NC̥ clusters in Malay single prefixation

Sharifah Raihan Syed Jaafar

This paper re-examines the occurrence of nasal and voiceless obstruent clusters when monosyllabic and disyllabic/polysyllabic roots are combined with nasal final prefixes like /məŋ+/ and /pəŋ+/. In Malay previous studies, a sequence of nasal and voiceless obstruent is not allowed in the surface representation. The clusters thus are regularly resolved by nasal substitution. Observation from the DBP-UKM (Malaysia Institute of Language and Literature-National University of Malaysia) corpus data however shows that nasal substitution somehow fails to apply to break up the clusters. Vowel epenthesis and nasal assimilation are also used as the strategies in the language. This paper claims that the different strategies of eliminating nasal and voiceless obstruent clusters are due to the etymology of the words. In order to analyse the data, the idea of lexical strata by Itô and Mester (1999) and the version of Generalised Template Theory i.e. Morpheme-Based Template (Downing 2006) which is developed in Optimality theory are used.

Keywords: *nasal and voiceless obstruent clusters, nasal final prefixes, nasal substitution, prosodic morphology, OT.*

Introduction

Malay is one of the languages which do not permit nasal and voiceless obstruent clusters in their process of prefixation. Other languages with the same constraint include Indonesian (Pater 1999), Toba Batak (Hayes 1986), Kaingang (Henry 1948; cf. Piggot 1995), Chamorro (Topping 1973: 50), Javanese (Poedjosoedarmo 1982: 51), the Bantu languages such as Umbundu, Si-Luyana and OshiKwanyama (cited by Pater 1999) and Mandar (Mills 1975). Nasal substitution is one possible strategy for languages to rid themselves of nasal and voiceless obstruent clusters (Pater 1999).

According to previous Malay scholars (e.g.: Hassan 1974; Omar 1986; Karim et al. 1994; Karim 1995; and many others), nasal substitution is the regular strategy applied to prevent nasal and voiceless obstruent clusters emerging in the surface representation. It has long been observed that the phonological behaviour of the nasal segments in the prefixes, /pəN-/ and /məN-/ is always homorganic to the following consonant of the root. Meanwhile, the obstruent voiceless consonants, /p, t, k and s/ are deleted when the consonants are concatenated with the nasal final prefixes, through the process called voiceless obstruent deletion. The process occurs here is called nasal substitution which can be summarised as follows:

məm- and pəm-	before p, b, f, v
mə- and pə-	before l, r, m, n, ɲ and ŋ
mən- and pən	before t, d, c, ʤ
məɲ- and pəɲ-	before c, s
məŋ- and pəŋ	before k, g, h, x, ɣ, w and vowels
məŋe- and pəŋə	before a monosyllabic base.

Let us consider some relevant examples, below, as cited in Karim et al. (1994). Note that this phonological behaviour of nasal segments in prefixes is also found in the corpus observed in this study which contains about one million words:

(2) Nasal final prefixes in Malay (from Karim et al. 1994: 147).

a. /məŋ-pukul/	[məmukul]
ACT.PRF-scold 'to scold'	
b. /məŋ-tari/	[mənari]
ACT.PRF-dance 'to dance'	
c. /məŋ-karaŋ/	[məŋaraŋ]
ACT.PRF-compose 'to compose'	
d. /məŋ-sinar/	[məɲinar]
ACT.PRF-ray 'to ray'	

From the data above, it is clear that the nasal segment is homorganic with the following voiceless consonant of the root, while the voiceless obstruents are deleted. Although the examples given fulfil the descriptive rules, they may not be able to explain the real process of prefixation in Malay, since there is evidence that some voiceless obstruent consonants are not deleted when the combining process occurs. This phenomenon of undeleted voiceless obstruents, as claimed by scholars in many cases, has been retained. Most of them resort to the same solution, which is to treat the phenomenon as somehow exceptional.

The following data from the DBP-UKM corpus provide evidence of this phenomenon. The undeleted voiceless obstruents as exemplified in the following examples have resulted in nasal and voiceless obstruent clusters in the surface representations. Only the nasal segments in the prefixes assimilate to the following voiceless obstruents, while the voiceless obstruents are retained. This phenomenon of undeleted voiceless obstruent is treated by previous Malay scholars as exceptional in the language. It should be argued in section 3, that the phenomenon treated as exceptional by Malay scholars (e.g.: Omar 1986; Karim 1995) can be accounted for by constraint-based analysis. The theoretical framework of OT offers a way of treating those problematic examples shown in (3) without claiming them to be exceptions.

