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Tone and downstep in Paicî (Oceanic, New Caledonia)

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In this paper, I propose an updated analysis of the tone system of Paicî, one of the rare tonal Oceanic languages. Building on Jean-Claude Rivierre's (1974) work, I show that the tonal system of Paicî is best described with three underlying primitives: a High tone, a Low tone, and a downstep /ꜜ/ analyzed as a register feature independent of tone. Paicî is particularly interesting for the empirical documentation as well as the typological and theoretical understanding of downstep, because it combines many rare properties: (i) only downstepped ꜜL is attested; (ii) downstep is incompatible with H tones within the prosodic word (*ꜜH, *H...ꜜL); (iii) it is realized utterance-initially; (iv) it has accentual properties, and very likely derives from a former accentual system. The paper also provides an acoustic description of tone and downstep in Paicî, an important step toward filling a serious gap in the documentation of downstepped ꜜL tones and their properties.

Keywords: Oceanic; New Caledonia; tone; downstep; prosodic structure

1 Introduction

The notion of DOWNSTEP, a "phenomenon by which a contrastive drop [in pitch] resets the register of the following tones" (Hyman 2017, 235), has drawn much attention since its emergence in the mid-20th century. The main effect of downstepping is to set a new, lower "ceiling" for following high (H) tones, creating "a terracing effect" (Connell 2011; see also Winston 1960), e.g. /HHH/ = [˥ ˥ ˥], but /HꜜHHHꜜHHH/ = [˥ ˦˦˦ ˧˧˧]. Downstep can be "automatic", when a L tone systematically downsteps a following H (/HLH/ = [HLꜜH] = [˥ ˩ ˧]), or "non-automatic", when there is no overt trigger of downstep, as in the /HꜜHHHꜜHHH/ example above (Stewart 1965; cf. Hyman 1979; Stewart 1983, 1993; Rialland 1997; Connell 2011; Leben 2018; and references therein). I will henceforth use 'downstep' to refer to the contrastive type.

It was initially thought that downstep was only possible between two high tones (HꜜH), until cases of downstepped mid (ꜜM) – e.g. Yoruba (Bamgbose 1966), Gwari (Hyman & Magaji 1970, 16) – and low (ꜜL) tones – e.g. Bamileke Dschang (Tadadjeu 1974; Hyman 1985b) – were described. It was also believed at first that downstep was systematically caused by a floating tone – ꜜH caused by floating L, or ꜜL caused by floating H as in Bamileke Dschang (Hyman 1985b; Snider 1999, 2020). This was also later shown to be

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incorrect, with languages such as Shambala (Odden 1982) or Supyire (Carlson 1983), where the downstep in (some) H$^{\downarrow}$H sequences results from dissimilation effects unrelated to the presence of a floating tone.

It is still the case, however, that tonal languages with downstepped non-high tones and/or downstep not caused by a floating tone are the exception rather than the rule. Only fourteen languages have been reported to have a $^{\downarrow}$L tone, to my knowledge.[1] Leben (2018) notes that "the search for criteria [for the definition of downstep] that take downstepped Mid and Low tones into account is hindered by the relative lack of information on their phonology and especially their phonetics."

This paper seeks to address this lacuna, by offering a description and analysis of tone in Paicî, an Oceanic language of New Caledonia, first described by Rivierre (1974). The present paper, which owes much to Rivierre's work and intuitions, mostly confirms his description, and proposes a reanalysis of both the tonal inventory and the tonal behavior of a varied set of enclitics. I show that the tonal system of Paicî is best described with three underlying primitives: two tones (H and L), and a downstep, best viewed as an independent register feature. Paicî is particularly interesting for the empirical documentation as well as the typological and theoretical understanding of downstep, because it combines many rare properties, among which the following: (i) it has a very limited distribution: it affects only L tones, and is attested only after a L tone or utterance-initially (i.e. only L$^{\downarrow}$L and #$^{\downarrow}$L are attested); (ii) it is arguably its own phonological object, a register feature separate from tone and only indirectly interacting with it; (iii) it is realized utterance-initially; (iv) it is "total" in Meeussen's (1970:270) terms, i.e. it lowers the register in such a way that the new "ceiling" corresponds to the former "floor"; and (v) it is culminative and demarcative within the prosodic word and is partly conditioned by metrical structure, which gives it a marked accentual flavor.

After giving background information about Paicî and the empirical basis of this paper in Section 2, I establish the toneme inventory of Paicî in Section 3. I then describe two downstep patterns: predictable, metrically conditionned downstep in Section 4, and unpredictable downstep present in a number of prosodic enclitics in Section 5. Further typologically rare characteristics of the Paicî downstep are described in Section 6. A register analysis of downstep is then developed in Section 7. Alternative analyses are considered in Section 8 and shown to be less satisfactory. Finally, Section 9 places the Paicî tone system in typological and historical perspective, and 10 concludes.

2 Paicî

2.1 Segmental inventory and phonotactics

Paicî [pàìcì̯] is one of the 28 Kanak languages of New Caledonia, all Oceanic, and one of the five tonal languages within this group. This makes it one of the rare Austronesian languages with contrastive tone, and one of the even rarer Austronesian languages whose tone system arose through endogenous tonogenesis (Haudricourt 1968; Rivierre 1972, 1993, 2001). Despite being the third Kanak language by number of speakers (6,866 in 2014; INSEE-ISEE 2014), and the most spoken on the main island of Grande Terre, it is still under-documented. The only three substantial descriptive works that have been published so far are Jean-Claude Rivierre's (1974) description and analysis of the tone system, his (1983) Paicî-French dictionary, and Gordon and Maddieson's (2004) phonetic description of the vowels.[2]

[1] Bamileke Dschang (Tadadjeu 1974; Hyman 1985b; Bird & Stegen 1993, 1995), Bamileke Ghomala (Nissim 1981), Kikuyu (Clements & Ford 1977, 1979, 1981), Nawdm (Nicole 1980), Podoko (Anderson & Swackhamer 1981), Nandi (Creider 1982; Hyman 1984), Ghotuo (Elugbe 1986), Päri (Andersen 1988), Edopi (Kim 1996), Saxwe (Beavon-Ham 2012), Igala (Adeniyi 2016), Yala (Adeniyi 2016), Sinyar (Boyeldieu 2019), and Kugama (Litvinova In preparation). Additionally, eight languages are known to have downstepped M tones: Peñoles Mixtec (Daly & M. 2007), Bagiro (Boyeldieu 2000), Ghotuo (Elugbe 1986), Gokana (Hyman 1985a), Klao (Lightfoot 1974), Yoruba (Pulleyblank 1986), and Ngamambo (Hyman 1986) (Larry Hyman, p.c., 15 February 2021).

[2] Aspects of Rivierre's (1974) analysis are also summarized in two subsequent articles (Rivierre 1978, 427-431, 1993, 161). He and anthropologist Alban Bensa have also created a very rich archive of recorded and transcribed texts of various genres, many of which have been published (Bensa & Rivierre 1976, 1983, 1994; Bensa, Muckle & Goromoedo 2015). Previous preliminary work on the phonology of Paicî includes Leenhardt (1946, 76-77), Grace (1955), and Haudricourt (1963, 1971).

Paicî has ten oral and seven nasal vowels, listed in (1) (Rivierre 1983, 21, confirmed by my data). In the southeastern part of the Paicî-speaking area, /ʌ̰/ and /a̰/ tend to be neutralized (Rivierre 1983, 18; Gordon & Maddieson 2004).[3]

(1) Vowels (Ṽ = nasalized vowel)

i	ɨ	u		ḭ	ɨ̰	ṵ
e	ə	o		ḛ	ʌ̰	o̰
ɛ	ʌ	ɔ				
	a				a̰	

The consonant system of Paicî is summarized in (2) (Rivierre 1983: 21). As with most languages of central and southern Grande Terre, the binary contrast among stops is between a voiceless and a prenasalized series.[4]

(2) Consonants

p	pw	t	c	k
b [ᵐb]	bw [ᵐbw]	d [ⁿd]	j [ᶮɟ]	g [ᵑg]
m	mw	n	ny [ɲ]	ng [ŋ]
	w	r, l		

Coda consonants are not allowed in Paicî, where the only permitted syllable types are V and CV. Whether vowel length is contrastive, as claimed by Rivierre (1974), is unclear, as there are no arguments so far in favor of viewing two subsequent identical vowels as a long vowel rather than a sequence of two short vowels. Overall, it seems like the syllable plays only a minimal role in the phonology of Paicî – and no role in the tone system, which, as we will see, refers to every prosodic category from the mora up to the prosodic word except the syllable.

2.2 The data

The data presented in this paper partly come from Rivierre's (1974) seminal article and dictionary (Rivierre 1983). I was able to both confirm Rivierre's description and collect additional data during two field trips to New Caledonia in December 2017 and October-November 2019, with the help of two native Paicî speakers: Hélène Nimbaye (HN), in her fifties, from Câba (Tchamba), and Anna Gonari (AG), in her thirties, from Göièta (Goyeta). Both are bilingual in French. The elicitation sessions were recorded to a Marantz PMD 661 MKII (for HN) or Zoom H4n (for AG) digital recorder at a sampling rate of 44.1 kHz and 16 bit sample size, with a Røde NTG2 shotgun microphone. The recordings and their transcriptions are all archived in the "Linguistic Materials on Languages of New Caledonia" collection of the California Language Archive (Lionnet & Nimbaye 2020; Lionnet & Gonari 2020a,b). Speaker participation and informed consent were

[3] All transcriptions use IPA symbols, except for vowel nasalization, indicated with a subscript tilde [a̰] in order to leave room for tone marks above the vowel. Rivierre (1974) transcribes the interior vowels of Paicî as back unrounded ⟨ɯ ɤ ʌ⟩. I have taken the liberty to change the transcription of the first two to ⟨ɨ ə⟩, in accordance with their phonetic status as central vowels (cf. Gordon & Maddieson 2004). I keep the back unrounded symbol ⟨ʌ⟩ for the mid-low vowel in order to avoid any confusion between front ⟨ɛ⟩ and central ⟨ɜ⟩.

[4] The consonant inventory can in fact be analyzed as consisting of 13 rather than 18 underlying consonants. Ozanne-Rivierre & Rivierre (1989) note that the oral vs. nasal vowel contrast is neutralized after prenasalized and nasal stops, with only nasal vowels attested after nasal consonants (NṼ, *NV) and only oral vowels after prenasalized stops (ᴺDV, *ᴺDṼ). A simpler and more economic interpretation of these facts is that nasal consonants are allophones of prenasalized stops before nasal vowels: /ᴺDV/ = [ᴺDV], /ᴺDṼ/ = [NṼ]. This analysis is similar to the one proposed by Steriade (1993) for the Gbeya variety described by Samarin (1966). The choice of the prenasalized stop as the underlying representation rests on the assumption, argued for by Steriade, that the feature [nasal] is privative. In this paper, I will keep prenasalized and nasal stops distinct and adopt the New Caledonian tradition of not indicating prenasalization in phonological transcription (i.e. /b/ = [ᵐb]). Vowel nasalization will always be indicated, including after nasal consonants. Coronals are apico-alveolar, slightly more retracted than English alveolars: /t d n r l/ = [t̠ ⁿd̠ n̠ ɾ̠ l̠]. /r/ is nasalized to [ɾ̠̃] when wedged between two nasal vowels; this nasalization will not be reported in phonetic transcriptions.

obtained in accordance with Princeton University Linguistic Fieldwork IRB protocol #10346.

The acoustic data presented in this paper are both from my elicitation work and from one text recorded by Rivierre: *Le Maître de Göbwinyara* (Rivierre 1967), as read by Novis Dui Pöömô (NDP), a male speaker from Pwaamâ (Paama). The recording and manuscript transcription of this text can be found in the online Pangloss collection.[5] Pitch and spectrograms were extracted from Rivierre's and my recordings with Praat (Boersma & Weenink 2021), using default settings.[6] Speakers are indicated with their initials in square brackets in figure captions.

Elicitation sessions were entirely transcribed and translated in ELAN. Examples are referenced with the ELAN filename followed by the corresponding annotation number within the file (e.g. 171228-02-HN1:67). Examples taken from Rivierre's text *Le Maître de Göbwinyara* are referenced with the letter G followed by the corresponding time code in Rivierre's recording: G:mm'ss".

3 Tonal inventory: High vs. low

Table 1 summarizes the distribution of word-level tone patterns in Rivierre's (1983) dictionary.[7] Looking at lexical items only (as opposed to functional items, which I will turn to in Section 5), one can establish a contrast between two underlying tones: H vs. L.[8] Lexical items are in their vast majority isotonic (93%), i.e. either all H (33%) or all L (60%). The vast majority of lexical items can thus be analyzed as bearing only one underlying tone, realized on all morae.[9] Isotonic lexical items are illustrated in (3) with a list of tonal minimal pairs taken from Rivierre's (1983) dictionary.

(3)	1μ	/í/	'to cry'	/ì/	'louse'
		/mṵ́/	'smoke'	/mṵ̀/	'flower'
	2μ	/kóó/	'humidity, cold'	/kòò/	'tree *sp.*'
		/pʌ̰́dí/	'to hit, to thrash'	/pʌ̰̀dì/	'to divide'
	3μ	/pwááí/	'to fill, to load'	/pwààì/	'tree *sp.*'
		/údʌ́rɨ́/	'to catch on fire'	/ùdʌ̀rɨ̀/	'to disjoin'
	4μ	/tɔ́ɔ́wá̰rḭ́/	'to accompany (music) in rhythm'	/tɔ̀ɔ̀wà̰rḭ̀/	'to reimburse'

The remaining 7% consist of (i) non-isotonic words (5%), mostly fossilized compounds, grammatical words, exclamations, and loanwords, illustrated in (4), and (ii) 48 second-position toneless bound verb roots (2%), always used with a verbal classificatory prefix from which they get their tone, as shown in (5) (from Ozanne-Rivierre & Rivierre 2004, 363). Tonelessness is represented with a superscript circle, e.g. /å/.

[5] Pangloss online archive, Paicî collection: https://lacito.vjf.cnrs.fr/pangloss/corpus/list_rsc.php?lg=Paicî, consulted on 04 Apr 2020. The data in the Pangloss archive are subject to the Creative Commons CC BY-NC-ND 2.5 license, which can be found at https://creativecommons.org/licenses/by-nc-nd/2.5/.

[6] Different settings were tested to accommodate for speaker differences, but none were found to offer any clear advantage over default settings.

[7] Only monomorphemic entries are taken into account. The 123 monomorphemic entries whose tone is either not noted by Rivierre or unclear are excluded.

[8] Paicî morphosyntax is mostly unstudied (apart from a brief sketch in Bensa & Rivierre 1976, and the few points in Rivierre 1974 touching on morphosyntactic aspects of tone). It is unclear what word categories exist in the language, and parts of speech are not indicated in Rivierre's (1983) dictionary. I have tentatively defined a preliminary split, mostly based on Rivierre's translations and examples, between lexical and functional items. Lexical items (ca. 85% of monomorphemic items in the lexicon) are words which translate as and seem to behave like nouns, verbs, and adjectives – although it is unclear what the status of those adjectives is, and many roots seem to ignore the noun-verb distinction (see Moyse-Faurie 2004, 15–61 and references therein for a detailed discussion of the problem of defining word categories in Kanak and other Oceanic languages). I tentatively group every other word in the loosely defined category of "functional items" (ca. 15% of monomorphemic items), which I will come back to in Section 5.

[9] As Rivierre (2001, 32) notes, "[t]he north-central languages, Cèmuhî and Paicî, were manifestly, until recently, languages with word tone", i.e. had only one tone per word before the development and/or borrowing of non-isotonic words.

Table 1: Distribution of tone patterns on lexical (i.e. non-functional) items in Rivierre's (1983) dictionary

Tone pattern	Number	% isotonic	% total
L	1379	64%	60%
H	771	36%	33%
Isotonic (L+H)	2150	100%	93%
Non-isotonic	112		5%
Toneless	48		2%
Total	2310		100%

(4) a. /ḛ́rḛ́wèʌ̰̀/ 'fish' (/ḛ́rḛ́/ 'contents' + /wèʌ̰̀/ (?))
/bwààwʌ́rɛ́/ 'bird *sp.*' (cf. /bwààmʌ̰̀tà/ 'bird *sp.*')
b. /cɛ́càà/ NEGATION
/àí/ 'or'
c. /ákàè/ 'yes, ok'
/àípàà/ 'bravo!'
d. /lààcí/ 'rice' (< English)
/mwà̰gàcʌ̰́/ 'store, shop' (< French *magasin*)

(5) /cí-dʌ̊rɨ̊/ [cí-^{n}dʌ́rɨ́] 'to split (/-dʌ̊rɨ̊/) with the tip of an object (/cí-/)'
/cɔ̀-dʌ̊rɨ̊/ [cɔ̀-^{n}dʌ̀rɨ̀] 'to split (/-dʌ̊rɨ̊/) by stepping on (/cɔ̀-/)'

Declination, defined as "a gradual modification (over the course of a phrase or utterance) of the phonetic backdrop against which the phonologically specified F0 targets are scaled" (Connell & Ladd 1990, 2; see also Connell 2011, 14-15), tends to affect the realization of sequences of like tones in unmarked declarative sentences, or in words pronounced in isolation. (see, for example, Figures 3, 7, and 12).

As clearly shown by Rivierre (1974), the tone-bearing unit is the mora.[10] The main argument comes from the phonological downstep pattern described in Section 4 below. Only vowels are moraic in Paicî, where coda consonants are not allowed.

H tones are stable, i.e. they are not directly affected by any tonal processes, and in general never change. L tones, on the other hand, are targeted by two tonal processes, which will be the object of the following sections: downstep – both phonologically derived (Section 4) and underlying (Section 5) – and floating H realization and spread (cf. (12)).

4 Phonological downstep

4.1 The data

Phonological downstep, described in Rivierre (1974), is illustrated in (6) with words taken from Rivierre (1983). As can be seen, while L-toned words of one to three morae are realized with a level L tone throughout (6)a-c, words of four morae and above undergo a register drop after the second mora (6)d-e.

(6) a. *µ̀*: /ì/ [ì] 'louse'
/mṵ̀/ [mṵ̀] 'flower'
b. *µ̀µ̀*: /kòò/ [kòò] 'tree sp.'
/pʌ̰̀dì/ [pʌ̰̀^{n}dì] 'to divide'

[10] "Paicî is the only New Caledonian tonal language that 'counts morae', and it does so with extreme precision" (Rivierre 1978, 431, my translation).

c.	µ̀µ̀µ̀:	/pwààì/	[pwààì]	‘tree sp.’
		/ùdʌrɨ̀/	[ùⁿdʌrɨ̀]	‘to disjoin’
d.	µ̀µ̀ꜜµ̀µ̀:	/àùkɔ̀ɔ̀/	[àùꜜkɔ̀ɔ̀]	‘kagu (bird sp.)’
		/pʌ̀ɟàɟìì/	[pʌ̀ᶮɟàꜜᶮɟìì]	‘molar teeth’
e.	µ̀µ̀ꜜµ̀µ̀µ̀:	/ɛ̀ààràbwà/	[ɛ̀àꜜàràᵐbwà]	‘crab sp.’
		/pwèrètɔ̀ɔ̀tɨ̀/	[pwèrèꜜtɔ̀ɔ̀tɨ̀]	‘wind’

This downstep systematically occurs after the second mora, irrespective of the skeletal structure (CV or V, between two different vowels, between two identical vowels, etc.). This shows that skeletal and syllable structures play no role here. The key constituent is the mora, which is both the TBU and the category counted by the phonological downstep process. Downstep in the tetramoraic word /àùkɔ̀ɔ̀/ [àùꜜkɔ̀ɔ̀] ‘*Rhynocetos jubatus*, kagu (bird *sp.*)’ is illustrated in Figure 1. The pitch contour is clearly different from trimoraic /ə̰̀bòrò/ [ə̰̀ᵐbòrò] ‘person’ in Figure 3, where downstep does not apply (only slight declination is visible). Downstep is sometimes realized as a slow fall on the downstepped mora, rather than an abrupt pitch drop before it, as shown by AG’s realization of [àùꜜkɔ̀ɔ̀] in Figure 2.

