The Diversity of Nasal Behaviour in Banjarese Prefixation: An Optimality Theory based Approach

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ABSTRACT

The prefixation of /maN-/ in the Banjarese is known to cause the nasal segment to behave differently. However, in previous studies on Banjarese prefixation, these nasal behaviors were not given full attention, as affixation (including prefixation) was merely considered one of the morphological processes of word formation. This paper aims to analyze these nasal behaviors at the prefix-base boundary and the factors that cause them to behave as they do. Data were collected using two methods: interviews and a word list. Three types of nasal behavior were identified as follows: nasal assimilation, nasal substitution, and nasal deletion. Each behavior is governed by specific constraints present in the language. Nasal assimilation results from a constraint that prohibits the clustering of nasal-obstruent segments with different places of articulation, while nasal substitution is employed to address sequences involving a nasal and a voiceless obstruent. On the other hand, nasal deletion occurs due to a constraint that disallows the clustering of sonorant segments at the prefix-base boundary.

Keywords: Banjarese; constraint; nasal assimilation; nasal deletion; nasal substitution

INTRODUCTION

The study of the affixation process in the Banjarese has received considerable attention from previous scholars such as Hapip, Kawi, and Noor (1981), Giovanni (2004), Humaidi, Kamariah, and Harpriyanti (2017), and Yayuk (2017). According to them, prefixes that end with a nasal segment such as /maN-/ and /paN-/, tend to change depending on the segment that follows, resulting in nasal assimilation, nasal substitution, or nasal deletion. These three nasal behaviors are also observed in several other languages. Katamba (1989) defines nasal assimilation as the sharing of the place of articulation between the nasal and the following consonant. Polish has a well-motivated process of nasal assimilation, in which coronal nasals assimilate to the place of articulation of the following plosive or affricate (Iwan, 2015). This process is shown as:

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(1) Nasal Assimilation in Polish (Iwan, 2015)

	Input	**Output**
(a)	/kɛnp+a/ 'cluster'	[kɛm.pa]
(b)	/kɔnt/ 'angle'	[kɔnt]
(c)	/rɛnk+a/ 'hand'	[r ɛ ŋ.ka]

Based on (1(b)), we can see that homorganic clusters in Polish can form either within the root itself or be triggered by the presence of affixes. In terms of Optimality Theory (OT), assimilation occurs as a result of the interaction between faithfulness constraints and well-formedness (markedness) constraints. Faithfulness constraints are a type of constraint that requires the observed surface form to match the underlying or lexical form in some particular way. In simple terms, these constraints require identity preservation between input and output forms. On the other hand, markedness constraints impose requirements on the structural well-formedness of the output. Iwan (2015) proposed a markedness constraint that can be used to enforce assimilation, which is formulated as follows:

(2) **Nasal Assimilation** (NA)
Nasals must agree in place with the following plosive or affricate.

Nasal assimilation can be found in various languages such as Malay (Syed Jaafar, 2013b), Indonesian (Kurniawan, 2016), as well as in some Malay dialects, such as the Saribas Malay dialect (Hamid @ Ahmed and Syed Jaafar, 2017). According to Syed Jaafar (2013b), the phonological behavior of the nasal segments in the Malay prefixes /pəN-/ and /məN-/ is always homorganic with the following consonant of the root. Both Malay and Indonesian share many similarities in terms of their prefixes. The following are some examples of the Malay and Indonesian prefixation processes that trigger nasal assimilation:

(3) Nasal Assimilation in Malay (Ahmad and Jalaluddin, 2012)

	Input	**Output**
(a)	/məN-ba.las/ ACT.PRF-react 'reacting'	[məm.ba.las]
(b)	/məN-da.taŋ/ ACT.PRF-come 'coming'	[mən.da.taŋ]
(c)	/məN-ga.li/ ACT.PRF-dig 'digging'	[meŋ.ga.li]
(d)	/məN-ʤi.lat/ ACT.PRF-lick 'licking'	[mən.ʤi.lat]

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(4) Nasal Assimilation in Indonesian (Kurniawan, 2016)

	Input	**Output**
(a)	/məN-be.li/ ACT.PRF-buy 'buying'	[məm.be.li]
(b)	/məN-da.pat/ ACT.PRF-get 'getting'	[mən.da.pat]
(c)	/məN-gun.tiŋ/ ACT.PRF-cut with scissor 'cutting with scissor'	[məŋ.gun.tiŋ]
(d)	/məN-ʤa.wap/ ACR.PRF-answer 'answering'	[mən.ʤa.wap]

Similar to Iwan (2015), Kurniawan (2016) as well as Ahmad and Jalaluddin also proposed a similar type of constraint to explain the assimilation process. Kurniawan (2016) introduced the Nasal Assimilation (NA) constraint, which is used to block any nasal-obstruent sequence that does not have the same place of articulation. On the other hand, Ahmad and Jalaluddin (2012) suggested a different approach to dealing with assimilation, through the CODA-COND constraint, as shown in (5). Both the Nasal Assimilation (NA) and CODA-COND constraints serve the same function: ensuring that the nasal segment shares the same place of articulation as the following segment.

(5) **CODA-COND**
A coda consonant is a nasal homorganic to a following stop or affricate.

