Burmese Sandhi-Voicing: From the Perspective of Emergent Phonology

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Introduction

Modern Burmese sandhi-voicing is a challenging phonology-morphology interface phenomenon. In general, the degree of the juncture linking two syllables determines if the sandhi-voicing is triggered or not. It is widely accepted that the absence of the voicing gives the evidence of open juncture, while close juncture contributes to the voicing (Soe, 1999; Nishi, 1998). However, some data from Vittrant (2012) and Jenny and Hnin Tun (2016) disprove this proposal. It has been discussed that the Emergent Grammar (EG) framework (Archangeli & Pulleyblank, 2022) surpasses generative rule ordering (Chomsky & Halle, 1968) and Optimality Theory (Smolensky & Prince, 1993) in analyzing similar phenomena. Specifically, the EG framework gives a relatively flexible link between the responsibilities of a languages's phonological and morphological system via DOMAIN (McCullough, 2020). By saying that, within the framework of EG, the phonology and the morphology of a language is allowed to interact.

This paper presents an analysis of Modern Burmese sandhi-voicing from the perspective of EG. On the way to my goal, a detailed process of how Modern Burmese learners acquire the sandhi-voicing pattern is also presented. This paper also uncovers the difference in Modern Burmese acquisition with respect to the words with different lengths and morphology. Last but not least, with the analysis of EG, I argue that the absence of the voicing does not necessarily mean an open juncture between morphemes or syllables within a word.

1 The Sandhi Pattern

Modern Burmese is largely *mono*-syllabic and analytic. Each syllable mostly maps to one single morpheme. Some loanwords with a single morpheme may contain more than one

syllable. The majority of Burmese speakers, who live throughout the Irrawaddy River Valley, use very similar dialects: Merguese, Yaw, Danu, Intha, and Taungyo, which are distinct from Standard Burmese (Bradley, 1997). The sandhi-voicing is found in these dialects. In this paper, I will simply call them Modern Burmese as a whole.

1.1   The Phonological Processes

It is observed that voicing occurs in the initial plosive, fricative, or affricate of the second of two consecutive syllables in *close juncture*, when the second syllable is preceded by an open first syllable (Soe, 1999). In example (1-a), the preceding open syllable triggers voicing of the voiceless obstruent onset of the second syllable. Nishi (1998) discusses one more case in which the first syllable ends in a nasal coda, and the following syllables have to begin with voiceless obstruents. Example (1-b) illustrates that the ending coda [n] is also able to trigger sandhi-voicing.

(1)   **Modern Burmese words with voicing (Soe, 1999)**

	SYLLABLE I	SYLLABLE II	COMPOUND
a.	sa	tai?	sa-**d**ai?
	'letter'	'building'	'post office'
b.	s^{h}in	p^{h}yu	s^{h}in-**b**yu
	'elephant'	'white'	'white elephant'

Examples in (1) are lexical compounds. The last segment of SYLLABLE I and the first segment of SYLLABLE II are linked by close juncture in both examples, or voicing is not triggered.

1.2   The Morphological Conditions

Modern Burmese shows several characteristics of mono-syllabicity. Although most of the words are mono-syllabic, there still exist many multi-syllabic words due to a great use of compounding, lexicalization, and borrowing from Pali and Sanskrit. Voicing sandhi in Modern Burmese only occurs right at the *morpheme boundaries* of a multi-syllabic word. Examples in (2) give the comparison between the close and open junctures in the morpheme boundary, when the phonological conditions are met. The voicing in example (2-b) is not triggered due to the open juncture relationship between the two morphemes.

(2)   **MB words with and without VOICING sandhi**

      a.   **lexical compounds**
         Ɂein-**z**áun   Close Juncture
         house-watch.out   house-watch out=guard
         'guard'   (Jenny & Hnin Tun, 2016)

b. **Verb phrase**
?ein **s**áun   Open Juncture
house watch.out   adapted from (Jenny & Hnin Tun, 2016)
'to watch the house'

1.3 The Lexicalization Processes

Excluding all loanwords, all the multi-syllabic words are sub-categorized into two groups:
1) The syllables within the words can be re-analyzed. The word meaning depends on the
semantics of each morpheme component. In example (2-a), in order to represent 'to guard'
in Modern Burmese, one has to combine *pein* 'house' and *sáun* 'to watch out' together.
2) The syllables within the words cannot be re-analyzed, i.e., the listeners cannot infer the
word meaning just by adding up the meaning of each morphological component within this
word, although sometimes they are able to figure out there are two components in the word.
In (3), the word $s^h \grave{o}unp^h ya$ 'to decide' consists of two morphemes: $s^h \grave{o}un$ 'endpoint' and
$p^h ya$ 'to cut off'. But 'to decide' is not inferrable from 'to cut off the end'. A key difference
between the two sub-categories is that the voicing sandhi can be found in the former one,
but not in the latter, even though the components are linked via close juncture in both cases.
In (3), the onset of the second morpheme $p^h ya$ does not become voiced.