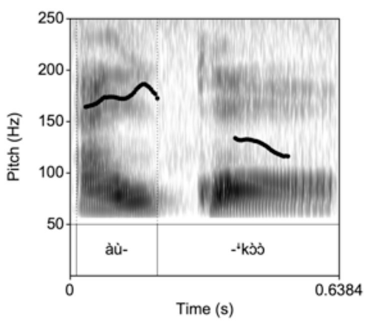


Figure 1: [àùꜜkɔ̀ɔ̀] ‘kagu (bird sp.)’ with abrupt downstep [HN] (171228-02-HN1:14)

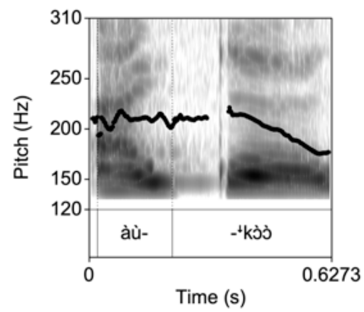


Figure 2: [àùꜜkɔ̀ɔ̀] ‘kagu (bird sp.)’ with delayed downstep [AG] (191121-07-AG1:69)

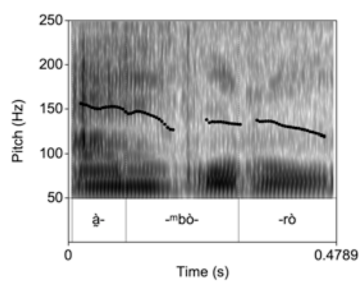


Figure 3: [ə̰̀ᵐbòrò] ‘person’, pronounced in isolation [HN] (171228-02-HN1:21)

Evidence for the downstep analysis comes from the fact that all following tones in the utterance, both H and L, are realized within a lower register. This can be seen in examples (7) and (8) and the corresponding pitch tracks in Figures 4 and 5.[11]

[11] Three forms of the verb ‘to arrive’ are attested in Rivierre’s and my corpus: /tèàpàà/ (HN, as in (7)), /tɛ̀ɛ̀pàà/ (speaker NDP, as in (15)); also the form in Rivierre’s dictionary), and /tèèpàà/ (AG). Whether this variation is idiolectal or dialectal is yet to be determined.

(7) /è tèàpàà =nå̰å̰ bʌ̀rʌ̀-wìʌ̀/
[è tèà↓pàà =nà̰à̰ ᵐbʌ̀rʌ̀-wìʌ̀]
(s)he arrive =DIR edge-wave
'(S)he arrived/was born on the seashore.' (171228-02-HN1:103)

(8) /è tèàpàà pʌ̰́ =nå̰å̰ bʌ̀rʌ̀-wìʌ̀/
[è tèà↓pàà pʌ̰́ =ná̰á̰ ᵐbʌ̀rʌ̀-wìʌ̀]
(s)he arrive =toward =DIR edge-wave
'(S)he arrived on the seashore.' (171228-02-HN1:106)

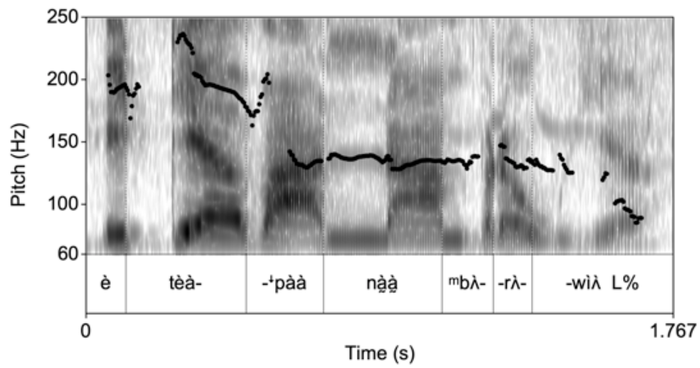


Figure 4: [è tèà↓pàà =nà̰à̰ ᵐbʌ̀rʌ̀-wìʌ̀] 'He arrived/was born on the seashore' [HN] (171228-02-HN1:103)

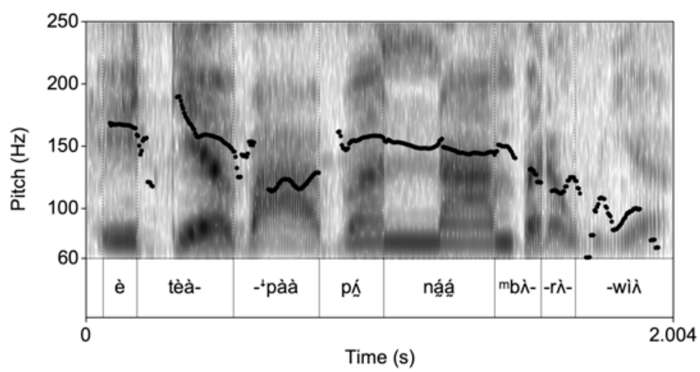


Figure 5: [è tèà↓pàà pʌ̰́=ná̰á̰ ᵐbʌ̀rʌ̀-wìʌ̀] 'He arrived on the seashore' [HN] (171228-02-HN1:106)

If L were to be analyzed as a M tone, and the lowered tone as a L tone resulting from a M → L change, one would expect (7) to be realized [ē tēāpàà =nà̰à̰ᵐbʌ̄rʌ̄-wīʌ̄], with [bʌ̄rʌ̄-wīʌ̄] having higher pitch than the preceding L tone.[12]

[12]Rivierre (1974) initially posited three contrastive tones in Paicî: H (my H), M (my L), and L (my ↓L). He correctly identified phonological downstep (which he transcribed as a L tone for convenience only) as non-contrastive and entirely predictable, but recognized contrastive status to his L tone on the basis of the handful of TAM markers listed in (21)f-h, which I argue are best analyzed as enclitics realized with a downstepped L tone (cf. Section 5.3). In subsequent publications, Rivierre (1978, 430, 1993, 161, 2001) explicitly describes Paicî as a two-tone language, and states, without giving more detail, that '[...] the few low tones [=my ↓L] attested on short morphemes can be explained as resulting from prosodic-morphological processes' (Rivierre 1978, 430, my translation). The present paper is a full development of Rivierre's later intuition. Note that Haudricourt (1971, 369–370) had already established in 1963 that "there are two registers" in Paicî.

Note that the preposition /=nå̰å̰/ 'to(ward), at' in (7) is a toneless enclitic: it gets its tonal specification from the preceding toned word (cf. Section 5). The word /bʌ̀rʌ̀-wìʌ̀/ 'seashore' in (7) is a noun-noun compound (/bʌ̀rʌ̀/ 'edge' + /wìʌ̀/ 'wave'), which explains why it does not undergo phonological downstep, despite it being four morae long. Indeed, apart from a few lexicalized cases (cf. Rivierre 1974, 327, fn.7), each member of a compound in Paicî is an independent prosodic word, which is the domain of application of phonological downstep, as we will see in Sections 4.2 and 5. /bʌ̀rʌ̀-wìʌ̀/ is thus made of two bimoraic prosodic words, none of which is long enough for phonological downstep to apply. Finally, /bʌ̀rʌ̀-wìʌ̀/ is realized with a falling pitch throughout, due to the realization of a final boundary L% tone, characteristic of declarative/unmarked utterances. This L% tone is realized as a strong pitch drop distributed over the the utterance-final prosodic word (more marked than declination, which incurs only a slight gradual pitch lowering over the entire utterance). It will be indicated in spectrograms and pitch tracks whenever necessary.

The example in (8) and Figure 5 further shows that H tones following a downstep are realized not only lower than a H preceding the downstep, but at about the same height as a L preceding the downstep. Paicî is thus a language with "total downstep", defined by Meeussen (1970, 270) as a kind of register lowering in which downstepped tones are 'not lowered just a little, but all the way to the next lower register' (see also Stewart 1993). The indirect effect of a downstepped L on following Hs clearly shows that the register drops to a non-overlapping lower register: the highest pitch of the following register setting corresponds to the lowest pitch of the preceding one, i.e. the new "ceiling" corresponds to the former "floor".

One final argument in favor of the downstep analysis is that the number of downsteps per utterance in Paicî is in principle unlimited. This produces the terracing effect that is one of the main cross-linguistic properties of downstep (Hyman 1979; Rialland 1997; Connell 2011; Leben 2018). This is illustrated in example (9), where a total of four downsteps are realized, including two instances of phonological downstep: [dà =kḛ̀ꜜḛ̀=wʌ̀] and [pwìrìꜜdùà]. The other two instances are underlying downsteps, which will be discussed in Section 5.

(9) [á̰ è =ꜜmwà̰à̰ tɨ̀-nʌ̰́pó gɔ̀ =ꜜì dà =kḛ̀ꜜḛ̀ =wʌ̀ pwìrìꜜdùà]
and (s)he =SUCC adjust-propeller on =DEF spear =his =SBJ (name)
'And Pwiridua adjusts the propeller on his spear.' (G:06'40")

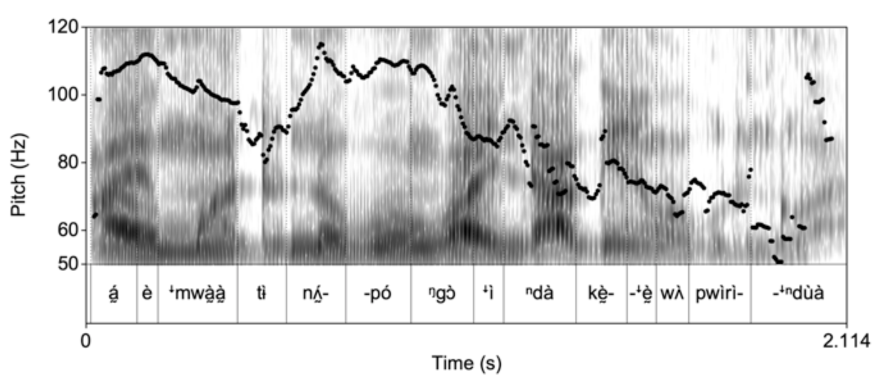


Figure 6: [á̰ è =ꜜmwà̰à̰ tɨ̀- nʌ̰́pó gɔ̀ =ꜜì dà =kḛ̀ꜜḛ̀ =wʌ̀ pwìrìꜜdùà] 'And Pwiridua adjusts the propeller onto his spear.' [NDP] (G:06'40")

4.2 Metrical analysis

Rivierre (1974) describes phonological downstep as conditioned by metrical structure, although without a full analysis of the prosodic categories involved. Lionnet (2019) goes further and shows that phonological downstep can be analyzed as a form of tonal dissimilation applying between two successive L-toned bimoraic feet licensed by a dipodic colon, within the same prosodic word (I will come back to the definition and role of the prosodic word in Section 5). This metrical analysis gives a simple explanation of (i) the locus of downstep (after the second, rather than first or third mora), and (ii) the four-mora requirement for the application of downstep, i.e. the absence of downstep in $1 \sim 3\grave{\mu}$ words. I only briefly summarize this analysis below. The reader is referred to Lionnet (2019) for more detail, and arguments against alternative analyses.

The four-mora requirement is straightforwardly accounted for in a foot-based analysis: phonological downstep appears between two adjacent L-toned feet, as a form of dissimilation: *(LL)(LL) → (LL)ꜜ(LL). This accounts for the data in (6), as shown in (10), where feet are in parentheses (...).

(10)	a.	$1 \sim 3\grave{\mu}$ words:			
		$\grave{\mu}$:	/ì/	ì	‘louse’
		$\grave{\mu}\grave{\mu}$:	/pʌ̰̀dì/	(pʌ̰̀dì)	‘to divide’
		$\grave{\mu}\grave{\mu}\grave{\mu}$:	/à̰bòrò/	(à̰bò)rò	‘person’
	b.	$4\grave{\mu}+$ words:			
		$\grave{\mu}\grave{\mu}^{\downarrow}\grave{\mu}\grave{\mu}$:	/àùkɔ̀ɔ̀/	(àù)ꜜ(kɔ̀ɔ̀)	‘kagu (bird sp.)’
		$\grave{\mu}\grave{\mu}^{\downarrow}\grave{\mu}\grave{\mu}\grave{\mu}$:	/pwèrètɔ̀ɔ̀tɨ̀/	(pwèrè)ꜜ(tɔ̀ɔ̀)tɨ̀	‘wind’

Lionnet (2019) shows that this analysis, although it correctly predicts the placement of phonological downstep, must be amended, on the basis of the application of another tonal process at work in Paicî: juncture H tone spread. In certain head+complement sequences, the dependency relation between the head and complement is marked by a H tone realized at the left edge of the complement. The head may be a subset of nominal determiners, a subset of preverbal TAM markers, all nominal and verbal derivational prefixes (e.g. causative /pà-/, agentive /à-/), the head noun of a (head-initial) genitive construction, or a transitive verb followed by its incorporated object. This is illustrated in (11) with the MIDDLE derivational prefix /pì-$^{\text{H}}$/.[13]

(11) a. /rʌ̀ wà̰dò/ → [rʌ̀ wà̰ⁿdò]
they drink ‘They drink.’

b. /rʌ̀ pì-$^{\text{H}}$ wà̰dò/ → [rʌ̀ pì-wá̰ⁿdò]
they MID- drink ‘They are getting drunk.’

Interestingly, the same discrepancy between $1 \sim 3\mu$ and $4\mu+$ words is found with the patterning of the juncture H tone, which is realized on the initial mora of the complement if it is less than 4μ long (12)a, and on the first two morae, i.e. on the entire initial foot, if it is a $4\mu+$ word (12)b.

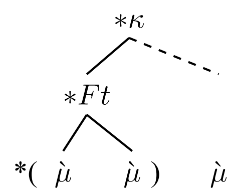
(12)	a.	1μ	/pì-$^{\text{H}}$ cɔ̀/	pì-cɔ́	‘move forward’
		2μ	/pì-$^{\text{H}}$ wà̰dò/	pì-wá̰dò, *pì-(wá̰dó)	‘get drunk’
		3μ	/pì-$^{\text{H}}$ tʌ̀mʌ̰̀rḭ̀/	pì-tʌ́mʌ̰̀rḭ̀, *pì-(tʌ́mʌ̰́)rḭ̀	‘give birth’
	b.	4μ	/pì-$^{\text{H}}$ nʌ̰̀ɟàìrì/	pì-(nʌ̰́ɟá)(ìrì)	‘curse’

The realization of the juncture H-tone can thus be used as a diagnostic for foot parsing: foot structure exists in $4\mu+$ words (12)b, but not in shorter words (12)a, where the juncture H is realized on the initial mora only. This is easily explained if foot parsing in Paicî is licensed by a dipodic colon, i.e. a constituent made of two binary feet, intermediate between the foot and the prosodic word in the Prosodic Hierarchy (cf. Lionnet 2019 and references therein; for the prosodic hierarchy, see Selkirk 1984; Nespor & Vogel 1986). This straight-

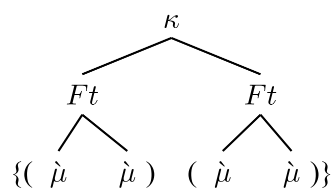
[13] This is described, although not in the same terms and with a different analysis, by Rivierre (1974, 332–333, 337–339). Rivierre analyzes juncture-H-assigning morphemes as “proclitics”. I depart from his analysis, because there is no evidence that these are clitics in any sense. I remain agnostic as to whether the juncture H tone is sponsored by specific morphemes, or rather assigned by specific constructions.

forwardly accounts for the 4μ minimum condition for foot parsing, as shown in (13). Note that there is no effect of the foot or colon on the realization of H tones in all-H words; there is thus evidence for foot and colon structure only in L-toned words.

(13) a.



b.



To summarize, phonological downstep targets only L tones, and is only attested between two L tones: L↓L. It is also entirely predictable, and need not be posited in underlying representation. Consequently, the two tonemes H and L are sufficient to account for the tonology of lexical (i.e. non-functional) items in Paicî. I show in the next section that the existence of unpredictable downstep in a set of functional items complicates the picture.

5 Enclitics and underlying downstep

There are a total of 217 functional items in Rivierre's dictionary – a tentative category which includes pronouns, prepositions, adverbials, TAM markers, coordinators, subordinators, and various "particles".[14] As shown in Table 2, these functional items fall into two separate prosodic categories: non-enclitics (137, i.e. 64%) and enclitics (80, i.e. 36%). Non-enclitics have their own underlying tone and are prosodically independent, i.e. are parsed as independent prosodic words, e.g. /mà̰à̰/ '(say) that', /cá̰/ NEGATION, /cíbwàà/ PROHIBITIVE. Enclitics, on the other hand, do not project their own prosodic word. Instead, they are included in the prosodic word headed by the closest non-enclitic element to the left, which I call "tonal nucleus", after Rivierre's *centre tonal*. Most (although crucially not all) enclitics are underlyingly toneless. This section explores the prosodic behavior of enclitics. I will come back to the definition and properties of enclisis in Section 5.5.

Table 2: Tone patterns in functional items

Prosodic status	Number		Tone	Number	
Non-enclitic	137	(64%)	L	74	(54%)
			H	34	(25%)
			Non-isotonic	29	(21%)
Enclitic	80	(36%)	H/L	61	(76%)
			H/↓L	11	(14%)
			L/↓L	8	(10%)
Total	217	(100%)			

Three types of enclitics exist, differentiated by their tonal behavior, as described by Rivierre (1974): (i) H/L enclitics, realized H after a H-toned nucleus, and L after a L-toned nucleus; (ii) H/↓L enclitics, realized H after a H-toned nucleus, and downstepped ↓L after a L-toned nucleus; and (iii) L/↓L enclitics, realized L after a H-toned nucleus, and ↓L after a L-toned nucleus. I propose to account for these differences in terms of different underlying representations: H/L enclitics are toneless /=x̊/ (Section 5.1), H/↓L enclitics are predownstepped and toneless /=↓x̊/ (Section 5.2), and L/↓L enclitics are predownstepped and L-toned /=↓x̀/ (Section 5.3). The full analysis is detailed in Section 7, and compared to alternatives in Section 8. As will

[14] Affixes and interjections are excluded, as well as nine functional items whose tonal identity is unclear.

be clear in many examples given in this and following sections, prosodic structure and morpho-syntactic structure are often at odds in Paicî.[15]

5.1 H/L enclitics

61 out of the 80 tonal enclitics (i.e. 76%) are toneless. They get their tonal specification through spreading from the tonal nucleus. This is illustrated in (7)-(8) above with the directional preposition /=nḁ̰ḁ̰/ 'to, at': /tèàpàà =nḁ̰ḁ̰/ → [tèà↓pàà =nà̰à̰] 'arrive at' vs. /pʌ̰́ =nḁ̰ḁ̰/ → [pʌ̰́ =ná̰á̰] 'go to'. Sequences of enclitics are frequent.[16] In such cases, the tone of the nucleus spreads to the entire sequence of enclitics. This is shown in (14) and (15) (/tɛ̀ɛ̀pàà/ is realized [tɛ́ɛ́pàà] in (15) after the docking of the juncture H tone assigned by the SUCCESSIVE marker /↓mwà̰à̰ᴴ/, cf. (12) above). As clearly seen in Figures 7 and 8, the toneless enclitics in these two examples are all realized at the same pitch as the immediately preceding tonal nucleus (with a slight declination effect in the realization of the extended H tone in Figure 7).