Aside from nasal assimilation, prefixation in Banjarese also triggers nasal substitution. Pater (1999) defines nasal substitution as the replacement of a base-initial voiceless obstruent by a homorganic nasal. Nasal substitution is one of several processes languages use to eliminate *NC̥ clusters. Other processes include post-nasal voicing, nasal deletion, and denasalization. The *NC̥ constraint is defined as follows:

(6) ***NC̥**
No nasal/ voiceless obstruent sequences

It has been widely claimed that a sequence of nasal and voiceless obstruent segments is not allowed to emerge in the surface representation. According to Pater (1999), NC̥ clusters are disfavored in a wide variety of languages. Some languages that adhere to this constraint include Javanese (Poedjosoedarmo, 1982), Toba Batak (Hayes, 1986), Indonesian (Kurniawan, 2016), and Malay (Syed Jaafar, 2013a). Below are some examples of nasal substitution that occur in Indonesian:

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(7) Nasal Substitution in Indonesian (Kurniawan, 2016)

	Input	**Output**
(a)	/məN-pilih/ ACT.PRF-choose,vote ‘chosing, voting’	[mə.mi.lih]
(b)	/məN-tulis/ ACT.PRF-write ‘writing’	[mə.nu.lis]
(c)	/məN-kasih/ ACT.PRF-give ‘giving’	[mə.ŋa.sih]
(d)	/məN-sa.pu/ ACT.PRF-sweep ‘sweeping’	[mə.ɲa.pu]

However, the case is slightly different in Toba Batak. According to Hayes (1986), in order to encounter the *NC̥ constraint, a process known as denasalization is used. The rule of denasalization converts nasals to voiceless stops before voiceless-initial consonants of the following word. The linear notation along with some examples of denasalization in Toba Batak can be seen as below:

(8) Denasalization Notation (Hayes, 1986)

$$\begin{bmatrix} \text{C} \\ +\text{nasal} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{nasal} \\ -\text{voice} \end{bmatrix} \;/\; \underline{\quad\quad} \begin{bmatrix} \text{C} \\ -\text{voice} \end{bmatrix}$$

(9) Denasalization in Toba Batak (Hayes, 1986)

	Input	**Output**
(a)	/ma.na.nɔm pi.riŋ/ ACT.PRF-bury dish ‘to bury a dish’	[ma.na.nɔp pi.riŋ]
(b)	/maŋinum tuak/ ACT.PRF-drink palm wine ‘to drink palm wine’	[ma.ŋi.nup tuak]
(c)	/ma.mɛ.rɛŋ ka.lab.bu/ ACT.PRF-look at net ‘to look at a mosquito net’	[ma.mɛ.rɛk ka.lab.bu]
(d)	/ho.lom saɔ.tik/ ACT.PRF-dark somewhat ‘somewhat dark’	[ho.lop saɔ.tik]

Denasalization in Toba Batak does not occur at the prefix-base boundary. Instead, it takes place within word boundaries. This nasal behavior is rarely observed in Banjarese, where the only attested strategy for avoiding *NC̥ clusters is nasal substitution. Another way a nasal segment in Banjarese may behave during prefixation is by being completely deleted from the derived word. The linear notation of nasal deletion is shown in (10) below. According to Alimi and Kassin (2018), nasal deletion occurs not only when the nasal is followed by another segment, but also when it is followed specifically by sonorant segments such as /l/, /r/, /w/, and /j/, as shown in (11).

(10) Nasal Deletion Notation (Alimi and Kassin, 2018)

$$\begin{bmatrix} \text{C} \\ +\text{ nasal} \end{bmatrix} \rightarrow \varnothing \; / \; \_\_\_ + \begin{bmatrix} \text{C} \\ +\text{sonorant} \end{bmatrix}$$

(11) Nasal Deletion in Malay (Alimi and Kassin, 2018)

	Input	Output
(a)	/pəN-rom.pak/ PRF-rob ‘robber’	[pə.rom.paʔ]
(b)	/pəN-la.jan/ PRF-wait ‘waiter’	[pə.la.jan]
(c)	/məN-ja.kin-i/ ACT.PRF-convince ‘to convince’	[mə.ja.ki.ni]
(d)	/məN-wa.kil-i/ ACT.PRF-represent ‘to represent’	[mə.wa.ki.li]

Nasal deletion also occurs in the Patani Malay dialect, one of the Malay dialects spoken in Southern Thailand, specifically in the Yala, Narathiwat, and Pattani districts. According to Hamid and Hayeeteh (2015), the deletion of one of the consonants in a homorganic nasal-obstruent cluster is due to a process known as *delinking*, which is influenced by the voicing of the obstruent segment. Unlike in standard Malay, the nasal deletion process in the Patani Malay dialect can occur within the base itself, as shown below:

(12) Nasal Deletion in Patani Malay Dialect (Hamid and Hayeeteh, 2015)

	Input	Output
(a)	/kam.puŋ/ ‘village’	[ka.poŋ]
(b)	/ban.tal/ ‘pillow’	[ba.ta]

Now, returning to the main issue discussed in this paper: the nasal segment in Banjarese can indeed behave in various ways, particularly at the prefix-base boundary. However, these nasal behaviors have not received full attention from previous scholars. The affixation process has generally been treated solely as a morphological aspect of word formation. In reality, affixation, especially the prefixation of /maN-/, also involves phonological changes to the nasal segment at the boundary between the prefix and the base word. In this paper, we examine three conditions that cause the nasal segment in the prefix to either assimilate, be substituted, or be deleted.

RESEARCH METHODOLOGY

Data for this study were collected using two methods: interviews and word lists. The aim of this study is to identify sound changes that occur when a base word in Banjarese undergoes the derivation process. Therefore, the interview method is an appropriate approach for collecting data focused on phonological aspects. This study employed an unstructured interview method, in which the interview does not follow a specific framework for questioning. There are no predetermined answers, and the interview adapts based on the participant's responses. This approach allows respondents greater freedom, resulting in a broader range of data for the study.

The conversation topics were based on a list of Banjarese words prepared in advance, prior to the start of the interviews. Respondents were asked about the meanings of certain Banjarese words, and they explained these meanings in the Malay language. For this purpose, individuals proficient in both Banjarese and Malay were selected as respondents. Once the meanings of the base words were provided, respondents were then asked to pronounce the derived forms that result from attaching the /maN-/ prefix to the base words. Afterward, respondents were asked again to explain the meanings of the resulting derived words. The reason respondents were asked to provide the meanings of both the base word and the derived word was to determine whether the prefixes in question carry the same meaning, even when paired with different words. In addition, the meanings provided by the respondents were compared with those in the dictionary to determine whether there are differences between the Banjarese as used in Malaysia and in Indonesia.

