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Phonetic evidence for phonotactic change in Nafsan (South Efate)

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Nafsan, an Oceanic language of central Vanuatu, is notable for the complex phonotactic structures it exhibits compared to languages spoken further to the north, and compared to the general preference for CV syllables among Oceanic languages. Various types of heterorganic consonant clusters are found in syllable onsets, and are thought to have arisen from the loss of selected medial vowels. Medial vowel deletion is suggested to be a process of change which has been underway for some time in the language, but the details of how this process operates have not been fully clear. Unresolved questions relating to the status of length in the vowel system and the location of lexical prominence have posed a challenge to arriving at a detailed description of vowel deletion and its consequences. Drawing together recent phonetic analyses and previous work, this paper provides an overview of phonotactic structures in contemporary Nafsan and outlines the main factors which lead to the deletion of medial vowels and result in the complex syllable onsets observed today.

KEYWORDS: Nafsan, Oceanic, phonotactics, vowel deletion.

1. Introduction

Nafsan, also known as South Efate (ISO 639-3: erk, Glottocode: sout2856), is a Southern Oceanic language spoken by an estimated 6,000 people on the island of Efate in central Vanuatu, in the villages Erakor, Eratap, and Pango (Clark 1985; Lynch 2000a; Thieberger 2006). It is also reportedly mutually intelligible with the variety spoken further to the north in Eton. Nafsan is one of more than 130 languages spoken in Vanuatu (François *et al.* 2015), and exhibits some phonological patterns which are strikingly different to those found in other languages of central Vanuatu (Thieberger 2006), and to patterns which are typologically common across Vanuatu and for Oceanic languages more generally (Lynch *et al.* 2002). The language is said to be at the core of "an unmistakable area of innovation" compared to closely-related Lelepa, Nakanamanga, and Namakura, spoken further to the north on Efate and small neighbouring islands (Clark 1985: 25), and it has been noted that Nafsan seems to form a transition between these

phonologically more conservative languages and the more 'aberrant' languages of southern Vanuatu (Lynch 2000a: 320). The two main phonological characteristics which are frequently noted to distinguish Nafsan from its relatives are a propensity for vowel deletion, especially in word-medial contexts, and the range of heterorganic consonant clusters permitted in the language. Early work by Ray (1926: 197) notes that word forms in Nafsan are "greatly contracted" compared to the "less abbreviated" forms found in Nguna (a Nakanamanga variety), and Capell (1935-1980: 1) similarly observes that "[i]n Nguna the words are at their fullest, and as one goes south towards the Erakor district of Efate, the words become shorter and shorter". He further suggests that vowel deletion in Nafsan is responsible for the closed syllables and consonant clusters not typically found in related varieties (1935-1980: 11). Vowel deletion was clearly an established process in Nafsan in the first half of the twentieth century, and as will be shown, it has also continued to progress in medial contexts.

Historical and descriptive research in recent decades similarly reports the apparent relationship between vowel deletion and consonant clusters (Clark 1985; Lynch 2000a; Thieberger 2006), while noting that there are various challenges to understanding the interactions between segmental, phonotactic and prosodic patterns in contemporary Nafsan. A key question emerging from previous research is: which vowels are available for deletion? Both Clark (1985) and Lynch (2000a) suggest, based on historical comparisons, that vowels of any phonemic quality apart from /a/ may be deleted. However, the possibility of distinctive vowel length has also been suggested for Nafsan (e.g. Lynch 2000a). If there are both short and long vowels in Nafsan, are both eligible for deletion? Another key question is: in which phonological environments are vowels deleted? Suggestions relating to word position and stress have been put forward (Clark 1985: 20; Lynch 2000a: 333; Thieberger 2006: 67), but reported impressions of word stress in Nafsan vary, and it is therefore difficult to determine how vowel deletion and prominence patterns might interact. The questions of vowel length and stress lead to a third, related question: does syllable weight influence prominence patterns? It is possible that lexical prominence may depend on syllable weight, where weight is determined by the presence of a long vowel or diphthong and/or a coda consonant, as in many languages of Vanuatu (Lynch 2000b); this would then have implications for any deletion patterns which are determined by stress.

As the scope of language documentation for Nafsan continues to increase, new insights have emerged regarding the sound system. Drawing on both recent findings and previous work, this paper will pro-

vide an overview of several aspects of Nafsan phonology which directly inform the above questions, in order to arrive at a better understanding of the mechanisms driving the emergence of complex phonotactic patterns in Nafsan. Though many languages of Vanuatu remain underdescribed, a relatively large collection of audio-visual and textual materials has been developed for Nafsan, including a lexical database and corpus of transcribed narratives resulting from a language documentation project which began in the late 1990s, and several datasets collected for experimental phonetic investigations as part of a project currently underway (Thieberger 1995, 2000, 2011a, 2011b; Billington 2017; Krajinović *et al.* 2019). Except where otherwise noted, the present discussion is based on these materials, collected with Nafsan speakers primarily from Erakor village. Nafsan phonotactic structures are described first, in §2, and the segmental inventory is then given in §3, with extended discussion of vowel distinctions. Patterns of prominence in Nafsan are explored in §4. An overview of medial vowel deletion is then given in §5, incorporating new observations on segmental and prosodic distinctions, and outlining the primary factors influencing its implementation. This is followed by conclusions in §6. Examples are given in broad phonetic transcription accompanied by an English translation, with morpheme-by-morpheme glosses and a corresponding orthographic transcription where relevant. Data citations for all examples given can be found in Appendix A.