(3) Nasal final prefixes (from the DBP-UKM corpus).

a.	/məŋ-pakeʤ-kan/	[mə**mp**akeʤkan]
	ACT.PRF-package-CAUS.SUF	
	'to cause to pack for'	
b.	/məŋ-kelas-kan/	[mə**ŋk**əlaskan]
	ACT.PRF-class-CAUS.SUF	
	'to cause to categorise for'	
c.	/məŋ-kabul-kan/	[mə**ŋk**abulkan]
	ACT.PRF-grant-CAUS.SUF	
	'to cause to grant for'	

As presented above, the undeleted voiceless obstruents after nasal segments which create nasal and voiceless obstruent clusters in the words show that the analyses postulated by previous Malay scholars are not accurate. Apart from this, there is another problem that arises from previous analyses. The problem is, nasal and voiceless obstruent clusters in the

language are not always resolved by nasal substitution, as postulated by previous scholars. The clusters somehow are resolved by vowel epenthesis, as occurred when monosyllabic roots combine with nasal final prefixes. Some of the examples from the corpus are exemplified below:

(4) Monosyllabic roots with nasal final prefixes (from the DBP-UKM corpus)

	Underlying forms	Output forms
a.	/məŋ-cam/ ACT.PRF-recognise	məŋ-ə-cam ACT.PRF-STEMEX-recognise 'to recognise'
b	/məŋ-cap/ ACT.PRF-stamp	məŋ-ə-cap ACT.PRF-STEMEX-stamp 'to stamp'
c	/məŋ-sah/ ACT.PRF-validate	məŋ-ə-sah ACT.PRF-STEMEX-validate 'to validate'
d	məŋ-kod ACT.PRF-code	məŋ-ə-kod ACT.PRF-STEMEX-code 'to code'

As we can see from the above examples, vowel epenthesis is another way the language uses to eliminate nasal and voiceless obstruent clusters from occurring in the surface representation as well as nasal substitution. A question that can be posed here is why vowel epenthesis is applied when monosyllabic roots are combined with nasal final prefixes? As we saw in (2) and (3), vowel is not epenthesized when nasal final prefixes are attached to roots that are larger than monosyllable. This issue will be discussed in this paper as it is absent in previous Malay analyses.

In this paper, the undeleted voiceless plosives after the nasal segments and the schwa epenthesis are analysed as the words are non-native. The non-native words are therefore could not undergo the regular phonological process i.e. nasal substitution. The issues involved are due to the etymology of the words i.e. native or non-native. This could be resolved by partitioning the Malay lexicon into three different strata: monosyllabic foreign words, undeleted voiceless plosive in loanwords, and native, as illustrated in Figure 1 below.

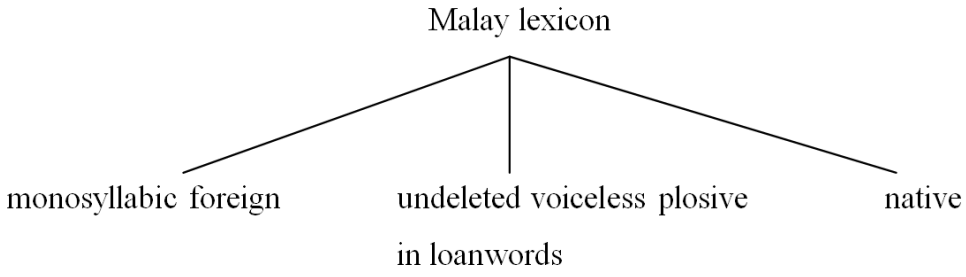


Figure 1The three strata of Malay lexicon (Syed Jaafar 2010).

This will be discussed in details on how those strategies i.e. vowel epenthesis, undeleted voiceless obstruents as well as nasal substitution are applied to Malay data. The discussion thus will be divided into three sections based on the proposed lexicon strata in Malay: (1) monosyllabic foreign words, (2) undeleted voiceless plosive in loanwords, and (3) native words.

Monosyllabic foreign words

In this section, we see how vowel epenthesis applies in the Malay sub-lexicon of monosyllabic foreign words. As shown above, monosyllabic roots are also involved in the process of prefixation. For monosyllabic roots, the process of prefixation is slightly different from that for disyllabic/trisyllabic roots. The difference can be seen when schwa is epenthesized between monosyllabic roots and nasal final prefixes. As will be seen in the following section, there is no process like schwa epenthesis in the process of prefixation for disyllabic/trisyllabic prefixed words to eliminate the clusters.

Before offering an OT account to explain the process of epenthetic schwa, let us observe the data in (5). The descriptive generalisations that can be summarised are as follows: (1) five prefixes can be attached to monosyllabic roots: /məŋ+/, /pəŋ+/, /di+/, /tər+/ and /bər+/; (2) schwa is epenthesized between monosyllabic roots and the nasal final prefixes, /məŋ+/ and /pəŋ+/ only; (3) the process of schwa epenthesis cannot however be applied if the prefixes are /di+/, /tər+/ and /bər+/; and (4) the nasal segment in the prefix then alternates with a velar nasal [ŋ] after the process of epenthesis occurs.

(5) Data for the Malay monosyllabic foreign lexicon (from the DBP-UKM corpus)

a.	məŋ-ə-**cam** ACT.PRF-STEMEX-recognise 'to recognise'	b.	məŋ-ə-**cap** ACT.PRF-STEMEX-stamp 'to stamp'
c.	məŋ-ə-**sah** ACT.PRF-STEMEX-validate 'to validate'	d.	məŋ-ə-**kod** ACT.PRF-STEMEX-code 'to code'
e.	məŋ-ə-**bom** ACT.PRF-STEMEX-bomb 'to bomb'	f.	pəŋ-ə-**bom**-an ACT.PRF-STEMEX-bomb NOM.SUF 'bombing'
g.	məŋ-ə-**had** ACT.PRF-STEMEX-limit 'to limit'	h.	bər-**cap** REF.PRF-stamp 'to stamp'
i.	tər-**pam** PAS.PRF-pump 'pumped'	j.	tər-**had** PAS.PRF-limit 'limited'
k.	di-**had**-kan PAS.PRF-limit-CAU.SUF 'is limited'	l.	di-**lap** PAS.PRF-wipe 'is wiped'