To investigate the effect of the nasal segment in the /maN-/ prefix on the base word, a total of 60 base words from different word categories (such as nouns, verbs, and adjectives) were selected for this study. The list was created based on a Banjarese dictionary titled Kamus Bahasa Banjar Dialek Hulu–Indonesia (Sugono, 2008), published in South Kalimantan, Indonesia. The Banjarese people are considered native to certain regions of South Kalimantan (Imadduddin, 2016). Therefore, the words retrieved from this dictionary are regarded as more authentic, given that the dictionary was published in an area where native speakers reside. In addition, the dictionary provides each word along with its derived form(s), which further simplified the data collection process for this study and enabled a comparison between the newly collected data and the existing entries in the dictionary.

The next method is known as the word list method. According to Haji Omar (2008), the pronunciation or word list method requires a respondent to respond to every word included in the prepared list. The list contains familiar words that are frequently used by the Banjarese community. Vaux and Cooper (1999) stated that word lists used in dialect surveys typically include terms related to farm implements, natural phenomena, household items, and culture-specific concepts. These types of words have proven to be highly effective in eliciting both interest and useful vocabulary from non-urban informants. Through this method, a selection of Banjarese base verbs was given to the respondents. The respondents were then asked to state the derived word that is formed when the base word receives the /maN-/ prefix. Unlike the interview method, the word list method does not require respondents to explain the meanings of each word in the Malay language. The list of words used in this method was the same as the one used in the interview method.

OPTIMALITY THEORY

In early Generative Grammar, phonological processes were represented as *rewrite rules*, and the primary mode of interaction between input and output was explained through *linear ordering*. Rules applied sequentially, with the output of one rule serving as the input for the next. However, it was soon observed that this rule-based framework imposed few restrictions on what constituted a 'possible rule' or a 'possible rule interaction.' To address these issues, a constraint-based theory known as Optimality Theory (OT) was introduced. This theory was first introduced by Prince and Smolensky in 1991, proposing that the observed forms of language arise from the optimal satisfaction of conflicting constraints. According to Kager (2004), the idea of violability constraints in OT is different from that of classical rule-based theory in that UG is defined as inviolable principles and rule schemata (or "parameters"). OT offers a unified way of expressing which constraints are violable namely, through constraint ranking, where violations of lower-ranked constraints are tolerated in order to satisfy higher-ranked ones (Archangeli, 1999). This theory differs from other approaches to phonological analysis, which typically use rules rather than constraints.

The grammar of a particular language can be effectively described using Optimality Theory (OT). At the universal level, a set of constraints on phonological representations (CON) exists. There is also a component responsible for generating the relationship between an actual input and all potential outputs (GEN). Finally, there is a mechanism for simultaneously evaluating all potential outputs against the ranked set of constraints to select the optimal output for the given input (EVAL). Each language must determine its set of inputs and an appropriate ranking of CON, known as the constraint hierarchy. The information encoded for a specific language interacts with universal grammar. Upon encountering an input, GEN produces a candidate set, showing correspondences between elements in the candidates and elements in the input. EVAL then applies the constraint hierarchy of the language to select the optimal output for that input. Figure 1 below illustrates how OT functions:

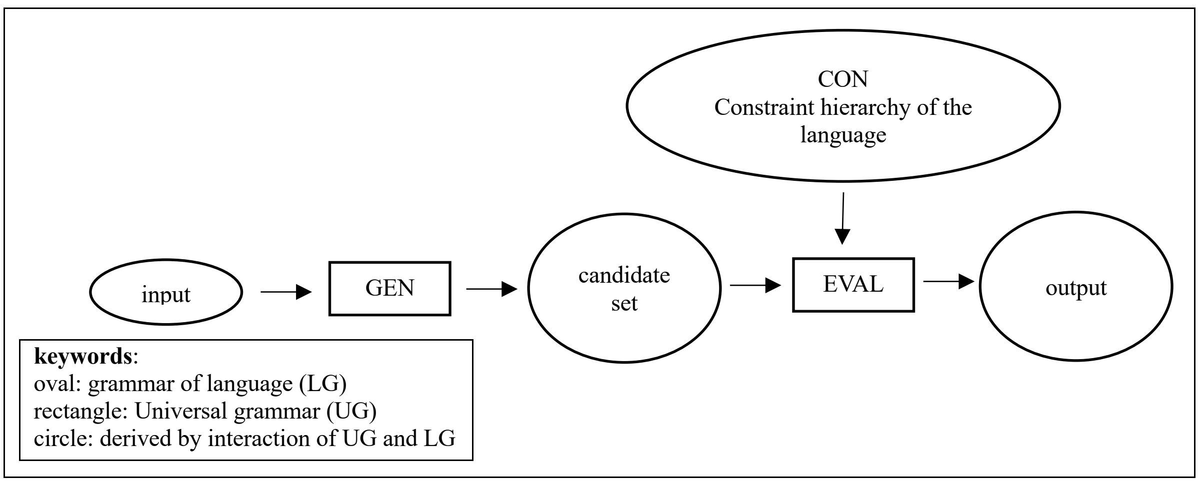

FIGURE 1. A Schematic Grammar at Work

In this study, the input refers to the Banjarese base word. Once prefixation occurs, GEN generates several derived words referred to as the candidate set that could potentially result from the base receiving the /maN-/ prefix. The output, on the other hand, refers to the most optimal derived word formed at the end of the analysis. A derived word is considered the most optimal output if it successfully satisfies all the constraints within the constraint hierarchy.

