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Phonetics and phonology of Idi

Dineke Schokkin
University of Canterbury/The Australian National University

Volker Gast
Friedrich Schiller-University Jena

Nicholas Evans
The Australian National University

Christian Döhler
Leibniz-Centre General Linguistics (ZAS)

1 Introduction[1]

This paper provides a description of the phonetics and phonology of Idi (ISO 639-3: idi, glottocode: idii1243) as spoken by about 1,000 people in the villages of Dimsisi (with its two satellites Birem and Iblamnd) and Sibidiri, located in the Morehead District of Western Province, Papua New Guinea (cf. Figure 1). Idi, also spoken in Dimiri, belongs to the Pahoturi River family (Evans et al. 2018), which further includes Agob, Taeme, Ende, Kawam and Em. Dimsisi Idi is in close and stable contact, mainly through intermarriage, with the unrelated Nen language (Yam family) spoken in Bimadbn village, and thus a sizable proportion of Idi speakers live there, and conversely a substantial number of Nen speakers in Dimsisi village (see Evans [2014, 2015a,b, 2017, 2019a,b] for general information on Nen). This longstanding bilingualism is probably leaving traces in the phonology of Dimsisi Idi, but despite this, there are significant differences in the phoneme inventories of both languages. Most importantly this involves the presence of what we call a retroflex series of plosives, a velar nasal and a palatal lateral in Idi, and in the difference between coarticulated labial-velars in Nen and labio-velars in Idi. Language contact in Sibidiri is more limited, and the use of languages other than Idi in daily communication is less common than it is in Dimsisi.

[1] All authors wish to thank the Idi speech communities in Bimadbn, Dimsisi and Sibidiri for their hospitality and support in making this research possible. For financial support of our fieldwork, NE and VG thank the Volkswagen Foundation's DoBeS program, the Alexander von Humboldt Stiftung (Anneliese-Maier Forschungspreis to NE) and the Australian Research Council (Discovery Project 'Languages of Southern New Guinea', Grant No. DP110100307), and CD, NE and DS thank the Australian Research Council (Laureate Project 'The Wellsprings of Linguistic Diversity', Grant No. FL130100111 and the ARC Centre of Excellence for the Dynamics of Language, Grant No. E140100095).

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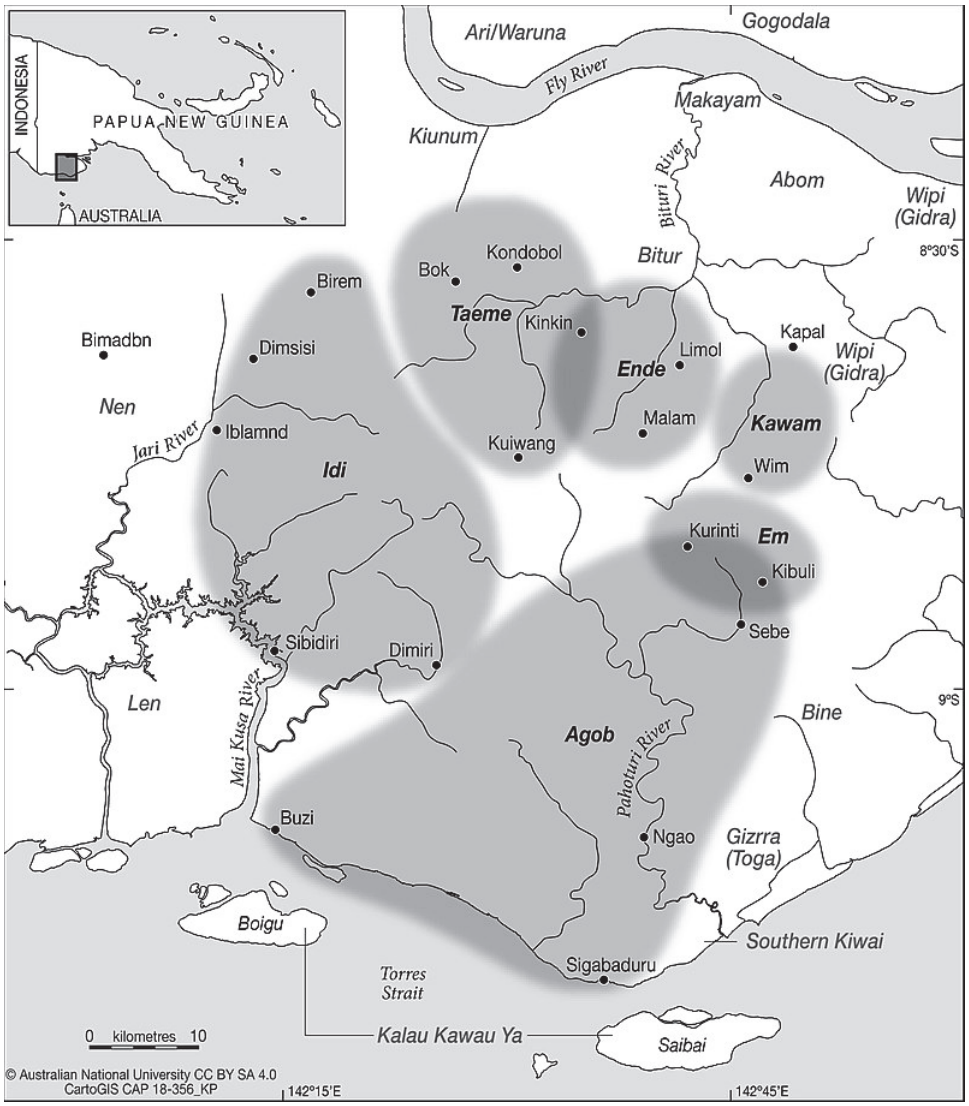

Figure 1. Approximate locations of Pahoturi River languages

The level of description for the languages in this region, though improving, is scarce; see Evans and colleagues (2018) for a recent overview, as well as the other contributions to this Special Issue of LDC. Nen and Ende have been the subject of recent JIPA Illustrations (Evans & Miller 2016; Lindsey 2021). The data on which the current description of Idi is based was gathered during various field trips between 2009 and 2018.[2] Unless indicated otherwise, recordings of the Dimsisi variety are provided by a female speaker from Dimsisi who is now a long-term resident of Bimadbn village, Titi Masa (born 1974). Recordings of the Sibidiri variety are provided by Gwama Dublä.

[2] Data on the Sibidiri variety was gathered by VG in September/October 2013, and in September/October 2014. Data on the Dimsisi variety was gathered by NE in Bimadbn in 2009 and during a Field Methods course in Boulder, Colorado in 2011, by DS in August/September 2014, July-September 2015 and August 2018, and by CD and NE in 2016/2017.

2 Preliminaries

The paper discusses segmental phonology in the sections to follow, by firstly looking at consonants (§3) and then vowels (§4). After that, discussion will turn to phonotactics. In order to interpret the examples in the sections on consonants (and indeed throughout the paper), a brief preliminary note about the status of Idi vowels is in order, before discussing the issue more fully in the corresponding section. The Idi vowel inventory includes six so-called "full" vowels occupying the peripheries of the vowel space, /i e æ a o u/, and two further vowels that are more centralised (a feature many languages of the region have in common). The exact phonetic quality of these central vowels is quite variable, and what predominantly sets them apart from the full vowels, from an auditory perspective, is their significantly shorter length.

Quite apart from the phonetics, the phonological status of the two central vowels is not straightforward. While on the one hand they appear to function as epenthetic vowels, inserted to satisfy phonotactic restrictions, the occurrence of the one central vowel over the other is not predictable based on the immediate phonetic environment, but the most reliable "predictor" appears to be phonological.[3] Idi exhibits a vowel harmony system, where {/æ/, /i/, /u/} comprise a "light" set and {/a/, /e/, /o/} a "dark" set. Basically, "light" versus "dark" is a morphophonological feature of a given root and is lexically determined (some verbal affixes also carry this feature, which complicates matters for inflected verbs). The occurrence of either central vowel strongly correlates with the harmony sets: the fronter, higher vowel combines with light vowels (i.e. occurs in the same domain), while the lower, more back central vowel combines with full vowels from the dark set.

For the sake of consistency and transparency, throughout the paper the two central vowels are phonemically represented as /ɪ/ and /ə/: /ɪ/ for the high front central vowel and /ə/ for the low back central vowel. However, the reader should bear in mind that (1) vowel quality can vary significantly, which is indicated by the close phonetic transcription supplied with each example, and (2) their phonological status is not quite the same as that of the full vowels, even though this is not indicated in the phoneme-level representation. In line with speech community preferences, in the practical orthography, /ə/ is not written. Whether a central vowel occurs is largely predictable from the phonotactic context. However, /ɪ/ is represented with <é>, in order to distinguish its occurrences from those of /ə/.

3 Consonant system

The consonant system of Idi can be represented as shown in Table 1. There is considerable inter-speaker variation both within and across communities in the realization of the voiced sibilant and the postalveolar segments. This will be discussed in more detail in the relevant sections. The sections below are organized according to manner of articulation, subsuming the consonants under the two major categories obstruents and sonorants.

[3] The central vowels' hybrid nature inspired Lindsey (2019) to analyse them as "ghost elements" in related Ende.

Table 1. The consonants of Idi, with orthographic representations deviating from IPA symbols shown in angled brackets

	Bilabial	Alveolar	Postalveolar	Palatal	Velar	Labio-velar
Plosive	p b	t d	ʈ ɖ		k ɡ	k^w $ɡ^w$
			<th> <dh>			<q> <ḡ>
Nasal	m	n		ɲ	ŋ	
				<ny>	<ng>	
Trill		r				
Sibilants		s z				
		<s> <dz>				
Glide	w			j		
				<y>		
Lateral approximant		l		ʎ		
				<ly>		

3.1 Obstruents

After providing a general overview of plosives, we will discuss several issues related to plosives separately: nasal-obstruent sequences and whether to analyse them as segments or not (§3.1.2), the analysis of plosives in a coronal place of articulation (§3.1.3), and labio-velar plosives (§3.1.4). Finally, we discuss affricates and fricatives in §3.1.5.

3.1.1 Plosives: overview

There are two series of plosives (voiced and voiceless) in five places of articulation: bilabial, alveolar, postalveolar (analysed and represented as retroflex here, justification is given in §3.1.3), velar, and labio-velar. Whether a prenasalised series can also be distinguished is discussed in §3.1.2. Plosives occur in both onset and coda position, with the exception of the labio-velar plosives, which are only found in the syllable onset. Examples of the plosives of Idi occurring in the syllable onset are given in (1). For examples illustrating consonants throughout the paper, forms with low vowels were chosen to the fullest extent possible. Labio-velar plosives show some variation with respect to their realization as co-articulated plosives/glides ([k͡w], [ɡ͡w), or co-articulated plosives ([k͡p], [ɡ͡b]; see §3.1.4 for more detailed discussion.

(1) Onset word-initial

/p/	/pa/	[pa]	‘bird’(001)
/b/	/ba/	[ba]	‘our’(002)
/t/	/tan/	[tan]	‘broom’(003)
/d/	/dabe/	[dæbe̯]	‘enough’(004)
/ʈ/	/ʈæʈ/	[t̪͡θɛt̪͡θ]	‘jaw’(005)
/ɖ/	/ɖapal/	[ɖ͡ʐapal]	‘sky, heaven’(006)
/k/	/kak/	[kak]	‘grandparent’(007)
/ɡ/	/ɡæd/	[ɡɛd]	‘child’(008)
/k^w/	/k^wak/	[k͡pak] ~ [k͡wak]	‘moon’(009)
/$ɡ^w$/	/$ɡ^w$æd͡ʒi/	[ɡ͡wædzi]	‘prawn’(010)

In intervocalic position, the realization of plosives is basically invariant, as shown in the examples in (2).