An interesting question, which might be raised, is: what is the motivation for schwa epenthesis? This is an interesting question because schwa is not epenthesized when

disyllabic/trisyllabic roots are attached to nasal final prefixes, as we will see later in Section 3. Before answering the question of what is the motivation of epenthetic schwa from the OT point of view, a first reason is that we can simply say that schwa might be epenthesized between a nasal final prefix and a monosyllabic root. This is because the nasal segment in the prefix would not have a place of articulation to alternate to a velar nasal /ŋ/ if schwa was not added. If epenthetic schwa was not added to monosyllabic bases, then we could make a prediction for the possible output. Expected outputs are, by way of example:

(6)	Input	Output
	a. /məŋ-pam/ ACT.PRF-STEMEX-pump 'to pump'	*[mə-mam]
	b. /məŋ-bom/ ACT.PRF-STEMEX-bomb 'to bomb'	*[məm-bom]

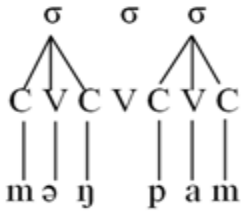
These outputs, *[mə-mam] and *[məm-bom], are predictable if the regular rules for nasal assimilation and voiceless obstruent deletion, as postulated in ruled-based analyses (e.g. Hassan 1974; Omar 1981; Karim et al.1994; Karim 1995 and many others) to avoid nasal and voiceless obstruent clusters, are applied to monosyllabic bases. The outputs above are predicted simply on the basis of the two rules postulated in rule-based analyses to account for the clusters in the language. In the above examples in (6), since schwa is not epenthesized between the prefix and the monosyllabic root, so the regular phonological processes, nasal assimilation and voiceless obstruent deletion, are applied. Therefore we get outputs with nasal substitution, *[mə-mam] and *[məm-bom].

The essential point which will be demonstrated here is that the process of prefixation for monosyllabic bases is not the same as that with other larger roots, such as disyllabic roots, as we will see in the following section. The difference can be seen in (6) where the outputs *[mə-mam] and *[məm-bom] for the inputs /məŋ-pam/ and /məŋ-bom/ are not the desired outputs. More importantly, such outputs as *[mə-mam] and *[məm-bom] are not found in the DBP-UKM corpus used in this study as initial voiceless plosives in monosyllabic bases do not undergo nasal substitution. I am convinced that this output is impossible to find, as it simply does not exist as any Malay word.

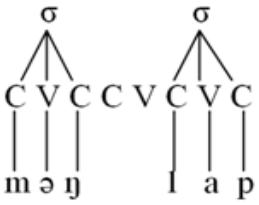
Second, schwa is inserted due to the disyllabicity minimality requirement of the language, as pointed out by Onn (1980), Maris (1980), Teoh (1994) and Ahmad (2000b), i.e. a word in Malay must have at least two syllables. Therefore schwa is by no means inserted to fulfil the word requirements of the language. Teoh (1994) and Ahmad (2000b), who agree with the disyllabicity minimality condition as postulated by earlier scholars, provide their own justifications for epenthetic schwa in monosyllabic bases from the viewpoint of non-linear analysis. Teoh (1994) claims that the template for a monosyllabic base is CV.CVC. He claims further that Malay is an inherently disyllabic language, and therefore this template is chosen as an underlying representation. Ahmad (2000b) claims the lexical representation for a monosyllabic word originally contains two syllables. In his analysis, he postulates that there is an empty V slot in the underlying representation. In my view, the empty slots, CV and V in Teoh's and Ahmad's analyses respectively, are mainly to ensure that the disyllabicity

minimality condition of words is satisfied. The templates as claimed by those scholars are presented below:

(7) a. INPUT (Ahmad 2000b)



b. INPUT (Teoh 1994)



As can be seen, we note that an empty slot in the underlying representations is the solution proposed by both scholars to explain how the disyllabicity minimality condition in the language is met. An argument should be made against the empty slot for a monosyllabic root as proposed by Teoh and Ahmad above. If a prefix was not attached to a monosyllabic root, then the skeletal tier for the prefix CVC would need to be deleted. Hence, the remaining skeletal tier is the template for monosyllabic roots, i.e. V.CVC (in Ahmad's UR) and CV.CVC (in Teoh's UR). In my view, the empty slots in the underlying representations seem to show that schwa is part of the input that must be filled in. It is important to note that schwa would not appear in monosyllabic roots, as exemplified in (8). In other words, the presence of schwa can only be seen in the surface form when nasal final prefix is attached to a monosyllabic root. Some of the examples from the corpus showing that schwa is not present in monosyllabic roots are illustrated below, as piece of evidence:

(8) Monosyllabic roots in Malay (from DBP-UKM corpus)

a. Monosyllabic roots

/pam/	[pam] 'pump'
/lap/	[lap] 'wipe'
/had/	[had] 'limit'
/bom/	[bom] 'bomb'

There is another explanation that can be given for the case in question. It is also predicted that the disyllabic minimality requirement cannot be satisfied for monosyllabic roots in Malay because they are not Malay words. Teoh (1994: 102) claims that monosyllabic roots in Malay are borrowed words. This can be clearly seen in the statement that: *'I can off-hand think of only several monosyllabic words, and borrowing which manifest with /məŋ+/'*. As noted in Maris (1980: 10), '*there are very few simple words (stems) in Malay, probably about twenty in all, that are monosyllabic'*. This is consistent with what I found in the corpus, monosyllabic roots that have combined with a single prefix are not as numerous as other larger roots[i].

