Foot Well-formedness in Western Austronesian Languages

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1 Introduction

McCarthy & Prince (1990, 1995) have shown that in many languages morphological operations involve prosodic units like the syllable and the (disyllabic) Foot. In this paper I give evidence for the Foot as an active phonological element in word-formation processes in the Western Indonesian language, Balinese. I also give evidence that the arguments adduced for Balinese apply in related languages such as Javanese and Madurese.

I show that a variety of phonological processes produce or target a disyllabic sequence, *ie* the Foot. Many of these processes are mediated by the following constraint, which holds until late in phonological derivations:[1]

(1) Foot Well-formedness:
Morphemes must be prosodically well-formed at the Foot level

Much of the evidence in the latter part of the paper comes from reduplication processes. I argue that certain facts associated with reduplication can be understood in terms of Foot Well-formedness, *if* reduplication is a purely phonological process. This goes against the claim of Prince (1987), that reduplication is always a morphological process. I give evidence that purely phonological reduplication occurs for example in 'inherently reduplicated' morphemes - those whose non-reduplicated base does not occur independently:[2]

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[1]Here I follow the assumption that the phonology is divided into two components, the lexical phonology and the postlexical phonology. Rice (1990:290) lists (amongst others) the following differences in the way rules apply in each (see also Kaisse & Hargus, 1993:16):

	Lexical	Postlexical
a.	may not apply across words	may apply across words
b.	may refer to word-internal structure	cannot refer to word-internal structure
c.	structure-preserving [AC: don't generate non-distinctive elements]	need not be structure-preserving [AC: do generate, for example, 'allophones']
d.	may have exceptions	cannot have exceptions
e.	must precede all postlexical rule applications	must follow all postlexical rule applications

[2]I use the term 'base' for the sequence targetted by reduplication, and 'copy' for the prefix-like element copied from that base (McCarthy & Prince 1995's 'reduplicant').

(2)

Morpheme:	Gloss:	Non-occurring base:
gigi	'tooth'	***gi**
bubu	'fish trap'	***bu**
cakcak	'chop up (vt)'	***cak**
mrésmés	'messy (eating rice)'	***mrés**
nangdanangda	'shilly-shally (vi)'	***nangda**
kupukupu	'butterfly'	***kupu**

(Evidence that all the morpheme-types exemplified in (2) are synchronic reduplications is given in Appendix A).

The paper has the following structure. In §2 I give evidence for the Foot: (i) from constraints on morpheme shape (§2.1, where variations in possible Foot shapes are also discussed) (ii) from a variety of processes giving rise to disyllabic or at most trisyllabic units (§2.2) (iii) in a distinct type of reduplication I term 'Foot-reduplication' (§2.3). In §3 I describe some peculiarities associated with inherent reduplications in Balinese (§3.1, §3.2), I then offer an account of them in terms of Foot Well-formedness (§3.3). In §3.4 I discuss evidence for a distinction between true morphological reduplication and purely phonological reduplication in Balinese . Throughout, the main data comes from Balinese; in many cases I give evidence for parallel phenomena in the neighbouring languages.

2 Evidence for the Foot in phonological processes

2.1 Evidence for the Foot from morpheme size

The first evidence that the Foot, and Foot Well-formedness constrains word-building processes comes from morpheme shapes. McCarthy & Prince give evidence that, in a wide variety of languages, the disyllabic Foot constitutes the minimal morpheme size (their 'Minimal [Prosodic] Word').

For Balinese, a count of a database of 14556 items taken from the main dictionary, Warna et al (1990) gave the following figures:[3]

(4)

	tokens	%'age of total
monosyllabics	475	3.2%
disyllabics	12629	86.8%
trisyllabic	1224	8%
4-syllabic	221	2%
5-syllabic	7	
Total	14556	100

[3]Counts were done using Fiesta software (Alsop 1990). Warna et al (1990) contains more than 15,000 headwords. Certain items, such as names of literary figures and terms restricted to Old Javanese literary texts were not included in the database.

In Balinese, therefore, 95% of the lexis consists of di- or trisyllabic morphemes. Uhlenbeck (1950) gives similar figures for Javanese. Similar proportions are also found in Madurese (Stevens 1968: 51-53) and in Malay (Adelaar 1985:12) and are reconstructed for proto-Austronesian (eg Dempwolff (1938), discussed by Ross 1994:62).

Of the few lexical bases in Balinese listed in Warna et al (1990) and larger than three syllables - the maximum in the native lexis is five syllables - all are analysable as complex in some way. They contain either recurrent affixes attached to bound roots, or consist of at least two recurrent 'meaningless morphemes', or morphs, and so of two prosodic Feet (Clynes, in preparation). Uhlenbeck (1978) similarly describes how quadri-syllabic 'morphemes' behave phonologically like compounds of two disyllabic units in Javanese.