(2) Onset intervocalic

/p/	/ɖapal/	[d͡ʐapal]	‘sky, heaven’ (006)
/b/	/dibæn/	[dibæn]	‘snake’ (011)
/t/	/pitæ/	[pitæ]	‘grass skirt’ (012)
/d/	/pudær/	[podær]	‘shoulder’ (013)
/ʈ/	/piʈæ/	[pi͡ʈʂæ]	‘palm cockatoo’ (014)
/ɖ/	/mapaɖag/	[mapaɖag]	‘roof’ (015)
/k/	/məkat/	[mə̆kat]	‘rat’ (016)
/g/	/age/	[age]	‘banana’ (017)
/gʷ/	/drgʷag/	[də̆rə̆g͡bag]	‘chase’ (018)
/kʷ/	/mikʷɪʈ/	[mik͡pɪ̆t͡ʂ]	‘angry’ (019)

In syllable-final position, all plosives except the labio-velar ones are found, as shown in (3). Word-finally, both voiced and voiceless plosives are optionally released into a vowel-like sound. This vowel does not have the exact same quality as the vowel occupying the previous syllable nucleus. It usually has very short duration, even shorter than the weak vowels discussed fully in §4.3, and no fully-fledged formant structure. It could be considered an anaptyctic vowel. Retroflex plosives, particularly word-finally, show a considerable degree of affrication.

(3) Coda

/p/	/gap/	[gɐp]	‘water cassava’ (020)
/b/	/karab/	[karab]	‘paddle’ (021)
/t/	/məkat/	[mə̆kat]	‘rat ’(016)
/d/	/gæd/	[gɛd]	‘child’ (008)
/ʈ/	/pæʈ/	[pæ͡ʈʂ]	‘log’ (022)
/ɖ/	/kəɖ/	[kə̆ɖə]	‘small ’(023)
/k/	/kak/	[kak]	‘grandparent’ (007)
/g/	/æg/	[æg]	‘morning’ (024)

In intervocalic position, the voiced plosives /b/ and /g/ are optionally lenited, thus being realized as [β] and [ɣ], respectively: see (4) and Figure 2, based on a recording by a male Sibidiri speaker.[4] No such lenition has been observed for the alveolar or retroflex plosives.

(4) /jagalaben/
[jaɣalaβen]
‘(S)he opened it. (remote past)’ (025)

The voiceless bilabial plosive is optionally realized as a voiceless fricative when preceding the voiceless retroflex plosive. In other words, the sequence /pʈ/ is realized as [ɸʈ]; see (5) and Figure 3, based on a recording by a male speaker from Sibidiri.

(5) /bopʈənən/
[boɸʈə̆nə̆n]
‘I will arrive.’ (026)

[4] All spectrograms were generated using the Praat software (Boersma & Weenink 2021, Elvira García 2018).

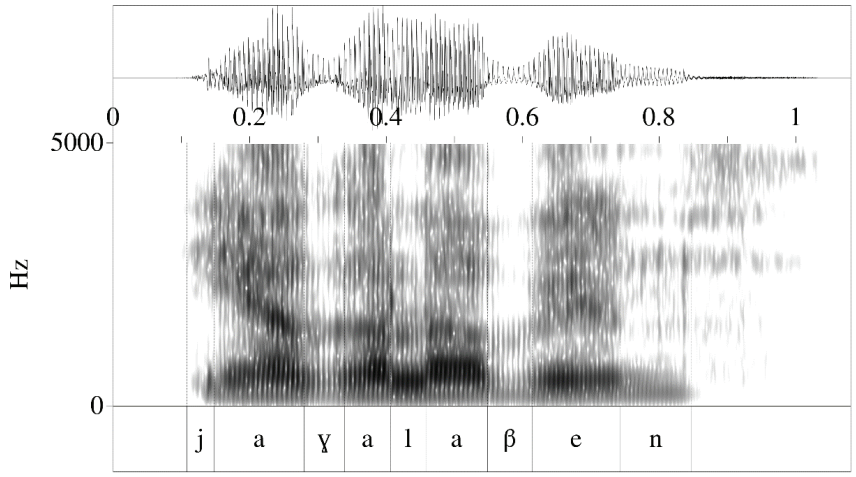

Figure 2. Lenition of /b/ and /g/ in /jagalaben/ '(s)he opened it'

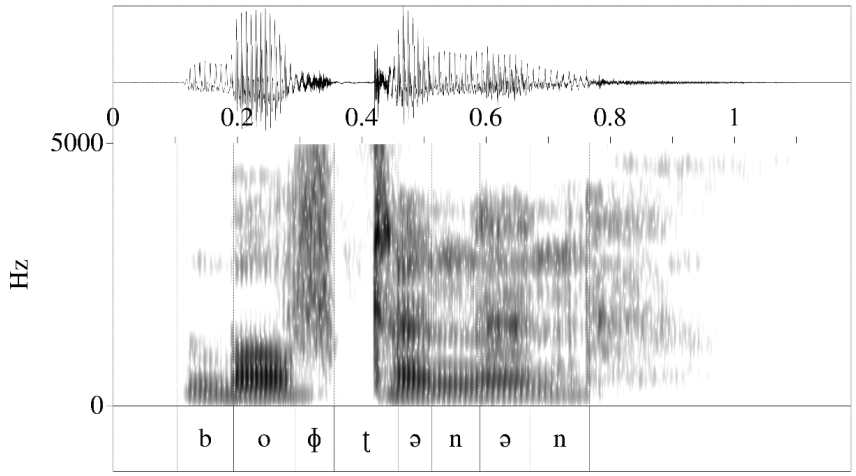

Figure 3. Lenition of /p/ in /bopʈənən/ 'I will arrive'

3.1.2 Nasal-obstruent sequences

Homorganic nasal-obstruent sequences are interesting due to the fact that, while very frequent, they are never subject to vowel epenthesis, which is otherwise a pervasive phenomenon in Idi. As will be shown in §5, most consonant clusters are illicit and will be broken up by an epenthetic vowel. This raises the question of whether we should treat homorganic nasal-obstruent sequences as unit phonemes. Phonologically, however, this analysis as single segments seems unlikely to us. In what follows, the surface realizations of these sequences will be discussed first, followed by a discussion as to why they are unlikely to be single segments.

Combinations of a voiced plosive or affricate preceded by a homorganic nasal are commonly found in intervocalic and word-final position, as illustrated in (6) and (7). Word-final sequences of /n/ and the voiced alveolar fricative /z/, however, do not occur. Titi Masa produced the first and last example, while the others are from different speakers. Note that in Idi, corresponding homorganic sequences of a nasal plus a voiceless obstruent are not found, which contrasts with some other languages of the region such as Ende (Lindsey 2019; 2020) and Ngkolmpu (Carroll this issue).

(6) Intervocalic position:

/mb/	/ɖamba/	[d͡ʐ̃amba]	‘wing’(027)
/nd/	/mənda/	[mə̆nda]	‘five’(028)
/nɖ/	/lanɖag/	[lanɖ͡ʐaɡ̈]	‘lizard sp.’(029)
/ŋg/	/rəŋgæ/	[rə̆ŋgæ]	‘medium-sized pig’(030)
/nz/	/kʷənze/	[k͡pə̆nd͡ze]	‘proper name’(031)

(7) Word-final position:

/mb/	/kʷɪmb/	[k͡pɪ̆mbə̆]	‘buttocks’(032)
/nd/	/mænd/	[mænd]	‘rope’(033)
/nɖ/	/lanɖ/	[lanɖ͡ʐ]	‘ear’(034)
/ŋg/	/ɲəŋg/	[ɲə̆ŋg]	‘leg’(035)

For completeness’ sake, we note that Idi allows heterorganic nasal-obstruent sequences when these occur across syllable boundaries (but not within the same syllable), as shown by the forms in (8):

(8)	/ankom/	[ankom]	‘ant’(036)
	/amtət/		‘breathe’ (no recording)
	/jɪnbu/		‘in-law’ (no recording)
	/bəmdər/		‘tree sp.’ (no recording)

Nasal-obstruent sequences do not occur word-initially. That is, in word-initial surface realizations we only find either a plain nasal, or a plain voiced obstruent. However, there are indications that the nasal is not functioning completely independently from the obstruent in homorganic clusters. The first bit of evidence comes from inflected verb roots. Verbs in their infinitive forms do not take any prefixes. Some roots that, as infinitives, start with a plain voiced stop have a homorganic nasal surfacing when the verb root is inflected, and a prefix is added. This is exemplified below in (9) with the verb /baland/ ‘to sell’.

(9)	Infinitive:	/**b**aland/	[baland]	‘to sell’ (037)
	Inflected verb form:	/ba**mb**alande/	[bambalande]	‘I will sell it.’ (038)

Prefixing /ba/ to the verb root previously realized as [baland] in infinitive form leads to a homorganic /m/ surfacing before the /b/.

Note that word-initial voiced plosives are very often produced with a brief period of weak prenasalization, at least in the careful speech of, e.g., a word list recording. This feature is optional and may disappear in connected speech. Importantly, this phonetic prenasalization is qualitatively different from nasal-obstruent sequences occurring word-medially and -finally. It does not show fully developed formant structures and is considerably lower in intensity. It may also be regarded as strong pre-voicing. Figure 4 shows a spectrogram of /bombeag/ ‘I will chase’. While the voice onset time seems to be comparatively long, the relevant segment does not have the same spectral structure as the [m]-segment constituting the coda of the first syllable.

A second piece of evidence regarding the special status of nasals preceding voiced obstruents comes from infinitival reduplication. A number of monosyllabic, monomorphemic verb roots show a reduplicated infinitive form.[5] In these cases, the root

[5] In related Ende, it appears that infinitival reduplication is a purely morphophonological process (see Lindsey [2019] for full discussion). In Idi, the picture is somewhat murkier, as verb conjugation class also seems to enter into it: verb roots from particular classes do not have

exhibits a nasal-obstruent sequence, while the preceding word-initial reduplicant does not. This is illustrated in (10) and (11).

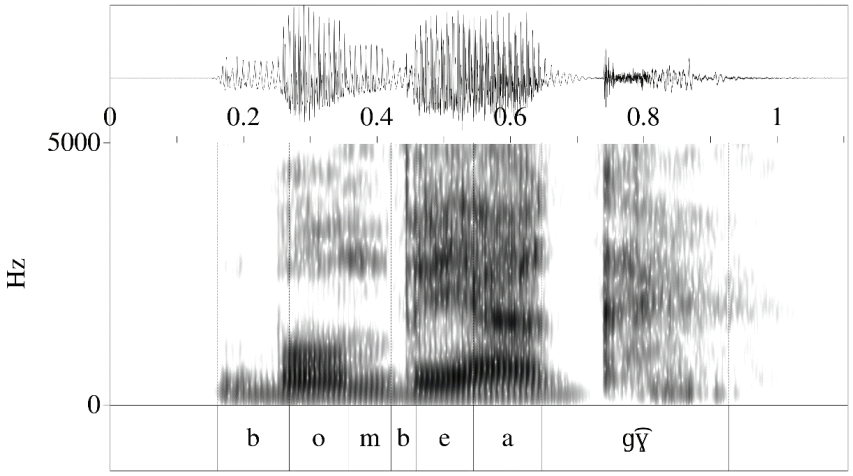

Figure 4. Contrast of phonetic prenasalization and a nasal-obstruent sequence in /bombeag/ ‘I will chase’ (039)

(10) Infinitive: /**ɖ**ə~**nɖ**əg/ [ɖ͡ʐɛ̆nɖ͡ʐɜ̆g] ‘to bite’ (040)
Inflected verb form: /be-**nɖ**əg-n/ [bɛnɖ͡ʐɜ̆gə̆n] ‘I/(s)he bit it.’ (041)

(11) Infinitive: /**d**ə~**nd**ər/ [də̆ndɜ̆rə̆] ‘to hear’ (042)
Inflected verb form: /g-w-a-**nd**r-a/ [g͡bə̆ndrə̆] ‘We listened.’ (043)

With infinitival reduplication, in the case of a nasal-obstruent sequence involving /b/, /d/, /ɖ/ or /z/, it is the obstruent that surfaces in the word-initial position, while the nasal does not. With a sequence involving /g/, by contrast, it is the nasal that surfaces when the verb root is reduplicated. This is exemplified in (12) for the verb /ŋaŋgas/ ‘to make’.