2. Phonotactic structures in Nafsan

2.1. Word and syllable structure

Words of up to six syllables are attested in Nafsan; disyllabic words are most common, followed by monosyllabic words (Billington *et al. forthcoming*). Though many Oceanic languages show a preference for open syllables and do not allow consonant clusters (Ross 1998: 17; Lynch *et al.* 2002: 34), complex syllable structures are permitted in Nafsan. A syllable template is (C)(C)(C)V(V)(C). The most common syllable type is CVC, followed by CV (Thieberger 2006: 58). Coda consonants are permitted both word-medially and word-finally. The prevalence of closed syllables is related to the historic deletion of many word-final vowels (Clark 1985: 19-20; Lynch 2000a: 331-333). Some closely-related languages of central Vanuatu retain these vowels, as shown in Table 1, though in the case of Lelepa, Lacrampe (2014) reports variation in whether these are fully produced, devoiced, or deleted, suggesting a change may be underway in the language.

GLOSS	POC	PNCV	NAFSAN	NAMAKURA	NGUNA	LELEPA
night	*boŋi	*boŋi	k͡poŋ	e^{m}boŋ	k͡p^{w}oːŋi	k͡p^{w}oŋ~ k͡p^{w}oŋi
die	*mate	*mate	mat	mat	mate	mat~mate
snake	*mwata	*mwata	ŋ͡maːt	mat	m^{w}ata	ŋ͡m^{w}aːta
stone	*patu	*vatu	faːt	vat	vaːtu	faːtu
louse	*kutu	*kutu	kuːt	kit	kuːtu	kutu

Table 1. Cognates showing retention compared to deletion of Proto Oceanic (POc) and Proto North and Central Vanuatu (PNCV) word-final vowels for some languages of central Vanuatu. Sources: Schütz (1969), Tryon (1976), Sperlich (1991), Greenhill *et al*. (2008), Clark (2009), Thieberger (2011a), and Lacrampe (2014); transcriptions are adapted to IPA conventions.

In Nafsan, consonant clusters are permitted in syllable onsets, both word-initially and word-medially. Given that coda consonants may also occur word-medially, sequences of up to three consonants are permitted across syllable boundaries, as shown in (1a-b). These are often found in word forms which are etymologically compounds (Thieberger 2006: 63).[1]

(1) a. kursŋ͡man^{d}r ‘to slip’
b. sulproŋ ‘lizard’

As shown in (2a-b), sequences of three consonants may also occur word-initially in a small number of words, all beginning with an initial alveolar nasal which originates from a nominal marker. This is sometimes produced as syllabic (Thieberger 2006: 58; Billington *et al. forthcoming*), as evidenced by durational and amplitude characteristics.

(2) a. nsfen ‘something like that’
b. ntŋ͡mat ‘peace’

Consonant clusters are not found in syllable codas (Thieberger 2006; Billington *et al. forthcoming*). The prenasalised alveolar trill /n^{d}r/ is a complex segment involving a sequence of articulatory gestures, and may occur in coda position as in (1a), but functions as a single phoneme (Thieberger 2006: 51-52).

2.2. Phonological profile of complex onsets

There is a strong preference for consonant clusters in Nafsan to be heterorganic rather than homorganic (Thieberger 2006: 59-62), and

almost all possible combinations of manner of articulation are represented (Billington *et al. forthcoming*). In many languages that allow complex syllable onsets and codas, there is a preference for the consonants in the sequence to be more sonorous closer to the syllable nucleus, and less sonorous closer to the syllable edge (e.g. Selkirk 1984; Clements 1990). However, in Nafsan, though many onset clusters do exhibit a rising sonority profile (3a,c,e), many others exhibit a falling sonority profile (3b,d,f) or a plateauing sonority profile (3g,h) (see Billington *et al. forthcoming*, Thieberger 2006: 59-63). A similar range of consonant clusters in onsets has been noted for closely-related Lelepa (Lacrampe 2014: 50-56).

(3) a. kfet ‘dry-tasting’
b. fket ‘spicy’
c. tnus ‘to sting’
d. ntuk ‘rope’
e. tlai ‘to warm oneself’
f. ltia ‘to weave end of mat’
g. k͡ptae ‘to divide’
h. tk͡pak ‘frizzy’

Word-medial sequences of three consonants may include various consonant types, but sonorant consonants appear more often as the coda of the first syllable and the second consonant of the following onset syllable, e.g. /n.fn/, /r.kr/, /l.k͡pl/. Identification of syllable boundaries is informed by phonetic characteristics of segments in different syllable positions, as well as the fact that coda clusters are not permitted in Nafsan.

2.3. Origins of phonemic consonant clusters

Complex onset clusters in Nafsan appear to have arisen from a process of medial vowel deletion (syncope) which has been underway for some time (Clark 1985; Lynch 2000b; Thieberger 2006). Comparisons between contemporary Nafsan word forms and word forms in Nafsan materials from the 1920s by Ray (1926) and in materials from the 1950s by Sope (reproduced in Thieberger & Kalsarap 1999) suggest that many Nafsan words lack vowels which were previously produced. Some examples (mostly monomorphemic) are given in Table 2; the rightmost column shows the phonemic forms used by Nafsan speakers today. Some examples from more phonologically conservative languages to the north are also included. These examples (from Namakura and Nguna) also show medial vowels which are not retained in contemporary Nafsan.

Gloss	1920s (Ray)	1950s (Sope)	Namakura	Nguna	Nafsan
afraid	metak	metak	matak	mataku	mtak
dark	maliko	namaliko	maliŋ	maliŋo	nmalko
sick	msak~masak	misak	mahak	masaki	msak
hook	takau	tekau~tikau~tkau		taŋau	tkau
steal		bunak	banak	panoko	pnak
say	bisa	bisa		pasa	psa
make	brini	bereŋ~beriŋ briŋ~breŋ			preŋ

Table 2. Presence *vs* absence of medial vowels in word forms recorded in early work on Nafsan, from Ray (1926) and Sope (1950s, in Thieberger & Kalsarap 1999), compared to forms recorded for Namakura (Schütz 1969), Nguna (Sperlich 1991; Tryon 1976), and contemporary Nafsan (Thieberger 2011a).[2]