(3) $s^h \grave{o}un$-$p^h ya$
        end-cut
        'to decide'

Vittrant (2012) proposes that this type of word has been lexicalized into a single word,
meaning there should not exist any morpheme boundary between the two components, dif-
ferent from the lexical compounds. That means the linguistic operations, such as phono-
logical rules, can only be applied to the word as a whole. By comparison, recall example
(2-a), in which the voicing rule is able to applied within the compound word.

In summary of this section, in order to hear the voicing sandhi, we have to make sure
that the phonological processes, and the morphological condition occur simultaneously.
At the same time, we will have our new question: *Are lexicalized words and the lexical
compounds the same for the language learners? If not, how are they acquired differently?
If yes, why is the sandhi-voicing realized in one, but not the other?* In this paper, I am
applying the Emergent Grammar framework (Archangeli & Pulleyblank, 2022) to explain
this phenomenon in that from the perspective of language acquisition, the EG framework
tries to bridge the relationship between phonology and morphology. By setting up the
specific domains for the phonotactic conditions, this theory is able to simplify the interface
problem.

2   An Emergent Phonology Analysis

2.1   Morph Sets and Learning Trajectory Hypothesis

Archangeli and Pulleyblank (2022) proposes a learning trajectory hypothesis, as adapted according to Modern Burmese and shown in (4) - (6). During the early period, a Modern Burmese learner might just begin to identify short mono-syllabic words, such as [tɕɛʔ] 'to cook', and [sáun] 'to watch', shown in (4).

(4)   **Early morph acquisition: [nonvoice]-words**
      a.   [tɕɛʔ] 'to cook'   b.   [sáun] 'to watch'

As the learners become aware of long sequences and store them, recurring longer chunks get high frequency counts. The learners realize that these longer chunks contain many familiar syllables, with the first segment being voiced, as in (5). When enough chunks are acquired, whether they are longer or shorter ones, the learner realizes that the word meaning of the longer chunks can be reduced into that of the components.

(5)   **Mid morph acquisition: the counterpart [voice]-words in longer morphs**
      a.   [tʰəmìn-dʑɛʔ] 'chef'   b.   [ʔein-záun] 'guard'

Once this step is reached, the learners are in position to hypothesize that those verbs might have two forms: voiced and unvoiced in different environments. Thus, in each morph set of a specific verb, there are two morphs acquired, such as $\{tɕɛʔ, dʑɛʔ\}_{\text{TO.COOK; VERB}}$, and $\{sáun, záun\}_{\text{TO.WATCH; VERB}}$. The VERB morph set in this stage is shown in (6).

(6)   **Late morph acquisition: the VERB morph set and its member morph sets**
    $\{\{tɕɛʔ, dʑɛʔ\}_{\text{TO.COOK}}, \{sáun, záun\}_{\text{TO.WATCH}}, ...\}_{\text{VERB}}$

Until this stage, the learners are able to generalize the Morph Set Relation (MSR) in terms of the voice condition of the first segment of the verbs, noted as $\textbf{MSR}_{\textbf{[VOICE]}}$, to illustrate the relation between morphs within one morph set, as shown in (7).

(7)   **Modern Burmese Morph Set Relation$_{\text{[VOICE]}}$ (MSR$_{\text{[VOICE]}}$)**
    In a minimal verb morph set, there is a systematic relation between morphs with voiced initial onset, and morphs with initial voiceless initial onset.

$$MSR_{[\text{VOICE}]}: \quad \{\mathcal{M}_i, \mathcal{M}_j\}_{\text{VERB}} \qquad \begin{aligned} \mathcal{M}_i &: \#\big[\text{nonvoice}\big] \\ \mathcal{M}_j &: \#\big[\text{voice}\big] \end{aligned}$$

Since most mono-syllabic words have their unvoiced onset consonant in Modern Burmese, and it is likely that the learners do not run into a lexical compound with their voiced counterparts, the learners thus might find two types of morph sets: the one with only unvoiced onset $\{\mathcal{M}_{[\text{NONVOICE}]}\}$ and morph sets with corresponding voiced and unvoiced

morphs $\{\mathcal{M}_{[\text{NONVOICE}]}, \mathcal{M}_{[\text{VOICE}]}\}$. In addition, it might be very rare to have morph sets with only the voiced morph $\{\mathcal{M}_{[\text{VOICE}]}\}$. This unbalanced acquisition is coded in the Modern Burmese grammar by a Morph Set Condition (MSC), which penalizes morph sets that only contain one type of morphs, as shown in (8).