(9) Monosyllabic roots are Malay borrowed words (from Teoh, 1994: 102).

cat	'to paint'	from Chinese
bom	'to bomb'	from English
pam	'to pump'	from English

had	'to limit'	from Arabic
sah	'to validate'	from Arabic'
syak	'to suspect'	from Arabic'

In order to deal with this problem, an alternative analysis that is couched in GTT terms that is Morpheme-Based Template (hereafter MBT)[ii] will be posed. The idea of MBT is that not all words in a language have the same minimality condition (Downing, 2006: 100). Hence, based on the idea of MBT, that not all words in a language have the same minimality condition, I offer a new analysis in order to account for monosyllabic roots in Malay.

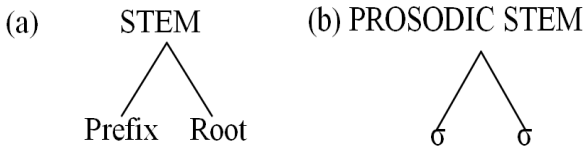
In MBT, there is a clear distinction in the minimality requirements between derived and underived words. As stated in Downing (2006: 128), underived words (monomorphemic) are optimally branching monosyllabic. For derived words, which consist of prefix and root (bimorphemic), they are minimally disyllabic by the MORPHEME-SYLLABLE CORRELATION, as can be formally defined below:

(10) **MORPHEME-SYLLABLE CORRELALTION** (adapted from Russell, 1997: 121, cited in Downing, 2006: 120)

Each morpheme prefix and root contains exactly one syllable.

The constraint in (10) means that a prefix must contain one syllable, and a root as well. Therefore, by MORPHEME-SYLLABLE CORRELATION, Stems must at least be disyllabic. The disyllabicity minimality required by MORPHEME-SYLLABLE CORRELATION (10) is a corollary to the constraint in (11), below, as it also formalizes the disyllabicity minimality requirement of Prosodic Stems (Downing 2006: 123).

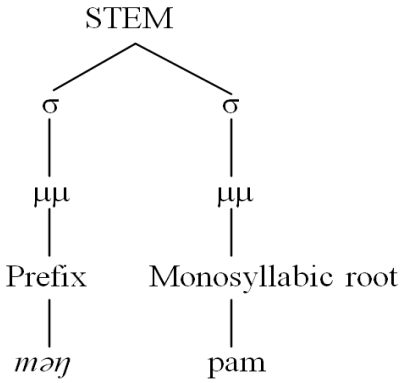
(11) **Prosodic Stem Minimality** (Ibid.: 124)



In the above diagram of Prosodic Stem minimality, the prefix contains one syllable. Cross-linguistically, the typical size of affixes is one syllable, or monomoraic. Since this theory predicts that all prosodic morphemes from the same morphological category should be subject to the same size restrictions (Ibid.: 26), then the size (i.e. one syllable or monomoraic) is claimed to be the canonical shape of that of prosodic morphemes (affixes). This means that affixes not containing their own syllable violate the MORPHEME-SYLLABLE CORRELATION (10), while a Stem that contains less than two syllables violates the Prosodic-Stem rule.

From the data shown in (5), it is clear that monosyllabic bases consist of bimorphemic stems (i.e. one morpheme for the prefix and another for the monosyllabic root). Thus, the construction of Prosodic Stem Minimality in Malay, for monosyllabic roots, can be illustrated as below:

(12) Prosodic Stem for Malay Prefixation



In order to account for Malay nasal substitution, a PROSODIC STEM will be high-ranked, as this constraint ensures stems (prefix and root) are minimally disyllabic. From the Prosodic Stem structure for Malay prefixation in (12), it is clearly seen that both prefixes and roots are minimally monomorphemic, as required by MORPHEME-SYLLABLE CORRELATION (10).

Now we return to the question of what the motivation for schwa epenthesis is in monosyllabic bases, as raised above. As we have just seen, schwa epenthesis is applied to monosyllabic bases. It was analysed by previous scholars (e.g.: Teoh, 1994; Onn, 1980; Maris, 1980; Ahmad, 2000b) and is a requirement of the word minimality condition in Malay. In contrast to those analyses, this study claims that schwa is epenthesized in order to satisfy the markedness constraint *NC̥, which requires that no nasal and voiceless obstruent clusters emerge in the surface form. By maintaining the analyses (i.e.: Teoh, 1994; Ahmad, 2000b) that the empty slot(s) are unable to resolve epenthetic schwa in a process for monosyllabic roots, I offer other possible solutions to resolve this problem. To give an OT account, this situation is captured by the constraint *NC̥. This constraint is defined as follows:

(13) ***NC̥**

No nasal/ voiceless obstruent sequences.

The constraint above bans a sequence of nasal and voiceless obstruent emerging in the surface representation. To satisfy this constraint therefore, nasal substitution applies to break up the cluster whereby the voiceless obstruent is deleted and leaves its place of articulation to the preceding nasal.

