Assibilation in Trans-New Guinea languages of the Bird's Head region

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Abstract

Previous studies have shown that assibilation of voiced stops is less common than assibilation of voiceless stops, the former requiring complex and competing aerodynamic conditions to be produced. The present study reveals that voiced assibilation is found synchronically in various Trans-New Guinea languages of the Bird's Head region, with the Mbahám peculiarity that assibilation affects prenasalized voiced stops, a case which has not been described previously. This paper reports new empirical data from previous understudied languages and provides evidences for a new treatment of the phonological inventory of these languages.

Index Terms: assibilation, Papuan languages, phonology, phonetics, reconstruction.

1. Introduction

This paper examines the phonological and phonetic aspects of assibilation in various Trans-New Guinea (TNG) languages of the Bird's Head region (West Papua, Indonesia), with a particular focus on Mbahám, a language of the Onin peninsula (app. 1000 speakers). One interesting feature of Mbahám assibilation is that it affects both voiceless stops and prenasalized voiced stops at the coronal place of articulation. Assibilation for this latter class of sounds has not been reported in studies on other languages. More generally, assibilation of voiced stops is considered to be more complex in terms of aerodynamic requirements ([1] and [2]) and is therefore found less frequently than voiceless stop assibilation.

Hall & Hamann [3] and Hall, Hamann & Zygis [4] define assibilation as a process 'which convert[s] a (coronal) stop to a sibilant affricate or fricative before high vocoids'. Assibilation covers palatalization, sibilant affrication and sibilantization in a [_i] context; similar aerodynamic, articulatory and perceptual conditions are involved in these three processes. Coronal is the place of articulation the most affected by assibilation [3]. As detailed in various studies ([3], [4] [5], [6] and [7]), assibilation originates from articulatory gestures at the stop-vowel transition: tongue movements in the oral cavity during the transition of a stop towards a high vowel create the aerodynamic conditions to produce frication. At the stop release, the tongue moves away from the passive articulator to produce the following segment. When this segment is a high front vowel, the tongue blade moves downward gradually; its movement is slower than for a non-high vowel [5]. A narrow channel is created between the tongue blade and the alveo-palatal region. Turbulence arises from the passage of the airflow through this restricted tube; frication is produced and perceived by the listener ([3] and [8]).

Before enlarging the scope to other TNG languages of the region, the phonological and acoustic properties of Mbahám assibilation are presented. Mbahám has been tentatively classified as a TNG language of the Bomberai sub-branch. Iha is the only language to which Mbahám is directly related; extended relations to other TNG languages are still under investigation. The author is currently working on the phonetic and phonological description on the northern variety of the language spoken in the Kokas area (app. 200 speakers).

2. Mbahám assibilation

2.1. Phonological description

In Mbahám, /t/ and /ⁿd/ assibilate before a sequence of two vocoids whose first segment is [+high]. Examples are given in table 1. The triggering segment is realized either in a stressed or an unstressed syllable. In the latter case, the vocoid does not form a syllable peak. The segments [j] and [w] belong to the onset position. This situation facilitates assibilation.

Table 1. *Assibilation of voiceless coronal stops and prenasalized voiced coronal stops in Mbahám.*

/tiɛ́kas/	[tʃjɛ́ɣas]	*food*
/miⁿdíɛt/	[mindʒíɛt]	*bitter*
/tiári/	[tʃjári]	*rain*
/kiⁿdián/	[kindʒján]	*person*
/túɔn/	[tʃúɔn]	*thigh*
/ⁿdúɔn/	[ndʒúɔn]	*to cut*

In Mbahám, affricates surface in initial and medial positions of a word, but not word-finally; it only occurs morpheme internally. Assibilation is distinct from lenition processes such as voicing, spirantization and debuccalization also operating in the language in that assibilation is conditioned by the quality of the following vowel and is not restricted to the intervocalic context. Unlike other processes, assibilation affects both voiceless and voiced stops.

