A multifaceted approach to understanding unexpected sound change: The bilabial trills of Vanuatu's Malekula Island

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Abstract

This paper demonstrates that unexpected sound changes are best explained by an approach that accounts for different motivations: phonetic, structural and social. Here, we focus on a multifaceted investigation of the cross-linguistically uncommon bilabial trills to show the complex interaction between different drivers of sound change. In this paper, we highlight and examine the prenasalized voiced bilabial trill ^{m}ʙ and plain voiceless bilabial trill ᴘ [ʙ̥] found in a number of Oceanic languages spoken on Malekula Island in Vanuatu. We offer a comparative-historical analysis, and we identify the various forces that led to the emergence and persistence of ^{m}ʙ and ᴘ in Malekula languages: the historical articulatory environments, the particular make-up of these languages' consonant inventories, complementary sound changes and phonological processes, contact with non-Austronesian languages, and in-group identity attachment. Furthermore, we offer a hypothesis for the relative timing of these factors on the historical pathway of Malekula's bilabial trills.

Keywords: bilabial trills; sound change; Vanuatu; Malekula; prenasalization; Austronesian; Austronesian-Papuan contact; language and identity

1. Introduction

Bilabial trills are cross-linguistically uncommon sounds. In an overview of bilabial trills in the world's languages, Keating (2007) reported that the approximately 50 languages with bilabial trills were clustered into a small number of locations. One such hotspot is Malekula Island in Vanuatu, where around 40 Oceanic languages (see §3.2 regarding the number of Malekula languages) of the Austronesian language family are spoken (see Figure 1 for the classification of Malekula languages within Oceanic). Bilabial trills have been documented, either as phonemes or as allophones, in 23 Malekula languages, however there is no evidence of bilabial trills elsewhere among the 170 other Southern Oceanic languages. Bilabial trills are innovations in these Malekula languages – no bilabial trills are reconstructed for the ancestral languages Proto Oceanic (POc) (Ross et al. 2016: 19) and Proto North Central Vanuatu (PNCV) (Clark 2009: 10-11).[1]

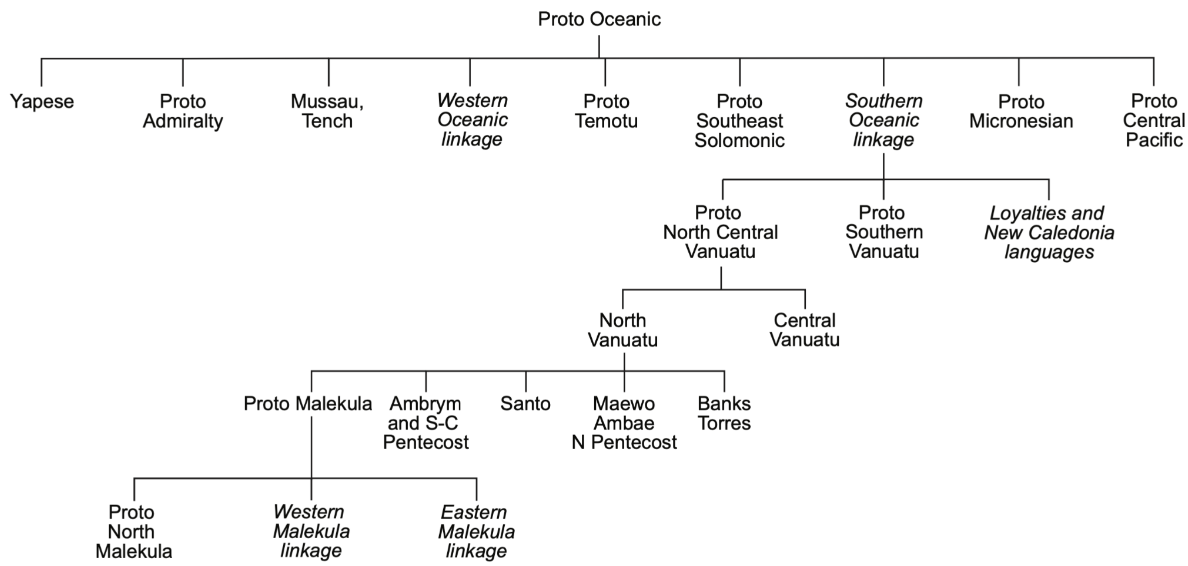

Figure 1. The classification of Malekula languages within Oceanic (Ross et al. 2016; Lynch 2016; Walworth et al. 2018).

[1] For POc the following labial consonants are reconstructed: *p, *p^w, *^{m}b, *$^{m}b^{w}$, *m, *m^w, *w (Ross et al. 2016). The PNCV labial consonant inventory reflects that of POc except that there were no voiceless bilabial plosives – they changed to fricatives denoted by Clark (2009: 10-11) as *v and *v^w. Clark describes these sounds as "labial" rather than labiodental fricatives, and they most likely had systematic bilabial manifestations as they do in many of the modern languages.

Bilabial trills, where they have been documented in the world's languages, are attested as plain phones, either voiced [ʙ], or voiceless [ʙ̥], or as complex phones, with prenasalization as [ᵐʙ] or [ᵐʙ̥], or pre-stopping as [t͡ʙ] or [t͡ʙ̥] (see e.g. Keating 2007 for an overview). It is important to keep in mind that all bilabial trills may be considered somewhat more complex sounds than, for example, a plain alveolar trill [r], because in bilabial trills the first bilabial release is more abrupt and plosive-like, which is why they can been viewed as "stops with a trilled release" (Ladefoged & Maddieson 1996: 30; see §2.2 for more details). (We will simply refer to them as "bilabial trills" in the rest of this text.) Prenasalized (and pre-stopped) bilabial trills are, however, even higher on the complexity scale, since they include yet another portion. All of the languages of Malekula Island with bilabial trills have the prenasalized voiced trill [ᵐʙ]; the plain voiceless bilabial trill [ʙ̥], henceforth ᴘ,[2] is found in a subset of them.

The origins of Malekula's bilabial trills have been under discussion for at least three decades since Maddieson (1989) analyzed ᵐʙ in a number of languages in Malekula, the Admiralty Islands in Papua New Guinea, Indonesia and Africa, and concluded that this complex phone derived from a [mbu] sequence. His hypothesis was supported by an account of the aerodynamic principles involved (§2.2, §3.1.1). Based on seven cognate sets in four Malekula languages, Lynch (2016), in line with Maddieson's (1989) conclusion, found that ᵐʙ derived from a [mbu] sequence, and that historical [mbo] sequences also could produce bilabial trills (§3.1.2). The plain bilabial trill has received little attention from historical linguistic study, however Olson (2015) hypothesized that a plain bilabial trill was an intermediate step between an earlier bilabial plosive and a contemporary bilabial fricative in the Malekula language Lamap (Port Sandwich) (§3.1.3). In addition to these hypotheses that address the phonetic motivations for the emergence of bilabial trills, other evidence suggests that Malekula's bilabial trills might be motivated by contact (Blust 2005b, 2008; Donohue and Denham 2008; Posth et al. 2018) (§3.1.4).

In this paper, we explore the unexpected development of these cross-linguistically rare sounds in a select group of Oceanic languages by examining the properties of bilabial

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[2] IPA lacks a special character for a voiceless bilabial trill. In the rest of the paper, we will use ᴘ (small caps p) to denote this trill for better readability. Such an approach was also argued for by Keating (2007: 57ff).

trills more generally, as well as by analyzing sound change as an interplay between language-internal, language-external and extra-linguistic factors (Labov 1994; Jones & Esch 2002; Salmons 2021). This paper thus presents new analyses on bilabial trills and offers detailed evidence for the need to investigate the multitude of pressures that can drive sound change. This study incorporates Blust's (2005a) more fine-grained typology, which classifies the motivations for sound change as phonetic, structural, or social, where we understand social motivation as referring to past and present language ecologies, including language contact phenomena. Such an approach responds to recent arguments, such as that of Salmons (2021: 164), that "[w]e need to understand not only the full set of factors that play a role in sound change but also how they interact, [and] which factors play what roles at what point in change".

We furthermore demonstrate that a multifaceted approach proves necessary in explaining the "emergence and persistence" of unusual sounds, such as bilabial trills. We contend that sounds are "unusual" or "unexpected" because they are constrained by certain factors; in the case of bilabial trills, these constraints are both general (purely articulatory, see §2.2, §5.2) and specific to the languages discussed here (their low functional load, see §3.3.3). These constraints can apply to the sound change itself (the emergence) and/or to the sounds' persistence, that is to say their continued use by speakers once they have emerged. Thus, we offer a detailed account of what factors are related to the emergence and what factors are related to the persistence of bilabial trills in Malekula languages.

Through an examination of legacy data and new field data from over 100 doculects throughout Malekula, we respond to the question: How did bilabial trills emerge and persist on this island, when they are cross-linguistically and genetically rare? Our analyses and results presented in this paper address gaps in the previous research on both prenasalized and plain bilabial trills and their historical origins. In §2, we present the known global distribution of bilabial trills and some phonetic, phonological, phonotactic and sociophonetic observations about these sounds. In §3, we discuss the existing hypotheses on the origins of bilabial trills on Malekula Island and we present an account of the distribution of bilabial trills on Malekula, followed by a comparative-historical analysis of the available data in §4. Here, the data are considered in relation to reconstructions of Proto North Central Vanuatu [PNCV] (Clark 2009) and Proto Oceanic [POc] (Ross, Pawley & Osmond 1998, 2007, 2008, 2011,

2016) to trace the origins of ᵐʙ and ᴘ in the languages of Malekula. The results are discussed in §5, where we conclude that a combination of phonetic, structural, and social factors in Malekula's linguistic history has driven the emergence and persistence of bilabial trills. In §6, we conclude with a discussion of the roles that different factors played and the relative timing of their effects.

2. Background

2.1 Geographic distribution of bilabial trills

Languages with bilabial trills cluster both genetically and geographically. In an overview of bilabial trills in the world's languages, Keating (2007) identified 47 languages that were reported to have bilabial trills. The majority of these languages are located in three geographic areas: Malekula Island in Vanuatu, Papua New Guinea, and Central Africa. In Papua New Guinea, they are found in languages from the Admiralties subgroup of Oceanic languages, spoken in Manus Province (see Figure 1), in addition to "Papuan" languages (a cover term for the non-Austronesian languages of Melanesia) of the unrelated Sko, Trans-New Guinea and Kwomtari-Baibai families that are spoken near the north coast of mainland New Guinea. In Central Africa, bilabial trills are found in the Central Sudanic, Niger-Congo and Afro-Asiatic families. Outside of these areas, bilabial trills have been reported in Nias (Northwest Sumatra-Barrier Islands) and Muna (Celebic) – two Austronesian languages of Indonesia[3] (e.g. Catford 1988; Brown 2001, 2005; Yoder 2010; van den Berg 1989).

The predominant bilabial trill in the above-mentioned languages is ᵐʙ. Ladefoged and Maddieson (1996: 130) observed that "the prenasalized instances are virtually the only occurrence of any bilabial trills in the world's languages". However, plain trills have been reported in a number of languages in Africa and on Malekula Island (e.g. Demolin 1988, 1992; McKee 2001; Olson & Koogibho 2013; Rangelov 2019; Williams 2019; see also Keating 2007 for an overview). Since they are cross-linguistically even more rare than the prenasalized trills, plain trills have received little attention in historical and phonetic literature (see, however, Demolin 1988, 1992 on Mangbetu; Olson & Meynadier 2015 on Medumba;

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[3] As members of the Malayo-Poynesian branch of the Austronesian language family, Muna and Nias are distantly related to the Malekula and Admiralties languages mentioned above.

Olson 2015 on Lamap). Furthermore, individual languages in Brazil, China and India present evidence of a pre-stopped trill t͡ʙ/t͡ʙ̥ (e.g. Ladefoged & Everett 1996; Coupe 2015; Yuan et al. 2019).

2.2 Phonetic and phonological properties of ᵐʙ and ᴘ

Phonetically, a bilabial trill is described as having two main parts: a bilabial closure, followed by a period of trilling, where the lips oscillate.[4] For the prenasalized trill, the bilabial closure period normally involves a relatively long period during which the lips are closed but nasal airflow is present. This is followed by a shorter full closure (without nasal airflow). Plain trills feature a longer oral closure without nasal airflow. A study of Ahamb's bilabial trills, for example, showed mean duration of 125 ms of the bilabial closure in ᴘ,[5] while for ᵐʙ, the mean duration of prenasalization was 78 ms, followed by full closure of 33 ms (Rangelov 2019: 1293-1294). Prenasalization, rather than voicing, appears to be the main distinguishing feature between trills (and plosives) in Malekula languages (Rangelov 2019; Barbour 2012: 26). The period of trilling can involve up to 4 oscillations of the lips. The first release of the oral closure is observed to be more abrupt and plosive-like, while the subsequent releases during the period of trilling tend to be weaker and sometimes involve incomplete closure (see e.g. Rangelov 2019 on the bilabial trills in Ahamb). Hence, Ladefoged & Maddieson (1996: 130) call bilabial trills "stops with trilled release". Similarly, Crowley (2006d: 30) describes the trill in Avava (a Malekula language) as "a prenasalized voiced bilabial stop with a bilabial trill release, which involves some rounding – or at least thrusting forward – of the lips".