The figures in (4) constitute the first evidence for both the disyllabic Foot as the preferred prosodic template, and for the following hierarchy of Foot templates determining morpheme shape (cf McCarthy & Prince 1995):[4]

(5)

Optimal Foot:	σσ
Maximal Foot:	σσσ
Minimal Foot:	σ

To be prosodically well-formed, then, morphemes in Balinese *must* satisfy one of the Foot templates in (5). So too must the output of processes applying to them during the lexical phonology. I assume that in the latter contexts, the Optimal (disyllabic) Foot is imposed whenever possible, by the Foot Well-formedness rule given in (1), and repeated here:

(6) Foot Well-formedness
Morphemes must be prosodically well-formed at the Foot level

Foot Well-formedness applies throughout the lexical phonology: it is a condition both on the input to, and the output of, phonological processes.[5] Monosyllables are either grammatical morphemes (which cross-linguistically are not subject to disyllabicity requirements, McCarthy & Prince 1995), loanwords, or expressives. Trisyllabics are restricted to the latter two classes (Clynes, in preparation). Uhlenbeck in his detailed study (1950) reported the same distributions in Javanese.

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[4] I use the term Maximal Foot for simplicity of exposition. McCarthy & Prince (1995) claim that the maximal Foot size is the disyllable, and that the three-syllable unit is a Foot plus extraprosodic final syllable.

[5] See footnote 6 on Foot Wellformedness as a condition on the input to lexical processes.

2.2 Processes creating morphemes of Optimal foot size

Other evidence for the disyllabic Foot in the phonology includes various processes which create disyllabic units.

(i) Before most monosyllabic words, including loanwords, /ə/ is optionally inserted:

(7)	**ling**	~	**eling**	'weeping (n)'
	nu	~	**enu**	'still (aspectual)'
	bé	~	**ebé**	'meat; fish'
	bom	~	**ebom**	'bomb'
	bél	~	**ebél**	'car horn' (from Dutch *bel*)

Speakers disagree as to which surface form of such doublets is the most basic one; Warna et al (1990) lists both forms, but gives priority to the monosyllabic root. The initial schwa does not surface when such morphemes bear suffixes or occur in compounds

(8)	**ling-ang**	[liŋaŋ]	*[əliŋaŋ]	'cry-APP; make cry'
	dum-a	[dum3]	*[ədum3]	'share-3; shared by him'
	bé siap	[besiap]	*[əbesiap]	'chicken meat'

No other vowels are 'deleted' in these contexts, suggesting that these morphemes are underlyingly monosyllabic, with initial /ə/ functioning to produce the preferred surface disyllabic unit where they would otherwise surface as monosyllables. This in turn can be seen to follow from a disyllabic minimum limit on grammatical words.

Similar facts apply in Javanese. Dictionaries, like Prawiroatmojo (1985), list many morphemes both as monosyllables, and as disyllables with [ə] filling the initial syllable. As in Balinese, in Javanese loanwords often are expanded to disyllabics by addition of [ə] initially:

(9)	**ebon**	'give credit'	Dutch *bon* 'receipt'
	etik	'type(write)'	Dutch *tikken* 'id.'
	esop	'soup'	Dutch *soep* 'id.'

(ii) {N-} the 'AGENTIVE' prefix normally 'replaces' initial stops consonants with their homorganic nasal equivalent (10a), and surfaces as /ŋ/ before vowels (10b):

(10)	a.	**mañcing**	%N-paɲciŋ%	'AP-angle'
		negak	%N-təgak%	'AP-sit'
		ñagur	%N-jagur%	'AP-punch'
		ngelah	%N-gəlah%	'AP-possess'
	b.	**ng-alih**	%N-alih%	'AP-look for'
		ng-ambil	%N-ambil%	'AP-take.HI'

However, with monosyllabic roots the output is disyllabic, adding a syllable to the prefix-root sequence:

(11)				
	bél	'bell (n)'	**ngebél**	'AP-bell; ring bell'
	dum	'share'	**ngedum**	'AP-share out (v)'
	cét	'paint (n)'	**ngecét**	'AP-~~id.~~(v)'
	ling	'weeping'	**ngeling**	'AP-weep'

I conclude that, while monosyllabic roots are tolerated, Foot Well-formedness requires that the output of lexical processes applying to those roots be an Optimal Foot (a disyllable). Disyllabicity is therefore imposed, via a process of augmentation.[6] Entirely parallel allophony patterns are found with the cognate agentive prefixes in Javanese (Horne 1974), Madurese (Stevens 1968:84) and Malay (*eg* Moeliono & Grimes 1994:453-4).