(12) Infinitive: /**ŋ**a~**ŋg**as/ [ŋə̆ŋgas] ‘to make’ (044)
Inflected verb form: /be-a-**ŋg**as-n/ [bæŋgasə̆n] ‘I/(s)he made it.’ (045)

Finally, a phenomenon is observed in which a nasal can “float” leftward (cf. Lindsey 2019) from a voiced obstruent to another voiced obstruent that is not word-initial. It is exemplified here by means of the verb /zoŋg/ ‘to burn’. Note the difference between the infinitive and the inflected verb form in (13):

(13) Infinitive: /zo**ŋg**/ [d͡ʒoŋg͡] ‘to burn’ (046)
Inflected verb form: /w-a-**nz**o**g**-en/ [wand͡ʒogen] ‘It burned.’ (047)

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infinitives or use other means besides reduplication to form them (cf. Schokkin & Lindsey [in revision]). The relation between infinitive morphophonology and verb class membership requires further investigation.

While the nasal precedes /g/ in the coda of the infinitive form, in the inflected verb it is no longer in this position and now precedes /z/, assimilating in place of articulation. It can do this because /z/ is a voiced obstruent (that does not have a nasal feature itself), and is no longer word-initial due to the addition of prefixes. These observations support the assumption that in Idi, a homorganic nasal-obstruent sequence is neither made up of two full segments, nor does it form a unitary segment, i.e. a prenasalised obstruent. Rather, the nasal may best be analysed as an underspecified feature of a particular segment that only surfaces when the segment it is associated with is a non-word-initial voiced obstruent, and that can float leftward in a phonological word when there is a suitable host (i.e. another non-word-initial voiced obstruent without a nasal feature).[6]

Summarizing the discussion above, there is good evidence for the conclusion that nasal-obstruent sequences are unlikely to be single segments. Firstly, they are limited in their distribution, not occurring word-initially. In this, Idi differs from other languages of Southern New Guinea for which nasal-obstruent sequences have been analysed as single segments, such as Ngkolmpu (Carrol this issue), Komnzo (Döhler 2018) or Coastal Marind (Olsson 2017). Secondly, nasal-obstruent sequences are not phonologically contrastive with either plain nasals or plain obstruents, and minimal pairs have not been found. Thirdly, the morphophonological alternations we find with respect to verbal reduplication and nasal float in inflected verbs are difficult to explain if we assume that the nasal-obstruent sequences consist of single segments.[7]

3.1.3 Coronal plosives: place of articulation

We now turn to the four coronal plosives /t/, /d/, /ʈ/ and /ɖ/. /t/ and /d/ are invariably produced as alveolar plosives, and do not show affrication. As with other plosives, word-finally they are frequently released into an anaptyctic vowel. The realization of /ʈ/ and /ɖ/, however, varies significantly across varieties of Idi as well as within varieties, i.e. across speakers. Generally speaking, the sounds we classify as "retroflex" are produced further back compared to the alveolar ones, in a postalveolar place of articulation, but they are not necessarily retroflex in a narrow (articulatory) sense. They are often also affricated, to the point where affrication is probably the most prominent acoustic correlate of the opposition. Still, affricated retroflex plosives are audibly different in realization from [d͡ʒ], the voiced postalveolar affricate allophone of /z/. Distributional patterns seem to support their analysis as retroflex sounds, as retroflexes typically tend to occur after back vowels and not front vowels (Flemming 2003). Based on counts from the Dimsisi Idi dictionary (Schokkin et al. 2019), the retroflex consonants are only very rarely flanked by mid or high front vowels, and also high back vowels. This is particularly true for the voiced /ɖ/, which occurs less frequently across the board compared to voiceless /ʈ/.

While there is considerable variation in realization, as shown below, on a phonological level we analyse the retroflex consonants as plosives rather than affricates. An apparent-time study from related Ende indicated that the plosive variant of the retroflex consonants is considered the conservative variant in that language (Strong,

[6] This explains the difference between forms such as /zoŋg/ and those like /baland/. In the latter, the nasal preceding /d/ never floats leftward, because /b/ already has a nasal feature associated with it (which can surface or not, depending on whether /b/ is word-initial).

[7] An anonymous reviewer enquired whether the nasal float phenomena could alternatively be explained by posing a phonotactic restriction on nasal-obstruent sequences which prohibits them from occurring adjacently (i.e. separated by a single syllable nucleus). While this solution is appealing for its elegance, it doesn't adequately explain the Idi data, as these sequences are quite often adjacent in complex forms: compare, e.g., /wɪnd-ændæ/ 'meat-INS', /b-a-mblo-nd-eo/ 'they will multiply', or /bla~mblamb/ 'to raid (INF)'.

Lindsey & Drager 2020). Figure 5 and Figure 6 show a comparison of the realization of /ʈoj/ ‘skin’ and /toj/ ‘plant species’ by a male speaker from Sibidiri. The duration of the release is approximately 63ms in the case of /ʈoj/, and approximately 34ms in the case of /toj/.

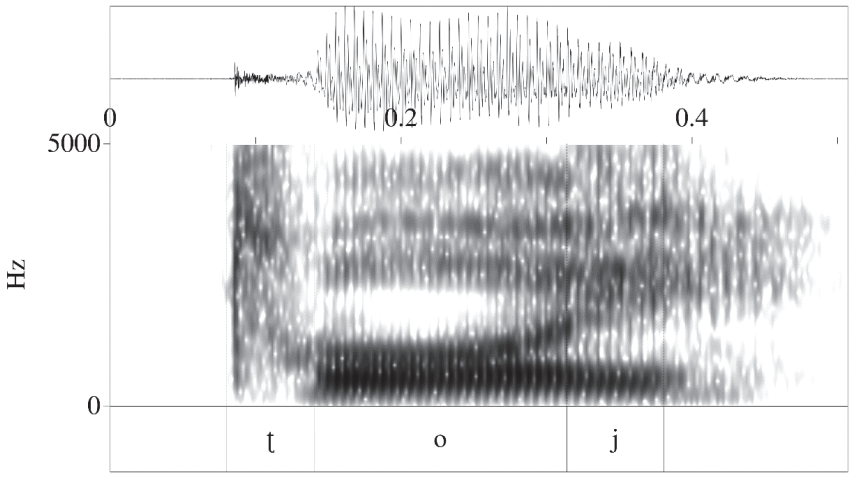

Figure 5. Release of the voiceless retroflex stop in /ʈoj/ ‘skin’ (048)

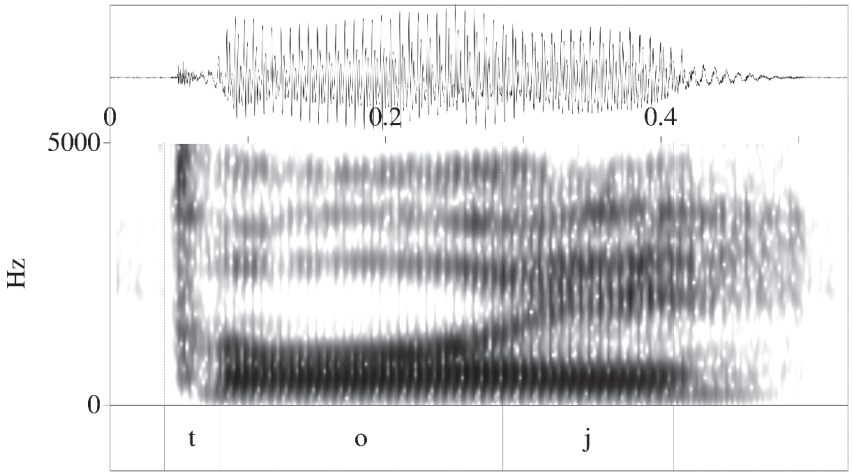

Figure 6. Release of the voiceless alveolar stop in /toj/ ‘plant species’ (049)

The difference between the opposition in the coda is shown in Figure 7 (/kʷɪʈ/ ‘bone’) and Figure 8 (/kʷɪt/ ‘night’). Figure 7 shows the characteristic fricated release of the retroflex, whereas in Figure 8 the release is short, followed by an echo schwa.

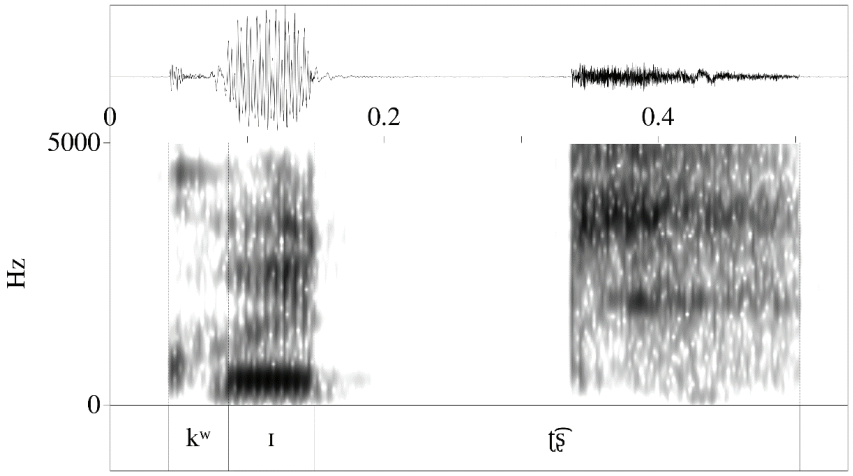

Figure 7. Word-final release of the voiceless retroflex stop in /kʷɪʈ/ ‘bone’ (050)

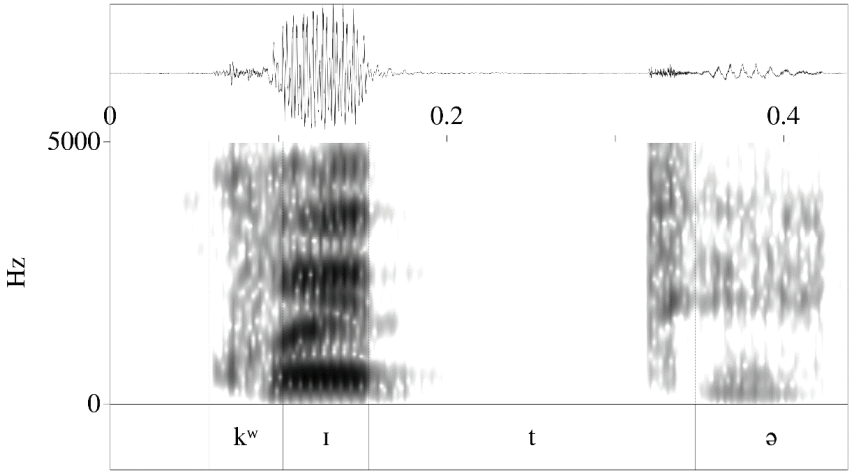

Figure 8. Word-final release of the voiceless alveolar stop in /kʷɪt/ ‘night’ (051)

The same situation can be observed with the voiced coronal plosives. Figure 9 shows the realization of /kəɖ/ ‘small’, and Figure 10 shows /kʷədkʷəd/ ‘hard’, said by the same speaker.