In Correspondence Theory (McCarthy and Prince, 1995), the phonological process of nasal substitution is explained as a process of merging, between the nasal segment in the prefix and the voiceless obstruent, that can be interpreted as a two-to-one mapping from input to output. In other words, two segments in the input correspond to a single segment in the output. The correspondence relationship between the input and output of a sequence of /ŋ+p/ is illustrated in (14). As can be seen, the voiceless obstruent [m] in the output is obtained from two segments in the input, nasal segment /ŋ/ and place of articulation /p/.

(14) Nasal substitution representation /məŋ$_1$+p$_2$ukul/ → [məm$_{12}$ukol]

For monosyllabic bases, nasal substitution does not however apply to break up the cluster, as presented in (5). The cluster is resolved by a strategy other than nasal substitution. This alternative strategy is epenthesis. Due to the *NC̥ constraint, it is claimed that the epenthetic schwa in monosyllabic bases is to satisfy the markedness constraint requirement. We have now seen that schwa epenthesis is also the strategy applied in the language to satisfy *NC̥.

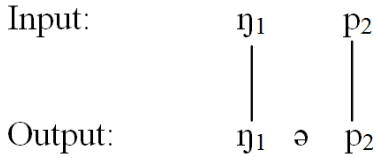
The process of schwa epenthesis has resulted in one segment being added to the prefix and the monosyllabic root. In OT, an additional segment, which is not part of the input, is analyzed under Correspondence Theory (McCarthy and Prince, 1995). The general claim of this theory is that faithfulness to the input-output is a kind of requirement, whereby this pair of representations must be identical (Kager, 1999: 24). One example of the identity requirement that is expressed by the faithfulness constraint is DEPENDENCE. In this case, schwa, which is not found in the input, has been added to the output and is related to input-output faithfulness. Hence, the faithfulness constraint between input-output is DEP-IO, as defined below.

(15) **DEP-IO**

Every segment in the input must have a correspondent in the output.

The violation of DEP-IO in the optimal output [məŋ$_1$əp$_2$am] is illustrated in the correspondence diagram below:

(16) Correspondence diagram for epenthetic schwa



The discussion of monosyllabic bases so far has considered three constraints. These are Prosodic Stem, *NC̥ and DEP-IO. Because the optimal output violates DEP-IO by epenthesizing schwa, this constraint has to be ranked beneath *NC̥. These constraints should now be demonstrated in the following tableau (where syllable boundaries are marked by a full stop “.”).

(17)

/məŋ$_1$əp$_2$am/	Prosodic Stem	*NC̥	DEP-IO
a. məm$_1$.p$_2$am		*!	
b. ☞mə.ŋ$_1$ə.p$_2$am			*

The presence of nasal-voiceless obstruent [mp] in candidate (a) has resulted in the violation of *NC̥. Although candidate (a) satisfies the faithfulness constraint, DEP-IO, by not epenthesizing schwa, it fatally violates the higher constraint *NC̥. In order to satisfy the *NC̥ constraint, schwa is epenthesized between the cluster, as in candidate (b). Since the cluster is separated by a schwa, candidate (b) satisfies *NC̥.

Considering all the constraints in (17), another potential candidate that must be taken into consideration is *[mə.m$_{12}$am]. This candidate seems predictable if nasal substitution is applied. In OT, if a candidate satisfies a particular constraint, it may violate other constraints in the hierarchy. In this case, the new candidate *[mə.m$_{12}$am] satisfies *NC̥, as the cluster is resolved by nasal substitution. Nevertheless, it violates a constraint which bans nasal substitution, namely UNIFORMITY, that requires that no element of the output has multiple correspondents in the input. This constraint can formally be defined as follows:

(18) **UNIFORMITY** (‘No Coalescence’) (McCarthy and Prince, 1999: 296).

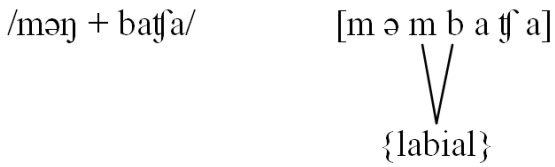
No element of S_2 has multiple correspondents in S_1.
For x, y ϵ S_1 and z ϵ S_2: if x R z and y R z, then x=y.

The following diagram (19) shows how this constraint is violated. In the input, there are two segments, /ŋ+p/. In the output, these two segments become a single segment, [m], which has multiple correspondent segments when nasal substitution occurs. UNIFORMITY is a constraint which bans nasal substitution and is known as an anti-nasal substitution constraint. As we will see in this study, UNIFORMITY is violated by all candidates with nasal substitution. In order for a nasal substitution candidate to be chosen as the optimal output, this faithfulness constraint must be ranked beneath the markedness constraint, *NC̥. We see this ranking *NC̥ >> UNIFORMITY in the analysis tableau in (22).

(19) Correspondence diagram for UNIFORMITY violation.

Besides the phonological requirement mentioned above, Malay requires a nasal segment to occupy the coda position of a syllable; it must be homorganic to the following consonant. A nasal segment in the coda position assimilates to the place of articulation of the following onset consonant, e.g. /məŋ$_1$+t$_2$arik/ VERBL-pull → [men$_{12}$areʔ] ‘to pull’ and /məŋ$_1$+b$_2$atʃa/ VERBL-read → [məm$_1$b$_2$atʃə] ‘to read’. I illustrate this in the following diagram of nasal assimilation:

(20) Diagram of nasal assimilation.