In the earlier written data for Nafsan, there is occasional variation in the presence or absence of medial vowels, for example as noted by Ray (1926: 199) for 'sick' as in Table 2, and recorded in materials produced by Sope, as for 'hook' and 'make'. While such variation is not generally noted among current speakers for words such as those in Table 2, with the forms in the rightmost column considered to be "fully derived and stable", similar variation has been noted in other word forms which appear to be subject to an active, productive process of vowel deletion (Thieberger 2006: 68-70). In previous research, the domain of vowel deletion has not been clearly identified. Clark (1985) suggests it applies iteratively, from right to left, to non-final interconsonantal vowels while Lynch (2000a) and Thieberger (2006) suggest that deletion targets medial vowels in unstressed syllables. Given that this is a productive process, and that more detailed information regarding segmental and prosodic distinctions is now available, a more comprehensive understanding of the domain of vowel deletion in Nafsan is possible.[3]

3. Segmental inventory and vowel length

The consonant inventory of Nafsan includes a contrast at four places of articulation for stops /k͡p p t k/ and nasals /ŋ͡m m n ŋ/, and two fricatives /f/ and /s/. There is no voicing distinction among the obstruents. Sonorants include both a trill /r/ and a prenasalised trill /n^{d}r/, the lateral /l/ and glides /w/ and /j/ (see Thieberger 2006; Billington *et al. forthcom-*

ing). There is a contrast between vowels of five qualities, /i e a o u/, as also found in neighbouring languages and typical of Oceanic languages (Lynch *et al.* 2002). The possibility of a length distinction in the vowel system has also been raised. Though no long vowels are generally written in Nafsan missionary texts and long vowels are not discussed in early works by e.g. Ray (1926), there are suggestions elsewhere that length may be distinctive for at least some vowel qualities (Capell 1935-1980: 7; Tryon 1976; Clark 1985: 17; Lynch 2000a: 330). However, the presence and status of phonemic length in the vowel system has been difficult to ascertain while data for the language remained limited.

More recent work building on the major grammatical description of Nafsan (Thieberger 2006) involves a targeted investigation of vowel distinctions in the language, incorporating both phonetic and phonological data. Following both experimentally-based and community-driven updates to representations of vowels in existing lexical data, possible short and long vowels in various words have been identified, revealing many examples of contrast as in (4). Preliminary acoustic phonetic analyses have been undertaken by the present authors using an archived audio recording of one female speaker producing over 1,100 words in isolation, with three repetitions (Billington *et al.* 2017a). The duration values for vowels in CVC monosyllables are shown in a series of boxplots in Figure 1. These preliminary results show clear evidence of substantial duration differences between vowels categorised as long and those categorised as short, for all five vowel qualities. Long vowels may occur in both open and closed syllables, and in syllables with simple and complex onsets. Based on an acoustic analysis of the first and second formant frequencies (F1 and F2) of the same vowel tokens, F1 and F2 values taken at the midpoint of each vowel are given in Figure 2. Ellipses show the distribution of formant values for each vowel together with their median centroid value at the centre of each ellipse. There are clear distinctions between the 5 phonemic vowel qualities which have been proposed for Nafsan, and indications that the short vowels may be slightly more centralised in the acoustic space. These acoustic and durational patterns for vowels have since been confirmed in a larger, ongoing study by the present authors involving multiple speakers and words produced in a controlled phrase-medial position (Billington *et al.* 2017b; Billington *et al. forthcoming*).

(4) a. kal ‘to dress oneself’
b. ka:l ‘digging stick’
c. puk ‘to be full’
d. pu:k ‘to cough’

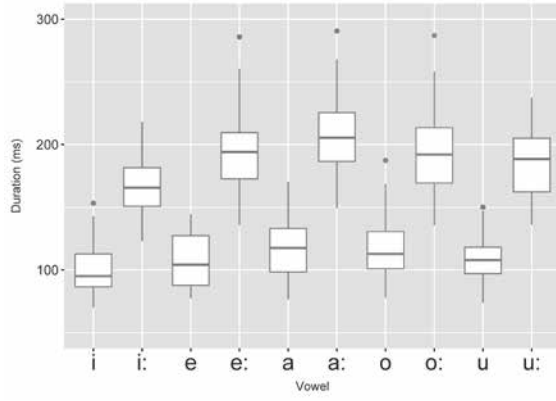

Figure 1. Duration values for vowels in CVC monosyllables produced by one speaker.

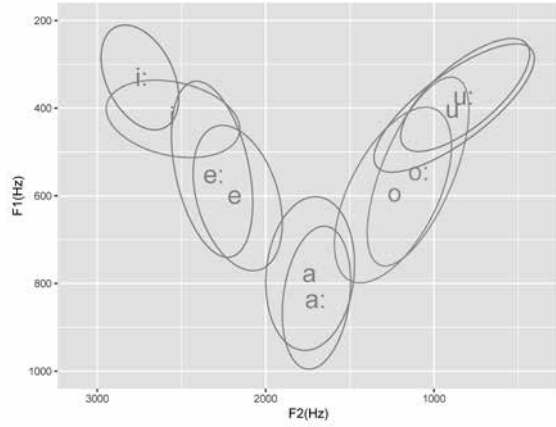

Figure 2. F1/F2 values taken at midpoint of Nafsan monosyllables produced by one speaker.

Some questions remain regarding the origin of phonemically long vowels in Nafsan, given that long vowels are not thought to have been present in Proto-Oceanic (Lynch 2000a: 336). While it is possible that these arose from a process such as compensatory lengthening or coalescence of vowels in a sequence, at this stage there is little evidence to draw on, particularly because the status of vowel length is not entirely clear across the lexicon in closely-related languages in central Vanuatu.