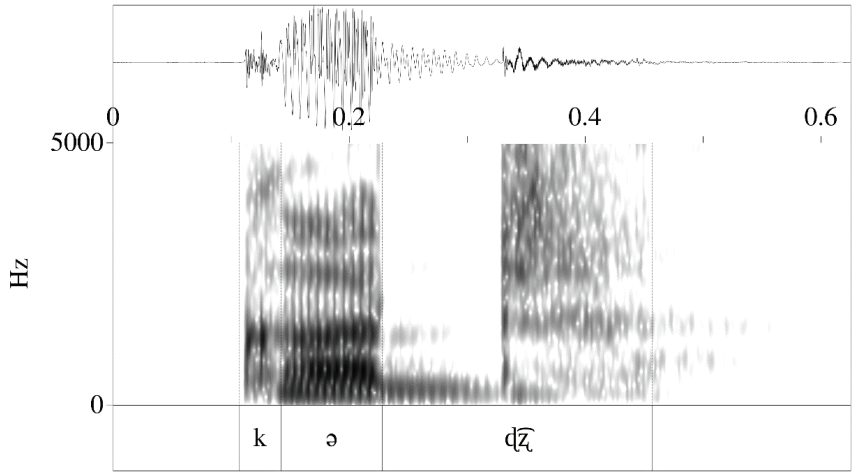

Figure 9. Word-final release of the voiced retroflex stop in /kəɖ/ ‘small’ (052)

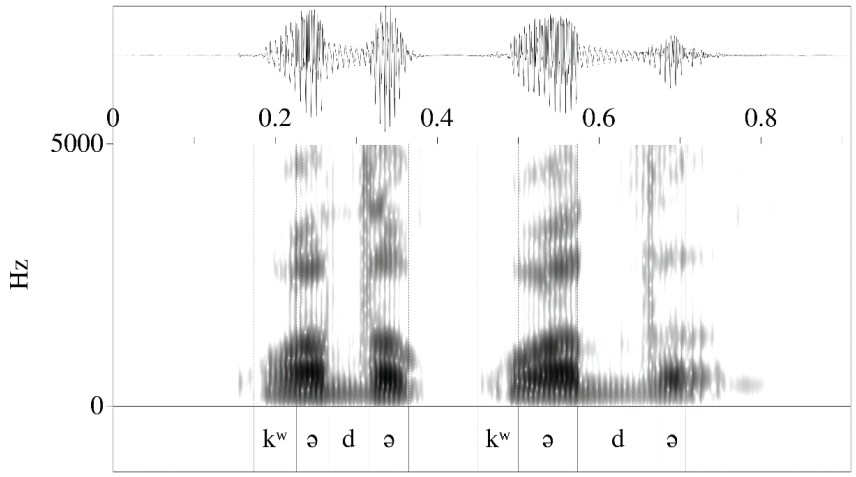

Figure 10. Word-final release of the voiced alveolar stop in / kʷədkʷəd/ ‘hard’ (053)

As an illustration of inter-speaker variation with regard to the retroflex segments, consider the spectrograms in Figures 11 and 12, showing the realization of /kaoʈe/ ‘clothes’ by two male speakers from Sibidiri. Note that while the realization in Figure 11 shows the characteristic long affrication with the retroflex /ʈ/, Figure 12 hardly shows it. The realization of the retroflex by that speaker is therefore much closer to that of /t/. Speech rate may be a factor in this and of course differs between individuals. This remains an area for further research.

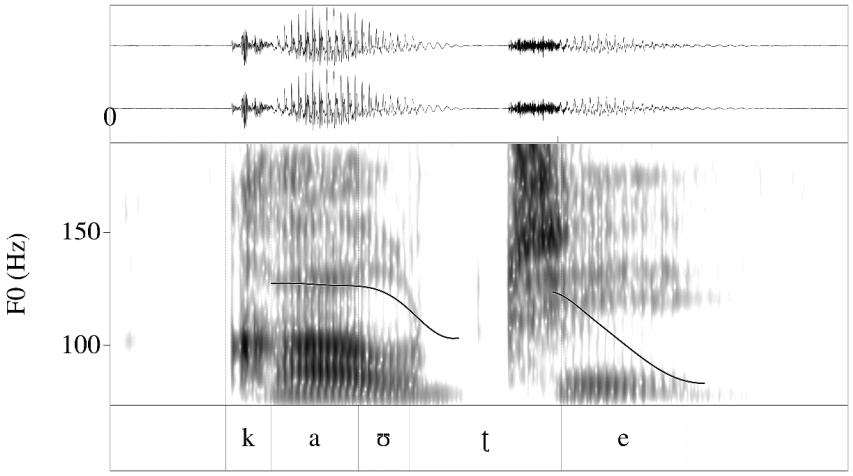

Figure 11. Realization of /kaoʈe/ ‘clothes’ with more affrication (054)

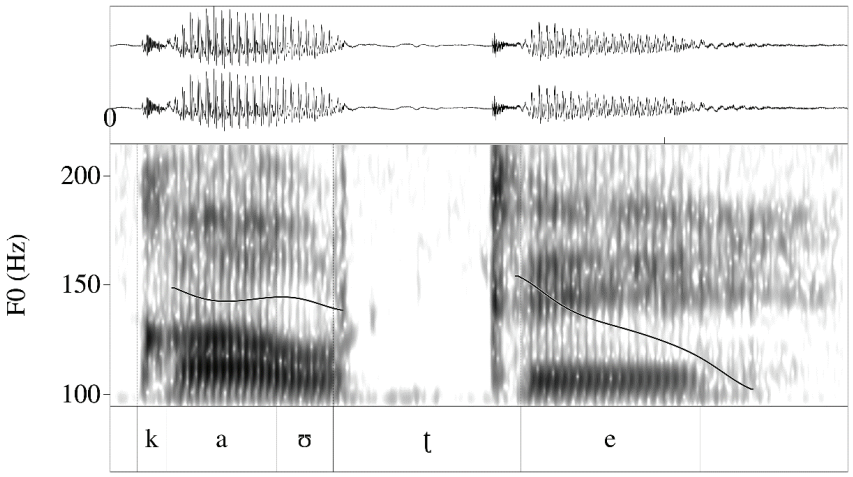

Figure 12. Realization of /kaoʈe/ ‘clothes’ with less affrication (055)

3.1.4 Labio-velar plosives

Idi has a series of labio-velar plosives for which the velar plosive and bilabial components are inseparable; whether the bilabial component is a glide or involves more complete closure varies with the village and the individual, as does the relative timing of the two gestures (from coarticulated to sequential). In Sibidiri Idi, the bilabial articulatory gesture corresponds to a glide, and no complete bilabial closure is produced. This realization can be considered a labialised velar plosive: a velar plosive with an approximant-like secondary articulation. In Dimsisi we also find this realization, but there is more inter- and intra-speaker variation, in particular for the voiced plosive. Here,

speakers sometimes produce a complete bilabial closure in addition to the velar closure, so that in those cases the sounds are realized as coarticulated labial-velar plosives. This variable realization is schematised below in (14):

(14) /k^{w}/ [k͡w] ~ [k͡p]
/g^{w}/ [g͡w] ~ [g͡b]

In Figures 13 and 14, spectrograms are shown for the contrasting forms /gap/ ‘water cassava’ and /dərg^{w}ag/ ‘to chase’, as realized by a female speaker from Dimsisi, Puli Ämädu. The [g] in /gap/ just has a velar release, while the co-articulated segment [g͡b] in /dərg^{w}ag/ superimposes a labial release (cf. Ladefoged & Maddieson 1996: 334ff.), characterised by a lowering of F2 as evident from the spectrogram.

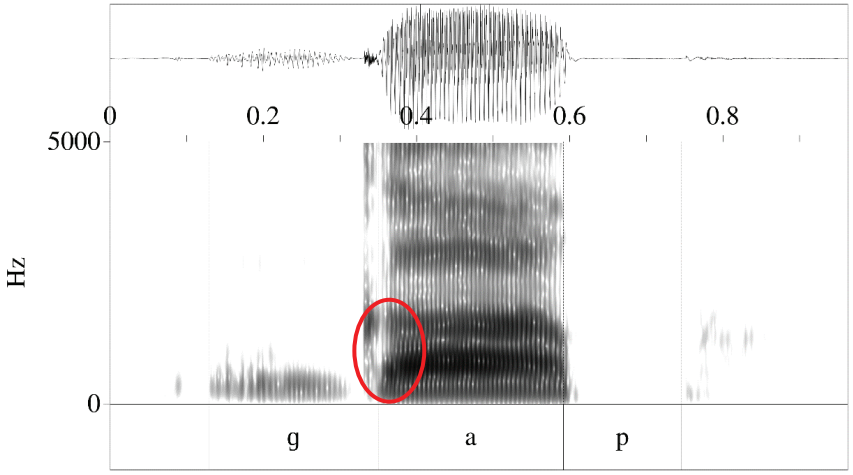

Figure 13. Release of the voiced velar stop in /gap/ ‘water cassava’ (056)

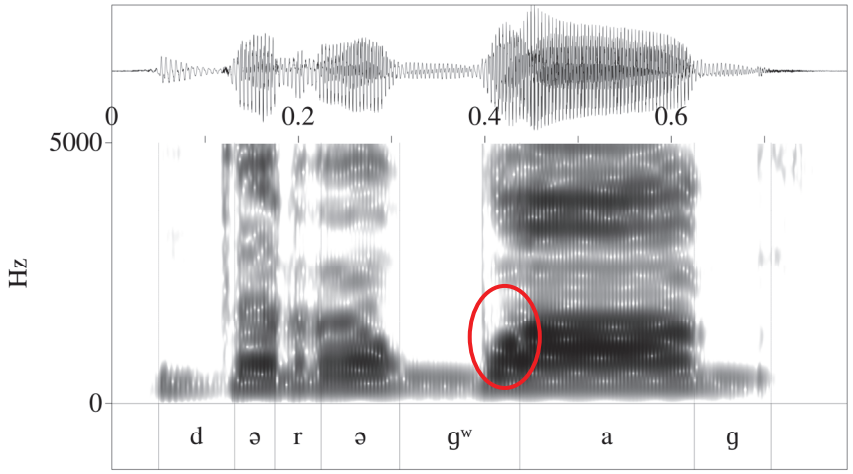

Figure 14. Release of the coarticulated voiced labio-velar stop in /dərg^{w}ag/ ‘to chase’ (057)

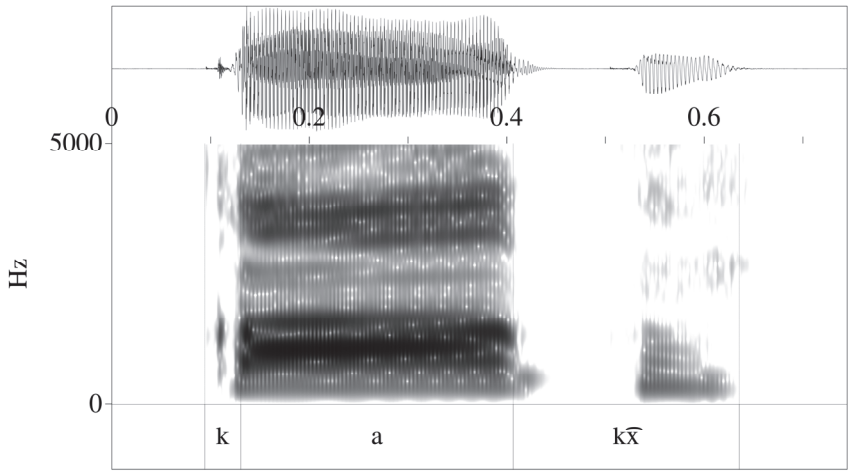

Figure 15. Word-initial voiceless plain velar stop in /kak/ ‘grandparent’ (058)

