

## Licensing and Blocking in Malay Morphophonology

**Overview** This work formalizes Malay morphophonological processes using Boolean Monadic Recursive Schemes (BMRS; Bhaskar et al. 2020; Chandlee and Jardine 2021). In Malay, processes relating to nasal-consonant clusters show an asymmetry as they only happen at prefix-related morphological junctures as seen in (1). Asymmetries are present too when comparing between multi and monosyllabic roots as seen in the difference between (1c) and (1d). Based on the argument that such processes happen only at the morphological word level, we show formally how feature prespecification and the presence of underlying empty prosodic structures like the mora can block otherwise regular phonological processes to explain the asymmetries observed (Inkelas and Cho 1993; Kassin 2000). This argument builds upon the structure in (2) and the fact that hierarchical prosodic structures can be equivalently represented as flat strings (Strother-Garcia 2019). We also show that BMRS provides a middle ground for current two-step rule-based and one-step fusion accounts of nasal-voiceless obstruent cluster behavior.

**Boolean Monadic Recursive Schemes** BMRS provide a logical characterization of sub-sequential functions, and are a useful formalism for phonological analysis. A BMRS program consists of a collection of functions that define input-output maps formally using an IF...THEN...ELSE... syntax yielding a Boolean value. A phonological feature  $f$  for the domain element  $x$  of a string is represented as  $f(x)$ . For  $[+f]$ , the function yields  $\top$  (true) and for  $[-f]$ , it yields  $\perp$  (false). Output values are determined with special functions  $\phi_f(x)$  that determine what position  $x$ 's value for  $f$  will be. A special function  $\text{out}(x)$  determines whether a position is present in the output while functions  $p(x)$  and  $s(x)$  helps capture information about the predecessor and successor elements of  $x$ . BMRS can represent blocking and licensing conditions. A function yielding  $\top$  when a given IF clause evaluates to  $\top$  when true means the IF clause acts as a licensing structure. Likewise, the clause is a blocking structure when the function evaluates to  $\perp$  (false). BMRS is also a declarative formalism which means functions in a program are evaluated simultaneously and thus have no intrinsic or extrinsic order assigned to them.

**Analysis** Applying BMRS to Malay, the functions in (3) collectively determine where nasal assimilation and post-nasal deletion occur. In (3a), an underspecified nasal segment is formally defined such that it yields  $\perp$  if the segment is specified for any place feature. The equation in (3b) defines the environment required for nasal assimilation by pinpointing the nasal segment such that place features can be specified in further processing. Formally defining an underspecified nasal segment in (3a) allows for any nasal segment with a prespecified place feature to block assimilation as it will not yield  $\top$  for the equation in (3b). These equations, together with the conclusion that nasal assimilation only happen at morphological word junctures prevent overapplication. Furthermore, input strings with monosyllabic roots like /mən $\mu$ bom/ will not undergo assimilation as it does not satisfy the environment required laid out in (3b) due to the presence of the mora, a blocking structure. Finally, (3c) and (3d) are examples of equations that implement assimilation by evaluating the place feature of the root-initial consonant.

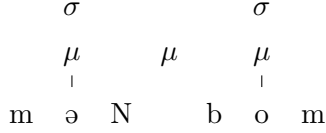
Nasal substitution requires post-nasal deletion on top of nasal assimilation. (4a) defines the environment for post-nasal deletion by evaluating the post-nasal segment's voice feature. This acts as a blocking structure in the output equation in (4b) that defines which segments surface in the output. The environment in (4a) is a blocking structure as a post-nasal voiceless obstruent is blocked from surfacing in the output in (4b). The BMRS program's structure offers a middle ground on the debate over how to represent the process, either through a two-step nasal assimilation process or a one-step fusion process. This analysis provides a parallel evaluation similar to the one-step fusion OT account, and also maintains the autonomy between both segments while including an overt deletion operation similar to the rule based account.

**Conclusion** The analysis of Malay morphophonology presented shows that contra Kassin (2000), edge-based analyses are not necessary to capture the facts. Moreover, prespecification and overt string-based representations of empty prosodic structures account for the multi/monosyllabic and prefix/suffix asymmetries surrounding nasal-related processes in Malay.

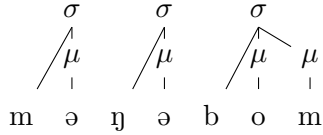
- (1) *Nasal assimilation and related processes* (Kassin 2000; Onn 1976)
- a. /pəN-daki/ [pəndaki] ‘climber’ c. /məN-kirim-kan/ [məŋirimkan] ‘to send’  
 b. /məN-lompat/ [məlompat] ‘to jump’ d. /pəN-bom/ [pəŋəbom] ‘bomber’

- (2) *Monosyllabic word structures* (Ahmad and Jalaluddin 2011)

- a. Underlying representation



- b. Surface representation



- (3) a.  $N(x) := \text{IF } \text{nasal}(x) \text{ THEN}$   
            $\text{IF } \text{lab}(x) \text{ THEN } \perp \text{ ELSE}$   
            $\text{IF } \text{cor}(x) \text{ THEN } \perp \text{ ELSE}$   
            $\text{IF } \text{dor}(x) \text{ THEN } \perp \text{ ELSE } \top$   
            $\text{ELSE } \perp$   
 b.  $\underline{NC}(x) := \text{IF } N(x) \text{ THEN } \text{consonantal}(s(x)) \text{ ELSE } \perp$
- c.  $\phi_m(x) := \text{IF } \underline{NC}(x) \text{ THEN}$   
            $\text{place}(s(x)) \approx \text{lab}$   
            $\text{ELSE } m(x)$   
 d.  $\phi_n(x) := \text{IF } \underline{NC}(x) \text{ THEN}$   
            $\text{place}(s(x)) \approx \text{cor}$   
            $\text{ELSE } n(x)$

- (4) a.  $\mathbf{B}(x) := \text{IF } \underline{NC}(p(x)) \text{ THEN}$   
            $\text{IF } \text{voice}(x) \text{ THEN } \perp$   
            $\text{ELSE } \top \text{ ELSE } \perp$   
 b.  $\text{out}(x) := \text{IF } \mathbf{B}(x) \text{ THEN } \perp \text{ ELSE } \top$

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