2.2. Acoustic experiment

2.2.1. Procedure

The quantitative study consists in measuring and comparing the duration of the frication portion in voiceless and voiced assibilated stops. Data consists of elicited wordlists which have been collected in Kokas village with four Mbahám informants: KM, MT and LM (female speakers) and JT (male speaker). Recordings have been made with a head-mounted AKG C520 cardioid condenser plugged in a Marantz PMD661 digital recorder. Wide-band spectrograms with a window

length of 5ms and a dynamic range of 50dB for female speakers and 40dB for the male speaker JT are used for measurements of the present study. These settings suit the range of frequencies of the different speakers. The fricative portion is expected to have energy in high frequencies. The spectrogram window goes up to 8kHz. Settings have been set to include four formants. Acoustic measurements follow Hall et al.'s [4] procedure and include the fricative release duration from the stop burst to the onset of the following vowel, comprising the burst itself, frication and aspiration. In addition to the quantitative study, qualitative observations of phonetic forms are reported. They are based on spectrogram and waveform indications, as well as perceptual data. Several features are described: the presence of voicing, the realization of a burst and the place of articulation of the frication as well as inter- and intra-speaker variations. For the present study, 322 tokens in total have been measured (207 for /t/ and 115 for /ⁿd/).

2.2.2. *Quantitative results*

For all Mbahám speakers, /t/ assibilated allophones have a longer frication than /ⁿd/ allophones. This difference is statistically significant for most speakers, with the exception of KM for whom there is a large variation (table 2).

Table 2. *Mean duration (in ms) of the frication of /t/ and /ⁿd/ assibilated surface forms.*

	/ⁿd/	/t/	One-way ANOVA
JT	40.29 (13)	51.51 (13)	F[1,86]=15.26, p < .001
KM	56.53 (18)	63.73 (20)	F[1,103]=3.555, p = .062
LM	49.71 (9)	59.70 (12)	F[1.55]=9.885, p = .003
MT	46.05 (15)	58.14 (17)	F[1,70]=8.074, p = .006

The duration of fricated release for voiceless stops and prenasalized voiced stops is represented on figure 1, for each speaker.

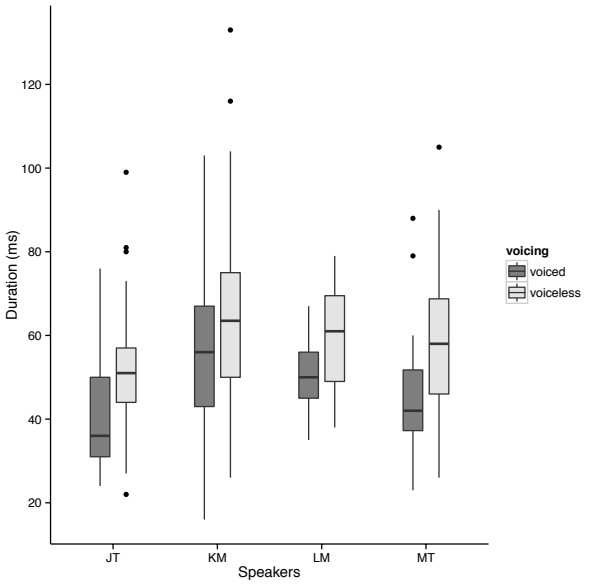

Figure 1. *Duration of the frication of /t/ and /ⁿd/ assibilated forms for four Mbahám speakers.*

2.2.3. *Qualitative results*

There is considerable inter-token variation in the quality of the assibilated surface forms of /t/ and /ⁿd/, particularly concerning prenasalized voiced segments.

The frication release of /ⁿd/ may be produced with or without voicing. Inter-speaker differences are observed. Speaker LM produces exclusively voiceless fricative release, while speakers MT, KM and JT realize a voiced fricative release for approximately 35% of tokens. The tendency is thus for an assibilated prenasalized voiced stop to be realized with a devoiced fricative release. Figure 2 shows a spectrogram and waveform of the prenasalized affricate in the word /kaⁿdúɔk:a/ [kandʃúɔk:a] *stork* pronounced by speaker LM. The blue arrow indicates the portion of frication, during the stop release. No voicing is produced. Figure 3 shows the pronunciation of /ⁿd/ in the word /miⁿdíɛt/ [mindʒíɛt] *bitter* by speaker MT. Energy is observed in the voicing bar across the bottom of spectrogram, indicating the presence of voicing.