RESULTS AND DISCUSSION

The data collected through the interview method indicates that Banjarese language used in Malaysia has the same grammar as the one in Indonesia. There is no difference in terms of semantic meaning between the words, although some may not be commonly used by the Banjarese community in Malaysia compared to those in Indonesia. The data also indicate that the nasal segment in the prefix behaves differently depending on the initial segment of the base. Three different behaviors were identified: nasal assimilation, nasal substitution, and nasal deletion. Throughout this section, we will discuss the constraints involved in each process in greater detail.

NASAL ASSIMILATION

The first condition we will discuss involves the clustering of nasal and voiced obstruent segments, specifically at the boundary between the prefix and the base. Voiced obstruent segments such as /b/, /g/, /d/, and /dʒ/ can trigger the assimilation of the nasal segment at the prefix-base boundary, as shown in (13) below:

(13) Nasal Assimilation in Banjarese Prefixation

	Input	**Output**
(a)	/maN-ba.bun/ ACT.PRF-drum 'hitting the drum'	[mam.ba.bun]
(b)	/maN-gan.dul/ ACT.PRF-hitchhike 'hitchhiking'	[maŋ.gan.dɔl]
(c)	/maN-da.daj/ ACT.PRF-hang 'hanging'	[man.da.daj]
(d)	/maN-dʒa.mur/ ACT.PRF-dry 'drying'	[man.dʒa.mur]

The nasal and voiceless obstruent (NC̥) cluster at the prefix-base boundary appears to be disfavored in many languages, including Banjarese. The common way to deal with this is by nasal substitution (refer to NASAL SUBSTITUTION section). However, there is an exception to this language. The *NC̥ was violated when it came to the voiceless obstruent segment /tʃ/. Instead of triggering the nasal substitution, the presence of this segment at the initial base has caused the nasal segment to assimilate. Below are some examples to support this claim:

(14) Violation of *NC̥ at Prefix-Base Boundary in Banjarese

	Input	**Output**
(a)	/maN-tʃu.ɲul/ ACT.PRF-appear 'appearing'	[man.tʃu.ɲul]
(b)	/maN-tʃun.tan/ ACT.PRF-steal 'stealing'	[mant.ʃun.tan]
(c)	/maN-tʃi.puj/ ACT.PRF-pour water 'watering'	[man.tʃi.puj]
(d)	/maN-tʃa.ri/ ACT.PRF-seek 'seeking'	[man.tʃa.ri]

Just like Polish (Iwan, 2015), homorganic cluster in Banjarese also can happen within the root-internally (as shown in (15)) or be triggered by the presence of affixes. However, only certain prefixes including /maN-/ and /paN-/ could trigger this process (as demonstrated in (13)).

(15) Homorganic Cluster within the Root-Internally in Banjarese

	Input	Output
(a)	/lam.bu/ 'cow'	[lam.bu]
(b)	/laŋ.gar/ 'prayer hall'	[laŋ.gar]
(c)	/man.di/ 'shower'	[man.di]
(d)	/un.ʤɔn/ 'fishing rod'	[un.ʤɔn]

Banjarese does not allow a nasal segment to be followed by a heterorganic segment, even within a base word. To account for this, we apply the NA constraint. Now, let us look at other constraints involved in the nasal assimilation process. According to Pater (1999), nasal-voiced obstruent sequences are treated differently from nasal-voiceless obstruent sequences, as they are typically preserved faithfully in the output (as shown in (13)). Both nasal and voiced obstruent segments need to be preserved in the output form. Simply put, all segments in both the base and the prefix are accurately represented in the derived form. However, there is an exception concerning the voiceless obstruent segment /tʃ/. Although /tʃ/ is classified as a voiceless obstruent, it is still preserved in the output form. Contrary to Pater's (1999) generalization, this voiceless obstruent behaves similarly to voiced obstruent in this context. Nevertheless, to ensure that both the nasal and the voiced obstruent segments appear in the output form, a constraint known as MAX-IO will be used in the analysis. This constraint can be explained as follows:

(16) **MAX-IO**
Input segments must have output correspondents.
('No deletion')

The MAX-IO needs to be placed at the highest rank in the hierarchy. This is to ensure that the optimal candidate will have all of the segments in the derived form. The next constraint that needs to be taken into consideration is LINEARITY-IO. Nasal assimilation happens between a nasal segment and the following consonant, in which they are homorganic to each other. Both segments should appear in the derived form and segment fusion is not allowed. LINEARITY-IO ensures that only a single input segment is related to a single output in a right order.

(17) **LINEARITY-IO**
The output reflects the precedence structure of the input, and vice versa.

LINEARITY-IO works in the same way as MAX-IO, which ensures that every segment in the input has a corresponding segment in the output. However, this constraint specifically targets segment fusion, particularly at the prefix-base boundary. Therefore, it should be ranked lower than MAX-IO. In some languages, the insertion of a segment between a nasal and an obstruent is used as a strategy to avoid segmental fusion, thereby satisfying LINEARITY-IO. However, this strategy violates another important segment correspondence constraint in Banjarese: the DEP-IO constraint. This constraint militates against the presence of segments in the output that have no counterparts in the input (Kager, 2004).

(18) **DEP-IO**
Output segments must have input correspondents. ('No epenthesis')

Nasal assimilation requires that the nasal segment in the prefix exist in the derived form. To put it simply, no denasalization is allowed to happen at the prefix-base boundary. The IDENT-I→O (nasal) constraint will militate against denasalization.

(19) **IDENT-I→O (nasal)**
Any correspondent of an input segment specified as F must be F.
('No denasalization')

It is important to ensure that the initial obstruent segment of the base remains the same voiced segment in the derived form. Therefore, IDENT-IO (voice) can be applied in this analysis. However, Pater (1999) proposed a more specific identity constraint that is more narrowly focused than IDENT-IO (voice), as it is limited to voicing in obstruent segments. This more specific constraint is known as IDENT-IO (Obstruent Voice).