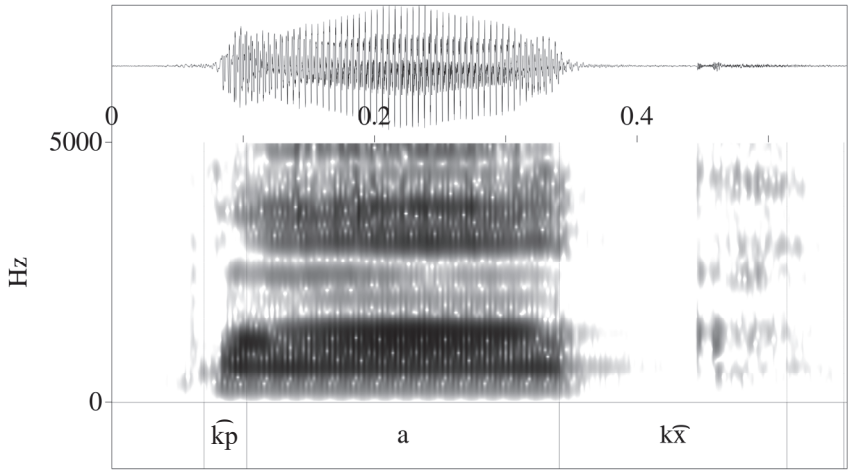

Figure 16. Word-initial /kʷ/ realized with a double closure in /kʷak/ ‘moon’ (059)

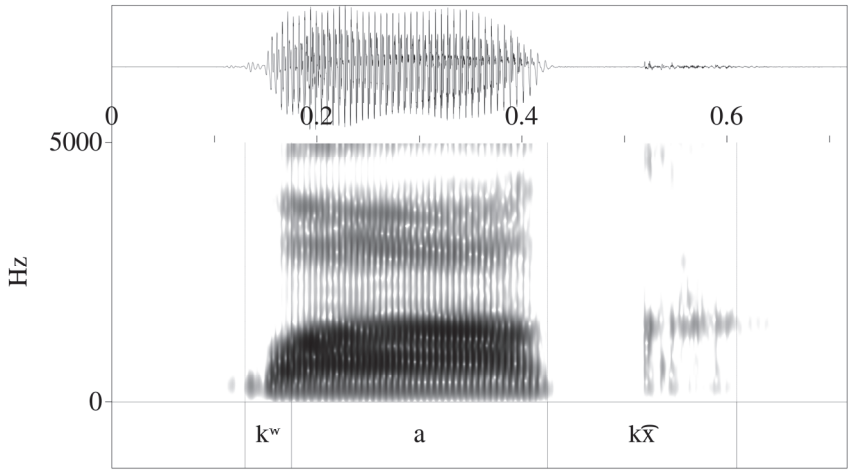

Figure 17. Word-initial /kʷ/ realized with a velar offglide in /kʷak/ ‘moon’ (060)

In Figures 15, 16, and 17, spectrograms are shown for the minimal pair /kak/ 'grandparent', with a plain velar voiceless plosive, and two realizations of /kʷak/ 'moon', one where there is a double closure, and one where there is a clear offglide after the velar closure. In both cases, the release is labial rather than velar. The examples in Figure 15 and Figure 16, are provided by Puli Ämädu, while the one in Figure 17 is provided by Titi Masa.

In (15), (near-)minimal pairs for the labio-velar plosives are given.

(15) /kʷam/ [k͡pɐm] 'hair' (061)
/kam/ [kam] 'fish sp.' (062)
/kʷak/ [k͡wak] 'moon' (009)
/kak/ [kak] 'grandparent' (007)
/gʷlin/ [g͡blin] 'mudcrab' (063)
/glen/ [glen] 'run' (064)

The voiced labio-velar plosive occurs in only a limited number of lexical items (82 in the latest dictionary of Dimsisi Idi [Schokkin et al. 2019]) and is not generally contrastive; /gʷlin/ ~ /glen/ is the only near-minimal pair that could be found. This phoneme is found predominantly in plant and animal names that are likely borrowings, and in some cases, particularly with bird names, onomatopoeic. Presumably, the co-articulated labial-velar realizations in Idi have been borrowed with these forms from Nen, where the relevant phoneme is clearly a coarticulated labial-velar rather than a velar plosive with a secondary bilabial articulation (Evans & Miller 2016). Velar plosives with bilabial coarticulation or secondary articulation are not a native feature of other Pahoturi River languages. Dimsisi Idi is the variety that is in most extensive contact with Nen, and there would be ample opportunity for borrowing.

Despite the fact that the co-articulated variant appears to be a realization introduced through language contact, there is some evidence that it is now being extended to original Idi words. Consider, e.g., the form /ɠwagn/, which is the first or third person singular intransitive auxiliary for the remote past. It consists of a root /g/, with the prefixes /ɠ/ for the remote past and /w/ in the slot for object agreement, indicating that the inflection is intransitive (it further bears an /a/ 'augment' prefix and a /n/ first or third person subject agreement suffix). Crucially, the elements /ɠ/ and /w/, while co-occurring in this form and other similarly inflected intransitive verbs, do occur separate from each other in other inflected verbs: /ɠ/ occurs with transitive verbs, which do not show /w/, and /w/ occurs with intransitive verbs of a different subclass, which do not take tense prefixes. They are thus obviously different segments. Still, in /ɠwagn/ and similar forms, the two are sometimes co-articulated as if they represented one segment,[8] and consequently we find [g͡bagə̆n] as a realization, as is evident from (16).

(16) /ɠwagn/ [g͡bagə̆n]1|3sg.INTR.AUX (065)

3.1.5 Affricates and fricatives

The Idi consonant inventory contains two alveolar sibilants: voiceless /s/ and voiced /z/. Voiced /z/ occurs in all positions, as shown in (17).

[8] In Nen and Nmbo (Evans et al. 2018: 757), at least some occurrences of the labial-velar unit phonemes derive historically from a sequence *k-w-* via *kʷ-*, most importantly the 1sg 'beta-series' object prefix *k͡p-*, which derives historically from *k-w-* where *k-* is a past tense prefix and *w-* a 1sg undergoer prefix. This gives a clear precedent for the diachronic pathway from two segments to one.

(17) /zəŋe/ [d͡ʒə̆ŋe] ‘sweet coconut’ (066)
/kəze/ [kə̆d͡ʒe] ‘crocodile’ (067)
/taz/ [taz] ‘poison root’ (068)

The phoneme /z/ has a broad range of realizations. It is variably realized as a fricative or an affricate, ranging between the alveolar and postalveolar places of articulation: [z], [d͡z], [ʒ] and [d͡ʒ]. The different variants are illustrated in (18) below with the frequent word /kədʒe/ ‘crocodile’. Example (a) and (b) are produced by the same speaker, Titi Masa, while (c) is produced by a different female speaker of comparable age, and (d) is produced by an elderly female speaker.

(18) /kəze/ ‘crocodile’
a. [kə̆d͡ʒe] (069)
b. [kə̆d͡ze] (070)
c. [kə̆ʒe] (071)
d. [kə̆ze] (072)

Comparable inter- and intra-speaker variation for /z/ is common throughout Southern New Guinea languages, cutting across families (see Evans & Miller [2016] for discussion of the Nen equivalent). It is our impression that there is some sociolinguistic conditioning, as there are several female speakers who seem to produce almost exclusively [z], especially in Dimsisi and Bimadbn. A more systematic study of cross-community language variation, controlling for factors such as age, gender and clan membership, would be informative.

While [d͡ʒ] seems to be the most common realization in Dimsisi, we regard /z/ as the voiced counterpart of the fricative /s/. The fact that some speakers seem to prefer the realization [z] could be taken as evidence pointing in the direction of ongoing language change integrating the two segments into a single oppositional category. The /s/ phoneme is relatively widely distributed and occurs in all positions as well (see (19)), without the variations in place of articulation and degree of affrication that is found with /z/.

(19) /sasa/ [s̪asa] ‘swim’ (073)
/kʷas/ [k͡was] ‘Chinese taro’ (074)

3.2 Sonorants

There are four nasals in Idi: bilabial /m/, alveolar /n/, palatal /ɲ/ and velar /ŋ/. All nasals can occur in both onset and coda position. Examples are given in (20)–(22). The alveolar nasal is often elided word-finally in inflected verbs. This variation is sociolinguistically conditioned, and is discussed in more detail in Schokkin (forthcoming).

(20) Onset word-initial
/maj/ [ma͡ɪ] ‘house’ (075)
/nag/ [nag] ‘friend’ (076)
/ɲuɲu/ [ɲɯ̹ɲu] ‘to growl’ (077)
/ŋi/ [ŋi] ‘coconut’ (078)

(21) Onset intervocalic
/kæmæ/ [kæmæ] ‘ignorance’ (079)
/wana/ [wana] ‘eagle’ (080)
/aɲo/ [aɲ̟o] ‘where’ (081)
/zəŋe/ [d͡ʒə̆ŋe] ‘sweet coconut’ (066)

(22) Coda

/kʷam/	[k͡pam]	‘hair’ (061)
/tan/	[tan]	‘broom’ (003)
/pæɲ/	[pɛ̯ɲ]	‘azure kingfisher’ (082)
/meaŋ/	[meaŋ]	‘younger brother of father’ (083)

Idi has a palatal approximant /j/ and a labio-velar approximant /w/, occurring in both onset and coda position. As we do not assume any diphthongs (justification is given in §4 on vowels), we treat phonetic sequences like [aj̯] as combinations of a vowel and a glide. Some examples are given in (23)–(25). Epenthetic glides are regularly inserted between vowels: see e.g., /joa/, realized as [joʷa], in (23).

(23) Onset word-initial

/joa/	[joʷa]	‘vulva’ (084)
/wap/	[wap]	‘stick’ (085)

(24) Onset intervocalic

/kajakaja/	[kajakaja]	‘plant sp.’ (086)
/awea/	[aweʲa]	‘cassowary’ (087)

(25) Coda

/naj/	[na͡ɪ]	‘sweet potato’ (088)
/aw/	[a͡ʊ]	‘yes’ (089)

The two lateral approximants of Idi, alveolar /l/ and palatal /ʎ/, can occur in both onset and coda position, as can the rhotic /r/, which is realized variably as a trill [r] or a tap [ɾ]. In (26)–(28), near-minimal pairs for the laterals and the rhotic in all positions are given.

(26) Onset word-initial

/lɪl/	[lĭlə̆]	‘pig’s burrow’ (090)
/ʎɪʎ/	[ʎĭʎə̆]	‘rub’ (091)
/rɪsi/	[rĭsi]	‘big’ (092)

(27) Onset intervocalic

/kalag/	[kalag]	‘saratoga (fish sp.)’ (093)
/kæʎi /	[kæʎi]	‘work’ (094)
/karab/	[kaɾab]	‘paddle’ (021)

(28) Coda

/təbəl/	[tə̆bə̆l]	‘arrow’ (095)
/təbəʎ/	[tə̆bə̆ʎ]	‘strangler fig’ (096)
/bærbær/	[bærbær]	‘shallow’ (097)

4 Vowel system

As in many other languages of the region, the main difficulty of analysing the vowel system of Idi consists in determining the status of vowels that can be described as “short”, “weak”, or “fleeting”; i.e. vowels whose (non-)occurrence and quality appear to be heavily context-dependent. We call such vowels *weak* vowels. Even though they exhibit these characteristics, coinciding with those of epenthetic vowels, from a phonological point of view they cannot be considered purely epenthetic. They will be dealt with in detail in §4.3. The analysis of the *full* vowels is more straightforward, and they will be discussed first.