(iii) Other evidence for Foot Wellformedness comes from the realisation of underlying %i% and %u% in Balinese. I show in Clynes (in preparation) that these do not contrast underlyingly with their respective homorganic glide counterparts [y] and [w]; they surface as either vowels or glides, according to the prosodic context. Crucially, %i% and %u% are syllabified so as to generate a disyllabic structure wherever possible:[7]

(12)				
	wayan	'first born'	/wayan/	*/uaian/
	satwa	'fable'	/sa.twə/	*/satua/
	byasa	'usual'	/bya.sa/	*/biasa/
	tuak	'palm wine'	/tu.ak/	*/twak/

These disyllabic surface forms are thus generated by the Foot Well-formedness requirement, which 'filters' the output of syllabification processes. Foot Well-formedness means then that there are no monosyllabic morphemes of shape CGVC, and very few of shapes (C)VV(C)V(C) and (C)V(C)VV(C).[8]

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[6]In Indonesian/Malay, the AP prefix, is usually of shape /məN/: a full syllable. One could therefore expect there to be no 'schwa augmentation' with monosyllabic bases, the output being automatically a disyllable. The AP form of the verb is nevertheless of shape məŋe[root]. This I take to be one piece of evidence that Foot Well-formedness is also a requirement on the *input* to lexical phonological processes in these languages: the monosyllabic base is expanded to a disyllable by schwa epenthesis *before* it can undergo prefixing.

[7]In Balinese only vowels represent distinct syllable nuclei.

[8]It thus accounts for the following skew in phonotactic distributions: in disyllabic morphemes of shape /CVV(C)/ a wide variety of $/V_1V_2/$ sequences are allowed (Clynes, in preparation). We would expect the same possibilities of $/V_1V_2/$ combination to occur in morphemes of shape <CVVCV(C)> and <CVCVV(C)>) (where V represents a vocoid). However, in such VV sequences <iV> and <uV> predominate by far: in Warna et al (1990) 103 out of the 141 tokens, or 73%, have /i/ or /u/ as the first vowel (59 /iV/, 44 /uV/). This skew indicates that <i> and <u> are here best analysed not as vowels but as glides: they can occur in this position precisely because they do not cause a departure from the preferred disyllabic morpheme structure.

(iv) Balinese has a variety of formal reduplication types, involving both partial and full reduplication of the base. Partial reduplications are of two shapes, either CV- where the initial CV- sequence of the base is copied:

(13)	*base*		
	duk	**duduk**	'pick up'
	buh	**bubuh**	'porridge'
	keh	**kekeh**	'stiff'

or Cə-, where the vowel in the copy/reduplicant is [ə]:

(14)	*base*		
	bai	**bebai**	'k.o. malevolent spirit'
	kupu	**kekupu**	'butterfly'
	tani	**tetani**	'termite'
	géndong	**gegéndong**	'tramp (n)'

CV-reduplication applies only to monosyllables to produce a morpheme which is a disyllable. Cə-reduplication applies only to disyllabic bases (never to mono- or tri-syllabics), to produce a stem which is a Maximal Foot. Clearly, in both cases the base is parsed for prosodic structure during the reduplication process. In both cases Foot Wellformedness is satisfied, but in different ways: by the *output* of CV-reduplication, but by the *input* to Cə- reduplication. The fact that Cə- reduplication only applies to disyllabics means that the output will also satisfy Foot Well-formedness, though as a less-preferred trisyllabic Foot (cf 5).

2.3 Foot reduplication

'Foot reduplication' in Balinese applies to complex stems consisting of a root plus suffix.[9] The copied sequence (underlined in the following examples) consists of the stem morpheme(s), *plus* the initial consonant from the following suffix:

(15)	**bé-n-né**	'fish-GEN-3; his/her/their fish'	**bén-bé-n-né**	'*id.*PL'
	oka-n-né	'child-GEN-3; his child'	**okan-oka-n-né**	'*id.*PL'
	ng-liu-nang	'AP-many-APP; multiply (vi)'	**ng-liun-liu-nang**	'*id.*DUR'

Certain prefixes, such {N}, the 'Agentive prefix', and **pe-** (causative verbal prefix), and can be optionally included in the copied sequence:

(16)	**ng-aji-nin**	'AP.price.LOC; charge (vt)'	**ngajin-ng-aji-nin**	'*id.*PL'
	pe-gedé-nin	'CAUS.big.LOC; enlarge'	**pegedén-pe-gedénin**	'*id.*PL'

The copied sequence is at first glance problematic, since it is non-coextensive with morpheme boundaries. This is moreover the only case in Balinese where material from the suffix reduplicates (Clynes in preparation).

[9]It may in fact be the basis for all reduplications where the entire root morpheme is copied.

However, the mismatch is easily explicable if, as the name proposed suggests, reduplication uses the smallest possible *Foot*-sized template which will include all the material in the stem (cf (5)). So monosyllabic template is imposed on a monosyllabic stem (**bén-bé-n-né**), and so on up to trisyllablics (**pegedén-pe-gedénin**).

The copying of the suffix-initial consonant can be explained if the parsed sequence is a Foot, given the following additional constraint on Preferred Foot structure:

(17) Prefer a Foot which has an extraprosodic consonant at the right edge

Rule (17) applies to *all three* foot types in (5). It can be seen as a variant of what McCarthy & Prince (1990:240) term 'obligatory extrametricality', where an extrametrical final constituent *must* be present for a prosodic operation to apply to a base (for example, the requirement that Arabic roots must end in a consonant).