Maddieson (1989: 104) described ᵐʙ as involving slack lip tissue and lip protrusion, paired with low intraoral pressure. In his article, Maddieson hypothesized on the origins of prenasalized bilabial trills based on the articulatory and aerodynamic conditions found in them. He analyzed prenasalized trills from a number of Austronesian and Bantoid languages, concluding that [ᵐʙ] developed from a [mbu] sequence. This hypothesis was supported by a detailed consideration of the aerodynamic conditions underlying the [mbu] sequence, which

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[4] Pre-stopped trills involve a different closure mechanism (Ladefoged & Everett 1996; Coupe 2015; Yuan et al. 2019). Since pre-stopped trills have not been recorded on Malekula Island, they are not discussed further in this paper.

[5] Demolin (1992: 176) also reported a relatively long bilabial closure (110 ms) for ᴘ in Mangbetu (Central Sudanic).

contribute to the articulation of a bilabial trill. Maddieson (1989: 104) observed that the initial nasal phase in [mbu] involves vocal fold vibrations, accompanied by nasal airflow, which means that "there is a minimal increase of intraoral pressure during [m]." This is followed by a very brief stop closure, again minimizing the increase in intraoral pressure build-up during [b]. The result is low intraoral pressure when the labial stop is released, and "the force acting to separate the lips due to intraoral pressure is relatively weak… [which] contributes to a slow initial rate of labial opening" (Maddieson 1989: 104). The transition from the labial consonant into a rounded vowel with a high jaw position produces a relatively slow opening of the lips, which means that lip aperture remains constricted for some time. Maddieson (1989: 104) made the assumption that "the lip tissue is relatively slack at the time of release, due to rounding and protrusion of the lips for the vowel". Further, he hypothesized that:

> Under these conditions the system remains briefly in a state during which Bernoulli forces created by accelerated flow through the narrow lip aperture may result in involuntary full or partial reclosure of the lips one or more times during the stop-vowel transition. (Maddieson 1989: 104)

Bilabial trills may have non-trilled allophones. For ^{m}B, such allophones have been described as "one-tap trill" (Dimock 2005: 26), or "stop with fricated release" (Yoder 2010). In Malekula languages, when ^{m}B fails, it is most commonly plosive-like before vowels and fricative-like word-finally. Our observations of P in Malekula languages show that when trilling is not observed, it is produced with occlusion and a single release, much like in [p]. Non-trilled allophony is understood to be common for trills in general; Ladefoged & Maddieson (1996: 217) wrote that "aperture size and airflow must fall within critical limits for trilling to occur, and quite small deviations mean that it will fail." For example, Rangelov (2019: 1294) measured success rates for ^{m}B and P in Ahamb and reported successful trilling in up to 59% of instances of ^{m}B and 44% for P in recordings of citation forms; success rates were below 26% in connected speech. Besides this allophonic variation, inter-speaker variation was also reported – some speakers never produced trills while others often did (Rangelov 2019). In the Malekula languages for which we have evidence of loss of bilabial trills in younger speakers (see §3.3.1, Footnotes 6 and 13), we see an advanced and systematic process of replacement of bilabial trills by bilabial plosives.

Even though bilabial trills are relatively easy to articulate (Blust 2013: 679), the fact that they are uncommon cross-linguistically has been attributed to phonetic properties which make them difficult to integrate into connected speech (Maddieson 1989: 92). They most commonly occur preceding [u] (Ladefoged and Maddieson 1996: 130). Less commonly, bilabial trills have been reported word-finally (e.g. in Malekula languages) or before other vowels. Bilabial trills before non-high rounded vowels have been reported most notably in Nias (Northwest Sumatra-Barrier Islands) (Catford 1988; Brown 2005), Medumba (Niger-Congo) (Olson & Meynadier 2015), Fas (Baibai-Fas) (Baron 2007), and Momu (Baibai-Fas) (Honeyman 2016: 38ff) but there are also a few examples in Malekula languages (see §3.3.1 and Appendix B).

3. Bilabial trills in Malekula languages

When Captain James Cook visited Port Sandwich in Southeast Malekula in 1774, members of his expedition wrote down words in the local language such as *brr(r)oòās* ‘a hog’, *nābrroos* ‘a bow’, *nābrruts* ‘plantains’ and *-gābrroon* ‘the belly’ (Lanyon-Orgill 1979: 69; Forster 1778: facing p. 284), where the <brr(r)> sequences certainly stood for bilabial trills (Olson 2015). Similarly, Commodore James Graham Goodenough (1876: 358-359) recorded the words *nagambrrr* ‘fire’ and *brruang* ‘taro’ when he landed in Port Sandwich in 1875. Williams (2019) recorded corresponding tokens with prenasalized bilabial trills (e.g. *^{m}ʙuas* ‘pig’, *naxa^{m}ʙ* ‘fire’ and *^{m}ʙuaŋ* ‘taro’) in present-day Lamap, which is spoken in the same area. Goodenough also noted (1876: 358-359) *mbruai* ‘pig’, *ambrrr* ‘fire’, *nambrr* ‘bamboo’ and *nalambrut* ‘cat’ and Deacon (1934: 737-755) transcribed *(na)mbrü* ‘bamboo’, *(ne)mbrüia* ‘water taro’, *nembrütün* ‘navel’ and *(na)ai limbr* ‘croton’ for a language spoken in Southwest Bay on Malekula. Dimock (2009: 21-22) identified cognate words in present-day Nahavaq (spoken in Southwest Bay), where these words can be pronounced with an allophonic prenasalized bilabial trill. Furthermore, Paviour-Smith (2005) hypothesized that the letter <b̃> from an 1880s missionary orthography for the Aulua language in Southeast Malekula stood for a bilabial trill which at the time contrasted with the plosive transcribed with <b>.[6]

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[6] Paviour-Smith (2005) reported that the prenasalized bilabial trill in Aulua was “in its final death throes” – only a few of the older speakers of Aulua, mostly in the village of Vartavo, had retained ^{m}ʙ, in only a subset of the relevant vocabulary items from the 1880s data.

For languages spoken in the west of Malekula, Capell & Layard (1980:7) reported a "voiced bilabial fricative trill, like an attempt to pronounce br with the lips alone, and without the tongue". Furthermore, Maddieson (1989) reported prenasalized bilabial trills in the Na'ahai, Windua (Ninde) and Uripiv languages of Malekula and listed 11 examples from Na'ahai based on data compiled with the assistance of Ross McKerras and Longdal Nobel.

Since these early reports of bilabial trills, increased documentation and description efforts on Malekula have revealed more languages that exhibit bilabial trills (see Table A.1 in Appendix A for more detail). In some languages, these sounds appear to be allophones of the prenasalized and plain plosives (/^{m}b/ and /p/). There are at least two languages – Ahamb and Lamap, where the two trills constitute separate phonemes in their consonant inventories (Rangelov 2019, 2020a: 46; Williams 2019: 32-33),[7] and four other languages – Avava, Neverver, Unua and Uripiv, where only ^{m}ʙ is phonemic (see also §3.3).

3.1 Existing hypotheses of the origins of Malekula's bilabial trills

There are several existing hypotheses that may account for the occurrence of bilabial trills in the languages of Malekula. These hypotheses draw on articulatory phonetics, comparative historical linguistics, and the study of language contact phenomena.

3.1.1 Maddieson's (1989) aerodynamic hypothesis

As outlined in some detail in §2.2, Maddieson (1989) analyzed trills in a number of languages, including three Malekula languages (Na'ahai, Ninde and Uripiv). He concluded that the articulatory and aerodynamic properties of the sequence [mbu] lend themselves to the development of the prenasalized bilabial trill.

3.1.2 Lynch's (2016) diachronic analysis of bilabial trills in four Malekula languages

Lynch (2016: 407) looked at contrastive ^{m}ʙ in seven cognate sets in four Malekula languages – Uripiv, Neverver, Unua and Avava. Comparisons with POc and PNCV reconstructions showed that trills in the daughter languages occur in contexts where there was a historic

[7] Williams lists ᴘ as a separate phoneme in Lamap and provides near-minimal pairs with some reservations: "Lamap speakers felt strongly that this was a distinct sound with its individual orthographic presentation as <pp> however, the realization of the voiceless bilabial trill was more or less emphasized depending on idiolects, and it could have been the result of careful speech."

sequence of a prenasalized plosive [^{m}b], followed by [u] (and sometimes [o]). Such evidence provides further support for Maddieson's (1989) aerodynamic hypothesis. Lynch (2016: 407) also demonstrated that the contrast between the prenasalized plosive and its trilled allophone emerged word-finally as a result of final vowel loss, a process that has been observed widely in the Malekula languages (Lynch 2014).

3.1.3 Olson's (2015) stop > trill > fricative hypothesis

Olson (2015) analyzed the emergence of plain trills in Malekula. Using data from the Lamap (Port Sandwich) language, spoken in Southeast Malekula, he proposed that plain bilabial trills may have emerged on a diachronic pathway from a voiceless bilabial stop (POc *p) to a voiced fricative. Olson extracted lexical data that had been recorded during Captain James Cook's expedition of 1774 (Forster 1778; Lanyon-Orgill 1979; see §3 for examples), and compared these with data from the 20th century, collected by Jean-Michel Charpentier (1974, 1982) and Darrell Tryon (1976).[8] Using established POc reconstructions (Ross 1988; Ross et al. 1998, 2007, 2011), Olson concluded that there would have been two bilabial trills in Lamap in the 18th century – a plain trill [ʙ] and a prenasalized trill [^{m}ʙ]. The prenasalized trill ^{m}ʙ would have developed from POc *mbu, which aligns with Maddieson's (1989) and Lynch's (2016) analyses. As for the plain ʙ, Olson hypothesized a pathway of lenition, where ʙ was an intermediate stage from a POc *p to contemporary β: the voiceless stop changed to a voiced stop, which in turn changed to a trill [ʙ] before /u/, as apparently attested in the 18th century Lamap data, which resulted in contemporary [β], in short: POc *p > *b > ʙ/_u > β

3.1.4 Sound change motivated by contact

It has also been suggested that the presence of bilabial trills in Malekula may be a residue of contact between Papuan and Malekula languages in Vanuatu's early settlement period (Blust, 2005b, 2008; Donohue & Denham 2008). Recent genetic findings in Posth et al. (2018) echoed and supported the claims by Blust (2005b, 2008) and Donohue & Denham (2008) that contact with Papuan-speaking peoples is responsible for some of Vanuatu's unique linguistic features, which include bilabial trills among other uncommon sounds, such as: dually articulated labial-velars, pre-stopped velar laterals, and rounded fricatives. Posth et al. (2018)

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[8] Charpentier's and Tryon's data did not demonstrate evidence of bilabial trills in contemporary Lamap (or any other Malekula language). However, more recent data show that Lamap has both ^{m}ʙ and ᴘ (Williams 2019).

proposed that many of these divergent features found among Southern Oceanic languages can be attributed to Papuan linguistic influence as a result of mixing with various Papuan-speaking populations in Vanuatu's early history. The early Papuan contact hypothesis may explain the presence of bilabial trills in some Malekula languages.

3.2 Distribution of bilabial trills on Malekula

The data used in this study derive from both published and unpublished sources of two types: firstly, phonological analyses – mostly as part of grammatical descriptions (grammars or grammar sketches, in some cases complemented by wordlists), in which bilabial trills have been identified; and secondly, the Vanuatu Voices database (https://vanuatuvoices.clld.org/; Shimelman et al. 2020), which provides primary recordings of a list of up to 191 words for 132 doculects of Malekula, covering the entire island. Audio recordings of all words in Vanuatu Voices are openly available online with transcriptions. These data were recorded between 2015 and 2018. Bilabial trills were identified[9] in 46 of the Vanuatu Voices doculects.[10]

A note is due here on the listing of languages used in this work. Different publications list a different count of the languages of Malekula: Tryon (1976: 80) lists 30 languages, Lynch & Crowley (2001: 17-19) – 39 languages, Francois et al. (2015: 3) – 42 languages, Ethnologue (Eberhard et al. 2021) – 26 languages. In Glottolog (Hammarström et al. 2021), 46 languoids (34 "languages" and 12 "dialects") are listed with glottocodes. This variation is due to at least four factors: (1) some varieties were counted as separate languages by some authors and as dialects by others; (2) some reportedly extinct varieties are counted by some authors but not by others; (3) there have been numerous reports of small, previously

[9] For the purposes of this paper, we did not rely entirely on the transcriptions provided in Vanuatu Voices. The first author verified the presence of bilabial trills where these appeared in the transcriptions against the audio recordings. Moreover, environments where a bilabial trill could be expected, but was not annotated in the transcriptions, were also checked, e.g. sequences of plosive and back/central vowel. For doculects where trills were already identified or expected, all tokens were checked. For concepts where one or more languages have a word with a bilabial trill, all doculects were checked. Where Vanuatu Voices data are provided in this work, the transcriptions are our own.

