

Realization of Serudung Murut word-final voiced stop alternation across prosodic contexts

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Introduction: Serudung Murut, an endangered Austronesian language spoken by roughly 1,000 speakers in Tawau, Sabah, Malaysia, has been reported to exhibit a typologically rare alternation in which intervocalic voiced stops surface as their nasal counterparts in word-final position (e.g., ‘to buy’ [alid-in] (object voice) vs. [aŋ-alin] (actor voice); [1]). Several theoretical frameworks, including Steriade’s P-Map hypothesis [2], predict that such a pattern should not exist. We conducted in-person fieldwork to assess the phonetic reality of this alternation. In light of evidence for incomplete neutralization [3] and the role of prosody in regulating contrasts [4], we further compare nasals derived from voiced stops with underlying, non-alternating nasals (e.g., /akan/ ‘to eat’) across different prosodic conditions, with the goal of clarifying their phonetic differences.

Methods: Recordings were collected from eight native speakers (6F, 2M; M_{age}=49.5) of Serudung Murut in a quiet, sound-treated room using a Shure SM35 headworn microphone. Target verbs varying in Place of Articulation (POA; Labial vs. Alveolar vs. Velar) and Nasal Type (NT; Underlying vs. Derived) (see Table 1) were embedded in carrier sentences and elicited under two prosodic conditions: Focus (Unfocused vs. Focused) and Phrasal Position (Medial vs. Final) (see Table 2). In Focused conditions, target verbs were presented in contrast with a lexical item bearing the opposite Nasal Type in the preceding phrase. Visual illustrations were provided alongside Malay translations. The nasal coda of each target verb was annotated from the onset to the offset of the nasal murmur. For each token, nasal coda duration was extracted using VoiceSauce [5], along with Cepstral Peak Prominence (CPP), Harmonics-to-Noise Ratio (0–500 Hz; HNR05), and Strength of Excitation (SoE) values at three temporal subsegments (TP; Timepoint 1-3). Linear mixed-effects models were fitted in R [6] with Place of Articulation, Nasal Type, Focus, Position, Timepoint, and their interactions as fixed effects, and Word and Speaker as random effects.

Results: Duration (Fig. 1) showed a significant Position×NT×Focus interaction ($\beta=44.29$, $p<.05$): Underlying nasals were longer than Derived nasals in Phrase-final compared to Phrase-medial position, with this difference being more pronounced in Unfocused than in Focused conditions. All VoiceSauce measures (Fig. 2) revealed significant negative main effects of NT (Derived < Underlying) and Position (Final < Medial), with the magnitude of the NT effect exceeding that of Position in two of the three measures. No significant interactions were found between POA and either NT or Position, indicating that the effects of NT and Position generalize across places of articulation. In addition, all measures showed a significant NT×TP2 interaction, such that Derived nasals exhibit reduced voicing as early as TP2. Taken together, these results indicate reduced periodicity and creakier phonation in Derived nasals, with the greatest divergence with Underlying nasals at the segment midpoint. Notably, Focus did not yield significant effects on any measures.

Implications: This study clarifies the phonetic nature of the nasals derived from alternation with voiced stops in Serudung Murut across different prosodic contexts. Derived nasals exhibited significantly lower CPP, HNR05, and SoE values than Underlying nasals, indicating that they are better characterized as laryngealized rather than plain nasals (see waveform and spectrogram in Fig. 3), contrary to [1]. Moreover, the magnitude of voicing reduction was consistently larger for NT than for Position, suggesting a principled distinction between phonological alternation and prosodically driven weakening [7]. In addition, the durational contrast between Underlying and Derived nasals was larger in Phrase-final than in Phrase-medial position, potentially serving as a more robust cue when voicing-based distinctions were attenuated phrase-finally. Lastly, the modulatory Focus effect on phrase-final lengthening suggests a coordinated interaction between prominence and boundary-marking mechanisms [8].

Table 1. Target verbs for two Nasal Types (Underlying vs. Derived) per three Place of Articulation conditions (Labial vs. Alveolar vs. Velar).