(14) /...pwʌ̰́-rʌ̰̊ í =gḙ̊ḙ̊ =mḙ̰̊ =nḁ̰ḁ̰ gɔ̀bwìnyḁ̰rḁ̰/
[...pwʌ̰́-rʌ̰́ í =ᵑgéé =mḛ́ =ná̰á̰ ᵑgɔ̀ᵐbwì↓ɲà̰rà̰]
noise-of cry =horizontally =toward.here =DIR (place name)
'[Then he heard the] crying noises coming from Gobwinyara.' (G:14'37")

(15) /...↓mwà̰à̰ᴴ tɛ̀ɛ̀pàà =dɔ̊ =mḙ̰̊ =nḁ̰ḁ̰ gɔ̀bwìnyàrà/
[...↓mwà̰à̰ tɛ́ɛ́pàà =ⁿdɔ̀ =mḛ̀ =nà̰à̰ ᵑgɔ̀ᵐbwì↓ɲà̰rà̰]
SUCC arrive =upward =toward.here =DIR (place name)
'[And then they] arrived in Göbwinyara' (G:07'09")

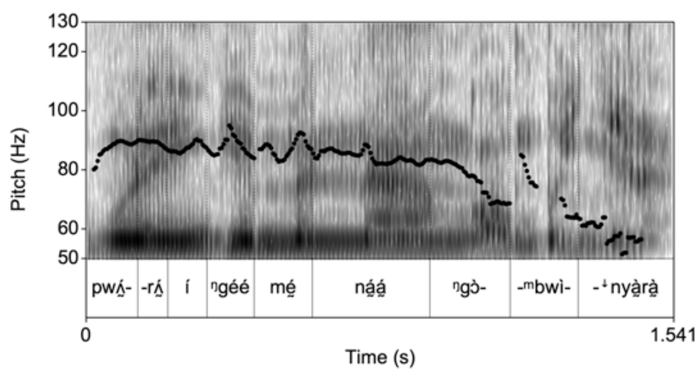


Figure 7: [pwʌ̰́-rʌ̰́ í =ᵑgéé =mḛ́ =ná̰á̰ ᵑgɔ̀ᵐbwì↓ɲà̰rà̰] '[Then they heard the] crying noises coming from Göbwinyara' [NDP] (G:14'37")

The tonal nucleus and all immediately following tonal enclitics form a prosodic word (PW), which is the domain of application of the phonological downstep described in Section 4. This is seen in (16) and corresponding pitch tracks in Figures 9, 10, and 11, where phonological downstep applies whenever the

[15] H/L (toneless) enclitics correspond to Rivierre's (1974) *enclitiques intégrés (i)*, H/↓L (predownstepped toneless) enclitics to his *enclitiques (j)*, and L/↓L (predownstepped L-toned) enclitics to his *enclitiques (d)*. Rivierre mentions a fourth type of enclitics – *enclitiques contrastifs (c)* – which are actually not tonal enclitics in the analysis I propose here, since they do not form a prosodic word with the preceding tonal nucleus. This class consists of five L-toned functional items whose initial mora has polar tone, i.e. always contrasts with the preceding tone, e.g. [bwɛ̀tì]~[bwɛ́tì] 'well' in [è púú bwɛ̀tì] 'he sleeps well' vs. [è cʌ̰̀bù bwɛ́tì] 'he dances well' (Rivierre 1974, 329). The analysis of these items falls outside the scope of this paper.

[16] There does not seem to be any upper limit on the number of enclitics following a tonal nucleus. The maximum I have found after a cursory search through Bensa and Rivierre's (1994) text collection is six.

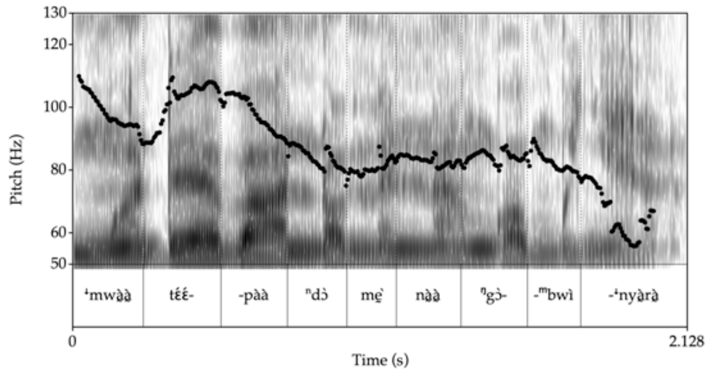


Figure 8: [...ꜜmwə̰̀ə̰̀ tɛ́ɛ́pàà =ⁿdɔ̀ =mḛ̀ =nə̰̀ə̰̀ ᵑgɔ̀ᵐbwìꜜɲə̰̀rə̰̀] ‘[And then they] arrived in Göbwinyara’ [NDP] (G:07’09”)

prosodic word contains at least four morae, irrespective of whether these morae are part of the tonal nucleus or one or several enclitics (feet are shown in parentheses, prosodic words in angle brackets; cola are ignored for the sake of legibility).[17]

(16) a. /pwḛ̀ḛ̀dì =kḛ̊ḛ̊/
[⟨(pwḛ̀ḛ̀)ꜜ(ⁿdì =kḛ̀)ḛ̀⟩]
youngest.brother =POSS:3SG
‘his youngest brother’ (G:07’31”)

b. /á̰ nʌ̰̀ rʌ̀ nḭ̀à̰ =bo̊o̊/
[á̰ nʌ̰̀ rʌ̀ ⟨(nḭ̀à̰) ꜜ(=ᵐbòò)⟩]
and when they look =down
‘And when they look down...’ (G:12’51”)

c. /è tɔ̀ =mḛ̊ =nə̰̊ə̰̊ bʌ̀rʌ̀-wìʌ̀/
[è ⟨(tɔ̀ =mḛ̀) ꜜ(=nə̰̀ə̰̀)⟩ ᵐbʌ̀rʌ̀-wìʌ̀]
(s)he enter =toward.here =DIR edge-wave
‘(S)he came back (from the sea) to the shore.’ (171228-02-HN1:95)

The constituent I call prosodic word is a postlexical constituent that systematically includes enclitics. One might argue that it is better analyzed as a “clitic group” (Nespor & Vogel 1986; Hayes 1989) or “composite group” (Vogel 2009). This is not the case, however. As we saw, the foot and colon parsing domain includes enclitics, which means that the prosodic word, which immediately dominates the colon in the Prosodic Hierarchy, must include all enclitics as well. There is thus no evidence in Paicî for a clitic/composite group distinct from the prosodic word.[18]

Phonological downstep applies within the prosodic word only. It is possible to have a long string of L tones with no downstep, if each individual prosodic word has a maximum of three morae. This is shown in (17), an utterance consisting of a succession of eight independent prosodic words, all but the last one L-toned. None of these is long enough to trigger phonological downstep, and as seen on Figure 12, the sequence of

[17] The final H% boundary tone in Figure 10 indicates that the utterance is not over (the main clause is coming). The pitch range has been adjusted to 50~100Hz for Figure 9, instead of the 50~130Hz used in other figures for Speaker NDP, to make the pitch drop more visible.

[18] Most versions of the Prosodic Hierarchy do not include the colon. As shown in Section 4.2 and as argued by Lionnet (2019), Paicî is one of the rare languages providing evidence in favor of this inclusion. The Prosodic Hierarchy up to the prosodic word in Paicî is as follows: mora > foot > colon > prosodic word.

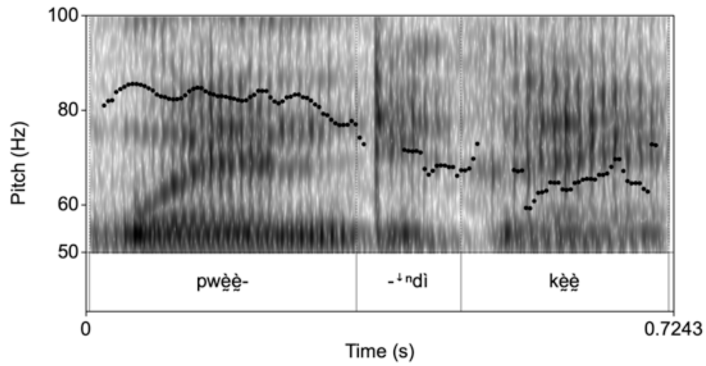


Figure 9: [pwẹ̀ẹ̀ꜜⁿdì =kẹ̀ẹ̀] ‘his youngest brother’ [NDP] (G:07’31”)

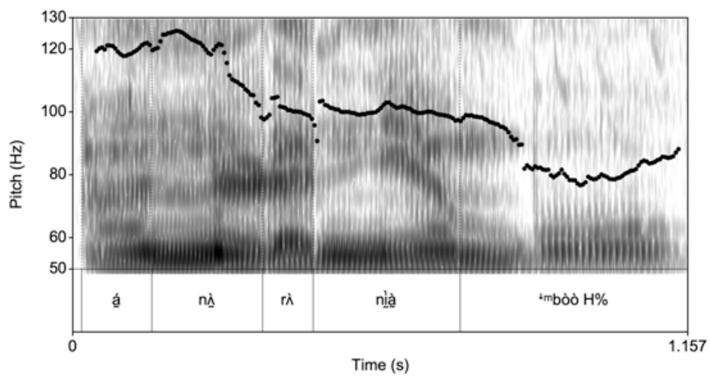


Figure 10: [ḁ́ nʌ̰̀ rʌ nḭ̀ḁ̀ =ꜜᵐbòò] ‘And when they looked down...’ [NDP] (G:12’51”)

L-toned morae is realized with approximately the same pitch throughout, with slight declination.

(17)	/gʌ̀ù	nʌ̰̀bwè	bàà	gò	jɛ̀	nḭ̀ḭ̀	pò^H^	mò̰ò̰/
	[ᵑgʌ̀ù	nʌ̰̀ᵐbwè	ᵐbàà	ᵑgò	ᶮɟɛ̀	nḭ̀ḭ̀	pò	mò̰́ò̰]
	you.two	end	because	I	PFV	alas	very	cold
	‘Stop, for I am freezing.’ (G:18’02”)							

Phonological downstep can thus be used as a diagnostic for identifying tonal enclitics: any morphologically free morpheme that is grouped with the preceding tonal nucleus for the application of phonological downstep is a tonal enclitic. (I will come back to this definition in Section 5.5.)

5.2 H/ꜜL enclitics

There is a set of eleven enclitics (14% of all enclitics) that are realized H after a H-toned nucleus, just like toneless enclitics, but ꜜL after a L-toned nucleus.[19] Analyzing these enclitics as toneless and preceded by an underlying downstep straightforwardly accounts for their behavior. This is shown with the animate subject marker /=ꜜwʌ̊/ in (18).

[19] The two relative markers /=ꜜnʌ̰̊/ and /=ꜜi̊å/ and their derived forms /=ꜜcɛ̊-nʌ̰̊/ (indefinite) and /=ꜜnʌ̰̊-ià/ (definite), the subject marker /=ꜜwʌ̊∼=ꜜV̊/ introducing animate subjects, the two prepositions /=ꜜwḁ̊∼=ꜜo̰̊∼=ꜜV̊/ (locative) and /=ꜜbånḁ̊ḁ̊∼=ꜜbånʌ̰̊/ ‘until’, the two adverbials /=ꜜɛ̊ri̊/ ‘later, in a moment’ and /=ꜜnʌ̰̊bʌ̊/ ‘today’, the complementizer /=ꜜnʌ̰̊ù/∼/=ꜜnḁ̊ḁ̀/ ‘for, in order to’, and the coordination /=ꜜbåù/ ‘and, with’.

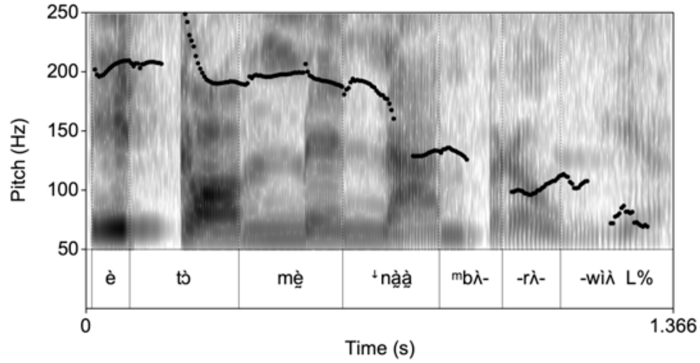


Figure 11: [è tɔ̀ =mḛ̀ =ꜜnà̰à̰ ᵐbʌrʌ-wìʌ] '(S)he came back (from the sea) to the shore.' [HN] (171228-02-HN1:95)

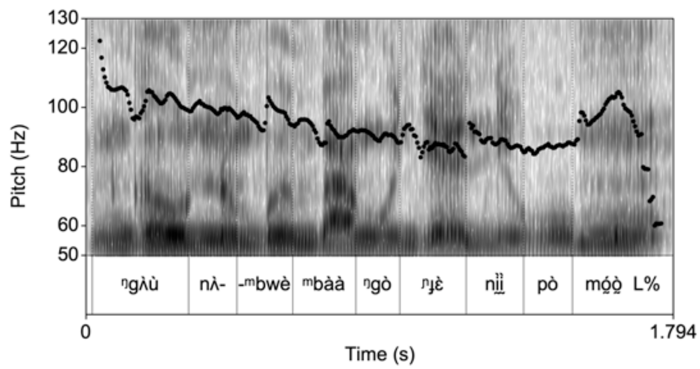


Figure 12: [ᵑgʌù nʌ̰ᵐbwè ᵐbàà ᵑgò ᶮɟɛ̀ nı̰̀ı̰̀ pò mɔ̰́ɔ̰̀] 'Stop, for I am freezing.' [NDP] (G:18'02")

(18) a. /ʌ̰́ è =ꜜmwʌ̰̀ʌ̰̀ᴴ ínʌ̰́ =ꜜwʌ̊ pwìrìdùà.../
[ʌ̰́ è =ꜜmwʌ̰̀ʌ̰̀ ⟨ínʌ̰́ =wʌ́⟩ pwìrìꜜⁿdùà...]
and (s)he =SUCC say =SBJ (name)
'And Pwiridua then said...' (G:16'19")

b. /è tɔ̀ =ꜜwʌ̊ dùì/
[è ⟨tɔ̀ =ꜜwʌ̀⟩ ⁿdùì]
(s)he enter =SBJ (name)
'Dui comes/goes in.' (201121-04-AG1:5)

The tone of both H- and L-toned nuclei spreads onto the toneless mora of the subject marker /=ꜜwʌ̊/ in (18)a and (18)b respectively. After a L-toned nucleus, the L tone that has spread is affected by the enclitic's underlying downstep (18)b/Figure 14. The reason why downstep is left unrealized in (18)a/Figure 13 is explained by a general incompatibility between H and downstep within the prosodic word, discussed in Section 6.1, and analyzed in Section 7.5.

Underlying downstep, contrary to the phonological downstep seen in Section 4 above, is not subject to the four-mora minimum condition, as clearly seen in (18)b, where it occurs after the first mora of the bimoraic prosodic word ⟨tɔ̀ =ꜜwʌ̀⟩.[20]

[20] Examples (18)b/Figure 14, (19)/Figure 15, and (20)b/Figure 17 illustrate a prosodic phenomenon that is frequent in AG's speech, but rare in HN and NDP: a L-toned lexical item followed by a downstepped element is often pronounced with a higher pitch

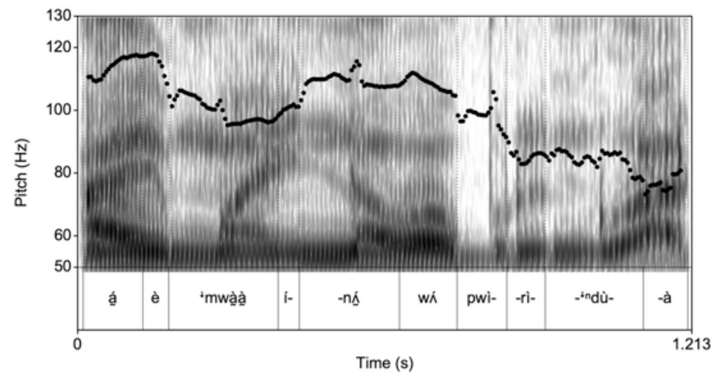


Figure 13: [á̰ è ↓mwà̰à̰ íná̰ =wʌ́ pwìrì↓^{n}dùà]‘And Pwiridua then said...’ [NDP] (G:16’19”)

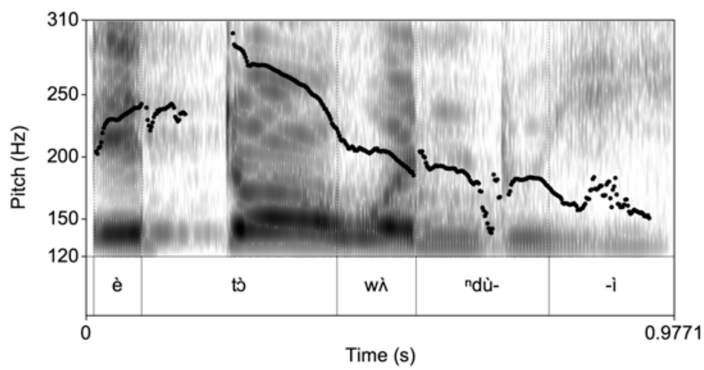


Figure 14: [è tɔ̀ =↓wʌ̀ ^{n}dùì] ‘Dui enters.’ [AG] (201121-04-AG1:5)

Evidence that predownstepped toneless enclitics form a prosodic word with the preceding tonal nucleus is given in (19) and Figure 15. As can be seen, the presence of a metrically conditioned phonological downstep between [=mḛ̀] and [=nḭ̀] can only be explained if the prosodic word headed by [tɔ̀] ‘enter’ is made up of at least four morae, i.e. if it includes the subject marker /=↓wʌ̊/ (the reason why the underlying downstep of /=↓wʌ̊/ is not realized in this case is explained in Section 6.3).

(19) /è tɔ̀ =mḛ̊ =nḭ̊ =↓wʌ̊ dùì/
[è ⟨(tɔ̀ =mḛ̀) ↓(=nḭ̀ =wʌ̀)⟩ ^{n}dùì]
(s)he enter toward.here =here =SBJ (name)
‘Dui comes in here.’ (191121-04-AG1:7)

The category of predownstepped toneless enclitics includes three “mixed” enclitics, whose first mora is toneless, but whose second (and third) mora is L-toned: the definite relative marker /=↓nå̰-ìà/ (cf. relative /=↓nå̰/ and definite relative /=↓ i̊å/), the coordinator /=↓båù/ ‘and, with’, and the purposive complementizer /=↓nå̰ù/~/=↓nå̰à̰/ ‘for, in order to (after motion verbs).’ The latter is illustrated after a H and a L tonal nucleus

than the immediately preceding L-toned functional item (see also (23)/Figure 21, and (35)/Figure 33, (34)b/Figure 32). This pitch rise anticipates on the following drop and makes it easier to realize and perceive. Rivierre (1980, 57) describes a similar phenomenon in neighboring Cèmuhî. This is reminiscent of H raising, a cross-linguistic tendency for H to be realized higher when it immediately precedes a L tone, thus making the H vs. L contrast more salient (cf. Connell 2011, 12-13, and references therein). Here the enhanced contrast is between L and ↓L.

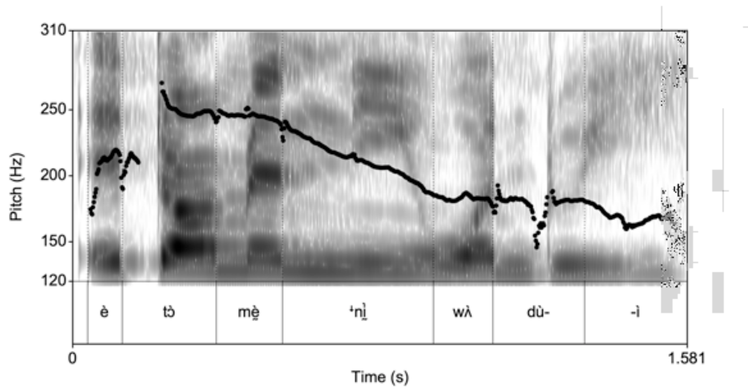


Figure 15: [è tɔ̀ =mɛ̰̀ =ꜜnɪ̰̀=wʌ̀ ⁿdùì] 'Dui comes in here.' [AG] (191121-04-AG1:7)

in (20)a and (20)b below.[21]

(20) a. /rʌ̀ pʌ̰́ =ꜜnʌ̰̊ù púú/
[rʌ̀ ⟨pʌ̰́ =nʌ̰́ù⟩ púú]
they go =PURP sleep]
'They go to sleep.' (191121-06-AG1:12)

b. /è tɔ̀ =ꜜnʌ̰̊ù púú/
[è ⟨tɔ̀ =ꜜnʌ̰̀ù⟩ púú]
(s)he enter =PURP sleep]
'(S)he comes/goes in to sleep.' (191121-06-AG1:2)

c. /ʌ̰́ è =ꜜmwʌ̰̀ʌ̰̀^{H} tòò =ꜜnʌ̰̊ù còò =ꜜV̊ gɔ̀/
[ʌ̰́ è =ꜜmwʌ̰̀ʌ̰̀ ⟨(tóó) (=nʌ̰̀ù)⟩ còò =ꜜò ⁿgɔ̀]
and (s)he =SUCC go.up =PURP stand =LOC on
'And he jumped onto [it = the stone].' (G:18'50")

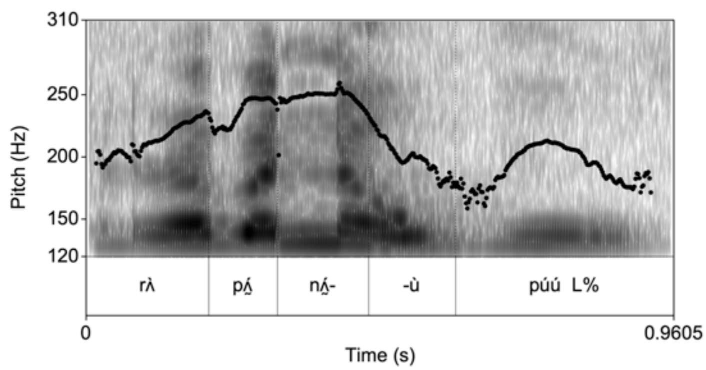


Figure 16: [rʌ̀ pʌ̰́ =nʌ̰́ù púú] 'They go to sleep.' [AG] (191121-06-AG1:12)

[21] Whether the last two items are monomorphemic is unclear. The /ꜜnʌ̰̊-/ part in =ꜜnʌ̰̊ù/~/=ꜜnʌ̰̊ʌ̰̀/ 'for, in order to' is likely related to a family of similar grammatical words: relative /=ꜜnʌ̰̊/, complementizer /nʌ̰̀/ 'that', /nʌ̰̀/~/nʌ̰́/ 'when', /(bà)-nʌ̰̀/ 'in order to'. Determining a possible origin of /=ꜜbʌ̊ù/ 'with' is less easy. Given its semantics, it might historically be related to the noun /bà/ 'group, society,' but this is purely speculative. In any case, the origin of the second, L-toned mora in both items is unknown.