[10] In Vanuatu Voices, a doculect normally corresponds to a speech variety in a specific settlement/village. The 132 doculects are grouped into 43 languages. 36 of the languages are paired with a glottocode and, where available, an ISO 939-3 code. For 7 languages no codes exist. These are Angavae (1 doculect), Batarxopu (5 doculects), Najit (1 doculect), Natangan (1 doculect), Ngata (1 doculect), Siviti (Njav) (5 doculects) and Tesmbol (2 doculects). Of these, only Tesmbol has bilabial trills.

unreported varieties that are/were spoken by a few older speakers (often belonging to groups who moved from inland areas to coastal areas and who adopted a local language) (see also Lynch & Crowley 2001: 69); (4) the same language variety is sometimes reported by different names. The listing of languages in this discussion is compiled based on the language names in the sources we used (see also Footnote 10). This discussion should not be seen as an attempt to establish linguistic variety status nor as an attempt to generate an exhaustive listing of the languages of Malekula.

Appendix A provides an overview of the available data in which instances of bilabial trills have been recorded. Map 1 summarizes the presence of ᵐʙ and ᴘ in Malekula languages, regardless of phonemic status. The mapped data show that none of the languages spoken in the northern part of Malekula (on “the dog’s head”[11]) contain bilabial trills. This is confirmed by the following works: Fox (1980) and Dodd (2014) on V’ënen Taut, Crowley (2006c) on Tape, Brotchie (2009) and Lynch & Brotchie (2010) on Tirax, Crowley (2006a) on Naman, Crowley (2006b) and Takau (2016) on Nese, Duhamel (2010) and Wessels (2021) on Atchin, Wessels (2013) on Malua Bay, Holmes (2014) on Espiegles Bay, and Barbour (2015-2016) on V’ao, as well as by the Vanuatu Voices data. Below “the dog’s neck”, there is evidence of bilabial trills for all languages, except for Larevat (Barbour 2016a, 2013-2021a), Neve’ei (Musgrave 2007), Ngata, Angavae, Nasarian, Natangan and Boinelang (Mbwenelang).[12]

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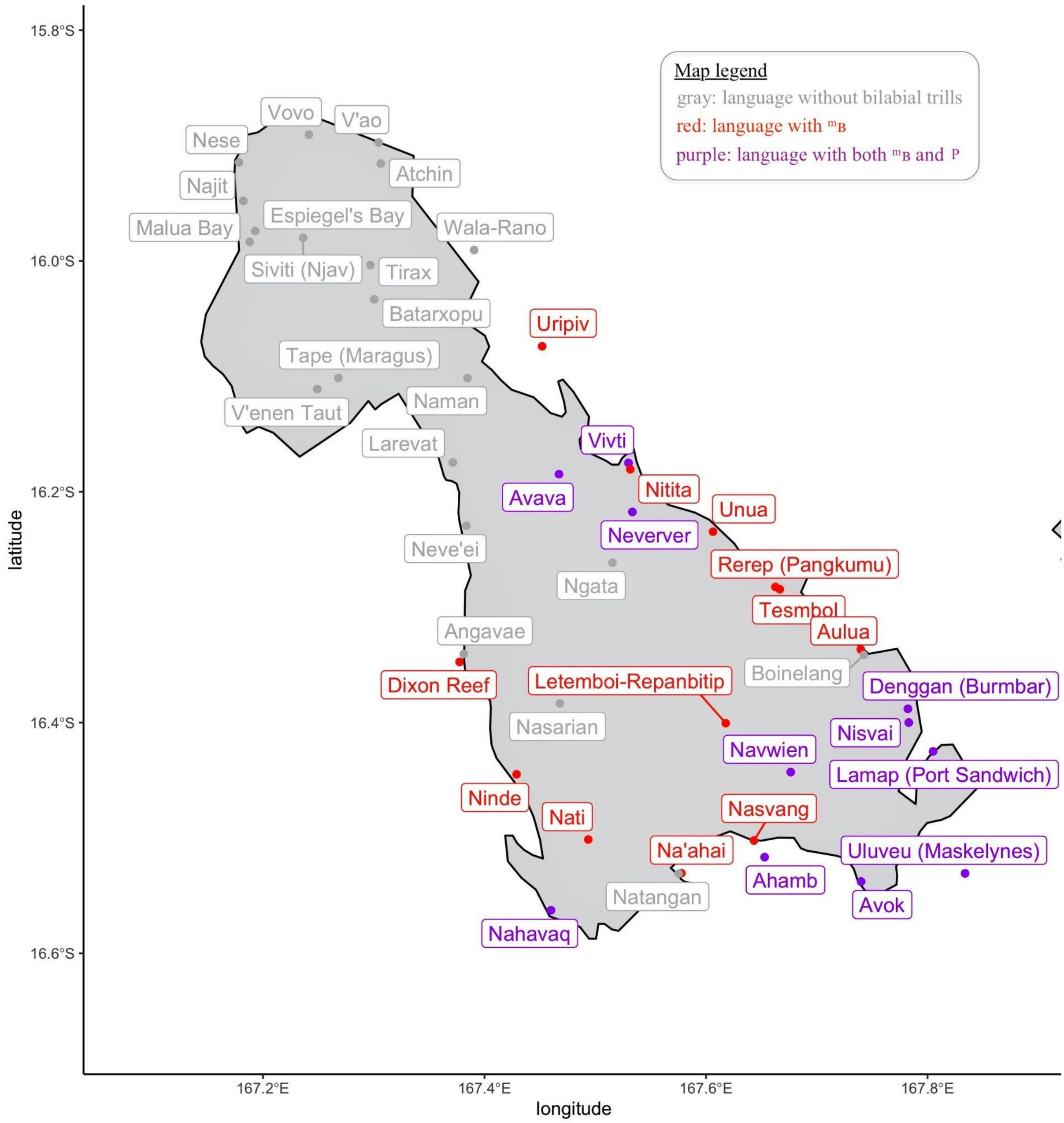
[11] Malekula’s shape is commonly compared to the outline of a sitting dog.

[12] In Vanuatu Voices, Boinelang is listed with the doculect name Xoli. A small moribund variety with the name Surua Xole spoken in the same area was reported by Lana Takau (p.c.) in 2020. There is no evidence of bilabial trills in this variety in any of these sources, at least in the speech of the two speakers who were recorded. This variety is listed in Glottolog (Hammarström et al. 2021) with its own glottocode (boin1237) as a variant of Aulua. It is also listed by Charpentier (1982) as a separate language (under the name Mbwenelaŋ). Note that for Aulua, only one word with a prenasalized trill has been attested in the Vanuatu Voices data (*taᵐʙe taram* ‘wood, forest’), but there is evidence that bilabial trills were more salient in the past (Paviour-Smith 2005) (see Footnote 6).



Map 1: Malekula languages with and without bilabial trills

As shown in the tree in Figure 1, Malekula languages can be divided into three main groups. Our data show that no bilabial trills are found in the Northern group, while both the Eastern and the Western linkages have a relatively high number of languages with bilabial trills. However, the northernmost languages in the Eastern and Western linkages appear to lack bilabial trills (or have lost them recently, as in the language of Uripiv[13]). Another important observation is that there is a concentration of languages with ᴘ in the south-eastern part of Malekula Island. All of them, except for Denggan, are part of a discrete group within the Eastern Malekula linkage (Lynch 2016: 418). Nasvang and Boinelang are the only languages of this Southeastern Malekula subgroup that do not show evidence of ᴘ.

3.3 Properties of Malekula's bilabial trills

3.3.1 The prenasalized trill ᵐʙ

The prenasalized trill ᵐʙ has been identified in 23 languages of Malekula. It can occur both in the syllable onset and coda. In onset position, ᵐʙ most commonly precedes /u/ but it has also been attested before other vowels. For example, in Ahamb ᵐʙ can occur before /ə, y, i/ as in [ᵐʙən] 'to kill', [ᵐʙyns] 'to watch', [naᵐʙiaᵑk] 'taro'. ᵐʙ has also been attested before /ə/ in Uripiv (McKerras 2001: 1), and for Uluveu, Healey (2013: 14) reports ᵐʙ "increasingly before /ə/". In Avava, ᵐʙ occurs before /a, e, i/: [suᵐʙat] 'coral', [ᵐʙel] '(s)he will come', [ᵐʙih] 'how many (irrealis)' (Crowley 2006d: 31). In Unua, ᵐʙ has been attested before /ji/ in one word: /iᵐʙjiᵐʙjir/ 'rough (3SG)' (Pearce 2015: 17). Unua also offers a few examples of ᵐʙ before other consonants, most notably before /ɾ/ (Pearce 2015: 17-18).[14]

In the syllable coda, ᵐʙ has been attested in a number of languages and it is usually devoiced in this position.[15] For example, in Neverver, /naɣaᵐʙ/ [naɣaᵐʙ̥] 'fire' contrasts with /ɣaᵐb/ [ɣaᵐp] 'explode' (Barbour 2012). For Ninde, Murray (2018: 24) lists three lexemes where a final /ᵐb/ can have a trilled allophone: /tiᵐb/ [tiᵐʙ̥] 'swell', /taᵐb/ [taᵐʙ̥] 'be fat', /neᵐb/ [neᵐʙ̥] 'firewood'. Unua presents an interesting scenario where ᵐʙ occurs word-finally after /u/ and /o/, while [ᵐb] occurs after other vowels in this position, meaning that the

[13] The bilabial trill appears to have completely disappeared from Uripiv since the 1980s when the data for McKerras (2001) and Natunmal & McKerras (2001) were collected. McKerras (2001) then observed that the trill was only produced by older speakers in careful speech, otherwise being articulated as the plosive /ᵐb/. Moore (2018) finds no evidence of bilabial trills in more recent Uripiv recordings collected by Barbour (2013-2021b), nor in religious recordings available online (Wycliff Bible Translators 2017).

[14] In earlier work, Dimock (2005: 25) suggests that a plosive, rather than a trill, is the sound in question in at least some such Unua examples.

[15] Final obstruent devoicing is common in Malekula languages.

plosive and the trill are in complementary distribution word-finally, while they are contrastive in the syllable onset (Pearce 2015: 17).

^{m}ʙ has been analyzed as a contrastive phoneme in some Malekula languages, and as an allophone of a bilabial plosive, /^{m}b/ or less commonly /$^{m}b^{w}$/, in other languages. Phonemic ^{m}ʙ has been identified in the Western Malekula linkage in Neverver (Barbour 2012: 32-34) and Avava (Crowley 2006: 31), and in the Eastern Malekula linkage in Uripiv (McKerras 2001: 1), Unua (Pearce 2015: 16), Lamap (Williams 2019: 35-36) and Ahamb (Rangelov 2019; 2020a: 46). Allophonic ^{m}ʙ has been reported in phonological analyses of (from west to east) Ninde (Murray 2018: 24), Nati (Crowley 1998: 107), Nahavaq (Dimock 2009: 21), and Uluveu (Healey 2013: 14).

^{m}ʙ was found in 22 languages in the Vanuatu Voices database (see Table A.2 in Appendix A). These data confirm the existence of ^{m}ʙ in all of the languages for which there is analytical data, except for Uripiv, in which it has been recently lost (see Footnote 13). It is impossible to determine the phonemic status of ^{m}ʙ in the languages for which data is limited to the wordlists in Vanuatu Voices. However, these data provide crucial evidence in determining the distribution of bilabial trills on Malekula (see §3.2). For some of these additional languages, only one or two words with ^{m}ʙ were attested (e.g. Aulua, Dixon Reef, Nasarian, Nasvang) while for others up to 8-10 words with ^{m}ʙ were attested (Avok, Navwien, Nisvai, Tesmbol, Vivti).

The salience of bilabial trills in Malekula languages is critical to understanding their persistence. Kerswill & Williams (2002: 81) offer a broad definition of salience as “a property of a linguistic item or feature that makes it in some way perceptually and cognitively prominent”. Salient features are characterized by, among other things, high frequency and “psychological prominence” (Kerswill & Williams 2002). The salience of ^{m}ʙ in different Malekula languages varies. We argue that in some languages, ^{m}ʙ is highly salient. For example, Crowley (2006d: 30) described the bilabial trills in Avava as a feature that is “immediately obvious and particularly salient to any observer, even to a non-linguist being exposed to the language for the first time… Speakers of neighboring Neve’ei often comment on the presence of these sounds in Avava, which they regard as rather comical.” Crowley’s comment likely refers to the visual availability of bilabial trills to observers. We counted over 100 lexemes with ^{m}ʙ for Ahamb (Rangelov 2019; 2020a, 2020b), Avava (Crowley 2006d), Neverver (Barbour 2012a, 2012b, 2016b), Unua (Pearce 2015, 2018), and Uripiv (Natunmal & McKerras 2001) (see Appendix B for wordlists). In these languages, bilabial trills are found in core vocabulary items such as ‘pig’, ‘taro’, ‘grandfather’, ‘fire’ and ‘bamboo’ which means that they occur frequently in speech (see also below, this subsection, on bilabial trills in verbal morphology in Avava and Neverver). These are, unsurprisingly, also the languages in which ^{m}ʙ has been analyzed as contrastive.