(20) **IDENT-IO(ObsVce)**
Correspondent obstruents are identical in their specification for voice.
('No changes in the voicing of obstruents')

Another factor to consider is that nasal assimilation often alters the place feature of the nasal segment, thereby violating one of the faithfulness constraints: IDENT-IO (place). This constraint ensures that each segment in the input retains the same place feature in the output. Segmental deletion does not violate this constraint; however, nasal assimilation does. Therefore, IDENT-IO (place) will be placed at the lowest ranking in the hierarchy. This constraint can be explained as follows:

(21) **IDENT-IO (place)**
The specification for place of articulation of an input segment must be preserved in its output correspondent.

Bringing together all of the constraints discussed so far, an OT analysis will now be presented. The tableau below illustrates the process of nasal assimilation following the prefixation of /maN-/ to the base /babun/ (a musical instrument):

MAX-IO >> LINEARITY-IO >> DEP-IO >> NA >> IDENT-I→O (nasal) >> IDENT-IO (place)

Input : /maN + babun/	MAX-IO	LINEARITY-IO	DEP-IO	NA	IDENT-I→O (nasal)	IDENT-IO (ObsVce)	IDENT-IO (place)
a. ma.babun	*!						
b. ma.mabun	*!	*					
c. maŋa.babun			*!				
d. maŋ.babun				*!			
e. mab.babun					*!		
f. mam.pabun						*!	
☛g. mam.babun							*!

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Seven candidates are presented in the tableau above. The '*!' symbol indicates a fatal violation of a constraint. Candidates that commit a fatal violation are disqualified from being selected as the optimal output. Even after disqualification, some candidates may still violate other constraints; these violations are marked with a '*' symbol. At the highest-ranked constraint, candidates (a) and (b) are eliminated due to segmental deletion, which violates MAX-IO. Candidate (b) also violates the LINEARITY constraint due to segmental fusion between /N/ and /b/, resulting in the formation of segment /m/. Next, the DEP-IO constraint, which prohibits epenthesis, eliminates candidate (c). Candidate (d) is eliminated for violating the NA constraint; the nasal segment in this candidate does not share the same place of articulation as the following segment. It is also crucial that the nasal segment appears in the derived form, which is why candidate (e) is eliminated. Due to a change in the voicing of the obstruent segment, candidate (f) violates IDENT-IO (Obstruent Voice) and is also eliminated. The remaining candidate, (g), violates IDENT-IO (place), but since no other candidate satisfies all higher-ranked constraints, it is selected as the optimal output.

We will now demonstrate how the same constraints within the same hierarchy can be used to analyze nasal assimilation of the voiceless obstruent segment /tʃ/. The tableau below presents an OT analysis of nasal assimilation for the base form /tʃuŋul/ (appear):

MAX-IO >> LINEARITY-IO >> DEP-IO >> NA >> IDENT-I→O (nasal) >> IDENT-IO (place)

Input : /maN + tʃuŋul/	MAX-IO	LINEARITY-IO	DEP-IO	NA	IDENT-I→O (nasal)	IDENT-IO (ObsVce)	IDENT-IO (place)
a. ma.tʃuŋul	*!						
b. ma.nuŋul	*!	*					
c. maŋa.tʃuŋul			*!				
d. maŋ.tʃuŋul				*!			
e. mab.tʃuŋul					*!		
f. man.dʒuŋul						*!	
☛g. man.tʃuŋul							*!

From the above tableau, we can see the outcome is the same as before. In the first rank, candidate (a) and (b) were eliminated due to the violation of MAX-IO. Next, candidate (c) was eliminated due to the existence of /a/ segment which violated the DEP-IO constraint. Since the nasal segment does not share the same place of articulation with the initial-base segment, candidate (d) was eliminated due to violation of NA. Due to the violation of IDENT-I→O (nasal) constraint, candidate (e) was eliminated. The remaining two candidates, (f) and (g) were then need to pass through the IDENT-I→O (nasal) segment simultaneously. Due to the violation of this constraint, candidate (f) was eliminated, leaving candidate (g) as the sole winner.

This section discussed how nasal assimilation is typically triggered by voiced obstruent segments. However, there is an exception in the case of the voiceless obstruent segment /tʃ/. Rather than triggering nasal substitution, as most voiceless obstruent does, this segment instead triggers nasal assimilation. Nevertheless, both phenomena can be analyzed using the same constraints within the same hierarchy. In the next section, we will discuss another nasal behavior in Banjarese prefixation: nasal substitution.

NASAL SUBSTITUTION

Banjarese is one of the languages that do not allow nasal and voiceless obstruent clusters during prefixation. According to Pater (2001), a way to deal with this *NÇ constraint is by substituting the obstruent segment with a nasal segment. Asides from /tʃ/, voiceless obstruent segments such as /p/, /t/, /k/ and /s/ can trigger the assimilation of nasal segment in the prefix-base boundary as shown in (22) below:

(22) Nasal Substitution in Banjarese Prefixation

	Input	**Output**
(a)	/maN-pa.gat/ ACT.PRF-cut off ‘cutting off’	[ma.ma.gat]
(b)	/maN-tu.kar/ ACT.PRF-buy ‘buying’	[ma.nu.kar]
(c)	/maN-kam.buh/ ACT.PRF-mix ‘mixing’	[ma.ŋam.buh]
(d)	/maN-sambur/ ACT.PRF-spray ‘spraying’	[ma.ɲam.bur]

However, there is an irregularity regarding nasal substitution in Banjarese. The data in (23) below indicates that nasal substitution does not happen at the base-suffix boundary. As we can see in the data, the nasal-voiceless sequence is allowed to be in the derived word despite violating the *NÇ constraint. Hence, it is safe to say here that nasal substitution in Banjarese only occurs at the prefix-base boundary and not at the base-suffix boundary.