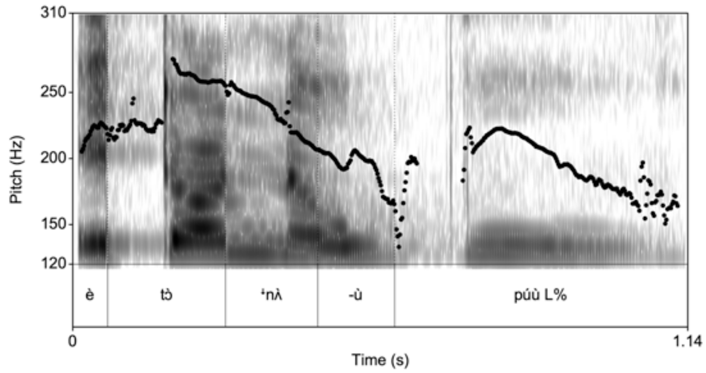


Figure 17: è tɔ̀ =ꜜnʌ̥̀ù púú] ‘(S)he comes/goes in to sleep.’ [AG] (191121-06-AG1:2)

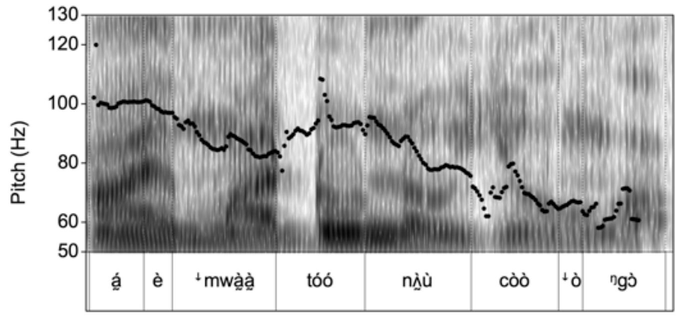


Figure 18: [á̰ è ꜜmwà̰à̰ tóó =nʌ̰̀ù còò =ò gɔ̀] ‘(S)he goes down to sleep.’ [AG] (191121-06-AG1:8)

In example (20)c/Figure 18, the realization of the juncture H tone on the initial two morae of the following word shows that the prosodic word is ⟨(tóó)(=nʌ̰̀ù)⟩, and not *⟨tóò=nʌ̰⟩ù – i.e. the L-toned second mora in /=ꜜnʌ̰̊ù/ (and presumably /=ꜜbåù/ as well) is parsed together with the initial toneless mora within the preceding prosodic word.[22]

5.3 L/ꜜL enclitics

The remaining eight tonal enclitics (10% of all enclitics) are systematically realized lower than the preceding tone: L after H, ꜜL after L. This is easily explained if they are analyzed as both underlyingly L-toned and predownstepped. The eight predownstepped L-toned enclitics are listed in (21).[23]

[22] Rivierre (1974, 333, fn.15) notes that the juncture H tone is realized on the initial two morae of the following 4μ+ prosodic word only if the tonal nucleus has at least three morae, i.e. [$\acute{\mu}\acute{\mu}\grave{\mu}$=$\grave{\mu}$...] vs. [$\acute{\mu}\grave{\mu}$=$\grave{\mu}\grave{\mu}$...] and [$\acute{\mu}$=$\grave{\mu}\grave{\mu}\grave{\mu}$...]. Neither instrumental measurements from *Le Maître de Göbwinyara* nor my elicitation work with AG confirm this remark: in all the recorded data at my disposal, the juncture H is systematically realized on the first two morae of any L-toned prosodic word of at least four morae, irrespective of the size of the tonal nucleus.

[23] Rivierre (1974) only includes the two definite determiners /=ꜜḛ̀/ and /=ꜜì/ in this category (*enclitique d* in his terminology). The prosodic behavior of the other six morphemes in (21), both in Rivierre’s (1974, 328, fn. 8) description and later transcriptions (Rivierre 1983; Bensa & Rivierre 1994) and in my elicited data, justifies treating them on a par with these two determiners. The question words /=ꜜdʌ̀/ ‘what’ (21)g and /=ꜜdʌ̀^{H}/ ‘what X, which X’ (21)h could be considered one single morpheme, with the assignment of the juncture H tone in ‘what X, which X’ simply the expression of the head-complement relation between the interrogative and its complement. I prefer to treat them as separate morphemes here, because they behave differently when utterance-initial, as we will see in Section 5.4. The realization of the underlying downstep in /=ꜜdʌ̀/ is sometimes blocked by what I assume are requirements

(21) a. /=ꜜḛ̀/~/=ꜜʌ̰̀/ DEFINITE DETERMINER (prenominal)
b. /=ꜜì/ DEFINITE DETERMINER (prenominal)
c. /=ꜜcò/ VOCATIVE (prenominal)
d. /=ꜜdʌ̀/ 'what'
e. /=ꜜdʌ̀^{H}/ 'what X, which X'
f. /=ꜜò/ FUTURE (preverbal)
g. /=ꜜbwàà/ IMPERFECTIVE (preverbal)
h. /=ꜜmwàà^{H}/~/ꜜmà̰à̰^{H}/ PUNCTUAL/SUCCESSIVE, 'then' (preverbal)

The behavior of predownstepped L-toned enclitics is illustrated with the definite determiner /=ꜜì/, after a H-toned nucleus in (22)a and a L-toned nucleus in (22)b.

(22) a. /...=wà̰ nʌ̰́ =ꜜì/ àu-^{H} ítʌ́ jàwè
[...=wà̰ ⟨nʌ̰́ =ì⟩ àù- ítʌ́ ᶮɟàwè]
LOC in =DEF place.of- run water
'[There is someone] in the waterhole' (171228-01-HN1:197)

b. /... gɔ̀ =ꜜì jɛ̀^{H} dìtʌ̀-rʌ̥̀ bwə̀/
[...⟨ᵑgɔ̀ =ꜜì⟩] ᶮɟɛ̀ ⁿdítʌ̀-rʌ̀ ᵐbwə̀]
on =DEF INDF branch-of banyan
'[the bird lands] on a banyan branch.' (171228-02-HN1:136)

As expected, the underlying downstep is realized when following a L tone, as in (22)b/ Figure 20.[24] When following a H tone, on the other hand, as in (22)a/Figure 19, the downstep is left unrealized, i.e. /=ꜜì/ is realized with a non-downstepped L toned [ì], because of the prosodic-word-level incompatibility between H and downstep discussed in Section 6.1.

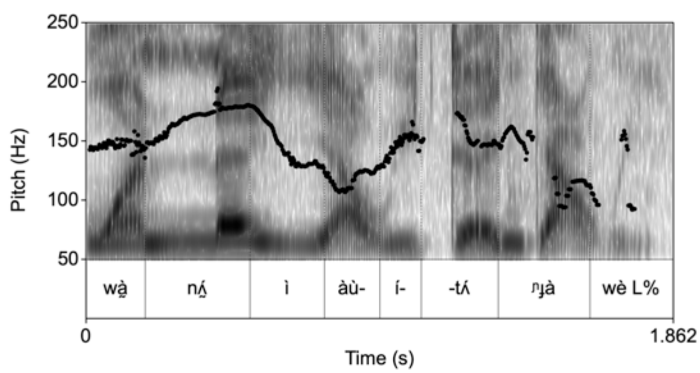


Figure 19: [=wà̰ nʌ̰́ =ì àù-ítʌ́ ᶮɟàwè] 'in the water hole' [HN] (171228-01-HN1:197)

Evidence for the enclitic status of predownstepped L-toned enclitics is shown in (23) and Figure 21, where the downstep in [tà̰ =mwà̰ꜜrà̰ =ì] can only be phonological, i.e. metrically derived. This means that [tà̰] heads a prosodic word which has at least four morae, i.e. which must include [=ì]. The underlying downstep

of interrogative intonation, e.g. /pè =ꜜdʌ̀ =ni̥̰/ (it.is =what =here) 'What is it?' and /pè =ꜜdʌ̀ =ni̥̰ =gḛ̊ḛ̊/ (it.is =what =here =across) 'What is that over there?' are both realized with a pitch drop on the final syllable: [pè =ⁿdʌ̀ =nı̏] and [pè =ⁿdʌ̀ =nì =ᵑgḛ̀ḛ̏] in AG's speech, instead of the expected [pè =ꜜdʌ̀ =nḭ̀] and [pè =ꜜdʌ̀ =nḭ̀ =gèè]. I leave the detailed investigation of these facts for further research.

[24]The pitch range has been adjusted to 75~200Hz for this figure, instead of the 50~250Hz used in other figures for Speaker HN, to make the pitch drop visible.

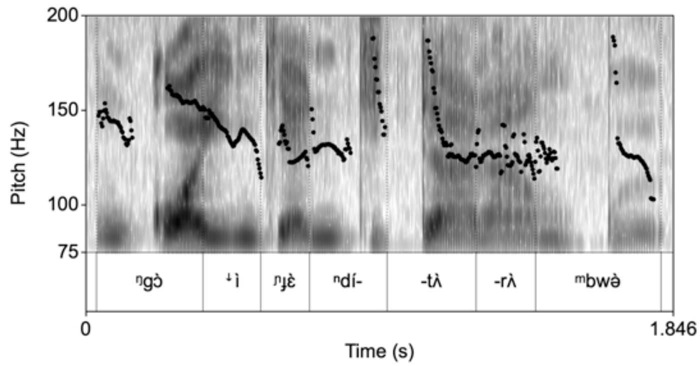


Figure 20: [ᵑgɔ̀ =↓ì ɲɟɛ̀ ⁿdítʌ̀-rʌ̀ ᵐbwə̀] ‘on a banyan branch’ [HN] (171228-02-HN1:136)

of /=↓ì/ is not realized here, as explained in Section 6.3.[25]

(23) /è tə̰̀ =mwə̰̊rə̰̊ =↓ì mʌ̰̀rɨ̰̀/
[è ⟨(tə̰̀ =mwə̰̀)↓(rə̰̀ = ì)⟩ mʌ̰̀rɨ̰̀]
it fly =again =DEF bird
‘The bird flies off again.’ (171228-02-HN1:145)

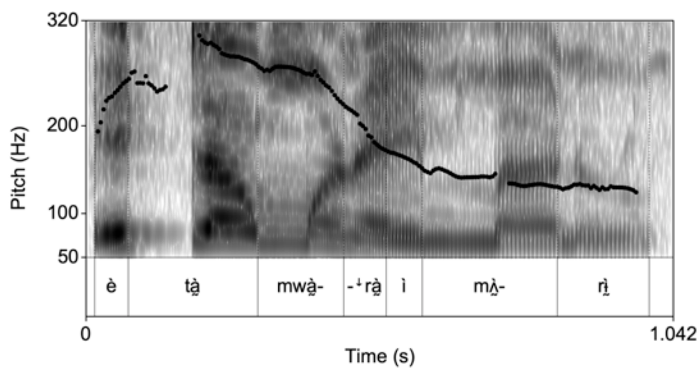


Figure 21: [è tə̰̀ =mwə̰̀↓rə̰̀ =ì mʌ̰̀rɨ̰̀] ‘The bird flies off again.’ (171228-02-HN1:145)

5.4 Utterance-initial enclitics

Many of the enclitics described above can occur utterance-initially, in which case, they are realized with a L tone. I come back in Section 5.5 to the potential problem this poses to their analysis as enclitics. Predownstepped toneless enclitics further lose their downstep, while predownstepped L-toned enclitics keep theirs – with only two exceptions: the definite determiner /=↓ì/ and interrogative /=↓dʌ̀^{H}/ ‘which’, realized [ì] and [ⁿdʌ̀] respectively when utterance-initial. The L-toned utterance-initial realization of the locative preposition /=↓wə̰̊/ is illustrated in (24).

[25]The pitch rise from [è] to [tə̰̀] in Figure 21 is due to L-raising before downstep, mentioned in footnote 20.

(24) /=ꜜwå̰ =nḭ̊ =bo̊o̊ jàà-wʌ̊/
[⟨(wà̰ =nḭ̀) =ꜜ(ᵐbòò)⟩ ᶮɟàà-wʌ̀]
=LOC =here =down at-you.PL
‘down at your (PL) place’ (171228-01-HN1:139)

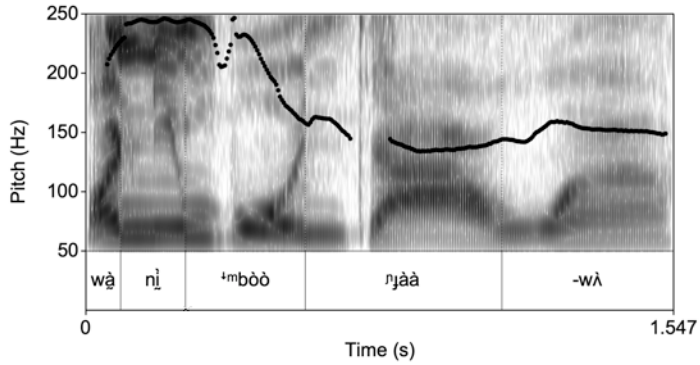


Figure 22: [wà̰ =nḭ̀ =ꜜᵐbòò ᶮɟàà-wʌ̀] down at your (pl) place’ [HN] (171228-01-HN1:139)

I analyze the L tone of utterance-initial toneless enclitics as a default tone inserted to give these enclitics prosodic word status (cf. Section 5.5). Evidence for this comes from the fact that an utterance-initial enclitic constitutes a tonal nucleus, i.e. it heads a prosodic word, as shown by the application of phonological downstep in (24)/Figure 22.

5.5 The status of enclitics

The fact that (some) enclitics may freely occur utterance-initially, i.e. without a prosodic word to their left to lean onto, seems to question their status as “enclitics”. More generally, as suggested by a reviewer, one might wonder whether the definition of enclitics might not be circular: tonal enclitics are defined by their interaction with the preceding tonal nucleus, but then sub-grouped into three representations which seem to be the only representations that would be expected to have tonal interactions with what precedes them. In this section I show that the enclitic analysis is justified.

Let us start with the potential circularity problem. If all enclitics were toneless, i.e. if prosodic binding amounted to tonelessness, then there would be no grounds for a separate class of enclitic morphemes. However, this is not the case, as we just saw in Section 5.3. Table 3 summarizes the morphological and prosodic properties of various types of morphemes in Paicî. As can be seen, and as one would expect, tonelessness is always synonymous with prosodic binding, i.e. all toneless morphemes are integrated into the preceding prosodic word, and get their tonal specification from it. However, not all prosodically bound morphemes (below the dashed line in Table 3) are toneless: the existence of enclitics with their own underlying tone – the eight predownstepped L-toned enclitics discussed in Section 5.3 – makes it necessary to recognize prosodic binding as a property unrelated to tonelessness.

Enclitics, then, are defined as morphologically free morphemes that are prosodically bound (the grayed cells in Table 3) – a typical definition of prosodic clisis. The morphological independence of enclitics is what distinguishes them from suffixes. Suffixes, all toneless, are integrated into the same word as the root to which they are bound, both morphologically and prosodically. Enclitics, on the other hand, are not morphologically bound, as clearly shown by the fact that they occur utterance-initially, and that their order with respect to their prosodic host is not fixed – their position in the utterance is the result of purely syntactic requirements, independent of morphological or prosodic requirements. Finally, the assimilation processes at work between

Table 3: Tonal, morphological, and prosodic properties of morphemes in Paicî (morphemes below the dashed lines are all prosodically bound)

	Toneless	Toned	Predownstepped	Morphological status	Prosodic status
Free lexical items	0%	100%	no	free	free
Prefixes	0%	100%	no	bound	free
Bound lexical items	100%	0%	no	bound	bound
Suffixes	100%	0%	no	bound	bound
/=x̊/	100%	0%	no	free	bound
/=ꜜx̊/	100%	0%	yes	free	bound
/=ꜜx̀/	0%	100%	yes	free	bound

roots and suffixes are not attested across clitic boundaries. This is illustrated in (25), where the feature [nasal] spreads rightward from a nasal vowel onto following sonorants within the morphological word (25)a, but never spreads to enclitics (25)b.

(25) a. /nḭ̀ʌ̰̀ -ri̊ -e̊/ → [nḭ̀ʌ̰̀-ꜜɾ̰ḭ̀-ḛ̀]
look -TR -him/her
'look at him/her' (Rivierre 1983, 163)

b. /wià̰ =ꜜì.../ → [wìà̰ =ꜜì...], *[wìà̰ =ꜜḭ̀...]
follow =DEF...
'follow the...' (Rivierre 1983, 272)

The fact that enclitics may occur utterance-initially is not necessarily a problem for the enclitic analysis. First, it is worth noting that none of the enclitics of Paicî have a close morphosyntactic relation with their prosodic host: they are post-verbal adverbials (e.g. /=bo̊o̊/ 'down(ward)', /=åwe̊/ 'completely'), subordinators (/=ꜜnʌ̰̊ù X/ 'in order to X'), relative markers (e.g. /=ꜜnʌ̰̊ X/ 'that/which X'), coordinators (/=mʌ̰̊ X/ 'and X'), preverbal TAM markers (e.g. /=ꜜò/ FUTURE), and other functional heads preceding their complements, such as prenominal determiners (e.g. /=ꜜì X/ 'the X'), prepositions (e.g. /=nå̰å̰ X/ 'toward X'). Many of these are "ditropic" enclitics, i.e. they are morphosyntactically grouped with the following morpheme or phrase (often their complement), but prosodically integrated into the preceding prosodic word (Cysouw 2005, 18; Spencer & Luis 2012; Himmelmann 2014). This mismatch between morphosyntactic and prosodic phrasing explains why enclitics can stand utterance-initially. Indeed, they are, if not prosodically, at least morphosyntactically licensed in this position, e.g. /(=)ꜜwå̰ =nḭ̊ =bo̊o̊/ 'down here' in (24) above is a well-formed prepositional phrase, and will occur at the beginning of the utterance if the syntax wants it there. The analysis I propose is that enclitics placed in utterance-initial position by the morphosyntax undergo last-resort de-encliticization, i.e. exceptionally project their own prosodic word, in which case tonelessness is remedied by the assignment of a default L tone, as we saw in Section 5.4 above.[26]

6 Further properties of downstep

6.1 Incompatibility between H and downstep

Downstep in Paicî is attested only in L-toned prosodic words. In H-toned prosodic words, not only does phonological downstep never apply, as we saw in Section 4, but underlying downstep is also systematically left unrealized. This can be described as a general ban against the co-occurrence of H and downstep within a

[26] The possibility for functional morphemes to be prosodified differently depending on context is empirically supported in other languages (cf. van der Hulst 1999, 7, *passim*, Peperkamp 1997a,b, a.o.).

prosodic word: *H/↓.[27] This explains the *↓H ban illustrated in (18) – /ínʌ̰́ =↓wʌ̊/ → [ínʌ̰́ =(*↓)wʌ́] – and the *H↓L ban seen in (22) – /nʌ̰́ =↓ì/ → [nʌ̰́ =(*↓)ì]. The realization of /...$^{\text{H}}$ tḛ̀rḛ̀ =↓ì/ as [tḛ́rḛ̀ =ì] in (26) illustrates a case where H and downstep are further apart (*HL↓L). It also shows that the incompatibility between H and downstep does not discriminate between underlying lexical H and juncture H.