There is an ongoing process of the loss of ^{m}ʙ in some languages. Besides the evidence from Uripiv and Aulua (see Footnotes 6, 13), Dimock (2009: 21) observed for Nahavaq that ^{m}ʙ was used by both younger and older speakers, but that it was more commonly produced by older speakers. She speculated that it may have been more prominent in the past, referring to the observations of Goodenough (1876) and Deacon (1934) (see §3). Even for Ahamb, where ^{m}ʙ is very salient in the speech of all generations of speakers, Rangelov (2019) observed substantial inter-speaker variation, where some speakers consistently produced trills, while others almost never did.

In all languages where ^{m}ʙ has been attested, it typically occurs morpheme-internally. However, in Avava and Neverver (two adjacent languages in central Malekula), ^{m}ʙ can also surface as a result of a productive morphophonological process across a morpheme boundary. In Neverver (Barbour 2012: 34, 174), when the irrealis prefix *m-* is attached to verb stems beginning with *v-* [β], the fricative is clearly trilled as in /im-βu/ [imʙu][16] ‘3SG:IRR-go’. When the bilabial fricative is followed by a consonant or another vowel, the fricative is still trilled, and there is a transition through a high back vowel or vowel-like articulation, as in /im-βlem/ [imʙulem] ‘3SG:IRR-come’ /im-βaβu/ [imʙ^{w}aβu] ‘3SG:IRR-walk’. A number of core motion verbs are involved in this process. In Avava (Crowley 2006d: 31-32), when the third person singular irrealis prefix /^{m}b^{w}V- ~ ^{m}bV-/ appears before a verb root beginning with /v-/, /w-/ or /v^{w}-/ followed by a vowel other than /u/, the prefix vowel is elided and a ^{m}ʙ is systematically

[16] We refrain from marking [m] as [^{m}] here since it is not obvious that /m/ is reduced to prenasalization, as it is the morphophonemic expression of irrealis mood. For example, in a verb root beginning with /m/, as in *mas* ‘die’, when *m-* is attached, this results in a geminated [m]: [imːas].

pronounced as in: /^{m}b^{w}e-v^{w}el/ [^{m}ʙel] ‘3SG:IRR-come’, /mbi-vi/ [^{m}ʙi] ‘3SG:IRR-COP (he/she will be)’. Again, this process is observed with core vocabulary items in Avava.[17]

3.3.2 The plain trill ᴘ

There are phonological analyses for five of the languages in which the plain bilabial trill ᴘ has been attested – Ahamb, Lamap, Neverver, Avava and Nahavaq. ᴘ is only found in the syllable onset, usually before /u/. There are a few examples of ᴘ before /ə, y/: e.g. Ahamb /ᴘ**ə**s/ ‘to go around sth’, /ᴘ**y**s/ ‘to blossom’, Lamap /ᴘ**y**ax/ ‘to hang (e.g. clothes)’. In Ahamb, ᴘ contrasts with /p, v, ^{m}ʙ/: /ᴘər/ ‘to be cold’ - /pər/ ‘diarrhea’ - /vər/ ‘to buy’ - /^{m}ʙər/ ‘to stand, step on’. In Lamap, there is evidence of contrast between ᴘ and /p, ^{m}ʙ/: /ᴘus/ ‘squeeze’ - /puse/ ‘road’ - /^{m}ʙus/ ‘to stop’ (Williams 2019: 33; Rangelov 2018).

In Neverver, Barbour (2012a: 29) described ᴘ as a trilled allophone of /p/ that only occurs before /u/. In Avava, Crowley (2006d: 28) described how /p/ “is generally realized as a voiceless lightly aspirated bilabial stop, though when the following vowel is /u/ and the next syllable begins with /r/, this alternates occasionally with a stop that is released with a voiceless bilabial trill.” One example was provided: /ipura/ ‘(s)he spat’, realized as [ip^{ʙ}ura]. In Nahavaq, Dimock (2009: 22) recorded one example of a trilled realization of /p/ in fluent natural speech: /^{n}du-ʔ-p^{j}ul/ [^{n}duʔᴘ^{j}ul] ‘1IN.DU-IRR-turn’.

Words with ᴘ have been attested in Vanuatu Voices data for three of the five languages mentioned above (Ahamb, Lamap and Avava) and six others – Vivti, Denggan, Navwien, Nisvai, Avok and Uluveu (from north to south, cf. Map 1), with one to four words with ᴘ per language (see Appendix B for wordlists).

ᴘ is less salient than ^{m}ʙ in the languages where it occurs – there are far fewer tokens with ᴘ than with ^{m}ʙ. Ahamb has the largest number of words with ᴘ recorded – 25 words out of a lexicon of around 3,500 items. For the other languages only a handful of words are

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[17] Blust (2013: 680) describes a diachronic process of bilabial trills emerging across morpheme boundaries in some Admiralties languages (see §1), where nouns with an initial POc *pu were preceded by the article *na, which in turn underwent cliticization, unstressed vowel loss and coalescence with the noun-initial consonant (Ross 1988: 337). In those cases, the additional morphology provided the nasal component necessary for meeting the aerodynamic conditions and thus the emergence of the trills. This scenario, unlike the one described for Avava and Neverver, however, still relied on a following *u as a necessary condition for a bilabial trill to emerge.

known to have P. Future work may, however, discover more words with P, especially in the languages for which no comprehensive documentation is available yet.

Putting aside Nahavaq in southwestern Malekula, for which only one instance of allophonic P for one speaker was identified, P is clustered in two areas: Central Malekula and Southeast Malekula (cf. Map 1), with the latter being by far the larger cluster of such languages. Most words in the cognate sets in §4.2 are from Southeastern Malekula languages. More research on the under-described Southeast Malekula languages Avok, Navwien and Nisvai is necessary to determine the status of P in them. The Vanuatu Voices data suggests that P is a relatively common sound in some of these languages, e.g. P is found in 4 words in Avok, 3 words in Nisvai and 2 words in Navwien, compared to 2 each for Ahamb and Lamap where phonological analyses show that P is phonemic.

The three languages in Central Malekula with P – Neverver, Avava and Vivti – are all part of the Western Malekula group. For Vivti we have a single example of P and future investigations might uncover more data on P in this language. For Avava, there are two examples in Vanuatu Voices, and for Neverver there are 12 examples reported by Barbour (2012a, 2012b), two of which are cognates with words containing bilabial trills in other Malekula languages.

3.3.3 Functional load of Malekula's bilabial trills

Finally, it is necessary to address the functional load of bilabial trills in Malekula languages. Salmons (2021: 163-164) provided an overview of the debate on the role of functional load in sound change and defined functional load as "how much 'work' a contrast does for creating distinctions". Blevins and Wedel (2009), for example, discuss the possibility of inhibition of a sound change if it would create (too much) homophony. Kaplan (2015: 268) argues that "although homophony avoidance does not appear to categorically rule out specific types of sound change, it does have a real effect… that holds up under rigorous statistical scrutiny". This view is supported by recent quantitative studies, e.g. Bouchard-Côté et al. (2013: 4227), Wedel et al. (2013), Silverman (2010), Kaplan (2011).

Labov (1994: 328) identified two measures of functional load vis-a-vis a phonemic opposition: lexical opposition – the number of minimal pairs that depend on a distinction, i.e. how many homonyms would a merger of the phonemes produce – and lexical predictability –

the extent to which the distinction depends on minimal pairs, i.e. "[i]f one or both of the phonemes show a skewing in distribution, and those skewings are almost complimentary" (Labov 1994: 328), this implies high lexical predictability. Low lexical opposition and high lexical predictability thus indicate a low functional load. In Malekula languages, where bilabial trills may contrast with the corresponding plosives (see Appendix A), the bilabial trills are best described as marginal phonemes, as only very few (near-)minimal pairs have been documented; this translates as low lexical opposition. The bilabial trills' restricted distribution (see §3.3.1, §3.3.2) means high lexical predictability. Based on this observation, we argue that bilabial trills in Malekula languages have a low functional load. The documented low trilling success rate, the high inter-speaker variation, and the trills' (recent and ongoing) extinction in some languages (see §3.3.1) are evidence that a bilabial trill-plosive merger, fueled by low functional load, has already happened or is underway in at least some varieties.

4. Comparative-historical analysis of Malekula's bilabial trills

Surveying the Malekula languages with bilabial trills, a number of cognate sets can be identified. We compare these sets with established reconstructions of Proto North Central Vanuatu (PNCV) (Clark 2009), and Proto Oceanic (POc) (Ross, Pawley & Osmond 1998, 2007, 2008, 2011, 2016)[18] in order to determine if these cognate sets are reflexes of PNCV and/or POc, as well as to identify the environment of sound changes in each language. The data sources for the various languages and full word lists for each language with data sources can be found in Appendix B. The following subsections present cognate sets and the patterns observed in them for ᵐʙ in both pre-vowel position (§4.1.1) and word-final position (§4.1.2), and for ᴘ (§4.2).

[18] In the following, we have adopted a system of transcription that is as close to IPA as possible. This includes marking prenasalization on voiced plosives both for the proto-languages and the modern languages, and exchanging Clark's (2009: 10) PNCV *q, *g and *y for *ᵑg, *ŋ and *j respectively.

4.1 Cognate sets with ᵐʙ

4.1.1 Cognate sets with ᵐʙ before a vowel

Data sets (1-23) indicate that ᵐʙ in Malekula languages regularly developed from a *ᵐbu sequence. In some cases, the vowel has undergone further changes. In the few cases where ᵐʙ appears to have developed before *o, as in cognate sets (18), (20), and (28) in §4.1.2 (and as also observed by Lynch 2016), a likely explanation is that the vowel was raised at an intermediate stage after PNCV.

(1) PNCV ***ᵐbue 'bamboo'**

Ahamb	na/ᵐʙu[19]
Avava	vunu/ᵐʙu
Lamap	na/ᵐʙu
Nahavaq	na/ᵐʙu
Neverver	ni/βin/ᵐʙu
Nitita	βiβi/ᵐʙu
Uluveu	ᵐʙu 'knife'
Unua	na/ᵐʙu
Uripiv	na/ᵐʙu
Vivti	nə/βu/ᵐʙu

(2) PNCV ***ᵐbukasi 'pig'**

Ahamb	na/ᵐʙwas
Avava	a/ᵐʙuah
Lamap	ᵐʙuas
Na'ahai	ni/ᵐʙuas
Nahavaq	ni/ᵐʙʷuwes
Neverver	le/ᵐʙuas 'castrated pig'
Uluveu	ᵐʙuaj
Vivti	ni/ᵐʙuasɣah 'boar'

(3) PNCV ***ᵐboe 'pig'**

[19] As per the tradition in the literature on Oceanic languages, we use forward slash </> to denote a morpheme boundary and n-dash <-> to mark bound stems.

Aulua   na/ᵐʙue

Unua   ᵐʙue

Uripiv   ᵐʙi

(4) PNCV ***ᵐbunu-ʔi ‘extinguish, kill’**

Ahamb   ᵐʙən ‘kill’

Avava   mat/ᵐʙun ‘dead’; -ᵐʙun ‘kill’

Avok   tamsᵐ/ʙʏn/i ‘kill’

Lamap   -ᵐʙun ‘kill’

Na’ahai   -ᵐʙun ‘kill, die’

Nahavaq   -ᵐʙʏn ‘kill’

Navwien   -ᵐʙʏn ‘kill’

Ninde   -ᵐʙʏn ‘kill’

Tesmbol   mus/ᵐʙʏn ‘kill’

Uluveu   -ᵐʙun/i ‘kill’

Unua   ᵐʙun/i ‘kill’

(5) PNCV *ᵐ**buaᵑga,** *ᵐbiaᵑga **‘swamp taro’**

Ahamb   na/ᵐʙiaᵑg

Aulua   ᵐʙuaŋg

Avava   ᵐʙuaŋ

Lamap   ᵐʙuaŋ

Na’ahai   ni/ᵐʙujaŋ

Nahavaq   ᵐʙʲujaʔ

Neverver   ni/ᵐʙuaŋ

Nitita   na/ᵐʙuaᵑk

Uluveu   ᵐʙəaŋ

Unua   ᵐʙuaᵑg

Uripiv   ᵐʙuak

Vivti   nə/ᵐʙuaŋk

(6) PNCV ***ᵐbutu ‘deaf, mute’**

Ahamb   ᵐʙut

Avava   a/ᵐʙutᵐʙut

Na’ahai ni/^{m}ʙut^{m}ʙut ‘a mute person’

Neverver na/^{m}ʙut^{m}ʙut

Unua na/^{m}ʙut ‘dumb’

Uripiv na/^{m}ʙut ‘dumb man (unable to speak)’

(7) PNCV ***^{m}buni** (*^{m}boni) **‘smell’**

Avava a/^{m}ʙun

Neverver na/^{m}ʙun

Ninde nə/^{m}ʙune

Nitita na/^{m}ʙun

Vivti na/^{m}ʙun

(8) PNCV ***^{m}bula ‘thigh, bone’**

Avava ^{m}ʙulal/am ‘thigh’

Avok ^{m}ʙul^{m}ʙul ‘bone’

Lamap na/^{m}ʙul/en ‘thigh’