4. Prominence patterns

Previous work on Nafsan includes some impressions of non-contrastive stress, or lexical prominence, but without a consensus on which syllable within a word is most prominent. Suggested patterns include both final stress and initial stress, with some lexically-specified differences (Capell 1935-1980; Thieberger 2006), but the unclear status of vowel length has posed an additional challenge to identifying prominence patterns. For Oceanic languages, there is a reported tendency for primary stress to fall on penultimate syllables (Ross 1998; Lynch *et al.* 2002), but a cross-linguistic survey shows that contemporary Oceanic languages exhibit a range of prominence patterns (Lynch 2000b). Observed patterns include stress which is regularly penultimate, generally penultimate but final if the final syllable is heavy (containing a coda and/or a long vowel or diphthong), regularly final, initial, antepenultimate, lexically specified, or dependent on morphological factors. All of these patterns have been reported for at least some languages of Vanuatu (Lynch 2000b; also Schütz 1969; Fox 1979; Crowley 1982; Thieberger 2006). In addition, for some languages, such as Nahavaq (Dimock 2009) and Daakaka (von Prince 2015), there are suggestions that prominence patterns may not be word-based but instead determined by a higher-level constituent, such as a phonological phrase. Cross-linguistically, cues to lexical prominence vary from language to language, and may relate to segmental duration, fundamental frequency characteristics, intensity characteristics, and vowel formant frequencies (e.g. Gordon & Roettger 2017). For the languages of Vanuatu, impressions of stress correlates are only occasionally noted, and instrumental investigations remain limited.

In order to determine any patterns of syllable prominence in Nafsan words, and their acoustic cues, an experimental investigation of disyllabic CV(V).CV(V)C words and trisyllabic CV.CV(V).CV(V)C words (with word forms in which vowel deletion is not attested) was undertaken as part of the present project (Billington *et al.* 2018; Billington *et al.* 2020). The results show a strong preference for prominence at the right edge of the word, and also show that both short and long vowels in this position may be produced as more prominent than preceding short or long vowels, suggesting that syllable weight is not a factor in prominence. The major acoustic correlate of the observed final prominence is fundamental frequency (f_0), with higher f_0 values observed across word-final vowels. Duration and intensity values are more closely correlated with phonemic vowel length. When comparing the spectral characteristics of short /a/ and long /a:/ (the majority of vowel tokens in the dataset),

results for F1 and F2 show that short /a/ exhibits significant centralisation and some degree of retraction when it occurs in penultimate syllables. Though the penultimate short vowels in these lexical items are not deleted, this finding could be interpreted as evidence for reduction of penultimate short vowels in CV syllables. Ongoing research by the current authors on the intersection of prosody and focus in Nafsan suggests that the observed right-edge prominence may relate to phrasal rather than lexical constituents, indicating that the high f_0 targets are the reflex of post-lexical high boundary tones that signal the accentual phrase boundary in both focal and non-focal words (e.g. Fletcher *et al.* 2019). While the preference for right-edge prominence is quite consistent in the experimental work based on 2- and 3-syllable words in a controlled utterance environment, the ongoing prosodic research shows that both the realisation and the location of prominence can be influenced by different pragmatic and prosodic conditions. The evidence for preferred right-edge prominence and the evidence for reduction in penultimate syllables are important in understanding Nafsan vowel deletion, and inform the following summary of the mechanisms behind the process.

5. Proposed mechanisms behind medial vowel deletion

5.1. Medial vowel deletion is pre-tonic

Comparisons between different inflected and derived forms of Nafsan lexical items show that it is crucial to consider accent when determining where vowel deletion occurs. Interactions between vowel deletion and the tendency towards right-edge prominence are exhibited in many CVC verb roots. The form in (5a), for example, corresponds to the root form of the verb 'to say', a CVC root. When the verb has a proclitic attached, as in (5b), both the vowel of the proclitic and the root are retained (see also §5.3). When this verb has both a proclitic and a transitivising suffix attached, as in (5c), the vowel of the root, /e/, is deleted. In this example, the root would occur in the penultimate syllable of the word, which likely precedes the accented syllable in this word. Similarly, in (5d), the vowel of the root would be penultimate in a nominalised form and is deleted.[4]

(5) a. pes 'to talk'
pes

b. ipes 'she says'
i=pes
3S.RS=talk

c. kafopsa ‘I will talk (about sth.)’
ka=fo-pes-a-Ø
1S.IRS=PSP.IRS-talk-TS-3S.O
d. nafsa:n ‘language’
na-fes-aan
DET-talk-NMLS

Other examples of productive vowel deletion in similar phonological environments can be seen among forms of directly possessed nouns. In (6a), the unpossessed form for ‘belly’, corresponding to the noun root, is shown, and as seen in (6b), once the possessive suffix is added, the vowel of the root, which would now be in the penultimate syllable, is deleted. Similarly, the vowel in the root shown in (7a) is deleted when a suffix is added as in (7b).

(6) a. na͡kpel ‘belly’
na͡pel
b. na͡kplen ‘his belly’
na͡pel-en
belly-3S.DP

(7) a. naŋal ‘gum’
b. naŋlam ‘your gum’
nagal *nagal-am*
gum-2S.DP

The above examples of vowel deletion all involve suffixation with a transitivising suffix, a nominalising suffix, or a suffix marking direct possession. The addition of these suffixes changes the accent position in each word. Whereas in unsuffixed forms as in (5b), the vowel of the root may appear in the word-final, typically more prominent syllable, once a suffix is attached it is the suffix which attracts greater prominence. These examples show a very regular process whereby vowels in penultimate syllables are deleted, and provide good evidence that productive vowel deletion in Nafsan is pre-tonic; that is, it affects vowels in syllables preceding the syllable which tends to be produced as more prominent within a word. In some cases, there is evidence that these reduced forms can then become lexicalised, for example when they occur as the first element in a compound form. When such compounds are suffixed, they show vowel deletion occurring a second time within the word form (Thieberger 2006: 70).

There is also evidence of vowel deletion as a process of change initiated many decades ago (see §2.3, Thieberger 2006). Based on written records, it is difficult to determine whether it applied in the same pretonic context in which productive vowel deletion is observed. However, comparisons between recordings from the 1990s/2000s and from 2017/18 offer some supporting evidence that the process is the same in

terms of the prosodic context it targets. For example, the three-syllable form for the verb 'to be strong' in (8a) was preferred by some older speakers in 1998, but the two-syllable form in (8b) is consistently used in more recent recordings with young to middle-aged speakers.