(26) /á̰ è =↓mwà̰à̰$^{\text{H}}$ tḛ̀rḛ̀ =↓ì pwʌ̰́-rʌ̰̊ í…
[á̰ è =↓mwà̰à̰ ⟨tḛ́rḛ̀ =ì⟩ pwʌ̰́-rʌ̰́ í...]
and (s)he) =SUCC hear =DEF noise-of cry
'Then he heard the crying noises [coming from Gobwinyara].' (G:14'37")

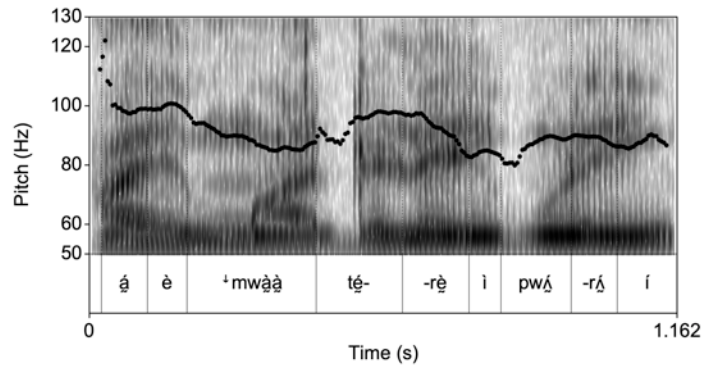


Figure 23: [á̰ è =↓mwà̰à̰ tḛ́rḛ̀ =ì pwʌ̰́-rʌ̰́ í...] 'Then he heard the crying noises [coming from Gobwinyara].' [NDP] (G:14'37")

Instrumental data clearly show that there is no phonetic distinction between /HL/ and /H↓L/ sequences, both realized with the same pitch drop (as already noted by Rivierre 1974, 328). This is the mirror image of languages with only downstepped H, where typically L↓H and LH don't contrast phonologically or differ phonetically.[28] This is shown in Figure 24. The upper pane in Figure 24a-b shows the F0 of the two tones in the first /HL/ (53 tokens, Figure 24a) and /H↓L/ (15 tokens, Figure 24b) sequences in all utterances in *Le Maître de Gobwinyara* (Rivierre 1967) where such sequences are not preceded by a downstep. Measurements correspond to the pitch target, accommodating for target delay, i.e. the highest pitch on (or near) the H-toned mora and lowest pitch on or near the L-toned mora. The lower pane displays the F0 difference between the first and second tone in each sequence. As can be seen, the realizations of underlying /HL/ and /H↓L/ sequences start on average with an equally high-pitched H: 105 Hz and 102 Hz respectively, i.e. a 3 Hz difference, statistically insignificant ($t(32.2) = -1.4$, $p = 0.1$).[29] The following /L/ and /↓L/ have nearly exactly the same pitch: 85 Hz and 86 Hz respectively, i.e. a 1 Hz difference, also statistically insignificant ($t(30.1) = 0.3$, $p = 0.7$). The pitch drop in /HL/ (20 Hz, Figure 24a, bottom) is on average 4 Hz greater than that in /H↓L/ (16 Hz, Figure 24b, bottom). This 4 Hz difference does reach statistical significance ($t(23.3) = 2.3$, $p = 0.02$*). However, with a p-value barely lower than 0.05, the significance level is rather low, and given the limited overall extent of the difference (4 Hz), and the non-significance of all other measurements, it is safe to conclude that these two sequences are perceptually indistinguishable, i.e. the pitch drop is virtually identical in both sequences. Note, additionally, that the minimal difference goes in the unexpected direction, i.e. if L and ↓L contrasted after H, one would expect [H↓L] to involve a greater pitch difference than [HL].

[27] Because H tones can only be found on tonal nuclei, and underlying downstep is found only in enclitics, H always precedes the co-occurring downstep.

[28] Thanks to Will Leben for bringing this parallel to my attention.

[29] Statistical significance is assessed using a Welch two-sample two-sided *t*-test at the 5% significance level ($p<0.05$).

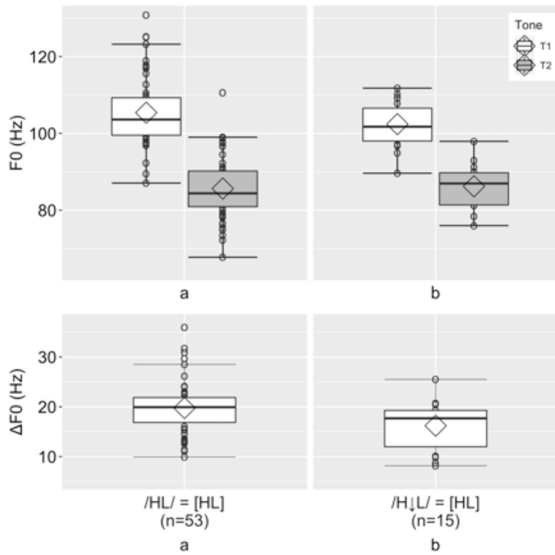


Figure 24: F0 (upper panel) and △F0 (lower panel) of /HL/ (a) and /HꜜL/ [NDP]

The *H/ꜜconstraint explains why the docking and spreading of the juncture H tone prevents both the realization of underlying downstep (cf. (26)), and the application of phonological downstep (cf. (12)b).

6.2 Utterance-initial downstep

The cross-linguistic expectation is that downstep is only realized when it contrasts with an immediately preceding tone, and is left unrealized when utterance-initial. This expectation is not met in Paicî, where ꜜL contrasts with L utterance-initially. Additionally, utterance-initial downstep in Paicî is not realized as a level L tone with lower pitch than a regular L, as in the few languages in which utterance-initial downstep has been reported to be contrastive.[30] Instead, it is most of the time realized as a downward pitch glide, at least in careful speech: /#ꜜL/ = [L͡ꜜL]/[3͡1] (the approximate pitch contour is represented with a schematic number notation from 1 (lowest) to 5 (highest), with utterance-initial L arbitrarily set at 3; morae are separated by dots). An utterance-initial /#ꜜL.L/ sequence is thus realized [L͡ꜜL.L]/[3͡1.1] and a /#ꜜL.H/ sequence as [L͡ꜜL.H]/[3͡1.3], as illustrated in (27)/Figure 25 and (28)/Figure 26 respectively.[31]

(27) /ꜜò nyḛ̀ cáápàì wʌ̀íjɛ́/
[ȍ ɲḛ̀ cáápàì wʌ̀íⁿɟɛ́]
FUT ASSERT all us
'It will be all of us together.' (G:19'54")

(28) /ꜜò cʌ̰́ jɛ̀ púú =ꜜwḁ̀ =nḭ̀/
[ȍ cʌ̰́ jɛ̀ púú =wḁ́ =nḭ́]
FUT NEG we sleep =LOC =here
'We will not sleep here.' (G:20'39")

[30] The only cases I am aware of are Bamileke Dschang (Hyman 1979, 12, Pulleyblank 1986, 39–42), Ikaan (Salffner 2009, 93, 96–97, 289–296), and Kipare, (Odden 1986, 263–264). There are most certainly more.

[31] Rivierre (1974, 328, fn.8) mentions this contoured realization only for the definite determiner /=ꜜḛ̀/ in utterance-initial position, but he does transcribe it for other predownstepped morphemes in texts published later, e.g. *ōò mwȁâ* = /ꜜò =ꜜmwḁ̀ḁ̀/ → [ȍ =mwḁ̀ḁ̀] (Bensa & Rivierre 1994, 177) (the second downstep is left unrealized here, cf. Section 6.3).

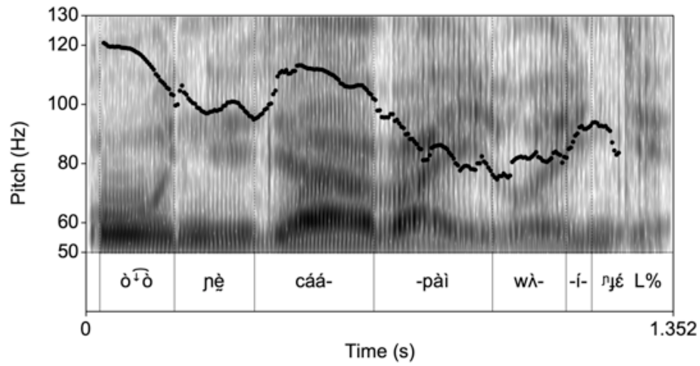


Figure 25: [ȍ̀ ɲḛ̀ cáápàì wʌ̀íⁿɟɛ́]' 'We will all enter together.' [NDP] (G:19'54")

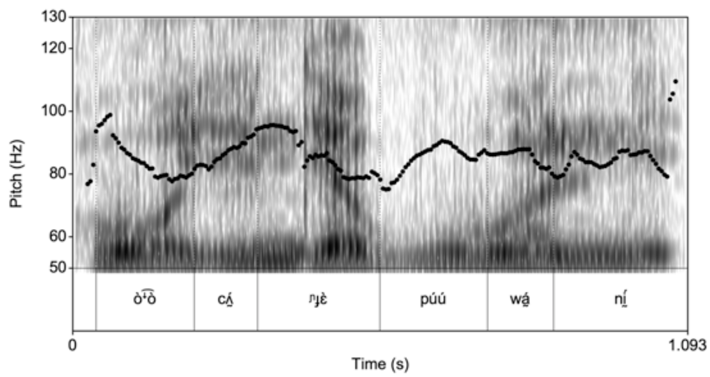


Figure 26: [ȍ̀ cʌ̰́ ⁿɟɛ̀ púú =wá̰ =nḭ́] 'We will not sleep here.' [NDP] (G:20'39")

In fast speech, the initial [L͡↓L]/[3͡1] contour is often simplified, and the downstep is delayed until the following mora. The realization of /#↓L.L/ thus varies between the expected [L͡↓L.L]/[3͡1.1] and simplified [L.↓L]/[3.1], both illustrated in (29)a/Figure 27, and (29)b/Figure 28. Similarly, /#↓L.H/ is frequently realized [L.↓H]/[3.3] instead of [L͡↓L.H]/[3͡1.3], as shown in (30)/Figure 29.[32]

(29) /↓ò =wi̊i̊ =↓dʌ̀/
a. [ȍ̀ =wìì =ⁿdʌ̀] (191121-07-AG1:86)
b. [ò =↓wìì =ⁿdʌ̀] (191121-12-AG1:54)
FUT =TIME =what
'When will it be?'

(30) /↓ò pʌ̰́ =nḁ̰̊ḁ̰̊ =↓pʌ̊/
[ò ↓pʌ̰́ =ná̰̰á̰ =pʌ́]
FUT AWAY =DIR =where
'Where will it be?' (191121-12-AG1:64)

In cases such as (30)/Figure 29, the downstep is thus "accidentally" realized on the following H, which, as expected in a total-downstep system, is realized at the same pitch as the preceding L. This clearly contrasts

[32]Since the H-toned prosodic word [pʌ̰́ =ná̰á̰ =pʌ́] is utterance final, it is realized as expected with pitch falling gradually to the final L%.

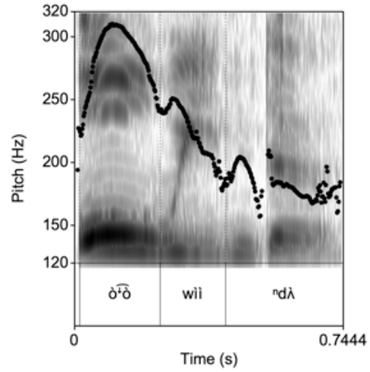


Figure 27: [ò͡↓ò =wìì =ⁿdʌ̀] ‘When will it be’ [AG] (191121-07-AG1:86)

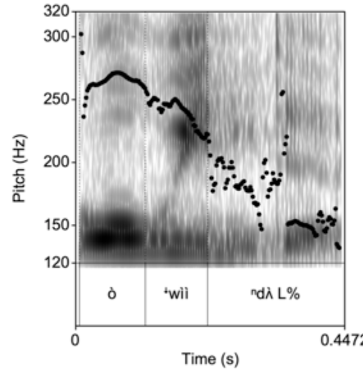


Figure 28: [ò =↓wìì =ⁿdʌ̀] ‘When will it be’ [AG] (191121-12-AG1:54)

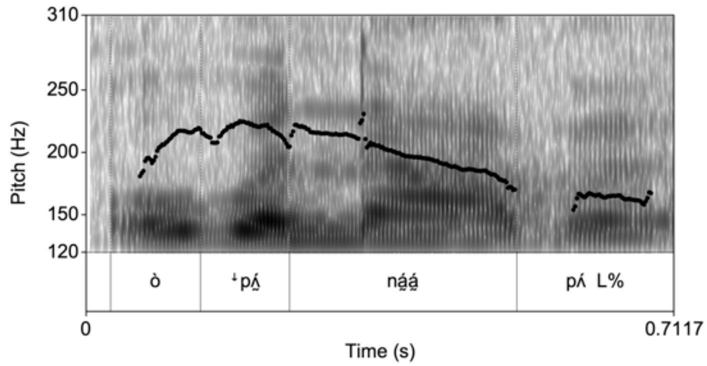


Figure 29: [ò ↓pʌ̰́ =nʌ̰́ʌ̰́ =pʌ́] ‘Where will it be?’ [AG] (191121-12-AG1:64)

with a non-downstepped /LH/ sequence, realized as a [35]. This is the only case of downstepped ↓H in the language (other than H tones indirectly downstepped by virtue of following a downstepped ↓L), and it clearly arises only as the occasional realization of an utterance-initial /↓LH/ sequence in fast speech.

Finally, utterance-initial downstep is sometimes left unrealized before a H tone in fast speech, i.e. /#↓L.H/ = [L.H]/[3.5] , as in (31) and Figure 30. The three realizations [L͡↓L.H], [L.↓H], and [L.H] of /#↓L.H/ appear to be mostly conditioned by speech rate.

(31) /↓bwàà cʌ̰́ gò càà wà̰dò kàpé/
[bwàà cʌ̰́ gò càà wà̰dò kàpé]
IPFV NEG I CHANGE drink coffee
‘I don’t drink coffee anymore.’ (191121-12-AG1:17)

6.3 Culminativity of downstep

The number of downsteps per utterance in Paicî is in principle unlimited, as we saw in example (9)/Figure 6 above, repeated in (32) below with the relevant metrical parsing. This is one of the main cross-linguistic properties of downstep (Hyman 1979; Rialland 1997; Leben 2018).

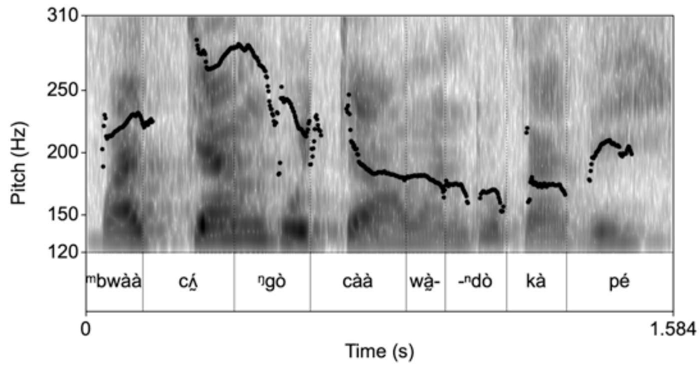


Figure 30: [bwàà cʌ̰́ gò càà wà̰dò kàpé]‘I don’t drink coffee anymore.’ [AG] (191121-12-AG1:17)

(32) /á̰ è =$^{\downarrow}$mwà̰à̰^{H} tɨ̀-^{H}nʌ̰́pó gɔ̀ =$^{\downarrow}$ì dà =kɛ̰̊ɛ̰̊ =$^{\downarrow}$wʌ̊ pwìrìdùà/
[á̰ ⟨è =$^{\downarrow}$mwà̰à̰⟩ tɨ̀-nʌ̰́pó ⟨gɔ̀ =$^{\downarrow}$ì⟩ ⟨(dà =kɛ̰̀)$^{\downarrow}$(ɛ̰̀ =wʌ̀)⟩ ⟨(pwìrì)$^{\downarrow}$(dùà)⟩]
and (s)he =SUCC adjust-propeller on =DEF spear =his =SBJ (name)
‘And Pwiridua adjusts the propeller on his spear.’ (G:06’40”)

However, within the prosodic word, the number of possible occurrences of downstep is limited to one. Whenever there is enough material within a prosodic word for more than one downstep, only the leftmost one is realized. This is shown in example (33), which, as seen in (33)a/Figure 31, is not realized with two downsteps, despite the fact that it contains eight morae, i.e. enough to parse two cola and trigger phonological downstep twice, as shown in (33)b. Only the first colon triggers phonological downstep. There is actually no evidence for foot and colon parsing past the initial colon, since phonological downstep and the realization of the juncture H tone, both of which are never attested past the third mora, constitute the only evidence for metrical structure (cf. Section 4.2, and Lionnet 2019). (The L-toned morae after the downstep in Figure 31 undergo declination, and the final mora in [pòìà] is further lowered by the realization of the final L%.)

(33) /...=mʌ̰̊ tɛ̀ɛ̀pàà =bo̊o̊ =nå̰å̰ pòìà/
a. [...=mʌ̰̀ ⟨{(tɛ̀ɛ̀)$^{\downarrow}$(pàà)} =bòò =nà̰à̰⟩ pòìà]
b. *[...=mʌ̰̀ ⟨{(tɛ̀ɛ̀)$^{\downarrow}$(pàà)} {(=bòò) $^{\downarrow}$(=nà̰à̰)}⟩ pòìà]
=and arrive =down =DIR (place.name)
‘...and [he] arrives in Poia.’ (G:12’22”)

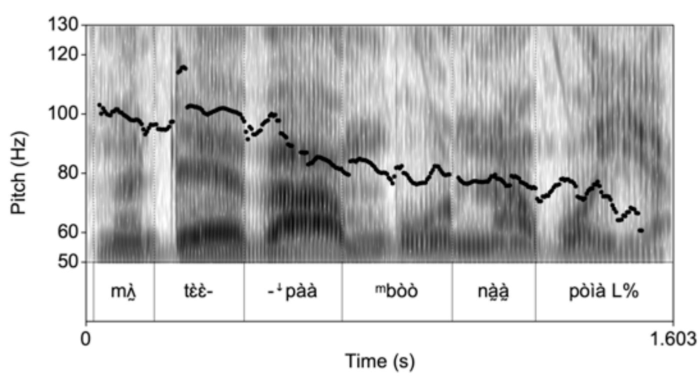


Figure 31: [...=mʌ̰̀ tɛ̀ɛ̀$^{\downarrow}$pàà =bòò =nà̰à̰ pòìà] ‘...and he arrives in Poia.’ [NDP] (G:12’22”)

This constraint applies to both phonological and underlying downstep. If a prosodic word meets the conditions of application of phonological downstep (i.e. is L-toned and at least four-morae long) and contains one or more predownstepped enclitics, the earliest downstep in the prosodic word always takes precedence, irrespective of its nature. This is illustrated in (34) below, where underlying downstep is exceptionally represented with a superscript exclamation point "ꜝ", to distinguish it from phonological downstep, represented with the regular downward arrow "ꜜ".[33]

(34) a. µ̀µ̀µ̀ꜝµ̀ → *(µ̀µ̀)ꜜ(µ̀ꜝµ̀) → (µ̀µ̀)ꜜ(µ̀µ̀)
/è tà̰ =mwå̰̀rå̰̀ =ꜝì mʌ̰̀rɨ̰̀/
[è ⟨(tà̰ =mwà̰)ꜜ(rà̰ = ì)⟩ mʌ̰̀rɨ̰̀]
it fly =again =DEF bird
'The bird flies off again.' (171228-02-HN1:145) (cf. (23)/Figure 21 above)

b. µ̀ꜝµ̀µ̀µ̀ → *(µ̀ꜝµ̀)ꜜ(µ̀µ̀)→ (µ̀ꜝµ̀)(µ̀µ̀)[34]
/ì nṵ̀ =ꜝbåù =ꜝì wáápwíí/
[ì ⟨(nṵ̀ =ꜝbà)(ù = ì)⟩ wáápwíí]
DEF coconut.tree =and DEF araucaria
'the coconut tree and the araucaria' (191121-05-AG1:5)

In the two examples in (34), only the leftmost downstep is realized, that is, the metrically conditioned phonological downstep in (34)a, and the underlying downstep in (34)b, as can be seen in Figure 21 above and Figure 33 (see also (19) and Figure 15 for an example similar to (34)a).[35]

When underlying and phonological downstep coincide, i.e. affect the same mora, as in (35)/Figure 33, the affected mora is realized with the regular one-step pitch drop expected of either type of downstep – i.e. there is no cumulative effect.

