, which outranks no deletion. In addition, all patterns of reduplication follow regular application where faithfulness precedes well-formedness, which is proceeded by reduplicative identity. Therefore, the order of constraints that apply to all patterns of reduplication can be shown as follows.

(a) Total Reduplication:
MAX-IO ⪢ *COMPLEX^{NUC} ⪢ MAX-BR
(b) Partial reduplication for reduplicating prefix:
MAX-IO ⪢ ALIGN-RED-L ⪢ RED ≤ σ ⪢ NO-CODA ⪢ MAX-BR
(c) Partial reduplication for reduplicating suffix
MAX-IO ⪢ ALIGN-RED-R ⪢ RED ≤ σ ⪢ DEP-BR ⪢ MAX-BR

The present study has shown the ranking of constraints for total and partial reduplications in Acehnese. However, rhyming reduplications are very frequent in the language, but the analysis in the present study is restricted due to the limitation of the framework. This requires the establishment of long and complex constraints, such as those used by Chand and Kar (2017), which can make the discussion in this paper imbalanced. Therefore, future study needs to seek a solution to the implementation of OT in analyzing rhyming reduplication in Acehnese and other languages to understand how vowel and consonant alteration between a base and reduplicant is governed by phonological constraints.

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