Due to this phonological requirement, another potential candidate that needs to be considered is *[məŋ$_1$p$_2$am]. The nasal segment [ŋ] in the prefix and the initial voiceless obstruent [p] in the surface representation give rise to a problem because the nasal segment [ŋ] is not homorganic to the initial consonant of the root, [p]. Note that in Indonesian, which also has the same requirement as Malay, the unassimilated nasal segment in the following consonant is resolved by a NASAL ASSIMILATION (henceforth NAS ASS) constraint (Pater, 2001), as defined in (21). This constraint will thus also be used for Malay in order to rule out any candidate without a homorganic nasal, such as *[məŋ$_1$p$_2$am].

(21) **NAS ASS** (cf.: Jun, 1995; Padgett, 1995; Boersma, 1998; Pater, 2001).

A nasal must share place features with a following consonant.

Given the fact that NAS ASS is higher ranked in the hierarchy, it is plausible for nasal segment /ŋ/ in the prefix becoming [m] as in *[məm$_1$p$_2$am]. This possibility however cannot be optimal since *NC$_o$ is ranked right after NAS ASS which causes *[məm$_1$p$_2$am] to be ruled out. In this situation, NAS ASS and *NC$_o$ do not conflict, and therefore they are not ranked with respect to each other. The interaction between the five constraints – Prosodic Stem, *NC$_o$, DEP-IO, UNIFORMITY and NAS ASS – is controlled by the following ranking: Prosodic Stem >> NAS ASS, *NC$_o$ >> UNIFORMITY >> DEP-IO. Bringing together all these constraints and all the candidates introduced thus far, I establish the following tableau:

(22)

/məŋ$_1$+p$_2$am/	PrStem	NAS ASS	*NC$_o$	UNI	DEP-IO
a. məm$_{12}$am				*!	
b. məm$_1$p$_2$am			*!		
c. məŋ$_1$p$_2$am		*!			
d.☞mə.ŋ$_1$ə.p$_2$am					*

We have just seen how monosyllabic roots combine with nasal final prefixes in Malay. Since the initial voiceless obstruent of the root does not assimilate to the nasal segment that precedes it, therefore schwa is epenthesized. This is mainly to avoid a sequence of nasal and voiceless obstruent emerging in the surface form. The constraint ranking thus is: PrStem >> NAS ASS, *NC$_o$ >> UNIFORMITY >> DEP-IO. In the following section, we are going to discuss the second category in the Malay lexicon i.e. undeleted voiceless plosive in loanwords.

Undeleted voiceless plosive in loanwords

We come to examine the second stratum in the Malay lexicon i.e. undeleted voiceless plosive in loanwords. As we will see soon, the undeleted voiceless plosive in loanwords occurs when nasal final prefixes are attached to disyllabic/polysyllabic roots in Malay. Since the voiceless plosives after nasal segments are not deleted nasal substitution therefore fails to occur. Instead, nasal assimilation occurs.

Let us see some relevant examples illustrating how nasal and voiceless obstruent clusters surface in one of the two categories of the Malay lexicon: undeleted voiceless plosives in loanwords.

(23) Group of undeleted voiceless plosives in the loanwords sub-lexicon (from the DBP-UKM corpus).

a. Consonant clusters initial root

	/məŋ-promosi/ ACT.PRF-promotion ‘to promote’	[məm-promosi]
ii)	/məŋ-kritik/ ACT.PRF-critic ‘to criticise’	[məŋ-kritik]
iii)	/məŋ-protes/ ACT.PRF-protest ‘to protest’	[məm-protes]
iv)	/məŋ-proses/ ACT.PRF-process ‘to process’	[məm-proses]
v)	/məŋ-transformasi/ ACT.PRF-transformation ‘to transform’	[mən-transformasi]
vi)	/pəŋ-struktur-an/ NOM.PRF-structure-NOM.SUF ‘structure’	[pən-struktu-ran]

b. Borrowed words

i)	/məŋ-ʃarat-kan/ ACT.PRF-condition-CAUS.SUF ‘to cause to condition for’	[mən-ʃarat-kan]
ii)	/məŋ-fokus/ ACT.PRF-focus ‘to focus’	[məm-fokus]
iii)	/məŋ-tadbir/ ACT.PRF-administrative ‘administer’	[mən-tadbir]
iv)	/məŋ-popular-kan/ ACT.PRF-popular-CAUS.SUF ‘to cause to be popular for’	[məm-popular-kan]
v)	/məŋ-fasakh/ ACT.PRF-divorce ‘to annul a marriage’	[məm-fasakh]
vi)	/məŋ-ʃukur-i/ ACT.PRF-gratitude-LOC.SUF ‘to cause to be grateful’	[mən-ʃukur-i]
vii)	/məŋ-xatan/ ACT.PRF-circumcision ‘to circumcise’	[məŋ-xatan]
viii)	/məŋ-tauhid/	[mən-tauhid]

ACT.PRF-monotheism ‘oneness and unity of god’

ix) /məŋ-komersil/ [məŋ-komersil]
ACT.PRF-commercial ‘to commercialise’

The descriptive generalisations that are observed in the above examples can be summarised as follows: (1) the voiceless obstruents remain undeleted even though nasal segments precede them; (2) the nasal segments in the prefixes are homorganic to the following initial consonants of the roots. The data in 23(a) will be discussed first and followed by the data in 23(b).