(35) µ̀µ̀ꜝµ̀µ̀ → *(µ̀µ̀)ꜜꜝ(µ̀µ̀) → (µ̀µ̀)ꜜ(µ̀µ̀)
/rʌ̀ cʌ̰̀bù =ꜝwå̰̀ =nḭ̀̊ =bò̊ò̊/
[rʌ̀ ⟨(cʌ̰̀ᵐbù) ꜜ(=wà̰ =nḭ̀) =ᵐbòò⟩]
they dance =LOC =here =down
'They are dancing down there.' (191121-02-AG1:2)

6.4 The accentual properties of downstep

As the reader might have noticed already, downstep in Paicî has properties that suggest that it might be an accentual rather than tonal phenomenon. Accent is typically defined by the combination of three properties: CULMINATIVITY, DEMARCATIVITY – accent occurs in a predictable position with reference to some morpheme edge, implying metrical structure in most cases –, and OBLIGATORINESS – every lexical (non-

[33] Some of my elicited data contradict this generalization – specifically trisyllabic L-toned nuclei followed by the relative marker /=ꜜnʌ̰̊̀/. For example, /...=ꜜì à̰bòrò =ꜜnʌ̰̊̀.../ (DEF person REL) '...the person that...' is most of the time realized [ì ⟨à̰bòrò =ꜜnʌ̰̀⟩] in elicitation by both HN and AG, instead of the expected [ì ⟨(à̰bò)ꜜ(rò =nʌ̰̀)⟩]. This unexpected realization – possibly partly conditioned by the word and morphosyntactic boundary between [à̰bòrò] and [nʌ̰̀] – is not attested in Rivierre's recorded texts, and is not mentioned in his 1974 paper. It is possible that the unnaturalness of the elicitation context might perturb the realization of downstep in this case.

[34] It is unclear whether foot/colon structure is present at all in such cases, or whether it is blocked by the realization of the earlier underlying downstep. This could be tested by looking at the realization of the juncture H tone in this context: /H µ̀ꜝµ̀µ̀µ̀/ → a. [µ́µ̀µ̀µ̀] (no metrical structure), or b. [(µ́µ́)(µ̀µ̀)] (metrical structure and deletion of downstep to comply with *H/ꜜ). I unfortunately do not have this data.

[35] L-raising before downstep (cf. footnote 20) is at work in (34)b and (35), which explains the pitch rise from [ì] to [nṵ̀] in Figure 32 and from [rʌ̀] to [cʌ̰̀ᵐbù] in Figure 33.

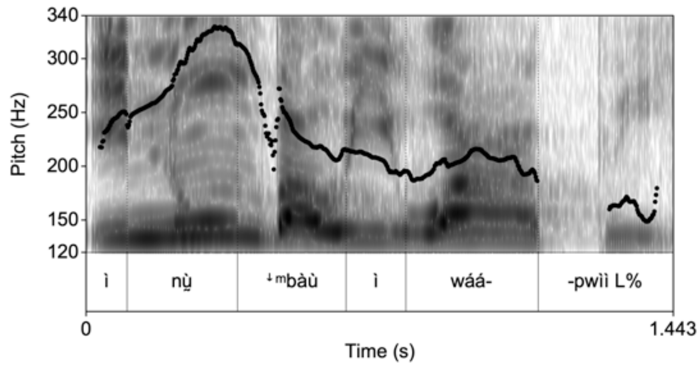


Figure 32: [ì nù̯ ꜜᵐbàù =ì wáápwíí] ‘the coconut tree and the araucaria’ [AG] (191121-05-AG1:5)

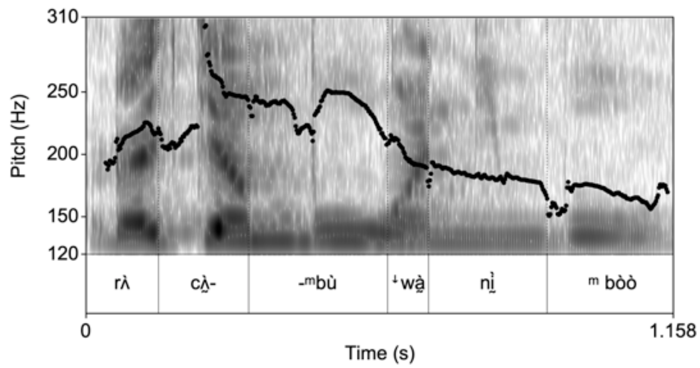


Figure 33: [rʌ̀ cʌ̯̀ᵐbù =ꜜwà̯ =nì̯ =ᵐbòò] ‘They are dancing down there.’ [AG] (191121-02-AG1:2)

grammatical) item in the language is accented (cf. van der Hulst 1999, 2002, 2006; Hyman 2006; van Zanten & Goedemans 2007; Downing 2010; a.o.). Note that these properties, taken independently of one another, are not specific to accent (Hyman 2006, 2011). Only their combination is taken to be definitional of accent.

Phonological downstep in Paicî shares two of these properties: it is culminative within the prosodic word (cf. Section 6.3), and demarcative – it systematically highlights the prominence of the initial foot and colon in the prosodic word (cf. Section 4.2).[36] However, downstep clearly fails to satisfy the obligatoriness criterion, and can thus not be considered a *bona fide* accentual system. Indeed, (i) downstep is only ever found on L-toned words (only 60% of lexical items are L-toned), and (ii) only L-toned words containing at least four morae ever trigger the application of phonological downstep.[37]

Downstep is thus not an accentual system independent of tone in Paicî, but is rather integrated into the tone system. There are at least two clear indications of this integration. Firstly, metrical conditioning is not characteristic of downstep only, but also plays a role in the realization of the juncture H-tone, which is assigned to the initial constituent within the prosodic word – the initial foot if there is enough material to parse a colon, otherwise the initial mora (cf. Section 4.2, example (12)). Secondly, the *H/ꜜconstraint

[36] Additionally, the “leftmost downstep wins” principle at work in enforcing downstep culminativity in Paicî is reminiscent of similar accentual phenomena, e.g. Turkish, where the culminativity violation created by the concatenation of two underlyingly stressed morphemes is solved by keeping only the leftmost one (Inkelas 1999).

[37] Underlying downstep is not in and of itself an argument against the accentual analysis, since (i) underlyingly accented morphemes are attested even in languages where accent is mostly derived and predictable, and (ii) underlying downstep is subject to the same culminativity constraint as predictable phonological downstep.

demonstrates a direct interaction between downstep and tone.

It is still striking, however, that the elements that constitute the tone system – H, L, and downstep – seem to naturally fall into two easily distinguishable categories: the H/L contrast, which defines a canonical tone system with none of the properties associated with accent[38] – and downstep, which, despite its integration into the tone system, has clear accentual flavors. I show in the next section that these marked differences justify an analysis in which tones (H and L) and register (downstep) are two separate phonological objects. I also present preliminary comparative data in Section 9.2 suggesting that the tonemes H and L emerged later and from a different source than downstep, which is most likely a former accent system reinterpreted as tonal after the innovation of the H vs. L tonal contrast.[39]

7 Downstep as a register feature

The representational analysis of enclitics proposed in Section 5 above rests on the idea that downstep and tone are two phonological objects of different nature. As such, downtep must be posited in underlying representation whenever it is not predictable, as with predownstepped enclitics (cf. Sections 5.2 and 5.3). This is easily captured if one analyzes downstep as a register rather than tonal feature (an analysis already tentatively proposed by Nicole (1980) for Nawdm). In this section, I present a register analysis of downstep in Paicî, using Snider's (1988; 1990; 1998; 1999; 2020) Register Tier Theory (RTT). I compare this analysis with a more conservative one deriving downstep from tonal interactions in Section 8.1.

Snider's model elaborates on Autosegmental Phonology by decomposing tone into two main tiers, with two possible features each: a tonal tier (H, L), and a register tier (*h*, *l*). The register features *h* and *l* are defined as instructions that the associated TBU(s) be realized within a pitch register higher (*h*) or lower (*l*) than the preceding register setting. Downstep is a transition from any register to *l*, while upstep is a transition from any register to *h*. TBUs bearing the tonal feature H or L are to be realized at a high or low pitch within the register setting to which they are associated (Snider 2020, 25). The register and tone tiers are both linked to a root node tier, which is what the TBU is associated with, as illustrated in (36).

(36) Geometry of tone (Snider 2020, 23)

h	Register tier
H	Tonal tier
○	Tonal root node tier
μ	Tone-bearing unit tier

Snider (2020) uses various combinations of register and tone features as well as underspecification to account for a variety of tonal inventories and processes such as tone spread, total tone assimilation, downstep, and upstep. The present paper is not the place for a full presentation and evaluation of Snider's theory. The goal of this section is to propose an illustrative analysis of Paicî tonology couched in RTT, in order to highlight the advantages of recognizing a register tier separate from the tonal tier to represent register-affecting phenomena

[38] Isotonic words are not a case of culminativity, despite arguably having only one underlying tone. Indeed, the tone in question is realized on every mora in the word, instead of just one or a subset – e.g., there is no syntagmatic contrast between a H-toned portion and a non-H-toned portion in a H-toned word.

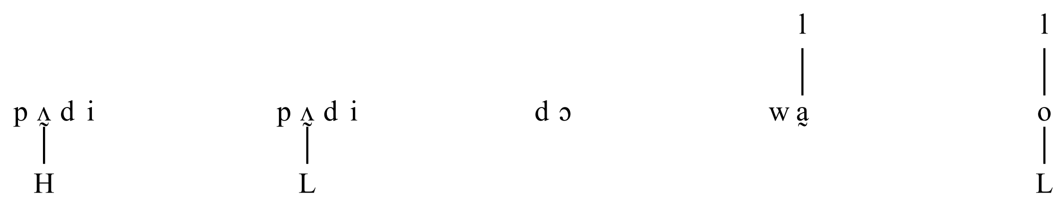
[39] The accentual flavor of downstep could suggest that Paicî is better characterized as a "pitch accent" language (see Hyman 2006 for a criticism of this notion), or at least a prosodic system intermediate between tone and accent. Interestingly, accent-like behavior only affects downstep and not the tonemes H and L. In that sense, Paicî is different from languages typically classified as "pitch-accent" such as Somali or Japanese, where accent-like behavior characterizes the entire tone system.

such as downstep. Tonal processes are understood as ordered rules, although this is not crucial to the argument – the same representations could be used in an Optimality-Theoretic parallel account.

7.1 Accounting for underlying downstep

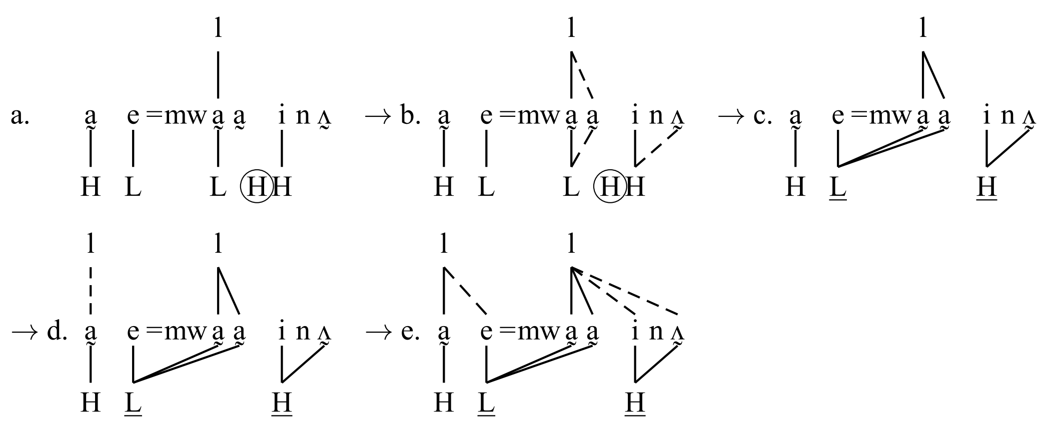
The Paicî tone system can be a analyzed with only three features: two tones H and L, and a *l* register feature. I propose to analyze all Paicî morphemes as underspecified for register, except for those with underlying downstep, which bear a *l* register feature. H- and L-toned morphemes are specified for the tonal features H and L respectively, and toneless morphemes are underspecified for tone. The five tonal types of morphemes attested in Paicî are represented in (37): H-toned (37)a, L-toned (37)b, toneless (including H/L enclitics) (37)c, predownstepped toneless (H/ꜜL enclitics) (37)d, and predownstepped L-toned (L/ꜜL enclitics) (37)e. (The sixth type – non-isotonic lexical items – are similar to isotonic ones in (37)a-b, except they bear more than one underlying tonal features.) I assume that tone is underlyingly associated with the initial mora in isotonic words and later spreads rightward within the prosodic word (alternatives are possible whereby tone is either not associated underlyingly and associates later, or is underlyingly fully associated with all TBUs). I also simplify Snider's representation by collapsing the TBU and tonal root node tiers (henceforth referred to as "TBU"), and by representing the register and tonal tiers above and below the TBU tier respectively.

(37) a. /pʌ̰́dí/ 'hit' b. /pʌ̰̀dì/ 'divide' c. /=dɔ̊/ 'up' d. /=ꜜwå̰/ 'at, in' e. /ꜜò/ FUTURE



The full specification of surface forms can be accounted for with three very common principles and operations of Autosegmental Phonology: spreading, the Obligatory Contour Principle, and fusion or "Merger" (Snider 2020, 9). All tonal operations occur in two postlexical domains: the prosodic word (PW), and the utterance. A subset of these operations are illustrated in (38), partially repeated from (18) above /á̰ è ꜜmwà̰à̰^{H} ínʌ̰́.../ [á̰ è ꜜmwà̰à̰ ínʌ̰́...] 'and [Pwiridua] then said...'.

(38)



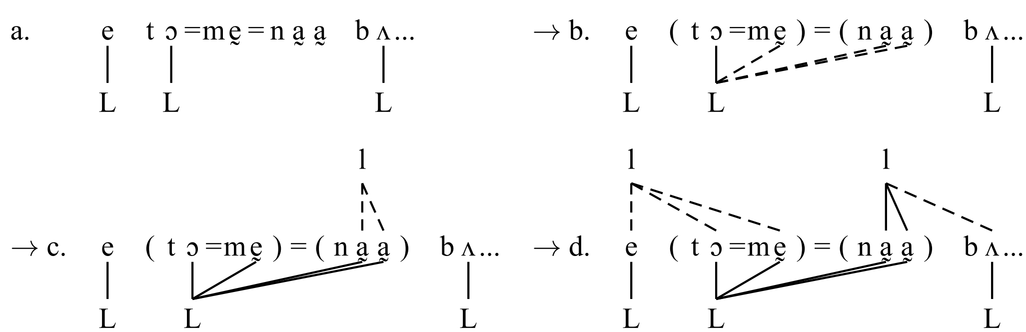
(38)b-c illustrate three PW-level operations: spreading of tone and register features onto following toneless or registerless morae in (38)b, and tone merger as a result of PW-internal OCP-Tone in (38)c (merged elements are underlined). (38)d-e illustrate two Utterance-level processes: utterance-initial boundary *l* insertion in (38)d (Snider 2020, 45-47), and spreading of register features to all following register-less morae, irrespective of prosodic boundaries (38)e. Note that the floating juncture H assigned by the successive marker

/ꜜmwà̰à̰^{H}/ merges with the H tone of the following PW /ínʌ̰́/ ‘say’ (floating tones are circled). Evidence that the utterance-initial *l* is a boundary register feature rather than late insertion of a default *l* onto register-less morae is given in (42)-(43) below and surrounding prose.

7.2 Accounting for phonological downstep

Metrically conditioned phonological downstep can be analyzed as insertion of a *l* register feature on the initial TBU of the second foot in a colon, to avoid an OCP violation between two L-toned bimoraic feet (OCP-Ft_L: $Ft_L Ft_L \rightarrow Ft_L{}^{\downarrow}Ft_L$). This is shown in (39), repeated from (16)c above /è tɔ̀ =mḛ̊ =nå̰å̰ bʌrʌ̀-wìʌ̀/ [è tɔ̀ =mḛ̀ =ꜜnà̰à̰ bʌrʌ̀-wìʌ̀] ‘(S)he came back (from the sea) to the shore.’ *l*-insertion takes place in (39)c, after prosodification and tone spread have applied in (39)b (the initial four morae/two feet must first be associated with L). It is followed by PW-internal register spread, also shown in (39)c. Utterance-level boundary *l* insertion and register spread are shown in (39)d.

(39)

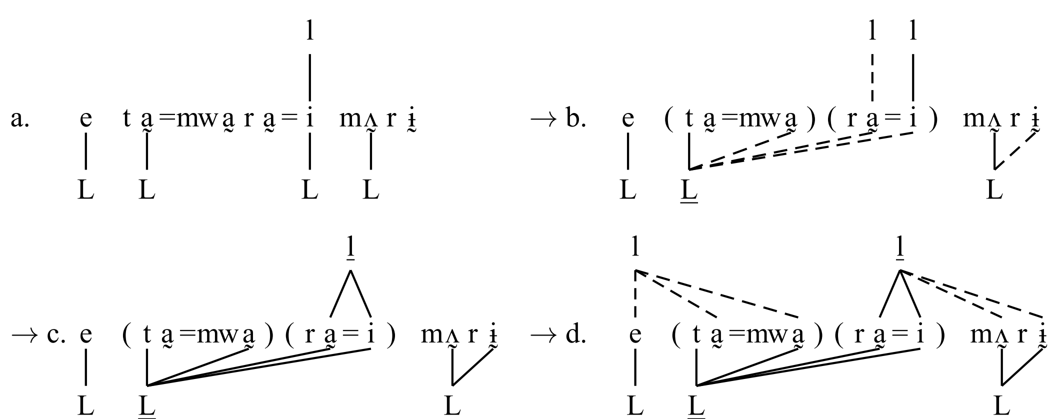


Note that, while OCP-tone (and OCP-register, see below) are evaluated on the tonal (or register) tier, OCP-Ft_L must be evaluated on the *surface string* of footed L-toned morae, which conflates information from the tonal and register tiers, as well as metrical structure. Evaluation on the tonal tier alone, where there is only one L tone spread over the four morae, is insufficient (cf. Jardine 2020 for more discussion on the distinction between *surface-string* and *melody-string* (≈ tonal/register tier) evaluation in tonal processes).

7.3 Accounting for downstep culminativity within the Prosodic Word

The culminativity of downstep within the prosodic word described in Section 6.3 is straightforwardly accounted for by register-feature merger, which applies to avoid a violation of a PW-internal OCP-register constraint. This operation follows the *l*-insertion caused by OCP-Ft_L and PW-internal register feature spread. This is shown in (40), repeated from (23) /è tà̰ =mwå̰rå̰ =ꜜì mʌ̰̀rɨ̰̀/ [è tà̰ =mwà̰ꜜrà̰ =ì mʌ̰̀rɨ̰̀] ‘The bird flies off again.’