(8) a. kerkerai 'to be strong' b. kerkrai 'to be strong'

Similarly, the disyllabic form for 'lift up' in (9a) was recorded with an older speaker in 2008, while several speakers aged in their late 20s-40s and recorded more recently consistently produce a reduced form, as in (9b).

(9) a. n^{d}rakat 'to lift up' b. n^{d}rkat 'to lift up'

5.2. Medial vowel deletion targets short vowels of any quality

When examining the quality and length of phonemic vowels which can, in specific contexts, undergo the productive deletion process discussed above, there is a clear pattern of deletion applying exclusively to phonemically short vowels. For example, the noun in (10a) has a long vowel /o:/ in the final syllable, and when a suffix indicating direct possession is added, as in (10b), this vowel remains. In comparison, the noun in (11a) has a short vowel /e/ in the final syllable, in a comparable consonantal context, but when a suffix for direct possession is added, the short vowel is deleted (11b).

(10) a. naŋ͡mo:l 'body' b. naŋ͡mo:lin 'his body'
nam̃ool *nam̃ool-in*
body-3S.DP

(11) a. naŋ͡mel 'tail (of fish)' b. naŋ͡mlen 'its tail'
nam̃el *nam̃el-en*
tail.of.fish-3S.DP

Similar examples can be seen when a transitivising suffix is added to verbs with a long vowel compared to short vowel in the stem, as for /o:/ in (12a), and with the suffix in (12b), compared to /i/ in the same consonantal context in (13a), which is deleted when the suffix is added as in (13b). The examples in (14a,b) and (15a,b) show the retention compared to deletion for vowels of the same quality.

(12) a. to:l 'to pass' b. to:li 'pass (sth.)'
tool *tool-i-Ø*
pass-TS.3S.O

(13) a. itil 'it tells'
i = *til*
3S.RS = say

b. itli 'he said (that)'
i = *til-i-Ø*
3S.RS = say-TS-3S.O

(14) a. isu:r 'he gouged'
i = *suur*
3S.RS = gouge

b. isu:ra 'he cut (sth.) out'
i = *suur-a-Ø*
3S.RS = gouge-TS-3S.O

(15) a. itu͡kp 'he achieved'
i = *tup̃*
3S.RS = shoot

b. it͡kpa 'he shot (sth.)'
i = *tup̃-a-Ø*
3S.RS = shoot-TS-3S.O

Although early work suggested that the open vowel /a/ was resistant to deletion (Clark 1985; Lynch 2000a), the evidence from contemporary Nafsan shows that short vowels of any quality can be deleted (see e.g. 'sick' and 'hook' in Table 2, 'gum' in (7a-b)). However, of the five long vowels, /a:/ occurs the most frequently (attested four to ten times more often than each of the other long vowels in our lexical database). It is therefore possible that many of the examples of the open vowel /a/ not undergoing deletion were in fact instances of the phonemically long /a:/.

Though vowel deletion in the morphophonological contexts given above applies quite regularly to short vowels, it is not obligatory. For example, the stem vowel in the verb shown in (16) was produced in full, even though in (13b), the same inflected form, produced by the same speaker in the same narrative, shows vowel deletion. The example in (16) occurs in the initial position of an utterance produced at a slower speech rate than the speaker used elsewhere in the narrative. Such examples fit with previous observations that vowels vulnerable to deletion may be retained in more slow or careful speech (Thieberger 2006: 68).

(16) itili 'he said (that)'
i = *til-i-Ø*
3S.RS = say-TS-3S.O

Other stylistic and rhythmic factors may also influence vowel deletion. For example, in the Nafsan corpus, the word 'village' is most frequently encountered in a form showing deletion (17a), whereas earlier written sources record a three-syllable word (e.g. *natokon* in 1950s materials from Sope, in Thieberger & Kalsarap 1999). An unreduced form with a penultimate short vowel is occasionally produced by contemporary speakers; as for (16), this sometimes appears to be related to speech rate, as in (17b), from the same speaker as for (17a). However, unreduced forms can also occur under circumstances where speech rate may

not be the primary factor. The example in (17c) is a form produced in a song, as part of a string band performance, and in this case, vowel deletion in 'village' would result in a disyllabic form violating the rhythmic structure of the verse.[5]

(17) a. natko:n'village'
b. natoko:n 'village'
c. natoko:n 'village'

There appear to be no clear examples in the opposite direction, where deletion would not be predicted, but does occur. There is one example which, on first impressions, seems to show unexpected deletion; the morpheme 'child', which generally appears to have a phonemically long vowel, as in (18a), sometimes exhibits vowel deletion, as in (18b) (from the same speaker, in the same narrative).

(18)a.	te:sa	iskei	'a child'
	child	one	
b.	tsa	nmatu	'girl'
	child	female	

However, closer inspection of the corpus materials shows that the production of the morpheme 'child' differs depending on the construction – whenever it occurs followed by *nanwei* 'male' or *nmatu* 'female' (18b), it is not produced with a long vowel but is instead reliably produced either with a short vowel, [tesa], or with vowel deletion, [tsa]. Examples of both can be seen in (19a) and (19b), taken from the same speaker and narrative. These examples, and (18b), show that when the morpheme occurs in noun phrases (arguably compounds) meaning 'girl' or 'boy', the penultimate vowel is phonemically short, and may therefore be optionally deleted (with free variation observed in whether deletion occurs). In any other constructions, the vowel in 'child' is phonemically long, and when it is long it is never subject to deletion. It is likely that the morpheme 'child' has undergone grammaticalisation in these noun phrases, and that the shortening of /e:/ to /e/ in the phonemic form of these (making /e/ available for deletion) relates to this. Reduction of phonemically long vowels is not otherwise an attested phonological process in Nafsan.