(23) Irregularity of Nasal Substitution at Stem-Suffix Boundary in Banjarese

	Input	**Output**
(a)	/ha.jam-ku/ chicken-POS.SFX ‘my chicken’	[ha.jam.ku]
(b)	/a.diŋ-ku/ younger sibling-POS.SFX ‘my younger sibling	[a.diŋ.ku]
(c)	/gawian-ku/ job-POS.SFX ‘my job’	[ga.wian.ku]

It is possible to look at this nasal behaviour through a rule-based analysis but according to Kager (2004), this approach seems to be inadequate. In rule-based analysis, nasal substitution involves two process which are nasal assimilation and post-nasal voiceless consonant deletion. The nasal assimilation transfers the place of articulation from the obstruent to the nasal. Following this, a separate rule deletes any voiceless consonant that comes after the nasal. The process can be seen as:

(24) Nasal Substitution as a Sequence of Rules (Kager, 2004)

Lexical form:	/məN-pi.lih/
Nasal assimilation	məm.pi.lih
Post-nasal voiceless consonant deletion	mə.mi.lih
Surface form:	[mə.mi.lih]

Although nasal assimilation is a cross-linguistically highly common process, there is no typological evidence seems to exist for ‘post-nasal voiceless consonant deletion’ as it is always in combination with nasal assimilation (Kager, 2004). By reversing the order of the processes, an incorrect outcome will emerge as shown below:

(25) Nasal Substitution: the ‘Dumb’ Rule Order (Kager, 2004)

Lexical form:	/məN-pi.lih/
Post-nasal voiceless consonant deletion	mə.Ni.lih
Nasal assimilation	-
Surface form:	[mə.ŋi.lih]

From (25), we can conclude that rule-based analysis is insufficient to address the issue of nasal substitution. Rather than seeing this process as a combination of multiple processes, it is better for us to see what kind of constraints apply in this situation. The most important constraint will be the *NC̥ constraint, which prevents nasal-voiceless obstruent sequences. However, by abiding by this constraint, a candidate may have to violate LINEARITY-IO due to the fusion between the nasal and obstruent segments.

(26) Correspondence Diagram for Fusion (Kager, 2004)

Input: N p

Output: m

We will now begin the OT analysis of nasal substitution in Banjarese. Since segmental fusion is proposed to prevent nasal–voiceless obstruent sequences, the output form must contain fewer segments than the input. As a result, MAX-IO and LINEARITY-IO must be ranked lowest in the hierarchy. Meanwhile, the *NC̥ constraint should be ranked highest to block nasal–voiceless obstruent sequences from surfacing in the output. Although epenthesis could theoretically resolve such sequences, Banjarese does not employ this strategy. Therefore, to prevent segmental epenthesis, the DEP-IO constraint is included. As with nasal assimilation, nasal substitution also requires the nasal segment to surface in the derived form. Bringing all of these constraints together, the tableau below illustrates the process of nasal substitution following the prefixation of /maN-/ to the base /pagat/ (cut off):

*NC̥ >> DEP-IO >> IDENT→IO (nasal) >> IDENT-IO (ObsVce) >> MAX-IO >> LINEARITY-IO

Input : /maN + pagat/	*NC̥	DEP-IO	IDENT→IO (nasal)	IDENT-IO (ObsVce)	MAX-IO	LINEARITY-IO
a. mam.pagat	*!					
b. manga.pagat		*!				
c. map.pagat			*!			
d. mam.bagat				*!		
e. ma.pagat					*!	*
☛f. ma.magat						*!

Six candidates were presented in the tableau above. Candidate (a) was eliminated first due to the violation of the *NC̥ constraint. Next, the DEP-IO constraint has caused the candidate (b) to be eliminated due to the epenthesis process. On the next level of constraint, candidate (c) was eliminated due to denasalization process which violated the IDENT→IO (nasal) constraint. The change in voicing of the obstruent segment in (d) has caused it to violate the IDENT-IO (ObsVce) constraint and was eliminated. Candidate (e) then was eliminated due to the violation of MAX-IO, leaving the candidate (f) to be the optimal winner in this analysis.

The OT analysis above works will most voiceless obstruent segments in Banjarese except for /tʃ/. As we discussed before, the appearance of this segment at the initial-base will not cause the nasal substitution but instead nasal assimilation. We now going to demonstrate how the above analysis can lead into a wrong output for the voiceless obstruent segment /tʃ/. The tableau below is an OT analysis of prefixation of /maN-/ and the base /tʃuŋul/ (appear):

*NC̥ >> DEP-IO >> IDENT→IO (nasal) >> IDENT-IO (ObsVce) >> MAX-IO >> LINEARITY-IO

Input : /maN + pagat/	*NC̥	DEP-IO	IDENT→IO (nasal)	IDENT-IO (ObsVce)	MAX-IO	LINEARITY-IO
☺a. man.tʃuŋul	*!					
b. maŋa.tʃuŋul		*!				
c. mat.tʃuŋul			*!			
d. man.dʒuŋul				*!		
e. ma.tʃuŋul					*!	*
☛f. ma.ɲuŋul						*!

From the above tableau, the real output was the first one to be eliminated due to the violation of *NC̥. Instead, a candidate with nasal substitution was selected as the optimal candidate for this analysis. Hence, we conclude that although NC̥ is prohibited in Banjarese, there is an exception for the /tʃ/ segment.