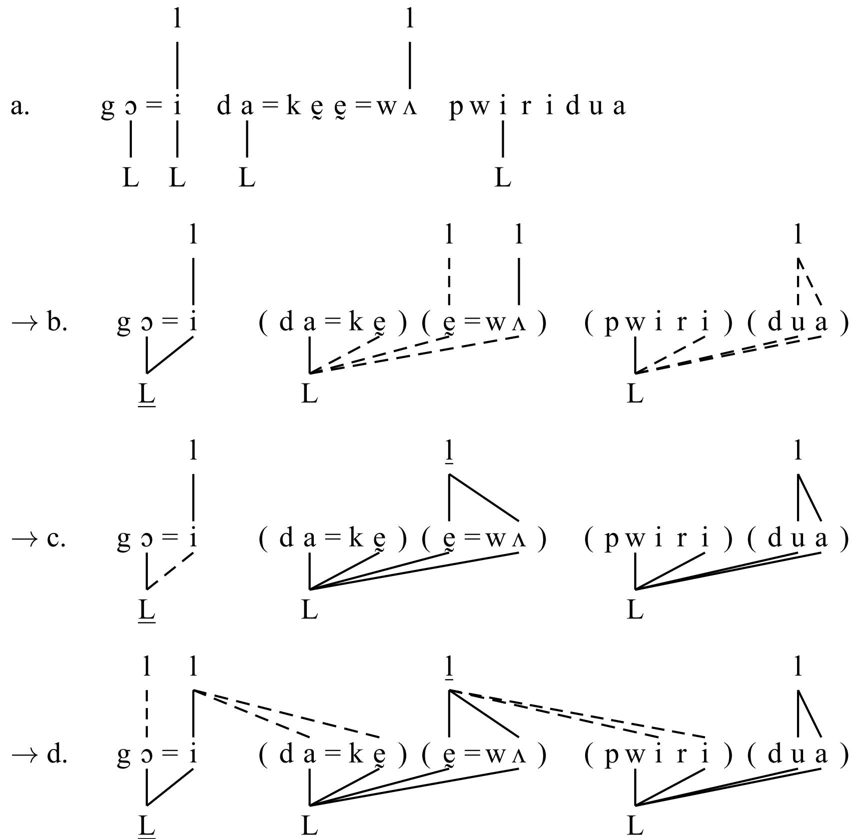
(40)



The metrically conditioned downstep is inserted in (40)b after tone spread and tone merger. It then merges in (40)c with the following underlying *l* borne by the determiner /ꜜì/. Utterance-level boundary *l* insertion and register feature spread finally take place in (40)d. One of the advantages of this analysis is that it naturally accounts for the leftmost preference described in Section 6.3. Indeed, merger effectively amounts to the disappearance of all but the first *l*.

The fact that it is possible to have an (in principle) unlimited number of successive downsteps in an utterance shows that OCP-register applies only at the PW level. This is shown in (41), partially repeating (32): /...gɔ̀ =ꜜì dà =kḛ̊ḛ̊ =ꜜwʌ̊ pwìrìdùà/ [⟨gɔ̀ =ꜜì⟩ ⟨(dà =kḛ̀)ꜜ(ḛ̀ =wʌ̀)⟩ ⟨(pwìrì)ꜜ(dùà)⟩] 'Pwiridua [adjusts the propeller] on his spear.'

(41)

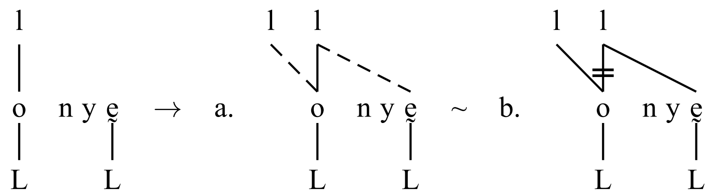


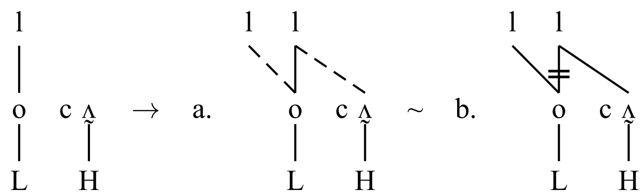
As seen, OCP-register applies within the prosodic word [dà =kḛ̀ꜜḛ̀=wʌ̀] in (41)c (after prosodification and application of PW-level tone spread, *l*-insertion, and register spread in (41)b, but it does not apply after Utterance-level register spread in (41)d.

7.4 Accounting for utterance-initial downstep

The tonal representations and operations proposed above naturally account for the realization of utterance-initial downstep (cf. Section 5.4). The inserted utterance-initial boundary *l* feature combines with the underlying *l* borne by the initial TBU, resulting in a $\widehat{ll}$ register contour on a L-toned mora, i.e. [L͡ꜜL]. This is illustrated in /# ꜜò nyḛ̀/ = [ꜜò ɲḛ̀] in (42)a and /# ꜜò cʌ̰́/ = [ꜜò cʌ̰́] in (43)a, partially repeated from (27) and (28) above. This contour does not violate OCP-register, because the boundary *l* is inserted at the Utterance level, where OCP-register is not active.[40]

[40] This is a "unitary" register contour in Snider's (2020, 55-57) terminology. Snider does not mention the possibility of unitary register contours involving two identical register features. However, his definition of register features as instructions to raise (*h*) or

(42) 

(43) 

The delayed realization of utterance-initial downstep, frequent in regular to fast speech, is straightforwardly analyzed as a simplification of this register contour by delinking the underlying downstep from the initial mora, as shown in [o ꜜɲḛ̀] in (42)b and [ò ꜜcʌ̰́] in (43)b.

The analysis developed so far predicts that predownstepped toneless enclitics (e.g. /=ꜜwḁ̊/ 'in, at') should behave like predownstepped L-toned ones (e.g. /=ꜜò/ FUTURE) utterance-initially: default L insertion caused by de-encliticization and boundary *l* insertion indeed yields exactly the same configuration as in (42) and (43) above. To account for the fact that predownstepped toneless enclitics do not keep their downstep when utterance-initial, one must analyze de-encliticization (i.e. last resort projection of a prosodic word) as operating in two different ways depending on whether the enclitic has an underlying tone or not. A prosodic word is necessarily headed by a tonal nucleus, i.e. a morpheme with an underlying tone, H or L. If an enclitic has an underlying tone, then its tonal profile (including its register feature) is kept unchanged when de-encliticized. If, on the other hand, it does not have an underlying tone, its tonal specification (including register feature) is entirely wiped out and replaced with a default L specification: /=ꜜwḁ̊/ → /wḁ̀/. The resulting tonal nucleus behaves exactly like any other L-toned nucleus.

The utterance-initial realization of underlying downstep is the main argument in favor of viewing the *l* feature inserted utterance-initially as a boundary tone, rather than simply a default register feature inserted for the sole purpose of specifying register-less morae: the association of the utterance-initial TBU with an underlying *l* in predowntepped toneless enclitics would prevent the insertion of a default structure-filling *l*, failing to account for the utterance-initial downstep in (43) and (42) above. Instead, the boundary *l* is inserted irrespective of whether the utterance-initial TBU is specified for register or not.[41]

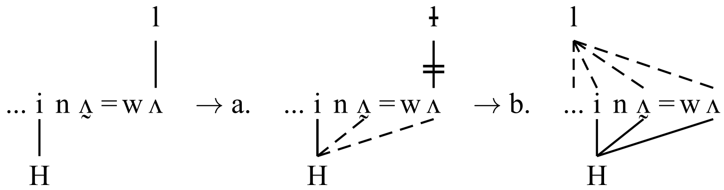
7.5 Acounting for the incompatibility of H and downstep

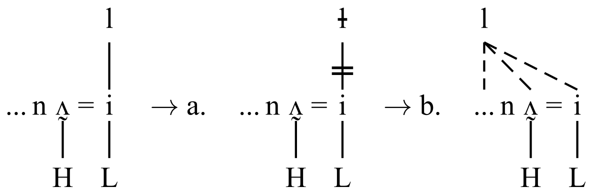
The incompatibility of H tones and downstep can be analyzed as the deletion of all *l* features within a prosodic word containing a H tone – underlying, as in (44) and (45) (partly repeated from (18) and (22)a), or from

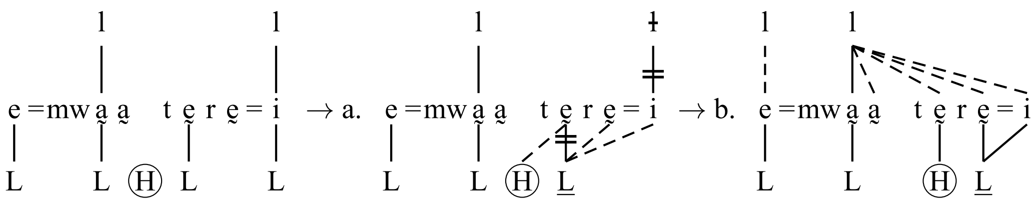
lower (*l*) the register makes such contours possible: a $\widehat{ll}$ contour does not contain the same indication of pitch or register twice, but two successive register-lowering instructions. Such contours are of course predicted to be ruled out by OCP. I have shown that this constraint does not apply in such contours in Paicî, because they are created at the Utterance level, which is not subject to OCP constraints. Defining the utterance-initial boundary register feature as *h* in Paicî (which would solve the OCP-register violation issue since the resulting contour would be $\widehat{hl}$) is thus not necessary – which is advantageous, since *h* is needed nowhere else in the language.

[41] The interpretation of an utterance-initial register feature in terms of pitch is taken to be relative to a reference point that native speakers have "in mind" (Snider 2020, 25). This reference point is not represented in Snider's theory. One possibility would be to replace the utterance-initial boundary *l* in the analysis above with a representation of the default reference point – whose exact translation in terms of pitch range depends on a number of factors, chief among which is the number of pitch drops contained in the utterance. In this analysis, an utterance-initial downstep would simply be represented by an underlying *l* feature on the initial mora, the downward gliding contour being the realization of the transition from the default reference pitch to the lower register imposed by this underlying *l*.

juncture H, as in (46).[42]

(44) 

(45) 

(46) 

Just like OCP-register, this constraint is not active at the Utterance level, where a *l* register may spread across a prosodic word boundary onto a H-toned mora, as in (44)b, (45)b and (46)b (see also (38) and (43) above).

7.6 Summary

The tone system of Paicî is entirely accounted for with the following representations and rules/constraints:

(47) a. Tonal representations:
- (i) Three tonal features: two tones (H and L) and one register feature *l*;
- (ii) Three types of tonal enclitics: Ø, *l*Ø, *l*L;

(48) b. PW-level phonology (ordered rules):
- (i) Tone spread onto toneless morae;
- (ii) Tone merger as a solution to OCP-Tone;
- (iii) *l*-insertion on initial mora of second foot as a solution to OCP-Ft_L;
- (iv) Register spread onto register-less morae;
- (v) Register merger as a solution to OCP-register.

(49) c. Utterance-level phonology (ordered rules):
- (i) Utterance-initial boundary *l* insertion;
- (ii) Unbounded rightward register spread onto register-less morae.

Register is mostly independent from tone in Paicî – at least in the sense that register and tonal features are manipulated independently.[43]

The overall register profile of (unmarked) utterances in Paicî is l_1^n, i.e. an utterance may be realized

[42] The juncture H tone delinks the following L from its original position. It further spreads to the entire initial foot if the first mora is footed. Since the juncture H tone is somewhat peripheral to the study of downstep, its detailed analysis is left aside here.

[43] The independence of the register and tone tiers in Paicî differs from most cases for which Snider uses RTT, where tone and register are tightly interrelated. In particular, tonal and register features are used as subtonal features, similar to Yip (1980) and Pulleyblank's (1986) [±upper] and [±high/raised], to account for three-, four-, or five-tone systems (e.g. H = H*h*, M_2 = L*h*, M_1 = H*l*, L = L*l*, Snider 2020, 58). There is no room in the present paper for further discussion of this difference and its implications for potential necessary revisions to RTT theory and the representation of register phenomena such as downstep and upstep.

with the same register throughout, or with a succession of lower registers. This terracing effect conforms to Rivierre's apt characterization of the system:

> the tonal melody of a Paicî utterance between two pauses can be likened to going down a flight of stairs step by step *[i.e. HL or L$^{\downarrow}$L transition]*, with numerous plateaus or upward movements – but at no point is it possible to go back up more than the last step down *[i.e. LH transition within the same register, in a total downstep system]*. (Rivierre 1974, 329, my translation and added comments)

8 Alternatives

In this section, I show that the analysis proposed in Section 7 (henceforth "Register Analysis") fares better than alternatives in which downstep is analyzed as the result of tonal interaction alone.

8.1 Downstep caused by OCP-L

One might propose a representationally more economic analysis positing only two tonemes H and L, and analyzing downstep as resulting from an OCP constraint against adjacent L tones on the tonal tier, with no need to view it as its own phonological object, register feature or otherwise. I develop such an analysis here (henceforth "Tone Analysis"), and show in Section 8.1.6 that it is inferior to the Register Analysis.

8.1.1 Basic representations

The analysis of H- and L-toned lexical items is unchanged, as well as that of H/L enclitics, still analyzed as underlyingly toneless (48)a. H/$^{\downarrow}$L and L/$^{\downarrow}$L enclitics are analyzed as L-toned (48)b and L-toned preceded by a floating L (48)c, respectively, as shown below.

(48) a. / d ɔ / 'up' b. / w ã / 'at, in' c. / o / FUTURE
L L L

PW-internal OCP is solved, not by merger, but by inserting a downstep between the two adjacent identical tones. The representations in (48) above together with this OCP effect offer a unified analysis of downstep, whether it be predictable (phonological downstep) or unpredictable (underlying). (The OCP will be further elaborated later.) This offers a straightforward account of H/$^{\downarrow}$L enclitics, as shown in (49) below (repeated from (18)b) with the subject marker /=wʌ̀/ (/=$^{\downarrow}$wʌ̊/ in the Register Analysis, cf. Section 5.2).

(49) t ɔ = w ʌ → t ɔ = w ʌ
L L L $^{\downarrow}$L

A H spread rule delinking a following L accounts for the H-toned realization of H/$^{\downarrow}$L enclitics after H-toned nuclei, as illustrated in (50).

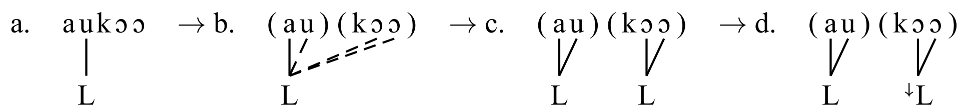
(50) a. i n ʌ̰ = w ʌ → i n ʌ = w ʌ (cf. (18)a)
H L H ~~L~~

b. t ɨ r a = n ʌ̰ = w a̰ → t ɨ r a = n ʌ̰ = w a̰
H L L H ~~L~~ ~~L~~

H spread is unbounded and delinks all following L tones within the prosodic word, as seen in (50)b, extracted from the utterance [...⟨tɨ́rá =n̰ʌ́ =wá̰⟩ n̰ʌ̀ígè] (... talk.to REL LOC path) '... talk to [the one] who [is] on the way' (Bensa & Rivierre 1994, 150), where both [=wá̰] and [=n̰ʌ́] are H/↓L enclitics, i.e. underlyingly /=wà/ and /=n̰ʌ̀/ in the Tone Analysis. I will present the analysis of L/↓L enclitics in Section 8.1.5.

8.1.2 Accounting for phonological downstep: tone split

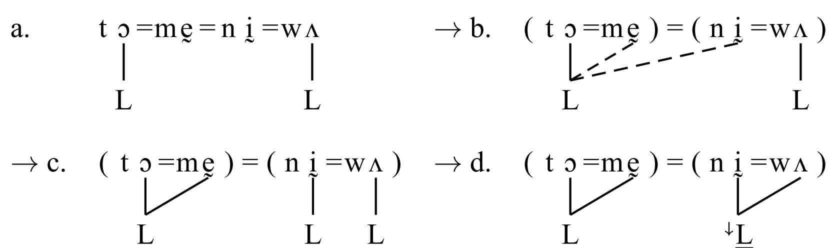
In order to analyze the metrically conditioned phonological downstep as resulting from the same OCP effect, the two feet in the PW-initial colon must bear two different L tones. This can be obtained by a split of the lexical L spread across the prosodic word, as a response to a constraint banning multiple linking of tones across a foot boundary, (e.g. CRISPEDGE(Ft,Tone), using Itô and Mester's 1999 formalism) – i.e. a split caused by metrical structure. This is illustrated in (51) (cf. Figure 1).

(51) 

After PW-internal tone spread and prosodification in (51)b, tone split occurs in (51)c. This creates an OCP violation, which is solved by downstepping the second L in (51)c, just like in (49) above. The non-application of phonological downstep in H-toned prosodic words can be accounted for in three different ways: (i) prosodic parsing does not occur in H-toned prosodic words (there is, after all, no evidence for prosodic structure in these words); (ii) H never splits; or (iii) there is a fundamental difference between OCP-L, solved by downstep, and OCP-H, solved by merger – which undoes tone split.[44]

8.1.3 Accounting for Prosodic Word culminativity: dichotomous OCP

The analysis developed so far does not account for the culminativity and leftmost preference of downstep within the PW. Indeed, OCP violations should lead to multiple successive downsteps in all prosodic words containing more than two L tones. Accounting for this with an OCP-downstep constraint (e.g. the OCP-register constraint in the Register Analysis in Section 7) is not an option here since the *raison d'être* of the Tone Analysis is precisely to avoid representing downstep on its own tier. To avoid a purely stipulative solution ("Delete all non-leftmost downsteps"), the only option left is to solve OCP differently in different environments: when it involves the PW-initial tone, OCP is solved by downstep, elsewhere, i.e. later in the PW, it is solved by Merger. This could be viewed as a form of faithfulness to the PW-initial tone, protecting it from Merger. This is shown in (52) (repeated from (19)).

(52) 

Prosodification and L spread take place in (52)b, followed by L-split in (52)c. Finally, in (52)d, a downstep

[44] Alternatively, one could analyze phonological downstep as L-insertion onto the initial mora of the second foot, after prosodification, but prior to tone spread: (L_1 -)(- -) → L-insertion (L_1 -)(L_2 -) → tone spread (L_1L_1)(L_2L_2) → downstep (L_1L_1)↓(L_2L_2). This inserted L causes downstep after L, and is deleted after H by virtue of the H spread rule illustrated in (50). However, it is unclear what would motivate this L-tone insertion.

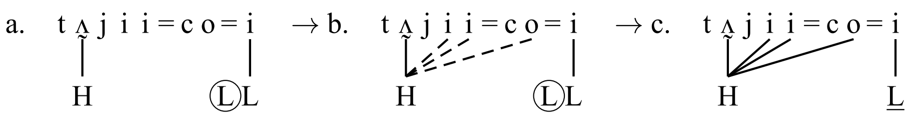
is inserted between the first and second Ls, while the second and third Ls merge, thus solving all OCP violations.

*8.1.4 Accounting for the *H/ꜜ constraint*

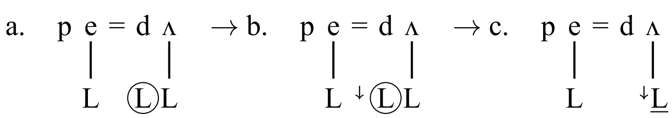
The non-co-occurrence of H and downstep within the prosodic word is straightforwardly accounted for with these representations. The fact that downstep is only the result of OCP-L explains why both ꜜH and HꜜL are unattested. It also explains the absence pf HL(L...)ꜜL. Indeed, since the H tone is always the first tone of the prosodic word, and OCP is solved by merger when it does not involve the PW-initial tone, underlying HL(L...)L is always changed to HL̲ by OCP, never to HLꜜL̲.

8.1.5 Accounting for L/ꜜL enclitics and utterance-initial downstep: floating L

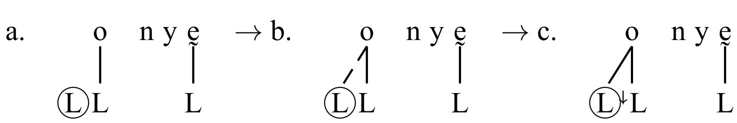
To account for L/ꜜL enclitics in this analysis, one must posit both an underlying L linked to their initial mora, and an underlying initial floating L tone: /=Ⓛx̀/. This floating L blocks H-tone spread and protects the following associated L tone from delinking, which accounts for the L realization after H-toned nuclei, as shown in (53)b, extracted from the utterance /gò tʌ̰́jíí =co̊ =ì dà/ [^{ŋ}gò ⟨tʌ̰́^{n}ɟí =có =ì⟩ ^{n}dà] (I throw =alone =DEF spear) ‘I throw away the spear on my own.’ [AG] (191125-AG:172).

(53) 

The floating L then merges with the following associated L in (53)c to avoid an OCP violation (neither of these two Ls is the initial tone of the prosodic word, OCP is thus enforced by Merger). This representation also accounts for the downstepped realization of these enclitics after L-toned nuclei, as shown in (54) (repeated from (22)b): the two OCP violations are avoided by inserting a downstep between the first and second L (54)b, and merging all subsequent Ls, floating or associated (54)c.