Nasal Type (NT)	POA	Words
Underlying	Labial	/inum/, /inam/, /indam/
	Alveolar	/batun/, /akan/, /palin/
	Velar	/tandaŋ/, /aruŋ/, /kajaŋ/
Derived	Labial	/sukab/, /kotob/, /tutub/
	Alveolar	/alid/, /tagad/, /solod/
	Velar	/balag/, /gimumug/, /polog/

Table 2. Carrier sentences for prosodic conditions of Focus (Unfocused vs. Focused) and Phrasal Position (Medial vs. Final) in Serudung Murut with English translations

Focus	Phrasal Position	Carrier Sentence
Unfocused	Medial	ulun injo ____ siono. person that ____ now. That person is ____ now.
	Final	siono ulun injo ____. now person that ____. Now that person is ____.
Focused	Medial	en ____ siono. ____ siono. don't ____ now. ____ now. Don't ____ now. ____ now.
	Final	siono en ____ siono ____. now don't ____ now ____. Now don't ____ Now ____.

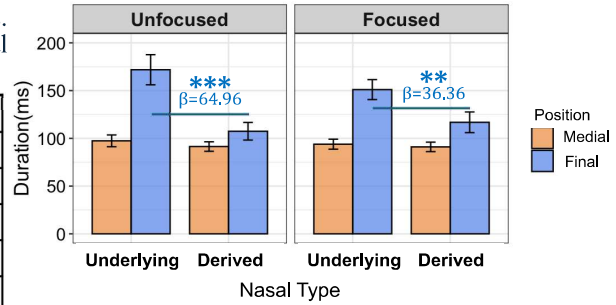


Figure 1. Coda duration of underlying and derived nasals across Phrasal Position (orange: phrase-medial, blue: phrase-final) and Focus conditions (left panel: Unfocused, right panel: Focused).

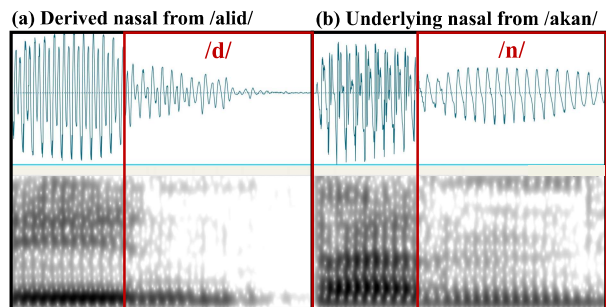


Figure 3. Waveforms and spectrograms of (a) /alid/ with an underlying voice stop realized as a laryngealized nasal and (b) /akan/ with an underlying nasal

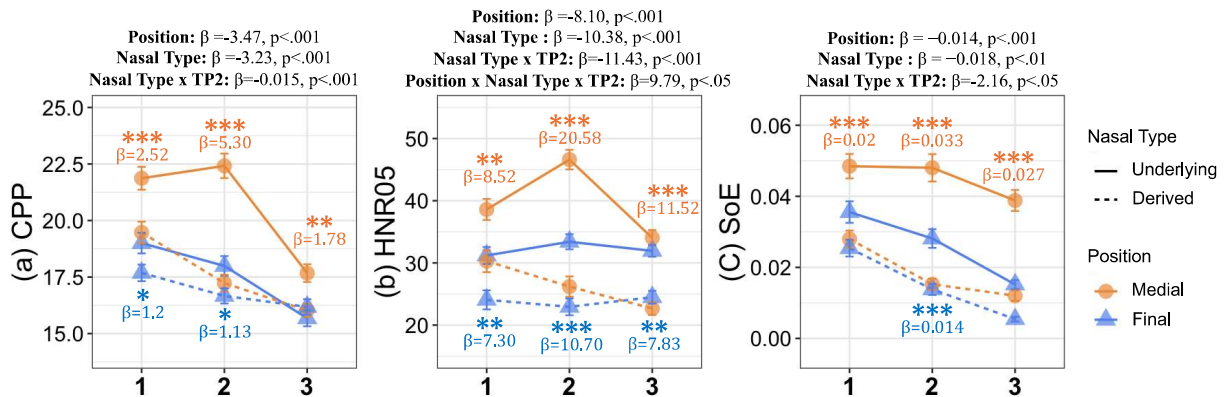


Figure 2. Values of (a) CCP, (b) HNR05, and (c) SoE across three Timepoints for different Nasal Types (solid lines: underlying nasals, dotted lines: derived nasals) and Phrasal Position (orange: phrase-medial, blue: phrase-final). Lower values indicate greater aperiodic voicing as well as greater glottal constriction.

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