Navwien na/^{m}ʙul^{m}ʙul ‘bone’; na/^{m}ʙul/in ‘leg’

Nisvai na/^{m}ʙul^{m}ʙul ‘bone’

Unua ^{m}ʙura^{ŋ}go/n

(9) PNCV ***^{m}bulu ‘hole, earth oven’**

Uluveu ^{m}ʙur

Unua na/^{m}ʙur

(10) PNCV ***^{m}bura ‘elephantiasis’**

Ahamb na/^{m}ʙur

Avava a/^{m}ʙur; ^{m}ʙur ‘swell’

Na’ahai ni/^{m}ʙur

Neverver ne/tal/^{m}ʙur; ^{m}ʙur ‘swell’

Nitita ^{m}ʙur ‘swell’

Uripiv na/^{m}ʙur

Vivti i/^{m}ʙuɾ ‘swell’

(11) PNCV ***^{m}bueli ‘empty, absent’**

Neverver ^{m}ʙul^{m}ʙul

Unua ^{m}ʙu^{m}bwer ‘deserted’

Uripiv ^{m}ʙu^{m}ʙil ‘be empty’

(12) PNCV ***^{m}bu(nu)si ‘see’**

Ahamb ^{m}ʙyns ‘watch’

Nisvai ^{ŋ}ga/^{m}ʙyns/i

Rerep ^{m}ʙyns/i

Unua ^{m}ʙuns/i ‘look at’

(13) PNCV ***^{m}butu ‘stamp, step on’**

Ahamb ^{m}ʙur ‘step on’

Avava ^{m}ʙut ‘step’

(14) PNCV ***^{m}bue^{m}bue ‘pufferfish’**

Ahamb na/^{m}ʙu^{m}ʙu

Unua ^{m}ʙu^{m}ʙu/^{n}des ‘pufferfish (general)’; nix^{m}ʙua ‘pufferfish with spikes’

(15) PNCV ***^{m}bua ‘deep, bottom (inside)’**

Ahamb na/^{m}ʙə/n ‘(its) bottom’

Uripiv na/^{m}ʙø/n ‘its bottom (of sea, canoe, basket)’

(16) PNCV ***^{m}busa (*^{m}buso) ‘foam’**

Ahamb na/^{m}ʙʏsə/n ‘saliva’

Avava mele/^{m}ʙus/n ‘saliva, foam’

Avok na/^{m}ʙusu/m ‘saliva-1sg’

Neverver ne/met/^{m}ʙus ‘saliva’

Uripiv mela^{m}ʙs/en ‘saliva, foam’

(17) PNCV ***maku^{m}bu- ‘grandchild’**[20]

Ahamb mxaj^{m}ʙ/ən

Avava e^{m}ʙu/n

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[20] Note that the reflexes of *maku^{m}bu- ‘grandchild’ are bound morphemes, which normally take a compulsory possessive/construct suffix and the *^{m}bu sequence is not word-final. The exception is Neverver, which does not retain a system of possessive suffixation.

Lamap	mxiᵐʙu-
Neverver	na/ɣaᵐʙun
Uluveu	məxaiᵐʙə-
Unua	mexeᵐʙu-
Uripiv	meᵐʙu-

(18) PNCV ***ᵐboŋi ‘day (unit of time); night’**

Avava	a/ᵐʙuŋ ‘day’
Neverver	na/ᵐʙuŋ ‘day’
Nitita	na/ᵐʙuŋ ‘day, time’
Uripiv	ko/ᵐʙong ‘now’
Vivti	na/ᵐʙuŋ ‘day, time’

(19) PNCV *ᵐbʷisi ‘backside’ > PMᴀʟ ***ᵐbusi ‘tail’**[21]

Ahamb	na/ᵐʙʏtʃ/ən
Avava	ᵐʙʏs/ən (ᵐʙus/n)
Avok	na/ᵐʙʏtʃ/ən
Letemboi-Repanbitip	ᵐʙʏs/in
Na’ahai	ni/ᵐʙʏs/in
Nahavaq	ni/ᵐʙʏs/ʏn
Nati	ni/ᵐʙʏs/ʏn
Navwien	na/ᵐʙʏtʃ/in
Ninde	ne/ᵐʙʏse
Nisvai	na/ᵐʙʏtʃ/ən
Nitita	ᵐʙʏs/n
Tesmbol	ᵐʙʏsi
Uripiv	ᵐʙurt/en ‘its tail (of bird)’
Vivti	ᵐʙʏs/n

[21] PNCV *ᵐbʷisi ‘backside’ > ‘tail (of pig)’ in some Malekula languages (Clark 2009: 97; Lynch 2016: 420, 424). Based on numerous cognate entries for ‘tail’ among Malekula languages found in Greenhill et al. (2008: https://abvd.shh.mpg.de/austronesian/word.php?v=105), we propose that PNCV *ᵐbwisi changed to *ᵐbusi at an intermediate stage, likely at the level of Proto-Malekula.

The cognate set in (20) deserves in-depth discussion as it appears to mark an irregular change. Given the regularity of ^{m}ʙ developing from POC *^{m}bu, we would not expect that reflexes of the POC *p in *posi would result in ^{m}ʙ. One possible explanation for this irregularity involves the well-documented oral/nasal grade alternations in Oceanic languages (e.g. Ross 1988: 32ff), in which prenasalized/plain consonant reflexes of POC may appear to be the opposite of what is expected in modern Oceanic languages. Data from the Austronesian Basic Vocabulary Database (ABVD) (Greenhill et al. 2008: https://abvd.shh.mpg.de/austronesian/word.php?v=88) shows that POC *posi also has reflexes with /^{m}b, v, p, ᴘ/ – both prenasalized and plain bilabial consonants – and with a similar meaning in Malekula languages, which supports the oral/nasal grade alternation scenario. We also present a cognate set with ᴘ in the modern languages as a reflex of POC *posi (see cognate set 39 in §4.2). We can only speculate about the trigger of this oral-to-nasal grade alternation in Malekula languages. A possible explanation is suggested by the synchronic morphophonological process that is found in contemporary Neverver and Avava, when a verbal prefix involving a nasal consonant is attached to a stem beginning with a non-nasal consonant (see §3.3.1). With the raising of *o to u, conditions are met for the emergence of a prenasalized bilabial trill. Another similar scenario has been observed in nouns in Admiralties languages (see Footnote 17).

(20) **POC *posi 'squeeze, wring (coconuts to extract cream +)'**

Ahamb	^{m}ʙus 'squeeze'
Avok	^{m}ʙus/i 'squeeze'
Dixon reef	^{m}ʙus 'squeeze'
Navwien	^{m}ʙus 'squeeze'
Ninde	^{m}ʙusŋe 'squeeze'
Nisvai	^{m}ʙus/i 'squeeze'
Uluveu	-^{m}ʙus 'squeeze'
Tesmbol	^{m}ʙus 'squeeze'

Regarding cognate set (21), based on data from ABVD (Greenhill et al. 2008, https://abvd.shh.mpg.de/austronesian/word.php?v=82), we posit a PNCV form *^{m}batu for 'dull, blunt'. All Malekula languages below the "dog's neck" – of the Eastern and Western

Malekula linkages – display *a > u assimilation; some of them also exhibit an irregular change of *t > *k > k/x/ɣ.

(21) PNCV *ᵐbatu > ***ᵐbutu/ᵐbuku 'dull, blunt'**

Ahamb	ᵐʙut
Avava	ᵐʙʏk
Avok	ᵐʙut
Denggan	ma/ᵐʙux
Lamap	ᵐʙut
Letemboi-Repanbitip	ᵐʙʏk
Nasvang	ᵐʙut
Navwien	ᵐʙət:u
Ninde	ᵐʙuko
Nisvai	ᵐʙʏt
Rerep	ᵐʙux
Tesmbol	ᵐʙuɣə (ᵐʙux)
Unua	ᵐʙux

We have not been able to find suitable PNCV/POC reconstructions to match the cognate sets in (22-23) and we propose that they constitute shared innovations. Based on the cognates presented here and cognates without bilabial trills in other Malekula languages (Greenhill et al. 2008, https://abvd.shh.mpg.de/austronesian/word.php?v=113), we propose the Proto-Malekula reconstruction *ᵐbuti for 'branch'.

(22) PMAL ***ᵐbuti 'branch'**

Avava	ᵐʙutn
Rerep	ᵐʙutʃi
Unua	ᵐʙutʃi/n

(23) **'wood, forest (dark bush)'**

Na'ahai	ni/ᵐʙun/xaj[22]
Nahavaq	ni/ᵐʙun/aj
Nati	ni/ᵐʙun/aj

[22] *xaj/aj* is a reflex of PNCV *kaju 'tree, (piece of) wood'

4.1.2 Cognate sets with ᵐʙ in the syllable coda

Data sets (24-30) indicate that word-final ᵐʙ in synchronic data from Malekula languages followed the same diachronic pathway as the syllable-onset trill. An ancestral *ᵐbu# sequence provided the environment for the bilabial trill to emerge. The final vowel was subsequently lost, producing synchronic instances of word-final trills. As noted earlier, final vowel loss is observed as a regular sound change in Malekula languages (Lynch 2014), which likely also contributed to ᵐʙ becoming contrastive in at least some of them (Lynch 2016: 407).

(24) PNCV ***kaᵐbu ‘fire’**

Ahamb	n/xaᵐʙ
Avava	a/aᵐʙ
Avok	n/xaᵐʙ
Lamap	na/xaᵐʙ
Letemboi-Repanbitip	na/xaᵐʙ
Na’ahai	na/ɣaᵐʙ
Navwien	n/xaᵐʙ
Neverver	na/xaᵐʙ
Ninde	n/əᵐʙ ‘firewood’
Nisvai	n/xaᵐʙ
Nitita	na/xaᵐʙ
Rerep	no/xoᵐʙ
Unua	no/xoᵐʙ
Uripiv	n/aᵐʙ
Vivti	na/xaᵐʙ

(25) PNCV ***makoᵐbu ‘gecko’**

Ahamb	n/maxoᵐʙ
Avava	moᵐʙulan ‘lizard sp., found in cool damp places frequented by frogs’[23]
Lamap	mexoᵐʙ ‘brown lizard’
Neverver	ni/ᵐbɣoᵐʙ

[23] Note that the additional morphology has preserved the vowel.

Nitita ne/moɣa^{m}ʙ ‘gecko’; meɾɣa^{m}ʙ=ɣa^{m}ʙ ‘lizard, skink’

Unua maɣe^{m}ʙ ‘lizard (type)’

Uripiv mo^{m}ʙ

Vivti ni/mɣo^{m}ʙ

(26) PNCV ***to^{m}bu/*tu^{m}bu ‘swell up’**

Ahamb tø^{m}ʙ

Avok ŋo/tø^{m}ʙ

Navwien i/ti^{m}ʙ

Ninde ti^{m}ʙ

Nisvai ŋa/tø^{m}ʙ

Uluveu i/tø^{m}ʙ

(27) PNCV ***no^{m}bu ‘pool, lake, deep place’**

Ahamb nø^{m}ʙ ‘deep’

Avava ene^{m}ʙ ‘deep water pool’

Neverver ni^{m}ʙu-tox[24]

Ninde nwoj ni^{m}ʙni^{m}ʙ ‘lake, lagoon’

Nisvai na/nø^{m}ʙ ‘lake’

(28) PNCV ***sa^{m}bo[25] ‘ignorant, incompetent, lost’**

Ahamb sa^{m}ʙ ‘bad’

Avok ŋa/sa^{m}ʙ ‘bad’

Lamap sa^{m}ʙ ‘bad’

Nisvai ŋa/sa^{m}ʙ ‘bad’

Tesmbol sa^{m}ʙ ‘bad’

(29) POc ***^{m}buluk ‘be wet, soaked, waterlogged’ + metathesis**

Ninde lu^{m}ʙ ‘wet/heavy’

Tesmbol lu^{m}ʙ ‘wet’

(30) **‘sit’ (innovation)**

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[24] Note that the additional morphology has preserved the vowel.

[25] As argued in §4.1.1, *o in was most likely raised to *u at an intermediate stage.

Ahamb su^{m}ʙ

Nati su^{m}ʙ

It is important here to examine the reflexes of *^{m}b in other environments. Before *a, *e, and *i, *^{m}b regularly remained a plosive. This is illustrated in PNCV ***^{m}ba**^{ŋ}ga ‘banyan tree’ > Ahamb *n/^{m}ba^{ŋ}g*, Lamap *na/^{m}ba^{ŋ}g*, Neverver *ne/^{m}baŋ*; PNCV ***^{m}be**a ‘where’ > Ahamb *^{m}bi*, Lamap *^{m}bi*, Neverver *a^{m}bi*; PNCV ***^{m}bi**ri=**^{m}bi**ri ‘k.o. tree (Hernandia sp.)’ > Ahamb *na/^{m}bir^{m}bir*, Lamap *na/^{m}ber* (Clark 2009; Rangelov 2020b; Williams 2019; Barbour 2012b). We have found very few exceptions: PNCV *^{m}biri ‘seed’ > Avava *^{m}ʙul* ‘seed of breadfruit’, Neverver *ni/^{m}ʙulu/n*; PNCV *^{m}bakewa ‘shark’ > Avava *^{m}ʙukumaas*; PNCV *^{m}be^{m}be ‘butterfly, moth’ > Unua *a^{m}ʙua^{m}ʙu* ‘moth’. These exceptions may likely be the result of historical conditioned or irregular changes to *u* in these languages that then triggered a change of *^{m}b to ^{m}ʙ. The historical voiced prenasalized labialized plosive phoneme *^{m}b^{w} offers another seemingly suitable environment for trills to develop – prenasalization, labial closure and labial rounding. However, reflexes of PNCV *^{m}b^{w} (which is mostly found in reconstructions before *a and never before *u or *o), are consistently plosives, not trills: e.g. *^{m}b^{w}aŋo ‘mouth, front of house’ > Ahamb, Lamap *^{m}baŋo-*, Neverver *ni/^{m}boŋo/n* (Clark 2009; Rangelov 2020b; Williams 2019; Barbour 2012b).