Independent evidence for rule (17) comes from preferred morpheme structures. Those which end in a consonant are clearly preferred to those which end in a vowel in Balinese. This can be seen from Table 1, which gives frequencies of occurrence for a selection of common morpheme-shapes (data from Warna et al 1990):

V(σ)		CV(σ)		CVC(σ)	
V.CV	108	CV.CV	966	CVC.CV	490
V.CVC	901	CV.CVC	4410	CVC.CVC	2070
VC(σ)		**CLV(σ)**		**CLVC(σ)**	
VC.CV	56	CLV.CV	185	CLVC.CV	51
VC.CVC	457	CLV.CVC	811	CLVC.CVC	398

Table 1: Numbers of some disyllabic morpheme types - with and without final consonants, in Warna et al (1990)

Each cell in Table 1 contains a 'minimal pair'. For a given pair, the number of tokens *with* a final consonant easily outnumbers those without - generally by a factor of five to one, but ranging up to close on nine to one. There is then a clear preference for morphemes with a closed final syllable.[10] The otherwise puzzling

[10]For the *non*-final syllable, the preference is reversed: generally around twice as many morphemes have an open penultimate syllable, as those with an otherwise identical structure, but with a closed penultimate (eg 966 of shape CV.CV versus 490 CVC.CV). This latter fact confirms that the 'filled-final coda' preference is not a syllable-level preference, but rather a morpheme-level one.

reduplication type above is therefore explicable in terms of a Foot structure for which there is independent evidence.

Entirely parallel Foot-reduplication types are found in Madurese (Stevens 1968:75-76), and Javanese (Horne (1974), Clynes (1994). For brevity I cite only examples from Javanese:[11]

(18)	**enti**	'wait'
	di-enté-ni	'UP-wait-LOC; be waited for
	di-entén-enténi	*'id.* PL'
	uni	'sound'
	di-uné-ʔké	'UP-sound-APP; be complained about'
	di-uné?-uné?ké	*'id.* PL'

3 Foot Well-formedness and anomalies associated with inherent reduplications

I have given a variety of evidence both for the Foot, and for Foot Well-formedness, as active in Balinese phonology (as well as some for their occurrence in the related Javanese, Madurese, and Malay). In this section I will argue that Foot Well-formedness also provides a simple account for two peculiarities associated with inherent reduplications in Balinese. In both cases, there is a marked split in the phonological behaviour of inherent reduplications, according to whether the base is (i) monosyllabic or (ii) disyllabic (or longer):

- Certain morpheme structure constraints holding for inherently reduplicated monosyllablic bases do not apply to inherently reduplicated disyllables.
- Underlying monosyllabic bases reduplicate *before* the application of postlexical phonological rules, while longer bases always undergo (full) reduplication *after* postlexical rules have applied.

This split in behaviour is unexpected, given that in all cases, the morphemes concerned must be underlyingly specified as undergoing reduplication.

I give evidence for these two claims in §3.1 and §3.2 respectively. In §3.3 I propose an explanation for them in terms of Foot Well-formedness. I also argue there that, despite appearances, inherent reduplications can in all cases be seen as being primarly located in the *lexical*, rather than the postlexical, phonology. Finally, in §3.4, I mention some apparent complications in the behavour of morphological reduplications.

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[11]Stem-final high vowels are lowered before C-initial suffixes in Javanese.

3.1 Inherently reduplicated morphemes and morpheme structure constraints

With respect to certain morpheme-structure constraints, lexemes formed from inherently reduplicated monosyllabic bases pattern like simple morphemes, whereas those formed from reduplicated di- and trisyllabic bases appear to pattern like a sequence of two morphemes.

(i) Like other monomorphemic lexemes in Balinese (Clynes, in preparation), reduplicated monosyllables allow only one CL-cluster in the surface form (base plus copy), (19a)), whereas inherently reduplicated disyllabics allow two (19b):

(19)		morpheme	underlying base	
	a.	**jriji**	%jri %	'finger'
		blabar	%blar %	'flood'
		bréngbéng	%breŋ %	'dilapidated'
	b.	**sliak-sliuk**	%sliuk %	'bob up & down'
		sumbrang-sambring	%sambriŋ %	'dishevelled'

(ii) In reduplicated monosyllables of shape $C_1VC_2C_1VC_2$, like **dugdug** 'pile up', **cakcak** 'chop up', C_2 can never be identical to C_1. Lexemes of shapes such as the following simply do not occur:

(20)		
	***kakkak**	***ngungngung**
	***kikkik**	***tuttut**

This is at first glance surprising, given that such C_2C_1 combinations are otherwise limited only by constraints on what can occur in morph-final (C_2) and syllable-initial (C_1) positions:

(21)				
	gukguk	'laugh uncontrollably'	**cahcah**	'chop up'
	ditdit	'tug'	**butbut**	'pull out'
	léklék	'eat.CRD'	***ñingñing***	'baby mouse'
	ngékngok	'have sex.CRD'	**sahsah**	'spread out (vt)'

The 'illegal' sequences *can* occur in inherently reduplicated disyllabics, (20b):

(22)		
	kayakkayak	'lie stretched out, helpless'
	nguéngngguéng	'sound of a bumblebee'
	kiikkiik	'sound of chicks, ducklings'
	kisikkisik	'move slightly'

McCarthy (1986) describes how the 'antigemination' effect in (20a) holds in a wide variety of languages, but only *morpheme-internally* (see also Perlmutter 1995:310). One could attempt to account for the different behaviour of inherently reduplicated monosyllables and disyllables with respect to it and to CL sequences ((i) above) by invoking the presence of a morpheme boundary in the one case but

not the other. This seems untenable: except in the number of syllables they contain, inherently reduplicated monosyllables appear to have the same morphological status as reduplicated disyllabics. When the evidence from ordering (presented in the next section) is considered as well, a different account is clearly required.