(8)   **Modern Burmese Morph Set Condition$_{[\text{VOICE}]}$ (MSC$_{[\text{VOICE}]}$)**
       With respect to MSR$_{[\text{VOICE}]}$, a minimal morph set is ill-formed if there is a morph with a unvoiced onset, and there is no corresponding morph with a voiced onset.
       $MSC_{[\text{VOICE}]}$: For two different morphs $\mathcal{M}_i, \mathcal{M}_j$ of MSR$_{[\text{VOICE}]}$, $^*\{\mathcal{M}_j, \neg\mathcal{M}_i\}$.

MSC in (8) guarantees the productivity and the morphs that are not acquired by the learners are expanded to the lexicon as a consequence.

2.2   The Emergent Analysis

From what we have analyzed in section 1.1, we are able to propose two phonotactic conditions regarding the phonological processes, as seen in (9) and (10). These two phonotatic conditions determine whether [voice] or [nonvoice] variants are chosen from the relevant verb morph sets. *Focus*, denoted as $\mathcal{F}$, explains, in some cases, the phonotactics is relevant only to particular segment types, such as consonants, vowels, etc. *Domain* is indicated by $\mathcal{D}$.

(9)   **No unvoiced obstruent after open syllables.**

$$^*V\begin{bmatrix} \text{NONVOICE} \\ \text{OBSTRUENT} \end{bmatrix}$$
$\mathcal{F}$: consonant
$\mathcal{D}$: word

With a focus on consonants, assign a violation to a word if an unvoiced obstruent is preceded by a long vowel.

(10)   **No unvoiced obstruent after nasal coda.**

$$^*\begin{bmatrix} \text{CONS} \\ \text{NASAL} \end{bmatrix}\begin{bmatrix} \text{NONVOICE} \\ \text{OBSTRUENT} \end{bmatrix}$$
$\mathcal{F}$: consonant
$\mathcal{D}$: word

With a focus on consonants, assign a violation to a word if an unvoiced obstruent is preceded by a nasal consonant.

Here, in each verb-labeled morph set there are two morphs. For each compound word, we will have four possible candidates formed by two morphs from two morph sets, as shown by the *assessment table* in (11).

(11)   **Tentative assessment for [tʰəmìn-dʑɛʔ]$_{\text{CHEF-NOUN}}$** (Jenny & Hnin Tun, 2016)
       morph sets: {tʰəmìn, dəmìn}$_{\text{RICE}}$; {tɕɛʔ, dʑɛʔ}$_{\text{TO.COOK}}$

RICE-TO.COOK	*V NONVOICE OBSTRUENT	* CONS NASAL NONVOICE OBSTRUENT
? a. tʰəm̀ìn-dʑɛʔ		
? b. dəmìn-dʑɛʔ		
c. tʰəm̀ìn-tɕɛʔ		*!
d. dəmìn-tɕɛʔ		*!

In (11), there are two possible surface forms that would respect the phonotatic condition (10). In the old framework of EG, the default condition is able to solve this problem, and tell us candidate (11-a) is the winner.[1] However, it seems that the setting of the default condition agrees with the existence of underlying representation, which Archangeli and Pulleyblank (2022) eliminates. Hereby, I will apply the condition in (12). In particular, the speaker would be expected to select the most commonly observed morph based on the prediction of exemplar theory (Lacerda, 1995, 1998; Pierrehumbert, 2001; Johnson, 2007), which can be formalised by imposing a penalty on any morph in a morph set that is not the most frequently occurring one, a lexically-based generalisation (Archangeli & Pulleyblank, 2022).

(12) **Penality on less frequent morphs**

$*\{morph_\beta\}$ Assign a violation to each $morph_\beta$, which is not most frequently occurring morph in the morph set.

Since the word-initial voiceless consonant is voiced only if the voicing conditions are met, their corresponding counterparts with word-initial voiced consonant are the less frequent morphs. Thus, there will be a recurrence of prohibitions of the less frequent forms: $*\{dəmín\}_{\text{RICE}}$, $*\{dʑɛʔ\}_{\text{TO.COOK}}$. On the other hand, the words originally with initial voiced consonant are not penalized, because they are observed frequently, such as $\{gəzà\}_{\text{TO.PLAY}}$, $\{zəgà\}_{\text{LANGUAGE}}$, etc. Then, a phonological generalization will be extracted from those penalized less frequent words, prohibiting words with initial voiced consonant. The extracted phonotactic condition is shown in (13).

(13) **Burmese word-initial phonotactic**

$*\#\begin{bmatrix} \text{VOICE} \end{bmatrix}$ With a focus on consonants, assign a violation to a word con-
$\mathcal{F}$: consonant   taining an initial voiced consonant.
$\mathcal{D}$: word

The new assessment table is provided in (14).