As we see in 23(a), the roots contain consonant clusters. The roots do not however undergo any phonological process, i.e. vowel epenthesis, to break up the clusters. It should be argued that the data in 23(a) are borrowed words because of the presence of consonant clusters *[CCV.] in the roots. In order to support this, it should be mentioned what previous Malay scholars have said about Malay syllable structure. In earlier studies of Malay phonology, such as Hassan (1974), Maris (1980) and Onn (1980), they discussed the basic syllable structure of Malay as being (C)V(C). Ahmad (2005) with his OT work states that Malay loan phonology offers good evidence that *COMPLEX is highly respected in the language. He claims that any consonant clusters in Malay are resolved by schwa epenthesis. This can be seen in borrowed English words such as *class, stem, post, glass* and *club*. These words are realised as [kəlas], [sətem], [pos], [gəlas] and [kəlab], respectively, in Malay (Ahmad, 2005: 18).

The data in 23(b) are also borrowed words. As we can see, the data in 23(b) are slightly different from the data in 23(a) in terms of the segments in the words. As we have already observed, in the data in 23(a), the roots contain more than one segment in the onset position. In contrast to the data in 23(a), if we take a closer look at the data in 23(b), the initial consonants of the roots are originally borrowed consonants. As claimed in (Ahmad, 2005: 16), Malay has 16 underlying consonants: /p, b, t, d, k, g, ʧ, ʤ, s, h, m, n, ɲ, ŋ, l and r/, and six vowels: /i, u, e, o, ə and a/. As far as the underlying consonants are concerned, it is apparent that every word in 23(b) consists of non-underlying Malay consonants. For example, consonants /f/, / ʃ / and /x/, in 23b (ii), (vi) and (vii) respectively, are not underlying Malay consonants. Thus they are all borrowed words. Observe that there are some examples which do not contain any borrowed consonant, as in 23(b) (iii), (iv), (viii) and (ix). These words are originally non-native words, see the examples in (24). Therefore, nasal substitution fails to apply.

(24)

[məm-fokus]	from English
[mən-ʃukuri]	from Arabic
[məŋ-xatan]	from Arabic
[mən-tadbir]	from Arabic
[məm-popular-kan]	from English
[mən-tauhid]	from Arabic
[məŋ-komersil]	from English

The data in (24) present a different phonological pattern of non-native words in the language than the one discussed in Section 2 (i.e. monosyllabic bases). The hierarchical ranking for

this type of data in (24) is therefore different from the sub-lexicon of monosyllabic foreign. The new constraint ranking to account for the sublexicon of undeleted voiceless plosive is: PrStem >> NAS ASS >> DEP-IO >> UNIFORMITY >> *NC̥, as demonstrated in the following tableau:

(25) Constraint ranking for the group of undeleted voiceless plosive in loanwords.

/məŋ$_1$+p$_2$roses/	PrStem	NAS ASS	DEP-IO	UNI	*NC̥
a. məm$_{12}$ro.ses				*!	
b.☞məm$_1$p$_2$roses					*
c. məŋ$_1$p$_2$roses		*!			
d. məŋ$_1$əp$_2$roses			*!		
/məŋ$_1$+t$_2$auhid/					
e. mən$_{12}$auhid				*!	
f.☞mən$_1$t$_2$auhid					*
g. məŋ$_1$t$_2$auhid		*!			
h. məŋ$_1$ət$_2$auhid			*!		

Candidates (c) and (g) are ruled out as they fatally violate the higher constraint NAS ASS, since the nasal segments in the prefixes are not homorganic to the initial consonants of the roots, [p] and [t], respectively. In the group of monosyllabic foreign (see section 1), vowel epenthesis is the strategy that can satisfy *NC̥. However this strategy cannot be satisfied in the group of 'undeleted voiceless plosive in loanwords', as DEP-IO is highly ranked in the constraint ranking. This shows that ə-epenthesis is not always a better option to break up nasal and voiceless obstruent clusters in the language. Therefore, candidates (d) and (h) cannot emerge as optimal output. In the above tableaux, as we can see, nasal substitution is a strategy to satisfy the constraint *NC̥, as candidates (a) and (e) show. However, these candidates fail to emerge as optimal output as the constraint which bans nasal substitution, UNIFORMITY, is ranked higher than *NC̥. Therefore candidates (b) and (f) are chosen as the optimal output.

Native words

Now, we come to examine the third category in the Malay lexicon, which is native. Here we will see whether the constraint ranking for the native Malay lexicon is the same as for the two groups (i.e. monosyllabic foreign and undeleted voiceless plosive in loanwords) we have discussed above. It is convinced that the constraint ranking of this group is different from those two groups as Malay does not permit nasal and voiceless obstruent clusters. This means the markedness constraint *NC̥ should be placed higher in the ranking compared to the constraint rankings of monosyllabic foreign (22) and undeleted voiceless plosives in loanwords (25).