3.2 The ordering of inherent reduplications with respect to other processes

Here I show how inherently reduplication applies to monosyllabic bases *before* many postlexical/allophonic processes apply, while disyllables are reduplicated *after* they have applied. I discuss in turn three processes:[12]

- Realisation of underlying %a% as [ɜ], word-finally
- Allophony of high vowels
- Lowering of high vowels in the 'genitive construction'

(i) Realisation of underlying %a%:

Word-finally, underlying %a% is always realised as [ɜ]:

(23)	**mata**	%mata%	[matɜ]	'eye'
	bapa	%bapa%	[bapɜ]	'father'

In inherently reduplicated disyllabic bases, this raising must occur *before* reduplication, since its affects are also found in the prefixed copy:

(24)	**lumbalumba**	%RED**lumba**%	[lumbɜlumbɜ]	'dolphin'
	nangdanangda	%RED**naŋda**%	[naŋdɜnaŋdɜ]	'shilly-shally'

In contrast, with reduplicated monosyllables, %a% raising must take place *after* reduplication, not before:

(25)	**jaja**	%jaja%	[jajɜ]	'cake'
			*[jɜjɜ]	
	gaga	%gaga%	[gagɜ]	'k.o. rice'
			*[gɜgɜ]	

(ii) High vowel allophony:

In unambiguously monomorphemic words, high vowels always have tense/[+ATR] allophones, except where they occur in a morpheme-final closed syllable:[13]

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[12]See Clynes (in preparation) for a more detailed account, including evidence for the postlexical nature of these processess.

[13]These allophony patterns apply in the Balinese spoken in Singaraja.

(26)	**kuluk**	[kulʊʔ]	'dog'
	intuk	[intʊʔ]	'pound (vt)'
	Bukti	[bukti]	'place name (Skt)'
	Lubdaka	[lubdakɜ]	'personal name (Skt)'

Reduplicated monosyllables of shape CVC always pattern exactly like non-reduplicated, monomorphemic words, with tense vowels in the copy (underlined in the following examples):

(27)	**Gitgit**	[g̲itgɪt]	*[gɪ̲tgɪt]	'place name'
	gudgud	[g̲ud̲gʊd]	*[gʊ̲dgʊd]	'extremely (old)'
	prungpung	[pr̲ʊŋpʊŋ]	*[prʊ̲ŋpʊŋ]	'chipped'

With monosyllabic bases, then, vowel allophony processes do not apply until *after* reduplication has occurred: if they applied before reduplication, we would get the (non-occurring) asterisked forms in (27).

On the other hand, when the base is a disyllable, the phonetic content of the copy shows the results of allophony effects applying *before* reduplication:[14]

(28)	a.	**undurundur**	[undʊrundʊr]	'small flying insect'
		undurundur-e	[undurundʊre]	'*id.*-DEF'
			*[undʊrundʊre]	
	b	**antinganting**	[antɪŋantɪŋ]	'earring'
		anting-anting-e	[antiŋantiŋe]	'*id.*-DEF'
			*[antɪŋantiŋe]	
	c.	**colocolo**	[cólócóló]	'garfish'
		colocolo-n-ne	[còlòcòlònnɛ]	'his garfish'
			*[cólócòlònnɛ]	

The asterisked forms in (28) are those which would be expected, if a morpheme boundary were present between base and prefixed copy.

Identical patterns of apparently postlexical reduplication of disyllabic bases, are found in both Madurese and Javanese, cf Steriade (1988).

(iii) Lowering of final high vowels in the 'genitive' construction.

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[14]At first glance, vowel pairs like [u] and [ʊ] (28a), [i] and [ɪ] (28b) and [ó] and [ò] (28c) seem to occur in contrasting environments, when they occur in the *copy* only, whereas everywhere else in the phonology their occurrence is purely predictable. The correct analysis is not to double the inventory of vowel phonemes in Balinese, based only on the evidence of reduplications like these. The phonetic content of the copy too is predictable: it is 'conditioned' by whatever conditions the shape of the base (cf Steriade 1988 on parallel facts in Javanese and Madurese).