(54) 

The realization of utterance-initial downstep can be argued to be evidence for the presence of this floating L (beside its H spread blocking effect, which on its own is weak evidence at best). In (55), the enclitic /=Ⓛò/ is parsed as a prosodic word because of its utterance-initial position (cf. Section 5.5). As a result, its floating L is PW-initial, which protects it from deletion and merger. Consequently, it must be realized, i.e. associated with the following mora (55)b, and a downstep must be inserted between this L and the following one to comply with the OCP, thus yielding a LꜜL contour on the initial mora (55)c.

(55) 

The representational contrast between H/ꜜL enclitics as L-toned /=x̀/ and L/ꜜL enclitics as L-toned with an initial floating L /=Ⓛx̀/ straightforwardly accounts for the fact that the former are not realized with a downstep when utterance-initial: with only one underlying L tone, they do not incur any OCP-violation to be fixed with downstep. This makes the Tone Analysis slightly more parsimonious than the Register Analysis, where the loss of the *l* feature in utterance-initial predownstepped toneless enclitics (/#=ꜜx̊/ → /x̀/) must be stipulated as part of the de-encliticization process, as we saw.

8.1.6 Comparison with the Register analysis

Despite the advantages noted above, the Tone Analysis has important drawbacks. The representational economy that makes it seem preferable to the Register Analysis is only minimal and achieved at the expense of representational and grammatical simplicity.

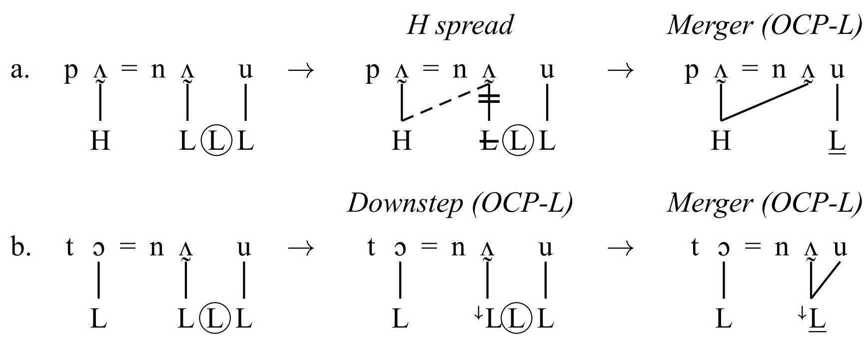
This is shown, for example, by the necessity to resort to tone split. Indeed, splitting a multiply linked autosegment goes against the fundamental intuition of Autosegmental Phonology. The most robust arguments in favor of tone split are cases where a postlexical floating L is inserted in the middle of a multiply linked H tone span (Hyman 2014, 381). In (51)b, there is no inserted tone, just a split triggered by metrical well-formedness (cf. Section 8.2 for an alternative involving H-insertion). The Register Analysis, by representing downstep as an independent register feature on a separate tier, has the advantage of avoiding this unnecessary complication.

Furthermore, the advantage of accounting for both predictable and unpredictable downstep with the same mechanism – a general OCP constraint on the tonal tier – is only apparent. The necessity to split PW-initial vs. non-initial OCP-effects makes the analysis at least as complex as the Register Analysis above, where two general OCP constraints are posited: melody-string OCP on the tonal and register tiers, and surface-string OCP-Ft_L, each solved in one and only one way. Another complication induced by the derivation of underlying downstep through OCP alone is the necessity to posit both a specific H spread rule deleting all following Ls in the prosodic word to account for the H realization of H/ꜜL enclitics after H-toned nuclei (cf. (50)) and floating L tones whose main function is to block this H spread. None of this is necessary in the Register Analysis.

The degree of representational economy offered by the Tone Analysis is, moreover, limited. Indeed, while the Tone Analysis does not need to posit a register feature independent of tone, it must posit a fundamental difference between underlyingly associated L (targeted by H spread) and floating L (blocking H spread). In other words, in both analyses, three tonal "objects" are necessary to account for the downstep patterns – the main difference is the number of distinct tiers where these objects live.

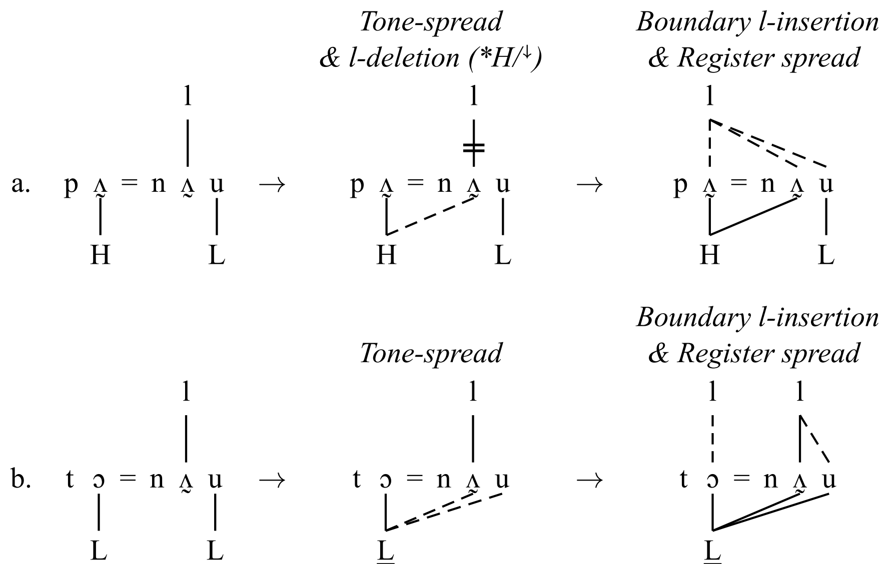
But the most important problem of the Tone Analysis is one of redundancy and circularity. Indeed, in order to derive all cases of downstep through OCP effects, it has to posit different kinds of OCP-violating underlying structure. The representation of L/ꜜL enclitics as underlyingly ⓁL is one case in point – particularly problematic in utterance-initial position, when the floating L and associated L combine into the OCP-violating isotonic contour tone /$\widehat{\mathrm{LL}}$/ → [$\widehat{\mathrm{L{\downarrow}L}}$] (cf. (55)). The $\widehat{ll}$ register contour posited by the Register Analysis (cf. (42) and (43)) is also OCP-violating, but I show that (i) the lack of OCP violation is expected given the different levels at which these two *l* features are introduced (whereas the two L tones in the Tone analysis are both underlying), and (ii) the OCP violation can be eliminated, e.g. by resorting to a boundary *h* instead of *l* (cf. notes 40 and 41). A more drastic case comes from the mixed enclitics, whose first mora behaves like a H/ꜜL enclitic, followed by an invariably L-toned mora, e.g. [pʌ̯́ =nʌ̯́ù] 'go in order to' vs. [tɔ̀ =ꜜnʌ̯̀ù] 'go up in order to' (cf. (20)). Since H spread is unbounded within the prosodic word (cf. (50)b) and can only be blocked by a floating L tone, the mixed enclitics must be associated with a highly problematic underlying LⓁL melody in order to account for the fact that the second mora is never targeted by H spread. This is shown in (56).

(56)



In contrast, mixed enclitics are easily and elegantly accounted for in the Register Analysis, as shown in (57).

(57)



The direct representation of downstep as a *l* feature in the Register Analysis looks less like an analytical fix than the awkward dichotomous OCP and the autosegmentally suboptimal representations posited by the Tone Analysis, and achieves a more parsimonious, more transparent, and more explanatory account of the Paicî downstep patterns.

8.2 Downstep caused by floating H tone

Let us now consider and reject possible arguments in favor of viewing downstep as conditioned by a floating H tone – an analysis that has been proposed for other cases of downstepped L tones, e.g. Bamileke Dschang (Hyman 1979, 14-15, 1985b; Snider 2020, 126-134), Nandi (Hyman 1984), and Päri (Andersen 1988). The OCP effect responsible for downstep could indeed be analyzed as triggering, not downstep directly, but the insertion of a floating H between the two OCP-violating L tones (splitting the spread L tone in the case of phonological downstep, cf. Section 8.1.2). This tone would undergo automatic downstep from the preceding L, and the H would eventually be deleted, leaving only a downstepped ꜜL as a trace of its former presence: (LL)(LL) → (LL)H(LL) → (LL)ꜜH(LL) → (LL)ꜜ(LL).[45]

This floating H is an unnecessary extra step in the Tone Analysis: it involves intermediate representations that never surface, violating economy with no analytical gain. Additionally, there is actual evidence against it. Firstly, there is no automatic downstepping of H by a preceding L in Paicî – if there were, both tones in

[45] A reviewer suggests an equivalent alternative whereby the H tone is the result of L → HL dissimilation: (LL)(LL) → (LL)(HL) → (LL)(ꜜHL) → (LL)ꜜ(LL).

a LH sequence would be realized at the same pitch, given the total nature of downstep. Secondly, floating H insertion is attested in the language – the juncture H tone described in Section 4.2 – and does not result in downstep. Instead, the inserted H systematically spreads to the entire foot, and is realized higher than the preceding L. If the floating-H analysis of downstep were correct, one would need to account for the existence of two types of floating Hs: one that spreads within a foot, and one that deletes after causing downstep. Although, as suggested by a reviewer, this would not be totally unmotivated (juncture phenomena could well be phonological objects in their own right and thus different from other floating tones), it is unnecessary in the Register Analysis.

8.3 Privative tone system: H vs. Ø

Let us, finally, reject an alternative which sees the L tone as underspecified, i.e. the default realization of toneless TBUs in a system that makes use of only one tonal primitive: H (as suggested for Paicî by Hyman 2001). Solid arguments can be put forth in support of this analysis. First, the fact that L is indeed used as a default tone, as we saw in Section 5.4. Another argument is that the L tone does not seem to be active in the language: the only grammatical tone is the juncture H, and H is the only tone that spreads. Indeed, the spreading of L from the tonal nucleus onto the following enclitics could just as easily be analyzed as default L being assigned to the toneless morae of both the nucleus and following material. In this analysis, phonological downstep would apply postlexically, after default-L insertion.

This very tempting analysis would make sense of the tone system of Paicî, were it not for the 19 enclitics realized with a downstepped L after a L tone, *viz.* the eleven H/↓L and eight L/↓L enclitics. In the Register Analysis, only the latter require an underlying L tone (e.g. /=↓ì/ DEFINITE), to account for their L realization after H. In the Tone Analysis, both categories require the presence of one (H/↓L enclitics, e.g. /=wà̰/ 'in, at') or two underlying L tones (L/↓L enclitics, e.g. /=Ⓛì/ DEFINITE). Furthermore, mixed enclitics must also carry at least one underlying L tone on their final mora in both analyses (e.g. /=↓nʌ̰̊ù/ ~ /=nʌ̰̀Ⓛù/ 'in order to'). However minimal these contrasts are, they are robust, and the underspecification analysis fails to adequately account for them. The existence of non-isotonic lexical items is one more argument in favor of the underlying status of both H and L: since toneless morae receive their tonal specification through spreading, a word like [pʌ́rìtò] 'oyster *sp.*' cannot be analyzed as underlyingly HØ (which, without further stipulations, would be realized [pʌ́rító]); it has to be HL.

Note that it is still possible to analyze L-toned lexical items (tonal nuclei) as underlyingly toneless, receiving default L specification during the derivation – crucially before the application of phonological downstep, i.e. at the stem-level, before postlexical PW- and Utterance-level phonology. This underspecification does not offer any advantage beyond increased parsimony in underlying representations.

9 The Paicî downstep in typological and historical perspective

9.1 Paicî in the typology of downstep

Downstep in Paicî shares most of the properties associated with downstep in tonal languages, summarized in Leben (2018) (building on Hyman 1979 and Rialland 1997): it 'preserves the affected tone's phonological identity' (↓L is still a L tone); it 'affects not a single tone but the entire tonal sequence in its domain'; it 'changes the register for what follows'; it is phonologically distinct from a lower underlying tone (H vs. L. vs. ↓L is different from H vs. M vs. L); 'the number of instances of downstep that can occur –in succession or in combination with other tones in an utterance– is in principle unlimited'. Additionally, the existence of both phonological and underlying/lexical downstep is in keeping with the expectation that 'downstep can come from a variety of sources: phonological, syntactic, morphosyntactic, and lexical.' It is thus reasonable to analyze it as downstep.

However, as we saw, downstep also has typologically unusual characteristics in Paicî:

(i) Paicî is one of the rare documented languages – with Nandi (Creider 1982; Hyman 1984), Podoko (Anderson & Swackhamer 1981), and Sinyar (Boyeldieu 2019) – where ꜜL is the only attested downstepped tone. The other ten languages with downstepped ꜜL that I was able to identify, listed in footnote 1 in the introduction, also have ꜜH and/or ꜜM. Such cases are so rare that Connell (2011) states that 'there are no languages reported where (non-automatic) downstep affects M (or L) but not H. Similarly, like Dschang, there are no languages reported where ꜜL occurs but not ꜜH'.

(ii) ꜜL is attested only after L (and utterance-initially), but never after H, a property shared with Kikuyu (Clements & Ford 1977, 1979, 1981), and perhaps Yala, Igala (Adeniyi 2016), and Ghotuo (Elugbe 1986) (the descriptions in the latter two papers is not precise enough on this point). In general, downstep is intrinsically tied to L, and incompatible with H.

(iii) Paicî is one of the few languages in which downstep is realized utterance-initially, a rare property it shares with Bamileke Dschang (Hyman 1979, 12; Pulleyblank 1986, 39–42), Ikaan (Salffner 2009, 93, 96–97, 289–296), and Kipare (Odden 1986, 263–264). It is the only language to my knowledge where utterance-initial downstep is realized as a falling tone, rather than as a lower level tone.

(iv) Downstep in Paicî is "total" (Meeussen 1970, 270), like in Kikuyu, Päri and Bwamu (Riccitelli 1965; Meeussen 1970).

(v) Downstep is accent-like in Paicî: it is culminative – like in Aghem (Hyman 1985a) and Dagaare (Anttila & Bodomo 2021) – and demarcative within the prosodic word, and it is metrically conditioned. Leben (2018, 15) notes that while downstep is conditioned by accent (i.e. by metrical structure) in many downstepping intonation systems, there are no cases so far linking downstep and metrical structure in tone languages. Paicî clearly fills this gap, and it is interesting to note that the accentual origin of downstep in Paicî is very likely, as I show in the next section.

9.2 Tone and downstep in Paicî: preliminary comparative data

It is beyond the scope of this paper to give a complete historical account of the Paicî tone system. The goal of this section is to propose a historical sketch highlighting two comparative and historical elements which are likely explanations of some its most unusual aspects: tonogenesis in Paicî and the accent system of closely related Xârâcùù. Only the most relevant aspects of the Xârâcùù prosodic system can be mentioned here, the reader is referred to Rivierre (1978) for more detail.

Paicî, like all New Caledonian tonal languages, developed tone relatively recently through the innovation of a H tone from transphonologization of the aspiration contrast on stops (and voicing contrast on sonorants) into a tonal contrast, i.e. *CV vs. *CʰV > CV̀ vs. CV́ (Haudricourt 1968; Rivierre 1972, 1993, 2001).

Rivierre hypothesizes that downstep in Paicî is older than tonogenesis, and "seems to simply be a tonal transposition of initially accentual elements" (Rivierre 1978, my translation). His main argument comes from a comparison with closely related Xârâcùù, another (non-tonal) Kanak language of New Caledonia's main island, whose accentual system shows striking similarities with phonological dowstep in Paicî. Indeed, as illustrated in (58), accent in Xârâcùù is marked with a register drop after the initial mora in words of one to three morae, and after the second mora in words of four morae and above, suggesting a foot-based analysis similar to phonological downstep in Paicî.

(58)	a. 1~3μ:	toꜜa	'arrive'	maꜜa	'bird sp.'
		kaꜜmu̯ru̯	'person'	aꜜpuu	'chief'
	b. 4+ μ:	(kɔrɔ)ꜜ(paa)	'canoe'	(mɛɛ)ꜜ(gɛɛ)	'yam sp.'

Rivierre's description shows that this prosodic phenomenon is a typical accent system: (i) it is culminative (there can only be one pitch drop per prosodic word), (ii) it is demarcative and involves metrical prominence, and (iii) it is obligatory (every lexical item must be accented). The pitch drop involved is best seen as a register drop (i.e. a form of downstep),[46] as shown by a very interesting process of “coupling” (after Rivierre’s *couplage*), whereby the dependent in a specific set of morphosyntactic head-dependent groupings is prosodically recessive, i.e. its accentual properties are made subordinate to those of the head. In such contexts, the prominent mora(e) of the recessive element cannot be realized higher than the last pitch of the preceding dominant element. For example, the noun + adjective phrase /kɔrɔpaa + kɛrɛna̰wa̰/ (canoe+yellow) is realized [ko^{5}ro^{5}pa^{3}a^3 kɛ^{3}rɛ^{3}na̰^{2}wa̰^{2}], and not *[ko^{5}ro^{5}pa^{3}a^3 kɛ^{5}rɛ^{5}na̰^{3}wa̰^{3}] (Rivierre 1978, 420). The lower register incurred by the initial accent is maintained throughout the “coupled” constituent, and the register is reset only between coupled constituents.

Based on the typologically unique four-mora threshold shared by both languages, Rivierre (1978) hypothesizes that the pre-tonogenesis ancestor of Paicî had an accent system similar to that of Xârâcùù, which was later reanalyzed as tonal after tonogenesis occurred. This historical hypothesis explains most of the typologically unusual properties of downstep in Paicî, notably its accentual properties, its semi-autonomy from lexical tone (H vs. L), and its incompatibility with H tones. Indeed, as a consequence of tonogenesis, H-toned words were, so to speak, removed from the “regular” accent system, while the rest of the lexicon maintained its former accentual behavior, only reinterpreted as involving a L tone. This also explains why the L tone has default status in Paicî (cf. Section 5.4), and why it is only a few morphemes away from not having any phonemic existence in the language (cf. Section 8.3).[47]

This historical hypothesis favors the Register Analysis proposed in Section 7. On the assumption that the accentual downstep of Xârâcùù and of the ancestor of Paicî is best represented as a *l* register feature, one can say that this *l* has been present in the language for a longer time than the H and L tonal features, and still behaves independently from them to a large extent.

10 Conclusion

In conclusion, this paper has provided a description of the tone system of Paicî, building on Rivierre (1974). I have shown that Paicî is a two-tone (H vs. L) system with downstep, a characterization that departs from Rivierre’s (1974) initial three-tone analysis, but is in keeping with his later intuition (Rivierre 1978, 1993, 2001). I have also shown that downstep in Paicî has many typologically unusual characteristics, which makes it particularly interesting for tonal typology and our understanding of downstep, still mostly limited to well-known cases of L-induced downstepped H tones. I have sketched a historical hypothesis, building on Rivierre (1978), which explains these typological quirks, notably the accentual properties of downstep, its semi-autonomy from lexical tone, and its incompatibility with H tones.

I have argued that downstep is best analyzed as its own phonological primitive, which can easily be formalized as a *l* register feature in Snider’s (1999; 2020) Register Tier Theory. I have shown that an alternative making use of only the two tonal primitives H and L, despite a few advantages over the Register Analysis, fails to adequately account for downstep.

Further work is needed in at least two directions. First, the exact mechanisms and steps involved in the gradual (and still incomplete) accent-to-tone shift triggered by tonogenesis in Paicî have yet to be fully uncovered and described. Finally, future work will explore the possibility to extend the Register Analysis (or a version of it) to other languages where downstep cannot be straightforwardly explained through tonal interactions alone.

[46] The exact analysis of this register drop is beyond the scope of this paper.

[47] Tracing the origin of the unpredictable downstep in H/ꜜL and L/ꜜL enclitics is not as straightforward, but the “coupling” phenomenon of Xârâcùù offers a few interesting clues. Indeed, when the head of a coupled constituent in Xârâcùù is mono- or bimoraic, the accentual register drop occurs between the head and the recessive element, as with the imperfective marker *maa* in [e ꜜmaa] (s/he + IPFV). The Paicî cognate form is the L/ꜜL enclitic /=ꜜbwàà/, e.g. [è =ꜜbwàà] (s/he + IPFV). These Xârâcùù and Paicî phrases are realized with identical prosody (Rivierre 1978, 430).

Abbreviations

In addition to abbreviations from the Leipzig Glossing Rules, the following are used in this article for language examples: DIR directional; SUCC successive. Abbreviations in the body text include IRB Internal Review Board; OCP Obligatory Contour Principle; PW prosodic word.

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