4.1 Full vowels

There are six full vowels: /i/ /e/ /æ/ /a/ /o/ /u/. These vowels can occur in monosyllabic monomorphemic words with open syllables, as illustrated in (29).

(29)	/i/	/bi/	[bi]	'we' (098)
	/e/	/we/	[we]	'penis' (100)
	/æ/	/bæ/	[bæ]	'you' (101)
	/a/	/ba/	[ba]	'our' (102)
	/o/	/bo/	[bo]	'(s)he, they' (103)
	/u/	/lu/	[lu]	'tree' (104)

Figure 18 below shows the Idi vowel space schematically represented in a trapezoid.

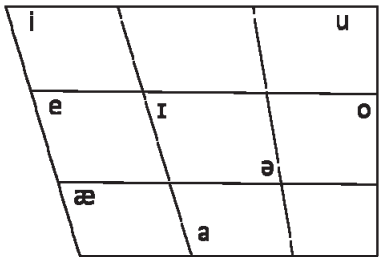

Figure 18. Idi vowel chart

Unlike the weak vowels, full vowels can occur in syllables with an empty onset. While this is relatively rare, all full vowels are found at the beginning of word forms, as shown in (30). Mid and high vowels are optionally realized with a slight on-glide [j] for the front vowels, as in the first word below, or a [w] for the back vowels.

(30)	/i/	/ibiek/	[ʲibiʲɛk]	'digging stick' (106)
	/e/	/era/	[era]	1|3sg present transitive auxiliary (107)
	/æ/	/æl/	[æl]	'river' (108)
	/a/	/aba/	[aba]	'swamp lake' (109)
	/o/	/obænæ/	[o̞bænæ]	'his, hers' (110)
	/u/	/umlæŋ/	[umlæŋ]	'knowledge' (111)

There do not seem to be any compelling reasons for assuming indivisible gliding vowels, i.e. diphthongs or triphthongs, in Idi. There are no obvious morphophonological alternations which can be used as diagnostics, e.g., suffixes showing different allomorphs depending on whether they attach to a base ending in either a vowel or a consonant. Vowel sequences like those illustrated in (31) can be analysed as combinations of a vowel and a glide, and the fact that the second element is always high favours its analysis as a glide. However, further study of Idi phonotactics will be needed to reach a definitive conclusion about the presence of diphthongs in Idi.

(31)	/aw/	/aw/	[a͡ʊ]	'yes' (112)
	/aj/	/maj/	[ma͡ɪ]	'house' (113)
	/æj/	/mæjk/	[me͡ɪk]	'yam house' (114)
	/æw/	/æwli/	[ɛ͡ʊli]	'how many' (115)

In Figure 19 all Idi vowels are plotted, based on the example recordings used for this article which amounted to 431 vowel tokens in total. Mean F1 and F2 measurements (represented by the IPA symbols), normalized with the Bark-difference method according

to Syrdal and Gopal (1986), are shown for the six full vowels and two weak vowels. The ellipses represent the area covered by standard deviation of the normal density contour estimated from the data. The plot indicates that there is clear phonetic evidence to distinguish six full vowels. Within one standard deviation, covering approximately 68% of the data (in a Gaussian distribution), they occur in largely non-overlapping areas of the vowel space. The plot also suggests that there is a fair bit of variable realization for some vowels, particularly /æ/ and /u/ and the two central vowels.

If we consider vowel realizations in individual words, it appears that the lexical items containing /æ/ form two major clusters, one positioned higher up and fairly close to /e/, the other in a typical place for /æ/. /æ/ is raised significantly, sometimes virtually to [ɛ], when there is a vowel /i/ present in the same word, or when it is flanked by a palatal nasal /ɲ/ or lateral /ʎ/. Examples of lexical items that on average have raised /æ/ include /pæɲ/ 'kingfisher' (116), /zuwæʎ/ 'milkwood tree' (117) and /dibæn/ 'snake' (118).

Similarly, for /u/ the presence of a palatal appears to make a difference, with, e.g., /ɲuɲu/ showing a much "fronter" /u/. The variable quality for /u/ cannot be explained satisfactorily by the phonetic environment alone, however, and it is possible that for some lexical items there may be a change-in-progress in which the full /u/ vowel gets increasingly more centralised and reduced in length. Evidence from sets of cognate Pahoturi River words suggests that reduction processes may have progressed to a greater degree in Idi than in some other languages in the family, and that there are many cases where a full vowel */u/ in the protolanguage corresponds to the weak vowel /ɪ/ in Idi (likewise, there are many cases where Proto-PR */o/ corresponds to the Idi weak vowel /ə/). For some present-day lexical items, this reduction may still be ongoing and we find inter-speaker variation. However, based on the presently available data, no significant effects were found for the social categories age and gender.

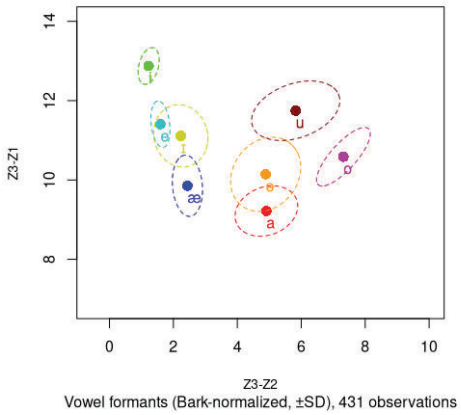

Figure 19. Idi vowel plot: Bark-normalized values for height (Z3–Z1) and advancement (Z3–Z2). (Generated with the package 'vowels' for R, Kendall & Thomas 2018.)

4.2 Weak vowels

As can be seen in Figure 19, two central vowels can be distinguished. At the phonemic level (even though they may not fully classify as such) we have labelled these /ɪ/ and /ə/. The two weak vowels rarely contrast, but we have found a couple of minimal pairs, given in (32).

(32) /dɪdɪr/ [də̆də̆r] 'dry' (119)
/dədər/ [də̆də̆r] 'rock' (120)
/tɪn/ [tĭn] 'smoke' (121)
/tən/ [tə̆n] 'clan' (122)

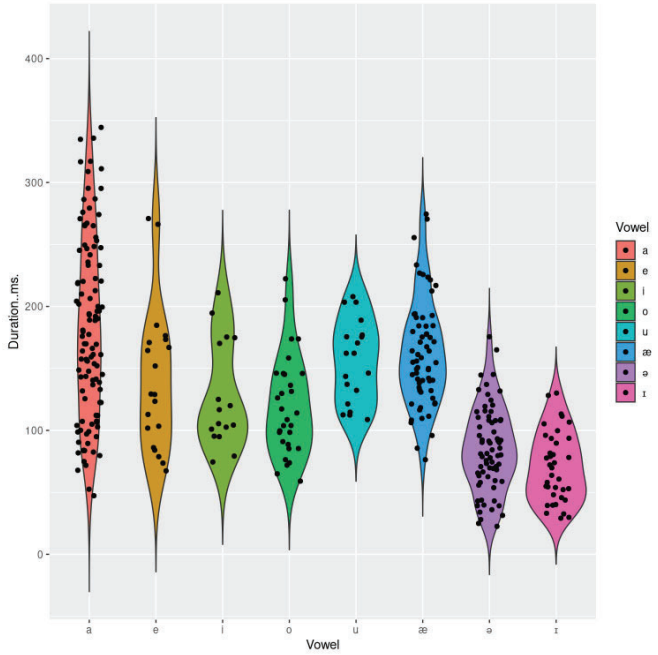

Figure 20. Length of non-final vowels in the sample used for this study. (Generated with the package 'ggplot2' for R, Wickham 2016.)

As is evident from Figure 19, weak vowels show much greater variation in quality than most full vowels (except /æ/ and /u/, discussed above). Realizations of /ɪ/ overlap with /e/ to an extent, as does /ə/ with /a/. The fleeting nature of the weak vowels and their short duration makes them more susceptible to influences from the immediate phonetic environment. /ɪ/ is realized as [ɜ̆] in some cases, and /ə/ shows considerable variation for both height and backness: realizations as [ɜ̆] and [ɐ̆] are attested, in addition to a more back and perhaps rounded variant, here represented as [ɞ̆]. Nevertheless, their mean F1 and F2 values are quite far apart. Phonological evidence, discussed below, suggests that considering them two separate phonemes is also justified on a more abstract level.

The weak vowels occur only between consonants or as (non-phonemic) "echo vowels". As mentioned above they are not attested in syllables without an onset, and they do not occur in open syllables word-finally. Weak vowels are significantly shorter than full vowels. Figure 20 shows the distribution of vowel length for all vowels in non-final position. A regression model shows that both short vowels differ significantly from all full vowels in terms of length. We fit two linear models with the function lm() of R, using 'vowel' as a predictor variable and 'length' as a response variable. In one model we used /ɪ/ as the reference level, in the other model /ə/. Significance levels for pairs of short and full vowels were estimated using a t-test. All pairs of short and full vowels differ significantly at $p < 0.001$, with the exception of the two pairs </ə/, /i/> and </ə/, /o/>, with $p < 0.01$. Pairwise comparisons (see Figure 21) also indicate that no long vowels differ significantly from any other. See the Appendix for the model statistics.

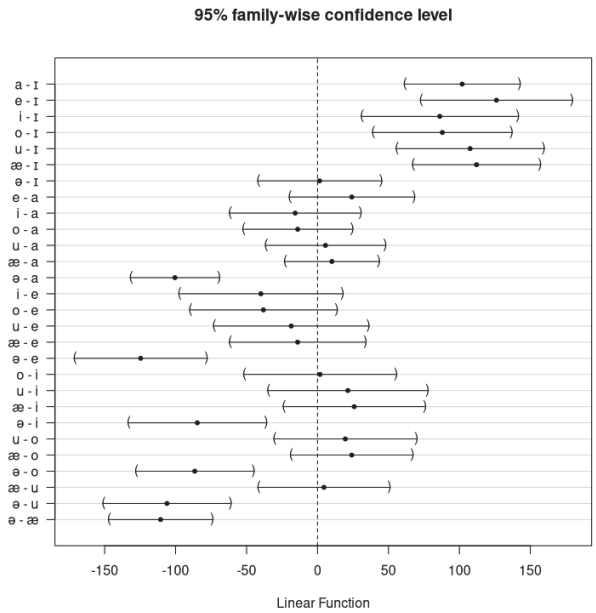

Figure 21. Pairwise comparison of vowel lengths according to linear model. (Generated with the package 'multcomp' for R, Hothorn et al. 2008.)

Some examples of weak vowels are given below: for /ə/ in (33) and for /ɪ/ in (34).

(33)	/ɖəg/	[d͡ʐə̆g]	‘back’ (123)
	/kəɖ/	[kə̆d]	‘small’ (124)
	/k^{w}əd/	[kwə̆d]	‘hard’ (125)
	/nən/	[nə̆n]	‘ant sp.’ (126)
	/lətən/	[lə̆tə̆n]	‘to arrive’ (127)
(34)	/bɪn/	[bɪ̆n]	‘head’ (140)
	/k^{w}ɪt/	[k͡pɪ̆t]	‘black’ (128)
	/mɪɖ/	[mɪ̆d͡ʐ]	‘bark’ (129)
	/tɪn/	[tɪ̆n]	‘smoke’ (121)
	/bɪbɪd/	[bɪ̆bɪ̆d]	‘to call’ (130)

As the examples in (33) and (34) show, /ə/ tends to occur in the context of retroflex plosives, but is not confined to these contexts (cf. /nən/, /kwəd/), and /ɪ/ seems to be more frequent in the neighbourhood of coronal consonants.