Before the analysis starts, let us consider first relevant examples of the native group. As we can see in the following data, the language disfavours nasal and voiceless obstruent clusters emerging in the surface representation, so the clusters have regularly been resolved by nasal substitution.

(26) Data for the native Malay sub-lexicon (from the DBP-UKM corpus).

a. **Nasal and voiceless obstruent clusters**

i)	/məŋ-temu-i/ ACT.PRF-meet-LOC.SUF ‘to cause to meet’	[mə-nemui]
ii)	/məŋ-potong/ ACT.PRF-cut ‘to cut’	[mə-motoŋ]
iii)	/məŋ-kuat-kan/ ACT.PRF-strong-CAUS.SUF ‘to cause to strengthen for’	[mə-ŋuwat-kan]
iv)	/pəŋ-pindah-an/ NOM.PRF-migrate-NOM.SUF ‘migration’	[pə-mindah-an]
v)	/məŋ-kunjuŋ-i/ ACT.PRF-visit-LOC.SUF ‘to cause to visit’	[mə-ŋundʒung-i]

In OT analysis, a candidate with nasal substitution can be obtained by ranking the constraint which bans the clusters, i.e. *NC̥, higher in the hierarchy. By satisfying *NC̥, a candidate with nasal substitution, for example [mən$_{12}$olaʔ] ‘to push’, violates a faithfulness constraint, i.e. UNIFORMITY. This is because both segments in the input /ŋ+t/ are not preserved as the input segments are not in a perfect one-to-one relation with the single output segment (Kager, 1999: 62). The following tableau is constructed to account for the data in (26). The tableau demonstrates the satisfaction of *NC̥ and violation of UNIFORMITY by the optimal candidate, as just mentioned.

(27) Constraint ranking of the Malay native lexicon

PrSTEM >> NAS ASS >> *NC̥ >> DEP-IO >> UNIFORMITY

/məŋ$_1$+t$_2$olaʔ/	PrStem	NAS ASS	*NC̥	DEP-IO	UNI
a.☞ mən$_{12}$olaʔ					*
b. mən$_1$t$_2$olaʔ			*!		
c. məŋ$_1$t$_2$olaʔ		*!			
d. məŋ$_1$ət$_2$olaʔ				*!	

From the above tableau it is apparent that Malay disallows nasal and voiceless obstruent clusters in surface form, as *NC̥ is ranked higher in the hierarchy. Because of this, candidate (b) violates this constraint, since the cluster [nt] emerges in the surface. Candidate (c) violates NASS ASS because the nasal velar [ŋ] is not homorganic to the following obstruent [t].

Candidate (d) with schwa epenthesis violates DEP-IO as the segment does not have an input correspondent. Given the above constraint ranking, candidate (a) is the optimal output. It obeys *NC̥ as the cluster /nt/ is resolved by nasal substitution. This candidate however violates UNIFORMITY, as the two input segments are not preserved in the output. The violation of UNIFORMITY does not however play any significant role because the rest of the candidates have already been ruled out.

Conclusion

The above discussion on prefixation, which covers both single and multiple prefixation, has presented some important points about the grammar of Malay. Nasal and voiceless obstruent clusters are disfavoured in the language. This can be seen in the analysis of single prefixation, where words in the native group obey *NC̥ – the constraint which bans the clusters from occurring – while in the remaining groups, monosyllabic foreign and undeleted voiceless plosive in loanwords, they do not. Words in these two groups, as was claimed, were originally non-native words, thus the regular process (i.e. nasal substitution) cannot be applied. It is impossible for borrowed words to be analysed in the same way as native words, since if the process for native words were to be applied to analyse borrowed words, then the surface output would become odd. The analysis above clearly shows that loanwords cannot be subject to a stricter set of constraints than those imposed on native words. By ranking the lexicon according to the etymology of words, this can limit the number of constraints used to analyse the process of prefixation in Malay. We probably need to consider more constraints to explain all the phonological matters regarding prefixed words in one hierarchy. As Inkelas, Orgun and Zoll (1997: 403) say, the model proposed by Itô and Mester 'would certainly limit the number of constraints available to define morpheme-specific co-phonologies to those true of the entire 'core' vocabulary'. One thing to note is that the phonotactics of loanwords cannot be totally changed to the phonotactics of native words, and therefore they cannot obey all the constraints obeyed by native words.

For convenience, I briefly tabulate the rankings that outline the constraint rankings for the proposed Malay lexicon, as illustrated in Figure 1:

a) Monosyllabic foreign:
   PrStem >> NAS ASS, *NC̥ >> UNIFORMITY >> DEP-IO

b) Undeleted voiceless plosive in loanwords:
   PrStem >> NAS ASS >> DEP-IO >> UNIFORMITY>> *NC̥

c) Native:
   PrStem >> NAS ASS >> *NC̥ >> DEP-IO >> UNIFORMITY

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[1] Interested readers may consult Syed Jaafar (2011) unpublished doctoral thesis for more details on monosyllabic roots in Malay.

[2] In this paper, I will not discuss what MBT is about. Only some of the important ideas in the theory which are relevant to this study will be touched upon. Reader who is interested in it may consult Downing (2006).

Sharifah Raihan Syed Jaafar
School of Langage Studies and Linguistics
Faculty of Social Sciences and Humanities
National University of Malaysia.
e-mail: raihansyedjaafar@yahoo.co.uk

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