High vowels are lowered when they occur in the final syllable of morphemes concatenated with the third person possessive morpheme **(-n)-né** '(GEN)-3POS: his/her/their':[15]

(29)	**bulu**		'body hair'
	bulo-n-né	[bulo̲nnɛ]	'his body hair'
	kucit		'piglet'
	kucét-né	[kuc̲ɛtnɛ]	'his piglet'

In inherently reduplicated disyllabic bases, this lowering must occur *before* reduplication, since its affects are also found in the prefixed copy:

(30)	**kapukapu**		'k.o. water plant'
	kapokapo-n-né	[kapo̲kapo̲nnɛ]	'his [...] plant'
	undurundur		'any small flying insect'
	undorundor-ne	[undo̲rundo̲rnɛ]	'his [...] insect'

Inherently reduplicated monosyllables, reduplication again show the opposite ordering: reduplication must take place *before* high-vowel lowering:

(31)	**kuko-n-ne**	[kukonnɛ]	'his nails'
		*[kokonnɛ]	
	gige-n-ne	[gigɛnnɛ]	'his tooth'
		*[gɛgɛnnɛ]	

To sum up, there is strong evidence that in Balinese inherent reduplication of monosyllabic bases occurs *before* certain phonological processes, whereas disyllabic bases appear to reduplicate *after* those same processes. Evidence for the same situation applying in the related languages, was cited in (ii) above. Further evidence comes from Madurese: 'roots in the form of reduplicated monosyllables' behave differently from other reduplicated words in reduplicating *before* the {N-} prefix attaches; with longer bases the order is reversed (Stevens 1968:71).

3.3 An explanation for the contrasting behaviour of inherently reduplicated mono- and disyllabic bases

Here I propose a simple explanation for contrasting behaviours of mono- and disyllabic bases, both with respect to morpheme-structure constraints (§3.1) and in their ordering with respect to other processes (§3.2). It involves the following three claims:

a. Inherent reduplication is a purely phonological process: the output always constitutes a single morpheme.

[15]This lowering is found in many, though not all varieties. The genitive suffix, {n} occurs, on vowel-final heads only, before the clitic {né}, 'third person', which is unique in having otherwise non-distinctive [ɛ] in a final open syllable.

b. That morpheme, like all morphemes, is subject to Foot Well-formedness - it cannot be quadrisyllabic (cf acceptable Foot structures, in (5)).

c. Foot Well-formedness ceases to apply late in the postlexical phonology.

There is good evidence for (a) above. With respect to both morpheme-structure constraints, and postlexical processes, inherently reduplicated monosyllabics behave in all cases as though they are monomorphemic. With the disyllabic bases, the realisations in (28) (and the non-occurrence of the asterisked forms) are consistent the same conclusion, though with the added note that the phonetic shape of the copy is identical to, and conditioned by, whatever conditions the phonetic realisation of the base. This in turn is accounted for by assumptions (b) and (c) above.

Reduplication of monosyllables therefore produces a single, disyllabic morpheme, satisfying Foot Wellformedness (*eg* $[kuku]_{Foot}$, $[jriji]_{Foot}$). It can therefore go ahead in the lexical phonology. The disyllabic output is subject to the various other morpheme-structure constraints applying in the lexical phonology, such as antigemination, and the 'one CL-cluster' limit (§3.1). At the same time, the disyllabic morpheme patterns like all other simple morphemes with respect to vowel allophony and to other postlexical effects (§3.2).

In the case of disyllabic bases, reduplication would produce illegal quadrisyllabic morphs (*eg* $*[sliuksliuk]_{Foot}$), violating Foot Well-formedness. Reduplication therefore fails in the lexical phonology. It nevertheless attempts to apply iteratively, until finally carried to completion when Foot Well-formedness ceases to apply, late in the postlexical phonology (claim (c) above). At that stage, all other morpheme-structure conditions have also ceased to apply. That accounts for the irregular behaviour of reduplicated disyllabics with respect to both morpheme structure constraints and post-lexical phonological rules.

Although there is then a split in the surface phonological behaviour of reduplicated morphemes, the account I have sketched above is compatible with the view that inherent reduplication is actually a lexical (rather than postlexical) process for *all* bases, mono-, di- or trisyllabic. More accurately, it is always *initiated* in the lexical phonology, even if, in some cases, it is blocked, and so not brought to full realisation until much later, when the necessary conditions for its realisation have been set up (after most allophonic rules and morpheme-structure constraints have ceased to apply).[16]

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[16]A clearer understanding of the way the blocking process is overcome can be had from a consideration of the steps involved in reduplication. Reduplication is clearly a complex process, no matter what model one chooses to describe it. In Balinese it appears to require at least these stages:
1) identify the base
2) impose a reduplicative template (defined either in morphological or prosodic terms) on the base

Postlexical reduplication of disyllabics then can be seen to be compatible with the Strong Domain Hypothesis that phonological rules apply, or attempt to apply, continuously from the first level of the lexicon, until they are 'switched off' (Kiparsky 1984, cited in Rice 1990). Rather than being arbitrarily assigned to two widely separated levels, the reduplication process is present from the early lexical phonology to the late postlexical phonology.

3.4 Is reduplication ever a morphological process? Evidence from derivational reduplication

So far, only evidence from inherently reduplicated morphemes has been discussed. In this section I look at derivational reduplications. These present a slightly more complex picture, but one still compatible with the analysis proposed so far.