NASAL DELETION

In Malay, nasal deletion is obligatory in accordance with the constraint that does not allow the clustering of sonorant consonants at the beginning of a word (Mohd Onn, 1980). The same statement was given by Ahmad (1995) which is the nasal segment will be deleted when it is clumped with liquid (/l/, /r/), glide (/w/, /j/), or nasal (/m/, /n/, /ɲ/, /ŋ/) segment. The same situation could be said regarding the nasal deletion in Banjarese. However, there are some additional segments that can caused nasal deletion in Banjarese which are vowel (/a/, /i/, /u/) and glottal (/h/) segment. In this language prefixation, nasal deletion happens more frequently compared to nasal assimilation and nasal substitution.

(27) Nasal Deletion in Banjarese Prefixation

	Input	Output
(a)	/maN-la.pas/ ACT.PRF-let go 'lettin go'	[ma.la.pas]
(b)	/maN-ra.haj/ ACT.PRF-expose 'exposing'	[ma.ra.haj]
(c)	/maN-wi.laŋ/ ACT.PRF-count 'counting'	[ma.wi.laŋ]
(d)	/maN-jakinkan/ ACT.PRF-convince 'convincing'	[ma.ja.kin.kan]
(e)	/maN-maŋ.kar/ ACT.PRF-hard 'hardening'	[ma.maŋ.kar]
(f)	/maN-ŋi.num/ ACT.PRF-drink 'drinking'	[ma.ŋi.num]
(g)	/maN-na.dʒat/ ACT.PRF-pray 'to pray'	[ma.na.dʒat]
(h)	/maN-ɲa.la/ ACT.PRF-lit up 'to lit up'	[ma.ɲa.la]
(i)	/maN-a.lih/ ACT.PRF-move 'to move'	[maʔ.a.lih]
(j)	/maN-i.laj/ ACT.PRF-lift 'lifting'	[maʔ.i.laj]
(k)	/maN-u.lah/ ACT.PRF-make 'making'	[maʔ.u.lah]
(l)	/maN-ha.daŋ/ ACT.PRF-wait 'waiting'	[mahadaŋ]

We will employ the OCP (Obligatory Contour Principle) in the analysis. The OCP is defined as follows:

(28) **Obligatory Contour Principle**
At the melodic level, adjacent identical elements are prohibited.

The OCP functions not only as a morpheme structure constraint but also as an output condition during derivation (McCarthy, 1986). Specifically, if the application of a rule would result in an OCP violation, that rule is blocked from being applied. In addition to rule-blocking, the OCP can also trigger rule application during the derivation process. Ahmad (2005) noted that some scholars have suggested the OCP may need to be 'dispersed' that is, broken down into several components to account for certain asymmetries, such as those involving primary vs. secondary features or root-adjacent vs. non-adjacent positions. In his analysis of dissimilation in Sundanese, Holton (1995) employed an OCP constraint characterized as follows:

(29) **OCP ([-lateral])**
Adjacent identical [-lateral] features are prohibited.

The application of OCP as a constraint in nasal deletion analysis has been done before by Ahmad (2005). In his analysis of nasal deletion at prefix-base in Malay, he characterized the constraint as below:

(30) **OCP ([+sonorant, +consonantal])**
Adjacent identical [+sonorant, +consonantal] features are prohibited.

The OCP in (30) can be applied to analyse the nasal deletion in Banjarese. However, there is little difference between nasal deletions in Banjarese and Malay. In Banjarese prefixation, it was not only sonorant consonants that could trigger the nasal deletion, but vowels that also had the sonorant feature could also do the same thing. The sonority feature can be determined from the Modal Sonority Hierarchy (Clements, 1990; Kenstowicz, 1994) below:

(31) Modal Sonority Hierarchy (Clements, 1990; Kenstowicz, 1994)

vowels > glides > liquids > nasals > obstruents

$\longleftrightarrow$

higher in sonority lower in sonority

From the figure above, it can be concluded that when a sonorant cluster occurs, the segment with lower sonority tends to be deleted rather than the one with higher sonority. This is shown in (27), where the nasal segment is deleted when followed by a liquid (/l/, /r/), glide (/w/, /j/, /h/), or vowel (/a/, /i/, /u/). In contrast, when the nasal is followed by a voiceless obstruent (/p/, /t/, /k/, /s/), it is the obstruent segment that is deleted. Although vowels have the [+sonorant] feature and occupy the highest position on the sonority scale, they lack the [+consonantal] feature, which allows the nasal segment to surface in the derived form. Examples of this phenomenon can be observed in the Malay prefixation data below:

(32) Prefixation with Vowel-Initial Base in Malay (Karim et al., 2015)

	Input	Output
(a)	/məN-a.lir/ ACT.PRF-flow ‘to flow’	[mə.ŋa.lir]
(b)	/məN-e.dʒeʔ/ ACT.PRF-mock ‘to mock	[mə.ŋe.dʒeʔ]
(c)	/məN-i.kat/ ACT.PRF-tie ‘to tie’	[mə.ŋi.kat]
(d)	/məŋ-o.lah/ ACT.PRF-create ‘to create’	[mə.ŋo.lah]

Hence, the next constraint is crucial for the nasal segment, as it ensures that the nasal is deleted from the derived form. This constraint is known as ALIGN-PREF and is defined as follows below:

(33) **ALIGN-PREF**
Align (Prefix, Right, σ, Right)

This constraint states that the right edge of a prefix must coincide with the right edge of a syllable. To fully satisfy ALIGN-PREF, the final segment of the prefix must align with the syllable's right edge. If tautosyllabification were to occur, the right edge of the prefix would fall within a syllable, resulting in misalignment between the syllable and prefix edges. According to Ahmad (2005), one way to ensure this alignment is through glottal epenthesis, as illustrated below:

(34) Prefix-Syllable Alignment

Input: /məN-alir/ Output: a. *[mə.ŋ | a.lir]
b. [məŋ. | ʔa.lir]

The presence of the glottal segment alongside the nasal segment will violate the OCP constraint. To comply with this constraint, the nasal segment must be deleted, as previously suggested. According to Ahmad (2005), two common strategies for resolving an OCP violation in a language are dissimilation and total assimilation. Dissimilation involves assigning different feature values to a segment in the input and output (Holton, 1995). However, this dissimilation process would violate the IDENT-IO [Son] constraint.