4.2 Cognate sets with ᴘ

A smaller number of cognate sets can be formed for the plain bilabial trill ᴘ, due to ᴘ occurring less frequently in Malekula lexicons. The sets involve reflexes of PNCV *v followed by *u (or *o) (POC *p > PNCV *v)[26] as in data sets (31-40).

(31) POC *puRas ‘spray water from the mouth’ //

*puRuk ‘to spray spittle etc. from the mouth for magical purposes’

PNCV: ***vura-i ‘spit’**

Ahamb ᴘure ‘spit’

Avava -ᴘura ‘spit’

Avok ᴘyje (ᴘule) ‘spit’

[26] Malekula languages typically reflect PNCV *v with fricatives or, less commonly, with /w/ (Clark 2009; Lynch 2019a, 2019b, 2020) (see also §5.2). The languages mentioned in this section, where *v became a trill, are exceptions to this rule.

Lamap ᴘuj ‘spit’

Navwien ᴘəraj ‘spit’

Nisvai -ᴘuraj ‘spit’

Uluveu ᴘulaj ‘spit’

(32) PNCV ***vusa**/*busa (*buso) **‘foam’**

Ahamb ᴘus ‘to foam (for sea water), break (for waves)’

Avok ᴘys ‘to foam (for sea water), break (for waves)’

(33) PMAL ***vuso ‘flower’**[27]

Ahamb na/ᴘysən ‘flower’ / ᴘys ‘to blossom’

Avok ᴘəsaxər

Uluveu ᴘysi/xaj / ᴘusxote

(34) POC *punut ‘coconut husk, fibers on coconut husk’

PNCV ***vunu**-ti **‘coconut husk fiber’**

Neverver ᴘut ‘be dry, of coconut’**,** naniᴘut ‘dry coconut, pre-germination’

(35) POC *poli- ‘buy’

PNCV *voli (***vuli) ‘buy, sell, pay price’**

Ahamb ᴘur ‘buy, sell, trade, pay price’

Navwien ᴘulᴘul ‘buy’

(36) PNCV ***vura ‘full’**

Ahamb ᴘur ‘full, a lot of’

Lamap ᴘu ‘plenty’

(37) POC *putun ‘Barringtonia asiatica’ //*puna(t) ‘vine used for fish poison’

PNCV ***vuabu** ‘fish poison tree (Barringtonia asiatica)’

Ahamb nxaj ᴘynᴘyn ‘fish poison tree (Barringtonia asiatica)’

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[27] Based on data listed for ‘flower’ in other Malekula languages in Greenhill et al. (2008: https://abvd.shh.mpg.de/austronesian/word.php?v=116), there appears to have been a shared innovation at a Proto-Malekula (PMAL) stage of *vuso ‘flower’, which is reflected in a number of Malekula languages.

For the cognate sets in (38) and (39) where the reconstructions have POc/PNCV *o rather than *u, we hypothesize a raising of *o at an intermediate stage, similarly to the corresponding examples in §4.1. This vowel raising is evidenced in cognates of non-trilling languages, e.g. PNCV *voᵑge ‘clean, white, albino’ (38) > Neve’ei *vux=vux* ‘be albino’ (Clark 2009: 226); POc *posi ‘squeeze, wring (coconuts to extract cream +)’ (39) has reflexes with high vowels in most Malekula doculects in Vanuatu Voices (https://vanuatuvoices.clld.org/parameters/180_squeeze).

(38) PNCV ***voᵑge ‘clean, white, albino’**

Avok	ᴘuxᴘux (pxaᴘux) ‘white’
Denggan	ma/ᴘœx ‘white’
Lamap	pxaᴘux ‘white’
Nisvai	-ᴘux ‘white’
Uluveu	pxaᴘux ‘white’

(39) POc ***posi** ‘squeeze, wring (coconuts to extract cream +)’[28]

Ahamb	(na/)ᴘus ‘to squeeze coconut milk onto food; coconut milk’
Avava	ᴘʊh/ᴘus ‘squeeze
Avok	na/ᴘus ‘coconut milk’
Lamap	ᴘus ‘to squeeze; squeeze coconut milk onto food’
Neverver	ᴘus ‘to squeeze out – custom practice’
Vivti	ᴘus ‘squeeze’

The cognate set in (40) includes only two forms from two neighboring languages. It is an innovation.

(40) **‘cold’** (innovation; cf. POc & PNCV *malaso; POc *ma(ka)(d)ri(d)ring & PNCV *madidi/*mariri)

Ahamb	ᴘur
Avok	ᴘur

[28] We have not been able to find a suitable reconstruction for PNCV. However, as mentioned above POc *p regularly became PNCV *v.

We also observe that PNCV *vu only results in trills stem-initially and otherwise regularly reflects as a fricative: *^{m}bara**vu** ‘long, tall’ > Ahamb *^{m}blav*, Uripiv *e/priv*, Lamap *^{m}be/^{m}beav*; *li**vu**ka ‘middle, between’ > Ahamb *rəvəx*, Neverver *livɣan* ‘center’, Uripiv *livø*, Ninde *live/ne* (Clark 2009; Rangelov 2020b; Barbour 2012b). Before vowels other than *u PNCV *v did not result in a trill either, e.g. before *a, *e, *i: ***va**reʔa ‘outside, public space’ > Ahamb *vare*, Avava, Neverver *vere*; *ra**ve** ‘pull’ > Ahamb *ləv*, Avava *rep*, Neverver *rev*; *va**vi**ne ‘woman, female’ > Ahamb *pne-vər*, Avava *vivin* ‘sister’, Neverver *vin* (Clark 2009; Rangelov 2020b; Crowley 2006d; Barbour 2012b); and before *o (unless *o was raised, as described above), e.g. ***vo**se ‘paddle’ > Ahamb, Lamap *vos*, Ninde *na/we*, Uripiv *ni/wos* (Clark 2009; Rangelov 2020b; Williams 2019).

5. Discussion of the results

If bilabial trills can develop from [mbu] or [βu] sequences, then why did they develop and persist only in relatively few geographically clustered Southern Oceanic languages (more specifically in a subset of Malekula languages) and not in the many other related and indeed geographically contiguous languages that also allow [mbu] and/or [βu] sequences? We first need to acknowledge that there are factors that act against the emergence and/or persistence of bilabial trills. Firstly, as discussed above, bilabial trills are generally difficult to integrate in connected speech (Maddieson 1989: 92). Secondly, specifically for Malekula languages, the attested low functional load of bilabial trills means a high likelihood that, once developed, they can easily be lost, e.g. through a merger with their corresponding plosives, as such a merger would not have created many homophones (see §3.3.3). Thirdly, in §5.2 below, we argue for an additional articulatory challenge to the persistence of ᴘ. In the following subsections, we attempt to identify factors that counteracted these negative forces and helped trigger the development of bilabial trills and ensure their persistence. In §5.1 and §5.2 we elaborate on the historical articulatory environments that substantiated the emergence of ^{m}ʙ and ᴘ respectively. In §5.3 and §5.4, we discuss structural (phonological) and social (contact, in-group identity attachment) motivations that have contributed to the emergence and persistence of ^{m}ʙ and ᴘ.

5.1 *ᵐb/_u > ᵐʙ

The observation that ᵐʙ developed from a *ᵐbu sequence is in line with Maddieson's aerodynamic hypothesis (§2.2, §3.1.1) and Lynch's observations (§3.1.2). Maddieson (1989) also observed that cross-linguistically, ᵐʙ typically occurs before /u/, with some exceptions (see §2.2). In Malekula languages, there are a few synchronic occurrences of ᵐʙ before /y, ə/ and even fewer occurrences before other vowels (see §3.3.1). The occurrences of ᵐʙ before /y, ə/ are most likely due to centralization or fronting of *u after the trill emerged. The few examples of ᵐʙ before /a, e, i/ in Malekula languages can be explained by either (1) a process which involves a loss or replacement of *u, e.g. Ahamb *na/ᵐʙiaᵑg* 'swamp taro' from PNCV *buaᵑga / *biaᵑga, or (2) a morphophonological process as described in Avava and Neverver (§3.3.1). Interestingly, in the latter case, it appears that the sufficient ingredients for a bilabial trill are a nasal component followed by a labial component. It appears that, at least in these two languages, in which ᵐʙ is very salient, bilabial trills can emerge in environments other than [mbu].

5.2 *v/+_u > ᴘ

PNCV *v is reflected conditionally as ᴘ, in the sequence *vu stem-initially. This change is an unexpected fortition after the lenition that occurred from POc *p to PNCV *v; most NCV languages reflect PNCV *v as a fricative or /w/ and neither a p nor a ᴘ can be reconstructed to PNCV[29] (see also Footnote 26). This observation that ᴘ is a reflex of PNCV *vu is somewhat different than Olson's (2015) hypothesis (POc *p > *b > ʙ > v) (§3.1.3). Olson's analysis was based on limited amounts of data – Captain Cook's data provided only two items (for 'banana' and 'bow') for one language that suggested the existence of a plain trill in 1774's Lamap. Both of these cognates happen to be exceptions in our data and have a fricative rather than a trill in present-day Lamap – *na/vytʃ // bre/vutʃ* 'banana' < PNCV *vudi and *na/vys* 'bow gun' < PNCV *vusu 'bow' (Clark 2009; Williams 2019). While Captain Cook's transcriptions clearly suggest the presence of bilabial trills in the items for 'banana' and 'bow' in 1774 Lamap, in present-day Lamap these words occur invariably with a fricative,

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[29] In the modern NCV languages which have /p/, it is normally a reflex of PNCV *ᵐb but it is attested as a conditioned reflex of *v in Ninde, Port Sandwich, and Avava, all Malekula languages (Clark 2009; Lynch 2019b, 2020).

just as their cognates do in other Malekula languages with salient trills (Clark 2009; Rangelov 2020b; Natunmal & McKerras 2001; Barbour 2012a; Pearce 2018; Healey 2013). It is unclear whether this variation represents a reversal of the fricative>trill change from PNCV, or if trill~fricative allophony was present at an earlier stage in the development of these particular languages, which has subsequently been lost to the benefit of /v/. Another exception to the *v > ᴘ rule is Ahamb *vər* 'buy' from PNCV *voli (*vuli) 'buy, sell, pay price', which also has the doublet form ᴘur 'buy, sell, trade, pay price' (Clark 2009; Rangelov 2020b).

We contend that the *vu > ᴘV (where V = /u, y, ə/, see §3.3.2) pattern also finds support in Maddieson's aerodynamic hypothesis. A bilabial fricative would satisfy the low intraoral pressure and slack lip tissue conditions necessary for the Bernoulli effect and oscillation of the lips to be triggered. These aerodynamic conditions cannot be expected to be met in, for example, a [pu] sequence where the complete closure is longer, meaning that intraoral pressure is expected to be higher (Zemlin 2011: 34, 305) and the lip tissue less slack. However, even if the aerodynamic conditions were present at an earlier stage to trigger the development of ᴘ in these languages, at least one of the conditions – that of low intraoral pressure – appears to be absent in ᴘ itself. Measurements of ᴘ show a relatively long complete obstruction of the air flow (§2.2), during which, as just mentioned, a build-up of intraoral pressure can be expected. This additional articulatory challenge can partially explain why ᴘ is cross-linguistically even rarer than ᵐʙ. In §5.4, we discuss the forces that likely countered the challenges to the emergence and persistence of ᴘ.

5.3 What contributed to the emergence and persistence of ᵐʙ?

In this subsection we attempt to answer the question: Why did ᵐʙ develop and persist in some Malekula languages and not in other directly related languages that allow [mbu] sequences?