Weak vowels seem to function epenthetically in many cases, occurring for instance in inflected verbs, where an affix consisting of just a consonant is attached to a root starting or ending in another consonant, resulting in a cluster. Conversely, they are absent when they are not “needed” to break up illicit consonant clusters. A few instances of the central vowels where they seem to more obviously serve epenthetic functions are given below. (35) shows an inflected form of the verb /ŋaŋgas/ ‘to make’, consisting of the prefixes /be/ and /a/ (indicating transitive remote past with a 3sg object), the root /ŋgas/, and a first/third-person subject agreement suffix /n/. /sn/ is not a legitimate coda cluster in Idi. Instead, the final /s/ of the root syllabifies with the /n/ of the suffix, and a vowel is needed to form the syllable nucleus. When the same suffix attaches to a root ending in a

(full) vowel, we don't find a central vowel.[9] This is shown in (36) with the vowel-final root /mɪltæ/ 'to get, to hold'.

(35) /be-a-ŋgas-n/ [bæŋgasə̆n] '(s)he made it' (remote past) (131)
(36) /be-mɪltæ-n/ [bemĭltæn] '(s)he held it' (remote past) (no recording)

A similar case is shown with the verb in (37), which is an inflected form of the root /dru/, 'wash', and bears the prefix /n/, indicating recent past with transitive roots, and the suffix /n/ for a first or third-person singular subject. A central vowel (here, /ɪ/) is found between the initial /n/ and the following plosive, as /ndr/ is not a legitimate onset cluster.

(37) /n-dru-n/ [nə̆drun] 'I/(s)he washed it' (recent past) (132)

Minimal pairs contrasting the two weak vowels have already been given, but there are also minimal pairs contrasting weak vowels contrasting with full vowels, see (38).

(38) /kak/ [kak] 'grandparent' (133)
/kək/ [kə̆k] 'spit' (134)
/k^{w}ap/ [k͡pap] 'womb' (135)
/k^{w}ɪp/ [k͡pĭpə̆] 'well' (136)
/sir=æ/ [siɾæ] 'grass (CORE)'[10] (137)
/sɪɾæ/ [sə̆ɾæ] 'tail' (138)
/ben/ [ben] 'name' (139)
/bɪn/ [bĭn] 'head' (140)
/gap/ [gap] 'water cassava' (141)
/gəp/ [gə̆pə̆] 'small hole' (142)

The fact that there are minimal pairs both between the two weak vowels, and between weak and full vowels, is an indication that they have phonemic status in at least some of their occurrences, despite the restrictions on their distribution. Another piece of evidence that they are something more than epenthetic comes from the fact that they participate in a phonological process of vowel harmony, a topic we turn to in the next section. An overview of near-minimal pairs for all Idi vowels is shown in Table 2.

[9] Another possible analysis for these and similar cases, is that the suffix would have an allomorph [ə̆n] ~ [ĭn], occurring after a consonant, in addition to a plain consonantal allomorph, occurring after a vowel.
[10] Core case is discussed below in §4.2.

Table 2. Near-minimal pairs for Idi vowels

	t_n/ŋ	b_n/ŋ	b_#	d_]σ	d_r	p_]σ
/i/			/bi/ [bi] 'we' (098)	/didu/ [didu] 'run' (163)	/dirɪmdirɪm/ [diɾĭmdiɾə̆m] 'dragonfly' (171)	/lu pi/ [lu pi] 'small branch' (178)
/ɪ/	/tɪn/ [tĭn] 'smoke' (121)	/bɪn/ [bĭn] 'head' (140)		/dɪdu/ [dĭdɯ] 'pain' (164)	/dɪdɪr/ [dĭdə̆r] 'dry' (119)	
/e/		/ben/ [ben] 'name' (139)	/abe/ [abe] 'come' (imp.) (155)	/ade/ [ade] 'also' (162)	/zəbo der/ [dʒə̆bo der] 'rainbow lorikeet' (170)	/tope/ [tope] 'index finger' (177)
/ə/	/tən/ [tə̆n] 'clan' (122)	/bəndɛ/ [bə̆nde] 'plant sp.' (148)		/dədara/ [də̆daɾa] 'grass' (158)	/dədər/ [də̆də̆r] 'rock' (120)	/pəpək/ [pə̆pʌ̆k] 'throat' (174)
/æ/	/tænæn/ [tænæn] 'to perch' (145)	/bænæ/ [bænæ] 'mine' (151)	/bæ/ [bæ] 'you' (101)	/dædærb/ [dædærb] '(get) permission' (161)	/dær/ [dær] 'ashes' (168)	/topæ/ [topɛ] 'crest' (176)
/a/	/tan/ [tan] 'broom' (144)	/banzro/ [bandʒɾo] 'to stop' (150)	/ba/ [ba] 'our' (102)	/ada/ [ada] 'thus' (160)	/badar/ [badar] 'tree sp.' (167)	/pa/ [pa] 'bird' (175)
/o/	/tondræl/ [tondrɛl] 'humbug' (147)	/boŋgo/ [bɔŋgo] 2SG.EMP (153)	/bo/ [bo] '(s)he, they' (103)	/dodo/ [dodo] 'to mash' (166)	/awea doro/ [aweə̯a doro] 'cassowary type' (173)	/po/ [po] 'rubbish heap' (179)
/u/	/tuŋgi/ [tuŋgi] 'giant' (146)	/bunibuni/ [bunibuni] 'tree sp.' (152)	/tubu/ [tɯbu] 'knee' (157)	/du/ [du] 'wild' (165)	/lu dur/ [lu duɾ] 'hollow tree' (172)	/pu/ [pu] 'reeds' (180)

4.3 Vowel harmony

The full vowels can be divided into the two harmony sets {/a/, /e/, /o/} and {/æ/, /i/, /u/}. Generally speaking, only vowels from either of these harmony sets can co-occur within a given phonological domain. Gast (2015) analyses this system as an instance of cross-height harmony. While the exact nature of the domain within which vowel harmony holds is a non-trivial question, in general harmony seems to hold within phonological words: verb roots including inflectional prefixes and suffixes, and nouns including case suffixes or enclitics. We call members of the first set "dark" (with the feature [-light]) and members of the second set "light" (with the feature [+light]). Primarily, whether a given form entails a dark or light domain is based on whether the root has the feature [+light];

this is lexically determined. Some examples of dark and light words, both nouns and infinitive verbs, are given in (39) and (40), respectively.

(39) Dark words:

/agɛ/	[agɛ]	'banana' (181)
/awea/	[aweˌa]	'cassowary' (182)
/ankom/	[ankom]	'ant' (183)
/topɛ/	[topɛ]	'index finger' (177)
/sepotar/	[sepotar]	'regent whistler' (184)
/zoŋg/	[d͡ʒoŋg]	'to burn' (185)
/beaŋg/	[beaŋg]	'to chase' (186)

(40) Light words:

/piplu/	[piplu]	'lizard' (188)
/tikɪp/	[tikɞp]	'heart' (189)
/tætu/	[tætɯ]	'wash' (190)
/buʈæl/	[buʈæl]	'axe' (192)
/pɪduj/	[pɞdu͡ɪ]	'to blow' (193)
/ɲuɲu/	[ɲɯɲu]	'to growl' (194)

Vowel harmony leads to systematic morphophonological alternations. For example, there is a nominal enclitic, glossed 'CORE', attached to NPs in core syntactic function (i.e. S of an intransitive, A or O of a transitive clause). Depending on whether the stem it is attached to has the feature [+light], it will be realized as either /a/ [-light] or /æ/ [+light]. Thus the [-light] root /jəbəd/ 'sun' (195) will take the enclitic /a/ to form [jɞbɞda] 'sun-CORE' (196), while the [+light] root /lu/ 'tree' (104) will take the other variant, /æ/, resulting in [luæ] 'tree-CORE' (197). The same happens with other case suffixes and enclitics; most of these are harmonizing without exception in terms of the words they attach to. Exceptions are found within monomorphemic lexical words, however, as is the case in most vowel harmony systems. A few examples of disharmony within lexical words are given in (41) and (42).

(41) /topæ/	[topɛ]	'crest' (176)
(42) /lu do/	[lu do]	'fishing rod' (potentially a compound) (198)

A precise analysis of vowel harmony in Idi is a complex undertaking, which we cannot tackle here. Specifically, the domain within which harmony holds is sometimes hard to define. Some affixes that are transparent when it comes to vowel harmony, like the case suffixes on NPs mentioned above, will have variable realization based on the harmony feature of the root. Other affixes, such as the durative suffix /nd/ on verbs, appear to block the spread of harmony. Yet others, such as the ventive directional prefix /i/ on verbs, are themselves [+light], and this will overwrite any lexically determined feature of a root, leading to systematic vowel changes spreading through certain inflected verbs. An example is of this is discussed below.

Extending the analysis just sketched for full vowels, the weak vowels /ɪ/ and /ə/ can also be regarded as participating in the vowel harmony system: /ɪ/ harmonizes with the vowels in the light set, /ə/ with the ones from the dark set. This is reflected in the choice of affixes for nouns, and in more global patterns for verbs. Remember the core case clitic discussed above, that is either realized as /æ/ or as /a/. The same alternation can be found when this clitic attaches to nouns containing weak vowels only: compare [bɪ̆næ], the core case form of /bɪn/ 'head', and [kɞ̆pa], the corresponding form of /kəp/ 'fruit'.

Weak vowels harmonise, just as full vowels do, when harmony spreads throughout inflected verbs. Many verbal roots of Idi are primarily defined by consonantal "skeletons" that have weak vowels occurring between them. Consider for example the

verb /ŋələbən/ ‘take (nonplural O)’. This is found in forms like those in (43)–(45), produced by a male speaker from Sibidiri. Note that the present tense in Idi can only be formed analytically, so (43) consists of an infinitive form plus an inflected transitive auxiliary, whereas the past tense forms in (44) and (45) are inflected verbs with inflectional affixes directly attached to the root.

(43)	/ŋələbən era/	[ŋ̆lə̆βə̆nera]	‘I am/(s)he is taking it.’ (202)
(44)	/nəŋgələbənan/	[nə̆ŋgə̆lə̆bə̆nan]	‘I took it.’ (recent past) (203)
(45)	/jɪŋgɪlɪbɪnæn/	[jĭŋgə̆lə̆bĭnæn]	‘(S)he took it.’ (recent past) (204)

From the quality of the weak vowels observed in the infinitive in (43), we can conclude that this verb root has a feature [-light] (remember that this feature is lexically determined, for both nouns and verb roots). This particular verb belongs to a conjugation class for which the recent past tense form indexing a third person singular agent and patient is formed by prefixing a form [i], which carries a feature [+light]. As you can see, when comparing (44) to (45), this feature spreads rightward throughout the entire verb form, and both the weak vowels and the full vowel in this form now have the feature [+light]. The fact that weak vowels behave identically to full vowels with respect to this phonological assimilation process suggests that they cannot be considered purely epenthetic, inserted into the output of assimilation processes that happen on an underlying level.

Based on the phenomena described above, i.e. the fact that their occurrence is unpredictable in monosyllabic and some multisyllabic lexical roots, and that they participate in a vowel harmony system, it does not seem accurate to analyse the weak vowels in Idi as purely, or always, epenthetic. Note that there have been similar issues for other Papuan languages: see, e.g., Pawley and Blevins (2010) on the need to postulate more than one status for epenthetic vowels in Kalam. The observed phenomena for Idi suggest that the phones represented throughout with /ɪ/ and /ə/ are sometimes phonemic, and sometimes epenthetic.