Derivational reduplications of disyllabic bases typically show exactly the same, clearly post-lexical, reduplication as inherent reduplications. The results of allophony, for example, are transferred to the copy, with no evidence for a P-word boundary separating copy and base:

(32)	a.	**belog**	[bəlòg]	'stupid'
		belog-belog		'trick (vt)'
		belog-belog-a	[bəlógbəlóg3]	'trick-3; tricked by him'
	b.	**cerik**	[cərɪʔ]	'small'
		cerik-cerik-é	[cərikcərike]	'small-PL-DEF; 'the kids'
	c.	**répot**	[rɛpòt]	'busy'
		ngrépotin	[ŋrɛpótɪn]	'AP-busy-LOC; busy (vt)'
		ngrépotin-ngrépotin	[ŋrɛpótrɛpótɪn]	'id. DUR'

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3) COPY the phonological material delimited by that template (cf Archangeli 1991:261)

4) PREFIX the copied material to the base.

The 'copy' stage of reduplication copies totally whatever is in the phonological material previously delimited by the reduplicative template, at the time that it (copy) applies: hence copying of non-contrastive material in postlexical reduplication.

Two possible ways in which the blocking process, and the subsequent resumption of reduplication, could proceed are either (i) the first three stages of reduplication are completed, then the final PREFIX stage simply stalls, or applies iteratively, failing each time, until Foot Well-formedness ceases to apply or (ii) reduplication fails totally once PREFIX has been blocked; it must begin again, from the first parse stage, iteratively, until satisfied. The evidence from copying of non-distinctive features indicates that the second model is the correct one: the transfer of non-distinctive features means that the process of COPY too must be delayed until after allophony rules cease to apply. Since there is no obvious reason why COPY, as opposed to PREFIX, should be blocked at an earlier stage, I conclude that the whole process of reduplication is reiterated, and finally effected in the postlexical phonology, once Foot Well-formedness has gone.

To my knowledge, this postlexical reduplication type is the only one reported for derivational reduplications in Javanese (*eg* Dudas 1975), and in Madurese (Stevens 1968, Steriade 1988).

However, in Balinese, in addition to the realisations in (32), speakers also accept, or in the case of **cerik-cerik-é** below, spontaneously use, realisations where the copy behaves phonologically as though it constitutes a distinct prosodic word from the base:

(33)	a.	**belog-belog-a**	[bəlɔ̀gbəlóg3]
	b.	**cerik-cerik-é**	[cərɪʔcərike]
	c.	**ngrépotin-ngrépotin**	[ŋrɛpɔ̀trepɔ́tɪn]

Another example where informants accepted both patterns was:

(34)	**alit**	[alɪt]	'small.HON'
	alit-alit-é	[alitalite]	'*id.*PL'
		[alɪtalite]	

Such alternate forms are rejected vigorously for inherent reduplications:

(35)	**undur-undur-é**	[undurundure]	'the [k.o.] insect'
		*[undurundure]	
	alun-alun-é	[alunalune]	'the public square'
		*[alunalune]	

I am unsure how to data like that in (33) and (34) should be treated. Most of it has only been obtained in elicitation, and, while the 'postlexical' reduplications of (32) are acceptable to all speakers, there is disagreement about the acceptibility of individual forms in (33).[17] The realisation of **cerik-cerik-é** as [cərɪʔcərike] is perhaps the more usual one, but it may be a lexicalised exception.

On the other hand, the realisations in (33) are those to be expected, *if* in derivational reduplication the prefixed copy constitutes a separate morpheme. Such reduplication would not be blocked by Foot Well-formedness from applying during the lexical phonology. A word boundary would be inserted between copy and base, and the normal allophony rules yield the expected (33) surface forms: [bəlòg]$_w$[bəlóg3] and so on.

Assuming the data in (33) are valid, the problem then is to explain the 'rival' (and more usual) forms in (32). These would appear to be produced by the same

[17]For example, realisation (33a) was offered spontaneously by one speaker, who also accepted [bəlógbəlóg3]; however two other (yopunger) speakers only accepted [bəlógbəlóg3]; (33b) is probably the standard realisation of this lexicalised expression, but the 'postlexical' version is also accepted in elicitation. Both [ŋrɛpɔ̀trepɔ́tɪn] and [ŋrepɔ́trepɔ́tɪn] were independently accepted by three speakers, however later two of them accepted only the latter form.

purely phonological reduplication process which produces inherent reduplications. Just why the two different options are available is a problem, but it is one which *any* more explanation must deal with.

No matter how the differing realisations of derivational reduplication are accounted for, it is very clear that with *inherent* reduplication of disyllabics the option of 'lexical' exemplified by the forms in (33) is *not* available. To that extent, the distinction made between a purely phonological function of reduplication (rejected as a possibility by Prince 1987), and a morphological one, is further demonstrated.[18]

4 Conclusions

I have given evidence (i) that the Foot is active in the phonology of Balinese and related languages, and (ii) that Foot Well-formedness, the requirement that morphemes be prosodically well-formed at the Foot level, holds during much of the lexical and postlexical phonology.