(19) a.	tesa	nanwei	'boy'		b.	tsa	nanwei	'boy'
	child	male				child	male	

5.3. Medial vowel deletion is mediated by phonotactic factors

Consonantal and phonotactic factors are also relevant for medial vowel deletion. There are three primary segmental contexts in which penultimate short vowels are not deleted. The first is when it would result in a dispreferred sequence of three consonants. While sequences of three consonants are permitted in Nafsan, there are some restrictions on their occurrence (§2.1, §2.2). Forms such as those in (20a-c), with one lexical stem, have short vowels in the penultimate syllable after the transitivising suffix has been added, but although the vowels /u/, /e/, /a/ could be eligible for deletion (cf. 11b, 15b), in these cases they are not deleted. The consonant sequences which might otherwise arise, /pnt/, /lfk/, /tkl/, are not attested elsewhere in data for Nafsan, and are likely illicit sequences.[6] It may therefore be an avoidance of dispreferred sequences of this sort that protects the vowels from deletion.

(20) a. kepnuti'she was closing (sth.)'
ke=pnut-i-Ø
3S.IRS=close-TS-3S.O
b. rulfeka 'they are all around (it)'
ru=lfek-a-Ø
3P.RS=around-TS-3S.O
c. rutkali 'they touch (it)'
ru=tkal-i-Ø
3P.RS=touch-TS-3S.O

Similarly, vowels between consonants which would together form an unattested onset cluster in Nafsan (see Thieberger 2006: 61-62) appear to be protected from deletion. For example, the vowel in the initial syllable in (21a) is not deleted; this is not surprising, as /k/ is rarely followed by a labial consonant in Nafsan onset clusters, and /km/ is not attested elsewhere in data for Nafsan as a syllable onset. Similarly, onset clusters beginning with /r/ are extremely uncommon, and the cluster /rk/ which could potentially arise from the form in (21b) is not attested. The articulatorily complex prenasalised trill /n^dr/, like /r/, is rare as the first consonant in an onset cluster. Given that /n^drk/ is not so far an attested onset, the lack of deletion in (21c) further confirms that consonant context is a factor in where deletion may occur.

(21) a. kumol 'sweet potato' b. rakum 'crab'
c. n^drokos'to follow'

Vowel deletion may also be precluded between identical consonants. Nafsan freely permits a range of heterorganic consonant clusters and sequences, but disprefers sequences of identical consonants (§2.2).

Where these phonemically occur at morpheme boundaries, a process of degemination occurs and the C.C sequence is realised as a singleton onset (Thieberger 2006; Billington *et al. forthcoming*). For penultimate short vowels flanked by identical consonants, it seems that potential geminates are resolved not via vowel deletion and then degemination, but by not permitting vowel deletion in the first place. Examples (22a-c) show monomorphemic words in which the penultimate short vowel is not deleted, and the potential for geminate [p:], [t:], and [s:] is avoided.

(22) a. popo:t 'white crab species'
b. tete 'some'
c. sasu 'grouper fish species'

Though it could be argued that in these examples, sequences of identical consonants may be more generally dispreferred given that word-initial position is less favoured for geminate consonants crosslinguistically (Thurgood 1993), examples such as that in (23) show that the same avoidance of vowel deletion between identical consonants can be seen where a resulting geminate would be word-medial. Taken together, these exceptions show that even though Nafsan can be considered to have relatively permissive phonotactic patterns, the occurrence of vowel deletion is still restricted to segment and syllable combinations which are otherwise allowed in the language (e.g. Taylor 1994).

(23) asoso 'I called (to him)'
a = sos-o-Ø
1S.RS = call-TS-3S.O

5.3. Medial vowel deletion is mediated by grammatical and lexical factors

There are other cases where a short, pre-tonic vowel is not deleted, but without apparent phonotactic reasons inhibiting deletion. Many of these are examples in which the pre-tonic vowel is part of an inflectional morpheme, specifically a proclitic attaching to the first element of the verbal complex. Examples (24a), (25a) and (26a) show the pattern whereby CV proclitics such as /ra-/, /ka-/ and /k͡pa-/ do not exhibit vowel deletion, even though the onset clusters which would result from this are permitted in other word forms such as those shown in (24b), (25b), (26b).

(24) a. rak͡pas 'you both pick'
ra = p̃as
2D.RS = pick.flower
b. rk͡pek 'wrapped laplap'
rp̃ek

(25) a. kalek ‘I was looking’
ka = lek
1S.IRS = look
b. klet ‘shellfish species’
klet

(26) a. k͡pale:r ‘you return’
p̃a = leer
2S.IRS = return
b. k͡plaŋ ‘to open’
p̃lag

These proclitics carry vital grammatical information which would be obscured without the syllable nuclei, especially because some distinctions rely on vowel quality, for example 2D.RS /ra-/ *vs* 3P.RS /ru-/, and 1S.IRS /ka-/ *vs* 2S.RS /ku-/. Proclitics which consist of only a vowel are also not deleted, as for 3S.RS /i-/ in (5b). This may be because deletion appears to occur in CV rather than V syllables, but as V syllables are not especially common apart from word-initially in morphologically complex forms (i.e. as proclitics), it is difficult to separate the syllable type and morpheme type factors in this case.

Other exceptions to medial vowel deletion appear to be lexically specified. Some of these are borrowed words, as for (27a, 28a, 29a), in which the penultimate vowel is not deleted by current Nafsan speakers, though the consonant sequences which could arise are permitted (cf. 27b, 28b, 29b).[7]

(27) a. tamarin ‘tamarind’
b. namru:n ‘something’

(28) a. petoŋ ‘petanque’
b. pton ‘coral species’

(29) a. afoka ‘avocado’
b. nafkal ‘battle’

In other cases, there is no obvious reason why a given word should resist deletion. For example, the penultimate short vowels in (30a, 31a, 32a) are consistently produced by current speakers, despite the possible medial /lp/, /ml/ and /rs/ sequences being found in many other word forms (30b, 31b, 32b). Exceptions of this sort are few, and it is possible that there is some other historical explanation, or that there are other factors involved in these examples which are difficult to ascertain without more data.