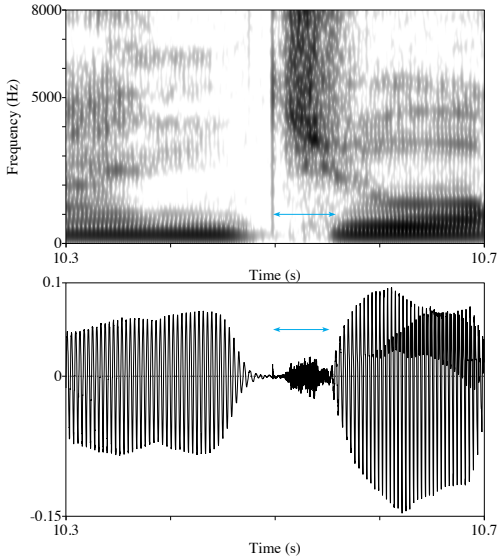

Figure 2. *Spectrogram and waveform of [ndʃ] in /kaⁿdúɔk:a/ [kandʃúɔk:a] 'stork': no voicing at the fricative release.*

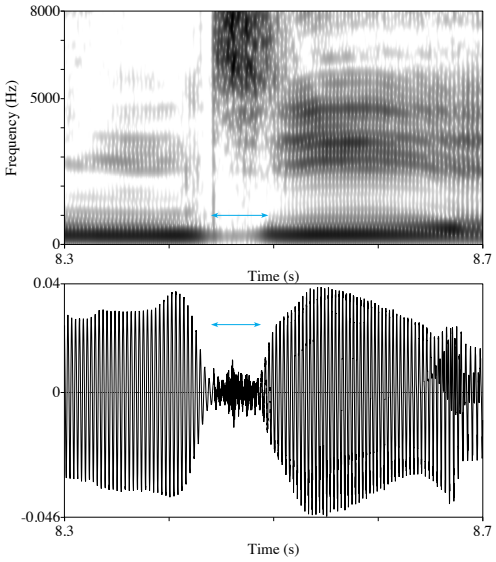

Figure 3. *Spectrogram and waveform of [ndʒ] in /miⁿdíɛt/ [mindʒíɛt] 'bitter': voicing at the fricative release.*

In Mbahám, assibilated forms of /ⁿd/ may be produced with or without an audible burst. An (non-nasal) oral closure might precede the burst (as in figure 2) or not (as in figure 3). In this latter case, the surface form is similar to a nasal-fricative sequence. Some tokens might be produced with two successive releases visible on the spectrogram.

Frication release may be produced in the alveolar region or further back in the palatal region. There is a substantial range of inter-speaker variation. Speaker JT produces mainly palatal frication, while the female speakers realize one or the other. Variation between an anterior and more posterior pronunciations are heard for both /t/ and /ⁿd/.

2.2.4. Discussion

Results on the duration of fricative release of assibilated stops in Mbahám correspond to Hall et al.'s [4] findings on German and Polish assibilation: the frication duration in voiced phones is generally shorter than in voiceless phones.

The study on Mbahám assibilation shows that, in most cases, voicing of prenasalized segments ceases at the fricative release. This observation correlates with Zygis et al.'s [9] results on Polish and German (non-prenasalized) voiced affricates. Zygis & Fuchs' [1] and Zygis' [2] studies show that aerodynamic settings for voiced affricates are more complex than for their voiceless counterparts. In the former case, two aerodynamic conditions conflict: on one hand, voicing requires a pressure difference between the supraglottal and subglottal cavities such as the intraoral pressure (Po) needs to be lower than the subglottal pressure (Pg); on the other hand, the production of frication involves a high Po to create airflow turbulence. In the realization of affricates, Po builds up during the oral closure of the stop. This creates the ideal conditions for frication but not for voicing which requires a low Po. Due to this aerodynamic conflict, vocal fold vibration after the burst is hard to achieve. In the particular case of prenasalized stop affricates, airflow goes out through the nasal cavity during the period preceding the stop burst. As a consequence, it is expected that Po does not increase as much as in the production of (non-prenasalized) voiced stops; voicing at the release should be possible. Yet, at the offset of nasalization, Pg is low. The pressure difference between Pg and Po required for voicing is minimal. Conditions are thus not ideal for voicing production. Additionally, the overall articulation of prenasalized voiced affricates is complex and involves the controlled gestures at three locations in the vocal tract: (1) in the alveo-palatal region where the oral articulators form the constriction, (2) in the laryngeal cavity where vocal folds vibrate and (3) in the velar region where the velum operates successive downward and upward movements. Assibilation of prestopped nasals generates complex aerodynamic and articulatory conditions for speech production that might explain why such a process is uncommon in the world's languages.

Data on Mbahám assibilation also show there is a large inter-speaker and intra-speaker variation. This observation correlates with Riehl's [10] findings on the realization of nasal-affricates sequences in four Austronesian languages.

3. Revisiting the phonological inventory of other TNG languages

I suggest that assibilation is a widespread phenomenon amongst the TNG languages of the South Bird's Head (SBH) group. This treatment contrasts with previous descriptive works that consider surfacing affricates in these languages as part of the phonological inventory.