This in turn gives an explanation of processes such as Foot reduplication, *found in Balinese, Javanese and Madurese. I am not aware that this reduplication* type has been accounted for previously. It also provides a simple explanation for the anomolies associated with inherent reduplications described in §3.1 and §3.2. At the same time, evidence that reduplication (that where the base is fully reduplicated) is often or always a phonological process in these languages has been provided.[19] Further evidence for all aspects of the above analysis can be found in Clynes (in preparation).

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[18]Other arguments motivating the distinction are given in Clynes (in perparation).

[19]I have yet to consult Schlindwein (1989), cited by Hargus as also arguing that reduplication in Javanese is phonological, rather than morphological, '[h]owever her conclusion is based on the controversial assumption that the bracketing erasure convention is cyclic (Hargus 1993:69).'

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Appendix

Evidence for the synchronic status of reduplication in 'inherently reduplicated' monosyllabics in Balinese

1. One of the few structural differences between inherently reduplicated monosyllables and simple morphemes in Balinese is that, like all reduplications except CV-reduplications (see 2.2), they carry two adjacent primary stresses:

(36)	**cucu**	'grandchild'	['cu'cu]
	gésgés	'scratch (vt)'	['gɛs'gɛs]
	crukcuk	'k.o. bird'	['cruk'cuk]

Reduplicated words, of all shapes, are the only ones to have these two stresses.

2. The second kind of evidence for synchronic reduplication comes from the following descriptive fact about morpheme structure, which derives in turn from a 'dislike' of morphemes which contain more than one consonant of a given place of articulation, underlyingly (Clynes, in preparation).

(37)
In a morpheme of shape $C_1(L)V_1(C)C_2V_2(...)$, where C_1 is identical to C_2, then V_1 and V_2 will also be identical.[20]

Figures showing the percentages of morphemes obeying the patterns in (37), as well as percentages for similar patterns, are given in table 2.

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[20]The only exceptions are trisyllabic morphemes of shape $C_\alpha eC_\alpha(\sigma\sigma)$ such as **gegitik** 'ticklish spot', **bebéki** 'mischievous', **kekupu** 'butterfly'; I analyse these as inherent Cə-RED reduplications (§2.2).

shape	example	total tokens	total $V_1 = V_2$	%'age $V_1 = V_2$
$C_\alpha V_1 C_\beta C_\alpha V_2 C_\beta$	**dugdug**	481	441	91.6%
$C_\alpha L V_1 C_\alpha V_2 C$	**blibis**	138	125	90.6%
$C_\alpha V_1 C_\alpha V_2 C$	**lalah**	413	353	85.5%
σσ–σσ	**kupukupu**	115	102	88.7%
$V_1 C_\alpha V_2 C_\alpha$	**udud**	41	28	68.3%
$C_\alpha V_1 C_\alpha V_2$	**gigi**	55	35	63.6%
Overall total		1243	1084	87.2%

Table 2: Numbers of morphemes containing C_α - C_α sequences, by shape (data from Warna et al (1990))[21]

If vowel patterns in disyllabic morphemes are purely random, given six vowel phonemes, the probability that a morpheme will contain two identical vowels is one in six. That is, without reduplication, we would expect to find around 17% of morphemes where $V_1 = V_2$. The actual figures in table 2 are much higher, and are highly significant, ($Z = 5.72$, $P < .0000$ using the Median Test (Hatch & Lazaraton, 1991)), even for the 'lowest' percentage of 63.6% with morphemes of shape $C_\alpha V_1 C_\alpha V_2$, like **gigi**. Other reduplicated monosyllabic bases showed percentages of identical vowels close to or higher than 90%. I take these figures, together with the evidence of stress, to be strong evidence for synchronic reduplication, in all cases.

3. Evidence for the synchronic status of inherent reduplications also comes from interaction of reduplication with other processes. In the following, both suffixing and syllabification (which then prompts deletion of /h/ in syllable onsets), must apply before reduplication to produce **me-kohkoh-an** and **menyahnyahan**:

(38)	a.	**kohkoh**	[kòhkòh]	'cough'
		me-kohkoh-an	[məkòkòan]	'VBL-cough-VBL'
	b.	**nyahnyah**	[ɲahɲah]	'dry fry (vt)'
		menyahnyahan	[məɲaɲaan]	'reheated (vi)'

Concatenation with suffixes must therefore be ordered before reduplication. Assuming that suffixes are unspecified for phonological domain, and cliticise to that of the root to which they attach (Kaisse & Hargus 1993:7-8), this automatically creates a disyllabic foot, which Foot Well-formedness blocks from being further expanded during the lexical phonology. If reduplication wasn't blocked at this stage, the non-occurring surface forms **me-kohkoh-an** *[kòhkòan], and **menyahnyahan** [məɲahɲaan] would be generated.

[21]For each shape, the sample is all lexical entries of that structure listed in Warna et al (1990), with the exception of reduplicated disyllabic bases, for which the sample is all entries listed in sections L-Y of Warna et al (1990), or about half the book.