5 Phonotactics

The Idi syllable consists of a nucleus, an onset, and a coda. Onsets and codas are optional and consist of consonants at the edges of the syllable, while the nucleus is obligatory and occupied by a vowel, either full or weak. In words with more than one nucleus, onsets are preferred over codas. Onsets and codas may consist of multiple segments as long as the cluster is phonotactically permitted. Licit onset clusters generally rise in sonority, while licit coda clusters fall in sonority. There are some generalisations that can be made with respect to combinations of natural classes of consonants that can co-occur in a cluster, but not many, and consonant clusters in general are a quite marginal phenomenon in the language. Examples of permissible clusters in both onset and coda position are given in Table 3.

Generalising over the data presented in Table 3, complex onsets can consist either of a bilabial or velar plosive (/p/, /b/, /k/, /g/) followed by a liquid (/r/, /l/, /ʎ/), or of an alveolar plosive /t/ or /d/ followed by /r/. Other, rarer complex onsets involve a bilabial nasal /m/ followed by a lateral approximant /l/ or /ʎ/, or the alveolar fricative /s/ followed by alveolar nasal /n/. An exception to the rising sonority generalisation is the complex onset /sp/. Retroflex obstruents and the voiced sibilant /z/ are not found in any clusters.

Complex codas are rarer, and even more limited in terms of the range of combinatorial possibilities. They can only consist of a liquid (/l/, /ʎ/, /r/) followed by a bilabial or velar plosive (/p/, /b/, /g/) or the glide /j/ followed by a velar plosive /k/ or /g/. While there are many intervocalic and coda sequences consisting of a homorganic nasal and obstruent, as discussed in §3.1.2, we do not consider these sequences to be

Table 3. Overview of permissible consonant clusters

	Complex			
	Onset 1 **._CV**	**Onset 2** **.O_V**	**Coda 1** **V_O.**	**Coda 2** **VC_.**
p	/næplæ/ [næplæ] ‘soft’ (205)	/speliŋg/ [speliŋg] ‘basket’ (206)	-	-
b	/brægu/ [brægu] ‘payment’ (207)	-	-	/dædærb/ [dædærb] ‘(get) permission’ (209)
t	/ætræ/ [ætræ] ‘yam’ (211)	-	-	-
d	/tondræl/ [tondræl] ‘humbug’ (212)	-	-	
k	-	-	-	/mejk/ [me͡ɪk] ‘yam house’ (213)
kʷ	-	-	-	-
g	/glabaj/ [glaba͡ɪ] ‘later’ (214)	-	-	
gʷ	/gʷlin/ [g͡blin] ‘mudcrab’ (063)	-	-	-
ʈ	-	-	-	-
ɖ	-	-	-	-
m	/mʌæmʌæ/ [mʌæmʌe] ‘to dress sores’ (216)	-	-	-
n	-	/snæɖəkæl/ [snæɖə̆kæl] ‘ring finger’ (215)	-	-
ɲ	-	-	-	-
ŋ	-	-	-	-
s	/speliŋg/ [speliŋg] ‘basket’ (206)	-	-	-
z	-	-	-	-
r	-	/ætræ/ [ætɾæ] ‘yam’ (211)	/dædærb/ [dædærb] ‘(get) permission’ (209)	-
l	-	/gæmblæ/ [gæmblæ] ‘weeds’ (210)	-	-
ʌ	-	/mʌæmʌæ/ [mʌæmʌe] ‘to dress sores’ (216)	/bmætæʌg/ [bə̆mæ͡ʂæʌg] ‘I will roast it’ (217)	-
j	-	-	/mejk/ [me͡ɪk] ‘yam house’ (213)	-
w	-	-	-	-

clusters of multiple segments, but rather analyse the nasal as a feature related to the obstruent segment in question, that only surfaces when following a vowel.

If a consonant sequence violates the legal onset or coda specifications, this will be resolved by inserting a weak vowel. In these cases, the weak vowels serve a more clearly epenthetic function, but still adhere to the vowel harmony domains as discussed above. There is quite a bit of variability in the realization of consonant clusters, and weak vowels

are found in legal clusters as well: for instance, /speliŋg/ ‘basket’ can be realized both as [speliŋg] and [sĭpeliŋg].

6 Lack of stress and tone

Like other languages spoken in Southern New Guinea, Idi does not have tonal contrasts. Stress seems to be a marginal phenomenon in the language, if at all present, and there are no minimal pairs distinguished by just word-level stress.

7 Illustrative transcription

The Idi version of the North Wind & Sun tale was recorded in 2016 and told by Bill Diwara, a middle-aged speaker originally from Sibidiri (218). The text was composed by Bill listening to the Nen version previously recorded by Jimmy Nébni (which appears in Evans & Miller 2016), then back-translating into English and writing this down, then giving a running translation into Idi. It was then transcribed and translated with the assistance of Jimmy Nébni of Bimadbn village, whose mother was an Idi speaker. Some minor adjustments to the original text were made in the interests of local comprehensibility, such as the substitution of ‘cold wind’ for ‘north wind’. Below, an Idi orthographic representation, with glossing and free translation, of the text is given, followed by a phonetic transcription. All phonemes except /ɖ/ and /ɲ/ are covered, which means 27 out of 29 phonemes or 93%.

7.1 Orthographic representation, gloss and free translation

1. *kalkal-ang* *buey=ä* *a* *ybd=a*
   cold-ATTR wind=CORE and sun=CORE
   The cold wind and the sun…

2. *kalkal-ang* *buwey=ä* *a* *ybd=a* *yka*
   cold-ATTR wind=CORE and sun=CORE talk

   g-w-a-plye-nd-o
   REM-INTR-AUG-tie-DUR-3NSGS
   The cold wind and the sun were arguing…

3. *ni* *yaka* *mnggal-ag* *b-r-en*
   SUB who strength-ATTR FUT-go.NPL-3SGS
   who would be the stronger (one).

{repetition of lines 1 and 2}

4. *nma* *yaka=nd* *mnggal-ag=a,* *obänä*
   maybe who=SG.PRS.COP strength-ATTR=CORE 3SG.POSS

   kauthe=a *gl* *b-kn-n*
   clothes=CORE will FUT-take.off-3SGA
   Whoever may be the stronger (one), he would [make the traveller] take off his coat.

5. *bo* *komblabe* *yka* *be-maly-o*
   3.NOM two talk 3SGO.REM-touch-3NSGA
   The two of them made an agreement…

6. *ämänä* *kauthe=a* *ni* *b-kn-n,* *bo* *gä*
whose clothes=CORE SUB FUT-take.off-3SGS 3.NOM EMP

mnggal-ag *mg* *da*
strength-ATTR INTS SG.PRS.COP
who will [make him] take his coat off, he is the strongest one.

7. *kalkal-ang* *buwey=ä* *mnggal-ändä* *mg*
cold-ATTR wind=CORE strong-INS INTS

bi-pdu-nd-n *oblä-pätä*
3SGO.REM.VEN-blow-DUR-3SGA 3sg.BEN-DAT
The cold wind blew strongly towards him.

8. *bo* *kauthe=a* *obänä* *qd~qd*
3.NOM clothes=CORE 3SG.POSS REDUP~hard

g-w-mla-n
REM-INTR-tie-3SGS
He tied his cloak very tightly.

kalkal-ang *buey=ä* *mnggal-ändä* *mg*
cold-ATTR wind=CORE strength-INS INTS

bi-pdu-n
3SGO.REM-blow-3SGA
The cold wind blew strongly towards him…

9. *gta* *mnggalmnd* *g-w-a-g-n*
but strength-PRIV REM-INTR-AUG-NPL.PFV.AUX-3SGS
but became exhausted.

10. *ybd=a* *ththm-ang* *mg* *w-a-ndzog-en*
sun=CORE heat-ATTR INTS INTR-AUG-burn-3SGS
But the sun shone very hot…

11. *kmänd-äg* *la* *bänä* *kauthe=a*
walk.around-ATTR man 3SG.POSS clothes=CORE

y-kn-en
3SGO-take.off-3SGS.REM
and the traveller took off his coat.

12. *kalkal-ang* *buey=ä* *obom* *ada*
cold-ATTR wind=CORE 3SG.ACC thus

be-gä-n
3SGO.REM-3SG.PFV.AUX-3SGS
The cold wind told him [the traveller],

13. *“bä* *gl* *kadramang* *yka* *w-a-g-o*
2.NOM will sorry talk INTR-AUG-NPL-PFV.AUX-2SGS.FUT
“You will say sorry [to the sun].

14. *ybd=a* *gä* *mnggal* *mg,* *mnggalag* *mg*
sun=CORE EMP strength INTS strength-ATTR INTS

da”
SG.PRS.COP
The sun is the strongest.”

15. *eso* *résі*
thank.you big
Thank you very much.

7.2 Phonetic transcription

Below, a narrow phonetic transcription is shown. The square brackets divide intonation units.

[kalkalaŋ buʷeʲæ a jəbə̆da] [kalkalaŋ buʷeʲæ a jəbə̆da jɛka gwapʌ̆ndo] [neˌ jaka mə̆ŋgalag bɾɛn] [kalkalaŋ buʷeʲæ a jəbə̆da] [kalkalaŋ buʷeʲæ a jəbə̆da jɛka gwapʌ̆ndo] [nə̆ma jakand mə̆ŋgalaga] [obænæ ka͡ʊ͡tʂea gəl bə̆kə̆nə̆n] [bo komblabe jɜka bemaʌo] [æmænæ ka͡ʊ͡tʂea neˌ bə̆kə̆nə̆n] [bo gæ mə̆ŋgalə̆g mə̆g da] [kalkalaŋ buʷeʲæ mə̆ŋgalændæ mə̆g bipɔ̆dunden oblæbætæ] [bo ka͡ʊ͡tʂea obænæ] [kwə̆də̆kwə̆də̆ g͡bə̆mə̆lan] [kalkalaŋ buʷeʲæ mə̆ŋgalændæ mə̆g bipɔ̆dun] [gə̆ta mə̆ŋgalmə̆nd gwagə̆n] [jəbə̆da] [tʂ͡ʐə̆͡tʂ̬ə̆mŋaŋ mə̆g wand͡ʒogen] [kə̆mændæg la bænæ ka͡ʊ͡tʂea jə̆kə̆nə̆n] [kalkalaŋ buʷeʲæ obom ada begæn] [bæ gəl kadɾamaŋ jɛka wago] [jəbə̆da gæ mə̆ŋgal mə̆g] [mə̆ŋgalag mə̆g da] [eso rĭsi]

Appendix

Model with /ɪ/ as reference level

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	70.609	8.531	8.277	2.62e-15	***
Vowela	110.747	9.885	11.203	<2e-16	***
Vowele	70.171	14.402	4.872	1.67e-06	***
Voweli	57.197	15.527	3.684	0.000266	***
Vowelo	48.754	12.749	3.824	0.000155	***
Vowelu	84.942	14.646	5.799	1.48e-08	***
Vowelæ	91.756	10.780	8.511	4.95e-16	***
Vowelə	13.997	10.548	1.327	0.185358	

Model with /ə/ as reference level

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	84.606	6.203	13.641	<2e-16	***
Vowelɪ	-13.997	10.548	-1.327	0.18536	
Vowela	96.750	7.963	12.150	<2e-16	***
Vowele	56.174	13.157	4.269	2.52e-05	***
Voweli	43.200	14.380	3.004	0.00285	**
Vowelo	34.757	11.324	3.069	0.00231	**
Vowelu	70.945	13.424	5.285	2.20e-07	***
Vowelæ	77.759	9.050	8.592	2.77e-16	***

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