3.1. Languages of the SBH group

Cases similar to Mbahám assibilation are found in Kokoda and Puragi, for which de Vries [11] provides brief phone inventories and word lists. In Kokoda, I suggest that /t/ is produced as [ɕ] or [tɕ] and /d/ as [ʝ] in the [_i] context, as a case of palatalization. This analysis is based on various observations of de Vries' data and is particularly motivated by the infrequency of voiceless and voiced stops before high vocoids in the corpus (2 words out of 209 for /t/ and /ⁿd/ respectively). Also, the word [ɛigaɕigaja] *cold* in Kokoda is related to the word [tigatiga] in Arandai dialects (wordlist from [12]), revealing a probable diachronic process of assibilation in Kokoda. In Puragi, the segments [t] and [ɕ] are in complementary distribution in de Vries' corpus, with [ɕ] only attested before a high front vowel and [t] in other contexts. The voiced palatal stop [ʝ] only occurs in 2 words and is followed by non-high vowels. De Vries collected data from three different dialects: Puragi, Bedare and Isogo and writes that [d] in Puragi corresponds to [dʒ] in Bedare and Isogo. I propose that the analysis of [ʝ] and [d] corresponds to dialectal variations in Puragi rather than allophonic variations in one language. The analyses I suggest for Kokoda and the Puragi dialects infer that assibilation in these languages is quite similar to assibilation in Mbahám, in regards to the segments undergoing change, the surfacing forms and the triggering context.

Other languages of the SBH subgroup do not show similar conditions of assibilation. Nonetheless, the process of affrication is reported in Inanwatan [11] and Arandai [12]. In Inanwatan, phonemes /ɸ/ and /s/ can be realized as affricates [p͡ɸ] a[t͡s] word-initially, before any vowel. In Arandai, the phonemes /p/ and /k/ can have a fricative release: [pᶠ] and [kˣ]. In Yahadian, based on de Vries' corpus [11], I propose to treat the alveo-palatal [ts] and [dʒ] and the palatal [c] and [ʝ] as two single series /c/ and /ʝ/. In this language, the alveolar stop series /t/-/d/ and the palatal stop series /c/-/ʝ/ both seem phonological.

3.2. Assibilation as a diachronic process

The Mbahám word /tiári/ *rain* is cognate with the term *water* in various SBH languages. I present them in table 3. I propose to reconstruct a common form *tair *water*, with the initial consonant *t reflected as /t/ or /s/ in modern languages. In Duriankere, Kais and Inanwatan, I hypothesize a diachronic assibilation *t > /s/. In Mbahám, a metathesis is likely to have occurred: *tair > tiar or *tair > tari followed by a spreading of the palatal feature: tiar ~ tari > tiari. The shift created the favorable environment for synchronic assibilation. In Kokoda, for which I have suggested that /t/ undergoes assibilation similarly to Mbahám, no synchronic assibilation occurs because the triggering context has not been created diachronically. No affrication is reported for Arandai word either.

The proto-TNG form reconstructed by Pawley [14] for the term water is *ok[V] or *nok; it does not seem to be reflected in the languages of the SBH group. In neighboring non-SBH languages, the words for *water* do not seem related to the SBH form either.

Table 3. *Cognate words in SBH languages and Mbahám.*

Languages	*Cognates*	*Meaning*	*Ref.*
Mbahám	tiári	'rain'	
Duriankere	sa	'water'	[13]
Kais	sau		[13]
Inanwatan	sa tsa: ~ sa:		[13] [11]
Kokoda (Kasuari dialect)	taja		[13] [11]
Kokoda (Tarof dialect)	tai		[13] [11]
Arandai	tajeg		[13]

3.3. Discussion

The study of cognate words, as shown with the word for *rain,* supports the hypothesis that Mbahám from the Bomberai group shares similarities with languages of the South Bird's Head group. Synchronic and diachronic assibilation processes described for the TNG languages of the Bird's Head region echo with Kratochvíl's [15] reconstruction of the diachronic process of assibilation proposed for the proto-TNG *t.

4. Conclusions

In this paper, it has been shown that quantitative and qualitative data on Mbahám assibilation correlates with existing phonetic studies on assibilation in other (unrelated) languages. The study has also proposed to revise the phonological analysis of surfacing affricates in two other TNG languages, Kokoda and Puragi, showing that these phones are the results of stop assibilation and should not be considered as phonemes. Finally, the present work has envisaged new arguments for a genetic and areal connection between TNG languages of the Bird's Head region.

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