(14) **Updated assessment for [tʰəm̀ìn-dʑɛʔ]**_{CHEF-NOUN} (Jenny & Hnin Tun, 2016)

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[1]For more information about the default morph, please refer to e.g., Archangeli and Pulleyblank (2016, 2018), McCullough (2020)

morph sets: {tʰəmìn, dəmìn}ᴿᴵᶜᴱ; {tɕɛʔ, dʑɛʔ}ᵀᴼ.ᶜᴼᴼᴷ

RICE-TO.COOK	*V [NONVOICE OBSTRUENT]	* [CONS NASAL] [NONVOICE OBSTRUENT]	*# [VOICE]
☞ a. tʰəmìn-dʑɛʔ			*
b. dəmìn-dʑɛʔ			**!
c. tʰəmìn-tɕɛʔ		*!	
d. dəmìn-tɕɛʔ		*!	*

Given the conditions and the ranking of them proposed with the help of lexical compounds, now I am going to test if they remain consistent for words as in (3). The hypothesis is that even though the language speakers are not able to analyze the whole word morpheme by morpheme, the absence of voicing still indicates the existence of word boundary (Soe, 1999). Hereby, it is reasonable to consider that the word *sʰòun-pʰya* 'to decide' consists of two morphs from different morph sets, as shown in the assessment table (15).

(15)   **Tentative assessment for [sʰóun-pʰya]**ᵀᴼ.ᴰᴱᶜᴵᴰᴱ-ⱽᴱᴿᴮ (Jenny & Hnin Tun, 2016)
       morph sets: {sʰóun, zóun}ᵀᴼ.ᴱᴺᴰ-ⱽᴱᴿᴮ; {pʰya, bya}ᵀᴼ.ᶜᵁᵀ-ⱽᴱᴿᴮ

TO.DECIDE	*V [NONVOICE OBSTRUENT]	* [CONS NASAL] [NONVOICE OBSTRUENT]	*# [VOICE]
a. sʰóun-pʰya		*!	
b. zóun-pʰya		*	*!
☞ c. sʰóun-bya			*
d. zóun-bya			**!

The assessment table (15) shows a different winner from what we are anticipating. This shows that once the grammar is acquired, the speakers should treat the lexical compounds and the lexicalized words differently. From the assessment table (14), if the lexical compounds are built upon two morphs, then the lexicalized words are morphs themselves, which means the lexical words are always encountered and stored as a whole. Then with the help of the MSC in (8), we are able to generate part of the verb morph set, as shown in (16). The updated assessment table in (17) returns the correct winner.

(16)   **Modern Burmese ᴠᴱᴿᴮ morph set**
       {{sʰóunpʰya, zóunpʰya}ᵀᴼ.ᴰᴱᶜᴵᴰᴱ, {sʰóun, zóun}ᵀᴼ.ᴱᴺᴰ, {pʰya, bya}ᵀᴼ.ᶜᵁᵀ, {gəzà}ᵀᴼ.ᴾᴸᴬʸ, …}ⱽᴱᴿᴮ

In (17), since *sʰóunpʰya* is not a lexical compound but a morph, it does not violate the higher ranked conditions, while the voiced counterpart is not a morph with high frequency at all. Therefore, *sʰóunpʰya* is our expected winner.

(17)   **Updated assessment for [sʰóunpʰya]**ᵀᴼ.ᴰᴱᶜᴵᴰᴱ-ⱽᴱᴿᴮ

morph sets: {sʰóunpʰya, zóunpʰya}TO.DECIDE-VERB

TO.DECIDE	*V $\left[\begin{array}{c} \text{NONVOICE} \\ \text{OBSTRUENT} \end{array}\right]$	* $\left[\begin{array}{c} \text{CONS} \\ \text{NASAL} \end{array}\right]\left[\begin{array}{c} \text{NONVOICE} \\ \text{OBSTRUENT} \end{array}\right]$	*# $\left[\text{VOICE}\right]$
☞ a. sʰóunpʰya			
b. zóunpʰya			*!

3   Conclusion

In this paper, I applied the EG framework to analyze the sandhi-voicing found in Modern Burmese. I show that it is not always the case that unvoiced onset means an open juncture between morphemes within a word. In some cases, the absence of sandhi-voicing indicates no morpheme boundary, and the learners acquire those chunks as a whole, even though they may realize these multi-syllabic chunks contain several smaller components. The acquisition analysis based on this framework shows the difference between distinct types of multi-syllabic words when they are acquired and stored in the morph sets. This paper also shows the strong ability of this framework in analyzing phonological phenomena with respect to the morphology within the grammar. However, the juncture issue should not be ending here. Since the syntactic structure of two constituents affects juncture between two syllables, thus two morphemes in Burmese, the syntax-phonology interface would bring one big challenge for the Emergent Grammar framework.

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