(30) a. maloput ‘middle’
b. talpuk ‘crowd’

(31) a. memelim ‘shellfish species’
b. namlas ‘bush’

(32) a. tarisal ‘flotsam’
b. k͡parsor ‘fish species’

Medial vowel deletion may also be prohibited when it would result in a homophonous form (Thieberger 2006: 69). A few examples suggest this as a possible factor, for example (33a) *vs* (33b), (34a) *vs* (34b), and (35a) *vs* (35b).

(33) a. timen ‘arrow’
b. tmen ‘father’

(34) a. nalaŋ ‘song’
b. nlaŋ ‘wind’

(35) a. pako ‘shark’
b. pko ‘to be interested’

The examples illustrating both where vowel deletion does and does not occur suggest interesting directions for further research. While the productive deletion process appears to be quite categorical, in that vowels are either produced in full or completely deleted, there is clearly some degree of reduction (centralisation and occasional devoicing) in pre-tonic short vowels which for various reasons are not deleted (Billington *et al.* 2018; 2020). A focused investigation of this, across all vowel qualities, would offer a more fine-grained understanding of the deletion process, as would an examination of whether deleted vowels leave any phonetic trace. In addition, especially in cases where deletion might be expected but does not occur, there is an overarching question of how vowel deletion patterns both synchronically and diachronically across Nafsan speakers. Variation in the presence or absence of medial vowels has been noted in previous work and attributed to individual and stylistic factors (Thieberger 2006), but larger-scale studies are required in order to understand how these interact with the spread of phonotactic restructuring in the language.

6. Conclusion

The findings presented here draw together observations from early to very recent work on Nafsan, and clarify the basis of medial vowel deletion. In particular, the results of recent and ongoing experimental phonetic investigations have offered crucial insights to the process. Evidence that there is a length contrast for all five vowel qualities has facilitated a better understanding of which vowels are vulnerable to deletion, and evidence that there is a tendency for prominence to occur at the right edge of the word has enabled a more specific description of the locations in which vowels are vulnerable to deletion. Taking these factors into account, a clear pattern emerges. Medial vowel deletion targets short vowels of any quality, but does not target long vowels. Deletion also appears to be pre-tonic, affecting vowels in penultimate syllables, which precede the syllable generally produced as the most prominent within a word (or phrasal constituent). There are some exceptions to the pre-tonic deletion of short vowels, but many of these can be accounted for by considering firstly whether phonotactic restrictions on certain types of consonant sequences inhibit deletion, and secondly whether grammatical or lexical factors influence the process. Vowels in proclitics carry important grammatical information, and appear to be preserved even when other criteria for deletion are met. Some borrowed words contain pre-tonic short vowels which are not deleted, as do some words which may lead to homophonous forms if deletion were to occur. Historical and productive deletion of medial vowels in Nafsan has led to phonotactic restructuring and the emergence of syllable onsets which are much more complex and varied than is typical of Oceanic languages. These findings illustrate the mechanisms behind the process in Nafsan and inform the understanding of typological patterns among Oceanic languages of Vanuatu, offering insights into some of the factors contributing to the emergence of strikingly diverse phonological systems across the archipelago.

Abbreviations

1	1st person	IRS	irrealis	O	object
2	2nd person	RS	realis	TS	transitive suffix
3	3rd person	PSP	prospective	DET	determiner
S	singular	POS	possessive	NMLS	nominaliser
D	dual	inPOS	inclusive possessive		
P	plural	DP	direct possession		

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Notes

[1] The component parts of forms which are etymologically compounds are not always attested as independent morphemes; e.g. for /kursŋ͡manᵈr/, /sŋ͡manᵈr/ exists independently as 'slap, whip', but /kur/ is not attested as an independent morpheme in current use.

[2] Forms represented with *b* in early work by Ray and Sope are not taken to indicate a change from voiced /b/ to voiceless /p/. Representation of stops varies in early work, likely because voicing is not contrastive in Nafsan and the degree of phonetic voicing may vary, and perhaps because the lack of aspiration for Nafsan stops means they may be perceived as more like English 'voiced' (unaspirated) stops.

[3] Apart from the historical deletion of final vowels noted in §2.1, there is at least one other type of vowel deletion not discussed in this paper, in the nominal article /na-/. In many words, this article has undergone accretion and is realised only as an initial /n/ on nouns. While the article is still productively used in some derivation processes, in many cases it is lexicalised and can be considered part of the phonemic representation of a noun (Clark 1985: 31; Lynch 2000a: 322; Thieberger 2006: 132-137).

[4] Alternations between /p/ and /f/ relate to a process of stem-initial mutation for a subset of verbs when marked for mood, reduplicated or nominalised (Thieberger 2006: 162-170).

[5] There may of course be a more general possibility that songs in Nafsan can preserve forms no longer used in natural speech, though in this case the unreduced form is also attested in natural speech.

[6] Given that the lexical database for Nafsan currently has ~3,800 entries and the corpus has ~130 narratives, it is possible that such sequences, and the onset sequences discussed next, are permitted but not yet attested due to rarity. However, in addition to the general patterns of segmental co-occurrence noted in §2.2 and by Thieberger (2006), the lack of deletion in examples (20a-c) and (21a-c) suggests the potential sequences are illicit.

[7] The words in (27a, 28a, 29a) are English and French in ultimate origin, but all were likely borrowed into Nafsan via Bislama.

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Appendix A. Data citations for all examples given, from archived audio materials: collection NT1 (Thieberger 1995), collection NT5 (Thieberger 2000), and collection BR1(Billington 2017).