We start by drawing on observations about the sound inventories of Malekula languages. In most (if not all) of them, labial consonants, prenasalization and trilling are prominent features. These features were likely inherited from an immediately shared ancestor. Firstly, the languages of Malekula exhibit labial plosives, nasals, fricatives as well as approximants. For example, McKerras (2001: 1) points out for Uripiv that "nine of the twenty consonants are bilabial". Secondly, nasalization was a main distinguishing feature in POc and PNCV plosives, fricatives and trills (Ross et al. 2016; Clark 2009: 14; see also §2.2

for synchronic evidence). Thirdly, POc is reconstructed with three contrastive trills: *r, *R, *^{n}r (also noted as <dr>) (Ross et al. 2016). Clark (2009: 10-12) reconstructs only *r and *R for PNCV, but acknowledges the persistence of ^{n}r in some languages on Efate Island and Malekula; Tryon (1976) also lists words with <dr> in a few languages spoken on Espiritu Santo. Captain Cook and his associates also noticed the abundance of trills in 1774 Lamap: "The letter R is used in many of their words, and frequently two or three together, such words we found difficult to pronounce" (Lanyon-Orgill 1979: 68). Ahamb, for example, has four phonemic trills: /^{m}ʙ, ᴘ, r, ^{n}r/ and a uvular trill as a free allophone of /x/.

The prenasalized alveolar trill ^{n}r deserves in-depth discussion here. Catford (1988: 154) proposed that in Nias (Northwest Sumatra-Barrier Islands), both the prenasalized bilabial trill and the prenasalized alveolar trill developed in parallel due to articulatory factors similar to those described by Maddieson (1989). Maddieson (1989: 111) argued against the hypothesis that the two prenasalized trills developed as parallel innovations, referring to the prenasalized alveolar trill being a reflex of "a Proto-Austronesian segment, usually symbolized as 'D'… itself probably originally a trill." As Blust (2007: 301) observed, "prenasalized alveolar trills are surprisingly rare in [Oceanic] languages", with most attestations in the Admiralties languages, in languages spoken in Vanuatu, and Fijian.[30] The available phonological analyses confirm that Malekula languages where ^{m}ʙ is salient and phonemic also have a ^{n}r phoneme, e.g Ahamb (Rangelov 2020: 46ff), Avava (Crowley 2006d: 25), Lamap (Williams 2019: 31), Neverver (Barbour 2012: 24) and Uripiv (Moore 2019: 29-31). It appears, then, that ^{n}r and ^{m}ʙ, both relatively rare typologically, tend to co-occur in the same languages, at least in the Austronesian context.[31] Critically to the matter at hand, languages that have ^{m}ʙ tend to also have ^{n}r. This is the case in Nias, in Admiralties languages, and in Malekula languages. Now, with significantly more data for this co-occurrence in hand, we can argue against Maddieson's (1989: 111) claim that "the occurrence of [prenasalized] (post)alveolar trills in Oceanic languages is not correlated with occurrence

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[30] In Fijian, ^{n}r rarely involves successful trilling (Ladefoged and Maddieson 1996: 131) and is relatively less salient than in other languages (Blust 2007: 306).

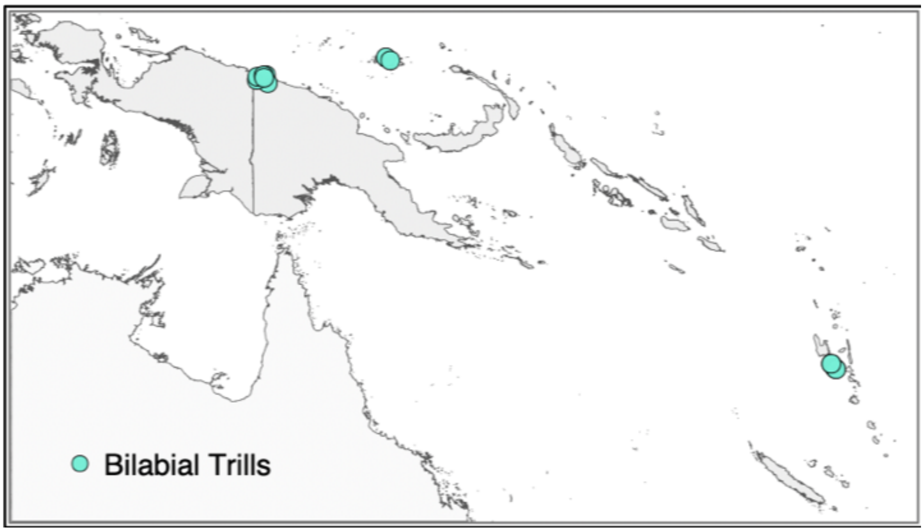
[31] A similar scenario is attested in some African languages. Mangbetu (Demolin 1992), for example, has both ^{n}r and ^{m}ʙ. Furthermore, in Mangbetu, prenasalization is a major distinguishing feature and there are also plain trills, which makes it very similar to Malekula languages, in this regard. A further discussion of bilabial trills in African languages is, however, beyond the scope of this article.

of bilabial trills". We know that ^{n}r likely existed in those languages before ^{m}ʙ emerged, as argued by Maddieson (1989: 111) for Proto Austronesian and reconstructed for Proto Oceanic (Ross et al. 2006). While not all languages that retained ^{n}r also developed bilabial trills (or allowed them to persist if they did), the observed pattern lends credence to the possibility that the spread of the (somewhat complex) manner of articulation of ^{n}r, supported by the general abundance of trills, prenasalization and bilabial segments in the Malekula languages, could have contributed to the emergence of ^{m}ʙ and its persistence in some Malekula languages.

Another factor that certainly played a role in the establishment of ^{m}ʙ, in at least some Malekula languages, is related to the well-documented process of final vowel loss in Malekula languages (Lynch 2014, 2016). Lynch (2016: 407) observed that after the emergence of ^{m}ʙ before a word-final *u, the loss of the vowel meant that ^{m}ʙ came to be in contrast with ^{m}b in at least some languages. While this contrast likely emerged word-finally, the status of ^{m}ʙ as a contrastive phone also expanded to pre-vowel positions as a result of subsequent changes, including the reorganization of the vowel inventory, as some languages expanded the original five-vowel system to add /ə/ and, in some cases, front rounded vowels.

While the present analysis has shown that phonetic and structural motivations may indeed account for much of the emergence of the prenasalized bilabial trills found among Malekula languages, a fundamental question remains: Why did prenasalized bilabial trills emerge and persist in these Malekula languages and not in other closely related languages, where similar phonetic and structural conditions also existed? One explanation may be that the emergence of bilabial trills in certain Malekula languages was supported by social motivations. In §3.1.4, we presented evidence of contact with unrelated Papuan languages spoken by populations that migrated to Vanuatu in the early settlement period. As previously discussed, bilabial trills are both typologically unusual and are rare throughout the world, however many of them have been attested in nearby but completely unrelated Papuan languages, which are spoken near the north coast of mainland New Guinea, opposite the Admiralty Islands, where Oceanic languages with bilabial trills are also spoken (Map 2). Given the uniqueness of this feature, its distribution among Malekula and Papuan-area languages, and the proven historical contact between peoples of Vanuatu and Papuans in Vanuatu's early settlement period (Posth et al. 2018), we contend that language contact with

Papuan languages that also contained bilabial trills is at least partially responsible for their unique development in Malekula, as appears to have also been the case in some Oceanic languages directly neighboring such Papuan languages.



Map 2. Distribution of bilabial trills in Oceanic and Papuan languages (Walworth 2019)

Another social factor that likely played a role in the persistence of $^{\mathrm{m}}$ʙ in Malekula languages is in-group identity attachment. Malekula residents have articulated their view that local language varieties are an important expression of local identities (Barbour, Wessels & McCarter 2018; Rangelov, Bratrud & Barbour 2019; Daly & Barbour 2019). There is anecdotal evidence that speakers of Malekula languages with bilabial trills are generally well aware of the existence of these sounds in their languages. As already mentioned in §3.3.1, Crowley (2006d: 30) reported that bilabial trills in Avava are a readily observable feature of language. It is well known that speakers use language to index certain sociocultural identities, where an entire subset of a speech community might use a particular sound to reinforce in-group membership. This kind of relationship between identity and specific features of speech has been observed in numerous speech communities throughout the world (Labov 1972; Trudgill 1972; Walworth 2017) and has also been suggested as a historical motivation for linguistic divergence in Vanuatu more specifically (François 2012). It is therefore entirely possible that bilabial trills form an integral part of the linguistic identity of speakers, which would support their persistence over time.

5.4 What contributed to the emergence and persistence of P?

At least three facts from our analysis above suggest that in Malekula languages, the emergence of P followed that of ^{m}B. First, there is an implicational hierarchy between the two trills: P is only found in languages with ^{m}B; P tends to persist in languages where ^{m}B is salient and widespread, such as Ahamb, Lamap, Avava, Neverver; it is not found, or only traces of it remain, in languages for which there is evidence of loss of ^{m}B (see §3.3.1). Furthermore, P is only phonemic in languages where ^{m}B is also phonemic (Ahamb and Lamap). Second, P is much less salient than ^{m}B. Third, P is less likely to satisfy the aerodynamic conditions for trilling due to the longer total closure of the vocal tract producing higher intraoral pressure, which makes it less likely for the conditions for trilling to be met.

We therefore offer the following hypotheses for the development of P in Malekula languages: The salience of ^{m}B is supported by it acquiring phonemic status in at least some languages, due to final vowel loss (Lynch 2016: 407). From an articulatory point of view, this new segment patterned as a trill[32] and was also prenasalized, which added a new segment to the trill inventory (r, ^{n}r) and to the array of prenasalized sounds that already existed (^{n}r and prenasalized plosives, as in, for example, modern Ahamb, see Table 1). Since prenasalization is a major distinguishing feature in these languages (see §2.2), this development led to asymmetry in the phonological system with an unfilled slot for a plain (non-prenasalized) bilabial trill. The historical *vu sequence provided the necessary phonetic conditions for a plain trill to develop. The forces to fill that empty slot may have led to the persistence of the

[32] An anonymous reviewer noted that from a phonological point of view P, ^{m}B and ^{n}r pattern as plosives rather than trills in a similar way as affricates do, unlike "true" trills such as [r], which pattern as sonorants. It is, however, difficult to definitively place bilabial trills on a sonority scale since they do not normally occur in consonant clusters. Another difficulty in establishing their sonority lies in the fact that they are more complex sounds than a [r] (see §1).

plain trill[33], perhaps by compensatory articulatory adjustments.[34] It is important to note here that the high rounded vowel environment is more or less omnipresent to satisfy, if only partially, the necessary aerodynamic conditions. While symmetry alone may not readily explain phonetically motivated sound change (Blevins 2004: 283), the identity attachment described in §5.3 for ^{m}ʙ, has likely also supported the emergence and persistence of ᴘ in some of the languages where ^{m}ʙ is most salient. In Ahamb and Lamap, further vowel changes meant that minimal pairs emerged and granted ᴘ contrastive status, although ᴘ is a marginal phoneme in these languages.

		labial	coronal	palatal	velar	labio-velar
Nasals		m	n		ŋ	
Plosives	**Plain**	**p**	**t**		**k**	
	Prenasalised	**^{m}b**	**^{n}d**		**^{ŋ}g**	
Fricatives		v	s		x	
Affricates			tʃ			
Trills	**Plain**	**ᴘ**	**r**			
	Prenasalised	**^{m}ʙ**	**^{n}r**			
Approximants			l	j		w

Table 1: The phoneme inventory of Ahamb (Rangelov 2020a)

6. Conclusion

The origins of the cross-linguistically rare bilabial trills have been a topic of discussion since Maddieson (1989) described the most likely articulatory environments in which bilabial trills can develop. Since bilabial trills are mostly found in underdocumented languages, the lack of

[33] An anonymous reviewer suggested that for true symmetry, the slot would be filled by a plain voiced ʙ to correspond to a plain voiced r. While the symmetry we see in languages with ᴘ is not ideal because of the discrepancy in voicing, the trill inventory displays symmetry regarding prenasalization, which is the main distinguishing feature (see §2.2). As the reviewer observes, this symmetry is also reflected in the fact that the plosive inventories of these languages feature voiceless /p/'s rather than plain voiced /b/'s.
ᴘ is also a better candidate than ʙ from a purely articulatory point of view. In ʙ, intraoral pressure is expected to rise more rapidly than in ᴘ, as voicing during the occlusion phase requires the maintenance of constant and sufficiently substantial airflow. Thus low intraoral pressure, which is required for a bilabial trill (see §2.2), can be more easily achieved in a voiceless, rather than a voiced plain phone.

[34] Measurements of intraoral pressure in ᴘ could provide valuable evidence in this regard.

data has been a major hindrance in investigating their origins. In this article, we have been able to use new and legacy data to investigate the distribution of bilabial trills in one of the geographic regions where they are found. We have shown that the distribution of bilabial trills on Malekula Island is much wider than previously believed – they are found in more than half of Malekula's languages and are clustered in the southern two-thirds of the island. More specifically, we have also revealed the origin and distribution of the rarer and under-researched plain trill ᴘ in Malekula languages.

Our data have confirmed that in Malekula languages the prenasalized bilabial trill developed from [mbu] sequences. They have additionally shown that the plain trill most likely developed from a [βu] sequence, which also satisfies the aerodynamic conditions for trilling to occur and further supports Maddieson's (1989) aerodynamic hypothesis. However, we have also observed exceptions from the attested diachronic pathway, as in the synchronic morphophonological processes in Avava and Neverver, where ᵐʙ can clearly result from a sequence that does not involve a following high rounded vowel. Additionally, bilabial trills are generally difficult to integrate into connected speech and we have established that they have low functional load in Malekula languages. Lastly, it is also likely that one of the key aerodynamic conditions – that of low intraoral pressure – is not met in ᴘ itself. All this means that bilabial trills can emerge and persist even in "non-ideal" conditions, but it also suggests that their emergence and persistence have to be supported by counteracting factors.