(35) **IDENT-IO [Son]**
The correspondent of the input segment specified as [sonorant] must be [sonorant].

On the other hand, total assimilation involves delinking the base node of one segment, followed by the spreading of the adjacent segment to fill the vacant slot, resulting in gemination. However, base node delinking violates the MAX-IO (10) constraint, while spreading violates the INTEGRITY constraint. INTEGRITY can be explained as below:

(36) **INTERGRITY (No splitting)**
No element of the input has multiple correspondents in the output.

In such cases, total assimilation can never be more favorable than nasal deletion, which only incurs a violation of MAX-IO. Therefore, the MAX-IO constraint must be ranked at the lowest level in the constraint hierarchy. In the following OT analysis, we will demonstrate how nasal deletion can be triggered by both consonant-initial and vowel-initial bases. The tableau below presents an OT analysis of the nasal deletion process that occurs when /maN-/ is attached to the base /lapas/ (let go):

DEP-IO >> IDENT-IO (Son) >> INTERGRITY >>ALIGN PREF >> OCP >> MAX-IO

Input : /maN + lapas/	DEP-IO	IDENT-IO (Son)	INTERGRITY	ALIGN PREF	OCP	MAX-IO
a. maŋa.lapas	*!					
b. mak.lapas		*!				
c. mal.lapas			*!	*	*	
d. maʔ.lapas				*!	*	
e. maŋ.lapas					*!	
☛f. ma.lapas						*!

Six candidates were presented in the tableau above. In the first level of constraint hierarchy, candidate (a) was eliminated due to the violation of DEP-IO. Next, the change of sonorant to obstruent segment in (b) has caused the violation of IDENT-IO (Son) and the candidate was eliminated. Candidate (c) has violated the INTERGRITY constraint when gemination process took place with the /l/ segment. Hence, it was eliminated. Candidate (d) was eliminated because it caused misalignment between the leading edges of the syllable and the prefix, thereby violating the ALIGN-PREF constraint. Two remaining candidates, (e) and (f) then need to pass through the OCP constraint which prevents the adjacent segments from having identical [+sonorant, +voice] features. In this level, candidate (e) was eliminated. Despite violating the MAX-IO constraint, candidate (f) still chosen as the optimal candidate in this analysis.

We will now demonstrate how nasal deletion occurs when the base begins with a vowel segment. As shown in (27), the presence of a vowel-initial base not only triggers nasal deletion but also results in the nasal segment being replaced by a glottal segment. The same set of constraints, within the same hierarchy as before, can be applied to this case. The tableau below presents an OT analysis of nasal deletion following the prefixation of /maN-/ to the base /alih/ (move):

DEP-IO >> IDENT-IO (Son) >> INTERGRITY >>ALIGN PREF >> OCP >> MAX-IO

Input : /maN + alih/	DEP-IO	IDENT-IO (Son)	INTERGRITY	ALIGN PREF	OCP	MAX-IO
a. maŋ.ʔalih	*!				*	
b. mak.alih		*!				
c. maŋ.ŋalih			*!	*	*	
d. ma.ŋalih				*!		
e. ma.alih						*!
☛f. maʔ.alih						

Six candidates were presented in the tableau above. The first candidate to be eliminated was candidate (a) due to the emergence of a glottal stop segment, violating the DEP-IO. Next, the change of nasal segment to /k/ has caused candidate (b) to violate the IDENT-IO (Son) and was eliminated. Candidate (c) has violated the INTERGRITY constraint when the gemination process took place with the nasal segment. Since the edges of the prefix lie inside the base, it has violated the ALIGN PREF and caused candidate (d) to be eliminated. The remaining candidates (e) and (f) do not, however, violate the OCP. Candidate (e) was eliminated due to the violation of MAX-IO when the nasal segment in the prefix was deleted. Candidate (f) was chosen as the sole winner for this analysis.

CONCLUSION

This paper has discussed three distinct nasal behaviors at the prefix–base boundary in Banjarese. Each behavior is governed by specific phonological rules present in the language. For instance, nasal assimilation occurs due to a constraint that prohibits nasal–obstruent clusters with differing places of articulation. In the Optimality Theory analysis, the NA constraint was used to enforce this rule. Nasal substitution, on the other hand, arises from a rule that prohibits nasal–voiceless obstruent sequences. To account for this, the *NÇ constraint is employed to ensure that such sequences do not occur at the prefix–base boundary. However, this constraint does not apply to the /tʃ/ segment. Finally, nasal deletion is triggered by a rule that disallows the clustering of sonorant segments at the prefix–base boundary. To uphold this rule, the OCP constraint is used to prevent adjacent segments from sharing identical [+sonorant, +consonantal] features. The same constraint hierarchy can be applied to analyze nasal deletion in both consonant-initial and vowel-initial bases. The features of the initial segment in the base play a crucial role in determining the behavior of the nasal segment.

The analysis in this paper also highlights the advantages of Optimality Theory compared to other theoretical frameworks. Optimality Theory belongs to the family of constraint-based theories, which differ fundamentally from earlier rule-based approaches. In rule-based theory, structural conditions and structural changes are embedded within specific rules, with each rule explicitly determining the change in response to a given condition. In contrast, when analyzing nasal behaviors in Banjarese prefixation, Optimality Theory can account for various types of nasal changes based on the interaction between constraints. This stands in contrast to rule-based theory, which cannot predict the functional unity of such processes, as it lacks a formal mechanism to express the 'output goal' of a phonological rule.

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