Example	IPA	gloss	audio reference
(1a)	kursŋ͡mandr	slip	NT1-98015B 00:05:53
(1b)	sulproŋ	lizard	NT5-200801-2 00:49:27
(2a)	nsfen	something like that	NT5-200801-2 00:23:03
(2b)	ntŋ͡mat	peace	NT1-98015A 00:27:44
(3a)	kfet	dry tasting	BR1-012-LE 00:02:00
(3b)	fket	spicy	BR1-012-LE 00:02:33
(3c)	tnus	sting	NT1-98015B 00:10:58
(3d)	ntuk	rope	NT1-98015A 00:42:38
(3e)	tlai	warm oneself	NT1-98015A 00:03:35
(3f)	ltia	weave end	NT5-200801-1 00:23:32
(3g)	k͡ptae	divide	NT5-200801-2 00:41:11
(3h)	tk͡pak	frizzy	NT5-200801-3 00:09:52
(4a)	kal	dress oneself	BR1-078 00:51:04
(4b)	kaːl	digging stick	BR1-078 00:35:02
(4c)	puk	to be full	BR1-036 01:08:42
(4d)	puːk	to cough	BR1-036 01:09:02
(5a)	pes	talk	BR1-057 00:33:58
(5b)	ipes	3S.RS = talk	BR1-057 00:34:05
(5c)	kafopsa	1S.IRS = PSP.IRS-talk-TS-3S.O	NT1-98001A 00:30:21
(5d)	nafsaːn	DET-talk-NMLS	BR1-057 00:45:02
(6a)	nak͡pel	belly	BR1-043 00:30:05
(6b)	nak͡plen	belly-3S.DP	BR1-043 00:30:18
(7a)	naŋal	gum	BR1-043 00:19:07
(7b)	naŋlam	gum-2S.DP	BR1-043 00:19:35
(8a)	kerkerai	be strong	NT1-98003B 00:12:21
(8b)	kerkrai	be strong	BR1-011 00:00:09
(9a)	ndrakat	lift up	NT5-200801-2 00:20:29
(9b)	ndrkat	lift up	BR1-078 00:13:16
(10a)	naŋ͡moːl	body	BR1-057 00:21:27

(10b)	naŋ͡mo:lin	body-3S.DP	BR1-057 00:21:45
(11a)	naŋ͡mel	tail of fish	NT1-98015A 18:33:00
(11b)	naŋ͡mlen	tail of fish-3S.DP	NT1-005A 18:33:00
(12a)	to:l	pass	NT1-98014A 00:19:08
(12b)	to:li	pass-TS-3S.O	NT1-98014A 00:19:06
(13a)	itil	3S.RS = say	NT1-004B 00:15:18
(13b)	itli	3S.RS = say-TS-3S.O	NT1-004B 00:33:05
(14a)	isu:r	3S.RS = gouge	NT1-20003B 00:11:54
(14b)	isu:ra	3S.RS = gouge-TS-3S.O	NT1-20003B 00:12:44
(15a)	itu͡kp	3S.RS = shoot	NT1-98002A 00:06:43
(15b)	it͡kpa	3S.RS = shoot-TS-3S.O	NT1-98017B 00:44:52
(16)	itili	3S.RS = say-TS-3S.O	NT1-004B 00:12:09
(17a)	natko:n	village	NT1-005A 00:06:57
(17b)	natoko:n	village	NT1-004B 00:08:58
(17c)	natoko:n	village	NT5-StringBand-001 00:12:36
(18a)	te:sa iskei	child one	NT1-98010A 00:33:17
(18b)	tsa nmatu	child female	NT1-98009A 00:10:51
(19a)	tesa nanwei	child male	NT1-98003B 00:24:18
(19b)	tsa nanwei	child male	NT1-98003B 00:23:51
(20a)	kepnuti	3S.IRS = close-TS-3S.O	NT1-98009A 00:29:20
(20b)	rulfeka	3P.RS = around-TS-3S.O	NT1-98009A 00:37:12
(20c)	rutkali	3P.RS = touch-TS-3S.O	NT1-98010A 00:07:05
(21a)	kumol	sweet potato	NT1-98015A 00:11:56
(21b)	rakum	crab	NT5-200801-2 00:34:18
(21c)	n^{d}rokos	follow	NT5-200801-2 00:21:51
(22a)	popo:t	white crab species	NT5-200801-2 00:34:18
(22b)	tete	some	NT5-200801-3 00:05:57
(22c)	sasu	fish grouper species	NT5-200801-2 00:44:00
(23)	asoso	1S.RS = call-TS-3S.O	NT1-004A 00:27:21
(24a)	ra͡kpas	2D.RS = pick flower	BR1-068 00:25:00
(24b)	r͡kpek	wrapped laplap	BR1-014 00:14:08
(25a)	kalek	1S.IRS = look	NT1-20001B 00:17:24

(25b)	klet	shellfish species	BR1-014 00:34:01
(26a)	k͡pale:r	2S.IRS = return	NT1-98009B 00:02:11
(26b)	k͡plaŋ	open	NT1-98015A 00:24:47
(27a)	tamarin	tamarind	BR1-068 00:24:04
(27b)	namru:n	something	NT5-200801-2 00:03:00
(28a)	petoŋ	petanque	NT1-98010A 00:39:37
(28b)	pton	coral species	NT5-200801-2 00:35:16
(29a)	afoka	avocado	NT5-200801-1 00:00:31
(29b)	nafkal	battle	NT1-98003-A 00:18:09
(30a)	maloput	middle	BR1-068 00:24:04
(30b)	talpuk	crowd	NT1-98001B 00:12:28
(31a)	memelim	shellfish species	NT1-98015B 00:01:42
(31b)	namlas	bush	NT5-200801-2 00:02:55
(32a)	tarisal	flotsam	BR1-063 00:28:48
(32b)	k͡parsor	fish species	NT5-200801-2 00:37:55
(33a)	timen	arrow	NT1-98017A 00:15:01
(33b)	tmen	father	NT1-004B 00:12:22
(34a)	nalaŋ	song	BR1-057 00:11:02
(34b)	nlaŋ	wind	NT1-98004A 00:13:52
(35a)	pako	shark	NT1-98004A 00:19:43
(35b)	pko	be interested	NT5-200801-2 00:39:47