The counteracting factors that we have proposed are summarized in Figure 2, which also shows in detail the role of each factor with the relative timing of its effect, allowing us to understand these complex sound changes in detail, as suggested by Salmons (2021: 164) (see §1). Besides the historical *ᵐbu phonetic sequence, the salience of bilabial consonants, prenasalization and trilling likely provided the basis for ᵐʙ to emerge. More specifically, it is likely that spread of the manner of articulation of the already existing prenasalized alveolar trill ⁿr was a major contributing factor. Early language contact with Papuan languages that had prenasalized bilabial trills, compounded with a phonetic and phonological environment amenable to their development, led to the emergence of ᵐʙ. Subsequent final vowel loss was responsible for ᵐʙ acquiring contrastive status in at least some languages. Thus, ᵐʙ established itself as a phoneme and we propose that its salience led to it becoming a unique index of identity in Malekula, a way for the speakers of these languages to differentiate themselves from other speaker-groups. A strong attachment of sound to identity would certainly have enabled ^{m}ʙ to persist. It likely also facilitated the emergence of a plain trill at a later stage, supported by the favorable phonetic environment in *vu. The disadvantage of the less favorable aerodynamic conditions in ᴘ itself has been further counteracted by a push to balance the asymmetric consonant inventories of the languages where ^{m}ʙ was most salient and phonemic (most notably in the discrete group of Southeast Malekula languages).

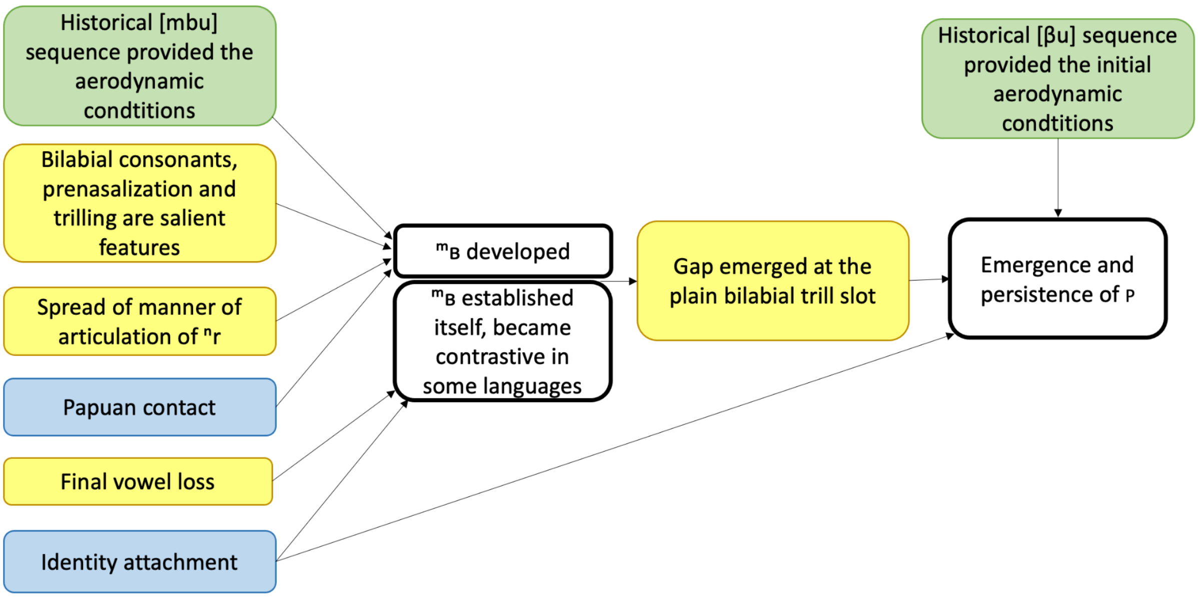


Figure 2: A detailed summary of phonetic (green), structural (yellow) and social (blue) factors, which facilitated the emergence and persistence of bilabial trills in the languages of Malekula

The different motivations that we propose for the emergence and persistence of bilabial trills in Malekula, as shown in Figure 2, are color-coded for type as per Blust's (2005a) typology: phonetic, structural, and social. This study not only contributes to general research on bilabial trills and their origins in Malekula, but it also supports claims that sound change may be complex and driven by multiple forces. This multifaceted approach to investigating sound change allows for a more thorough understanding of unexpected language change that might otherwise be constrained under a single-faceted approach. For example, as we have shown, it would have been impossible to account for ᴘ by discussing only articulatory conditions or consonant inventory symmetry. Our study clearly demonstrates that phonetic and phonological analysis of uncommon sounds and unexpected sound change is valuable, but a more fine-grained and comprehensive account is achieved through consideration of the social factors within a language ecology, including the function of sound systems to index identity and the way that sound systems are influenced by language contact phenomena, which can both serve as significant pressures on the shape of a language.

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Abbreviations

ABVD	Austronesian Basic Vocabulary Database
NCV	North Central Vanuatu
PMAL	Proto Malekula
PNCV	Proto North Central Vanuatu
POC	Proto Oceanic

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Appendix A. Malekula languages with and without bilabial trills and data sources

Table A.1 shows an overview of the data on bilabial trills in Malekula languages from phonological analyses or other publications, including the inferred phonemic status of the trills (where available).

Table A.2 shows the languages for which bilabial trills were attested in Vanuatu Voices.

Table A.3 lists Malekula languages with and without trills (see also Map 1 in the main text).

Table A.1. Data from phonological analyses and other published and unpublished sources

Language (Glottocode | ISO 639-3 code)	Publication / source	Type	Status of ^{m}ʙ (number of attested words with ^{m}ʙ)	Status of ᴘ (number of attested words with ᴘ)
Ahamb (axam1237 | ahb)	Rangelov (2019, 2020a, 2020b)	Article, Grammar, Deposit, Word list	Phonemic (105)	Phonemic (25)
Aulua (aulu1238 | aul)	Keating (2007: 113) (cites Martin Paviour-Smith p.c.)	Overview	Unknown (5)	-
Avava (katb1237 | tmb)	Crowley (2006d)	Grammar sketch, wordlist	Phonemic (164)	Allophonic (1)
Avok (avok1244 | -)	Rangelov (2018)	Fieldnotes	-	Unknown (3)
Denggan (Burmbar, Banam Bay) (burm1263 | vrt)	Brittany Hoback (p.c. 2021)	Personal communication	Allophonic (3)	-
Lamap (Port Sandwich) (port1285 | psw)	Williams (2019) Rangelov (2018) Jocelyn Aznar & Romarik Tavo (2015)	Grammar Fieldnotes Field recordings (personal communication)	Phonemic (20) (1) (8)	Phonemic (4) (3) -
Na'ahai (malf1237 | mlx)	Maddieson (1989: 94) Anastasia Riehl (p.c. 2019)	Article Personal communication	Allophonic (11) Likely phonemic (11)	- -
Nahavaq (sout2857 | sns)	Dimock (2009)	Grammar	Allophonic (2+)[35]	Allophonic (1)

[35] Dimock (2009: 21) says that both /^{m}b/ and /$^{m}b^{w}$/ can have trilled allophones and provides two examples, but there are many other words in Nahavaq that meet the criteria for having variants with bilabial trills.

Nati (nati1244 | -)	Crowley (1998)	Grammar sketch	Allophonic (3+)[36]	-
Neverver (ling1265 | lgk)	Barbour (2012a, 2012b)	Grammar, Word list	Phonemic (198)	Allophonic (12)
Ninde (labo1244 | mwi) [37]	Murray (2018) Keating (cites Pike 1963:94) Maddieson (1989)[38]	Grammar Overview Article	Allophonic (3) Unknown (6) (0)	- - -
Nitita (Viar) (niti1249 | -)	Keating (2007: 124) (cites Crowley 2004)	Overview	Unknown (19)	-
Uluveu (Maskelynes) (mask1242 | klv)	Healey (2013)	Grammar	Allophonic (10)	-
Unua (unua1237 | onu)	Pearce (2015, 2018)	Grammar, wordlist	Phonemic (215)	-
Uripiv[39] (urip1240 | -)	McKerras (2001), Natunmal & McKerras (2001) Maddieson (1989)	Grammar sketch, dictionary Article	Phonemic (286) Unknown (0)	- -
Vivti (vivt1234 | -)	Keating (2007: 126) (cites Crowley 2004)	Overview	Unknown (24)	-

[36] Crowley (1998) says the prenasalized bilabial trill is an allophone of /mp/ sequences before /u/. He provides three examples where a trill has been observed. There are additional words involving /mpu/ sequences in this publication, but it is not specifically mentioned that they had variants with trills, so they are not included in the count.

[37] For Ninde, Pearce et al. (2014) did not identify any bilabial trills. Murray (2018) only found bilabial trills in the syllable coda. Carolyn Crouch, who conducted fieldwork on Ninde in 2018 reported the existence of bilabial trills as allophones of prenasalized /^{m}b/ or /^{m}b^{w}/ before high vowels (p.c. 2021). The Vanuatu Voices data confirms some of Murray's data and further includes examples of bilabial trills in the syllable onset for four Ninde doculects (see Table A.2 and Appendix B).

[38] Maddieson's data is for "Windua (Ninde)". There is a village called Windua where Nati (Crowley 1998) is spoken and which is in close proximity to where Ninde is spoken.

[39] See Footnote 13 in the main text on the documented loss of bilabial trills in Uripiv.

Table A.2: Data from Vanuatu Voices

Language (Glottocode | ISO 639-3 code)	Number of doculects with trills	Number of words with ᵐʙ[40]	Number of words with ᴘ	Data from other sources for this language? (see Table A.1)
Ahamb (axam1237 | ahb)	2	7	2	Yes
Aulua (aulu1238 | aul)	1	1	-	Yes
Avava (katb1237 | tmb)	4	13	2	Yes
Avok (avok1244 | -)	2	9	4	Yes (marginal)
Denggan (Burmbar/Banam Bay) (burm1263 | vrt)	1	2	1	Yes
Dixon reef (dixo1238 | dix)	1	1	-	No
Lamap (Port Sandwich) (port1285 | psw)	2	2	2	Yes
Letemboi-Repanbitip (lete1241 | nms)	3	6	-	No
Na'ahai (Malfaxal) (malf1237 | mlx)	4	5	-	Yes
Nahavaq (sout2857 | sns)	3	8	-	Yes
Nasvang (nasv1234 | -)	1	2	-	No
Nati (nati1244 | -)	1[41]	2	-	Yes
Navwien (navw1234 | -)	1	8	2	No
Neverver (ling1265 | lgk)	3	7	-	Yes
Ninde (labo1244 | mwi)	4	11	-	Yes
Nisvai (nisv1234 | -)	2	8	3	No
Nitita (Viar) (niti1249 | -)	1	7	-	No
Rerep (Pangkumu) (rere1240 | pgk)	2	5	-	No
Tesmbol (- | -)[42]	2	10	-	No
Uluveu (Maskelynes) (mask1242 | klv)	2	9	3	Yes[43]
Unua (unua1237 | onu)	2	6	-	Yes
Vivti (vivt1234 | -)	2	8	1	Yes

[40] This column and the next one list the unique number of tokens across all doculects for a given language, i.e. if the same word is attested with a trill in 2 or more doculects of the same language, it is counted only once.

[41] This doculect is from the village of Windua. Vanuatu Voices contains another doculect from Windua, which is classified as belonging to the Ninde language (see also Footnote 38).

[42] Tesmbol is listed as a separate language in Vanuatu Voices. It lacks both a Glottocode and an ISO693-9 code. It is spoken in the same location as Rerep (Pangkumu).

[43] Note that Healey (2013) does not report plain trills in Uluveu, but they appear in three words in the Vanuatu Voices data.

Table A.3. Malekula languages with and without bilabial trills

	Languages without trills	Languages with trills (languages with both ^{m}ʙ and ᴘ are in bold)
Languages with phonological analysis	Atchin Espiegel's Bay Larevat Malua Bay Naman Nese Neve'ei Tape (Maragus) Tirax V'enen Taut	**Ahamb** Aulua[44] **Avava** **Denggan (Burmbar)** **Lamap (Port Sandwich)** **Nahavaq** Nati **Neverver** Ninde **Uluveu (Maskelynes)** Unua Uripiv
Languages without phonological analysis	Angavae Batarxopu Boinelang Najit Nasarian Natangan Ngata Siviti (Njav) V'ao Vovo Wala-Rano	**Avok** Dixon Reef Letemboi-Repanbitip Na'ahai Nasvang **Navwien** **Nisvai** Nitita Rerep (Pangkumu) Tesmbol **Vivti**

[44] Paviour-Smith (2005) offers a short discussion of phonemic contrasts in Aulua.

Appendix B. List of lexemes with bilabial trills in Malekula languages

The full list of all words with bilabial trills in Malekula languages that are known to us can be found at https://doi.org/10.5281/zenodo.6491334