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Prosodic words in cyclic derivation: the strange case of Murrinhpatha compound verbs

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Abstract Lexical compounding generally works by adjoining a second lexeme either directly to the stem of the first lexeme (as in [sabre-[tooth]]-s), or to the whole inflected form of the first lexeme (as in [milk-[teeth]]). Murrinhpatha presents a third distinct type, where the adjoined lexeme is attached to a prosodic edge, which may occur either before or after various inflectional affixes, rather than attaching to a fixed morphosyntactic host. "Prosodic compounding" of this type has not been previously attested in natural language. However, I argue that in Stratal Phonology (Bermúdez-Otero 2016), where prosodic constituents are formed and reformed on distinct morphological strata, we may formulate a motivated account in which prosodic compounding fills a typological gap. This account of Murrinhpatha verb morphology offers a structurally motivated alternative to previous accounts that posit a purely stipulative morphotactic template.

Keywords Prosodic morphology · Stratal phonology · Compounding · Opacity · Cyclicity · Templatic morphology · Australian languages

Abbreviations

DEF	definite
DIR	directional
F	feminine
FUT	future
IMPF	imperfective
INCL	inclusive
IRR	irrealis
LOC	locative

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M	masculine
NFUT	non-future
NP	noun phrase
OBJ	object
OBL	oblique
PAUC	paucal (specific)
PC	paucal (broad)
PH	prosodic phrase
PL	plural (broad)
PLUR	plural (specific)
PLCT	pluractional
PST	past
PW	prosodic word
RR	reflexive/reciprocal
SG	singular
SL	stem level
SUBJ	subject
WL	word level

1 Introduction

Murrinhpatha, a polysynthetic language of northern Australia, exhibits an unusual type of verb compounding. A coverb is aligned to a prosodic edge in the verb, rather than a morphosyntactically defined host. I call this "prosodic compounding", a word formation process that is hitherto unattested in natural language (as far as I know), though it bears theoretically predictable relations to other instances of prosodically determined morphology. The Murrinhpatha compound verb is formed by attaching a coverb to the right edge of a prosodic word (PWord). This PWord is headed by a verb, but may in addition encompass some inflectional suffixes; other inflectional suffixes are prosodically external, and attach to the right of the coverb. The compound formed of inflected verb and coverb itself constitutes a PWord, recursively containing the head PWord. However it is only the recursive PWord that determines stress assignment and bimoraic minimum length, the phonological features generally associated with PWords in Murrinhpatha.

The phonological opacity of the head PWord implies a cyclic or *stratal* model of morpho-phonological interaction, explored in the second half of this article. I argue that the Murrinhpatha compound verb data can be quite naturally modelled in Stratal Phonology (Bermúdez-Otero 2016), assuming that morphological exponents may align at prosodic edges internal to the morphological base (McCarthy and Prince 1993a). Prosodic alignment of this type is a recognised phenomenon for infixing and clitic morphology, and other than the lack of previous attestation, there is no reason why we should not extend the facility to lexical compounding. The discovery of PWords playing an alignment role in compound stem formation suggests that further research might uncover a diverse range of PWord effects in stratal word formation. In the stratal account of Murrinhpatha, it is shown that PWords have distinct effects in stem formation and phrasal phonology.

This analysis builds on previous work on the morphological structure of the Murrinhpatha verb (Blythe 2009; Mansfield 2015, 2016b; Nordlinger 2010, 2015; Street 1987; Walsh 1976), but in the light of insights provided by prosody, proposes a revised description of the morphology. The main revision proposed is to replace a purely morphotactic "template" morphology with a mixture of prosodic constituency and morphotactics. Prosodic morphology provides a more principled account of word formation than a stipulative template; however, conventionalised templates must have some role in lexical productivity, as will be shown for verbs that appear only in compounds.

The structure of this paper is as follows: Section 2 describes the characteristics of the Murrinhpatha PWord, and the verbal inflectional suffixes that are either internal or external to this domain. Section 3 briefly introduces the coverb category, describing how these combine with finite verbs to generate the verbal lexicon. Section 4 describes the morpho-prosodic structure of compound verbs, in which the compounded coverb attaches to the PWord headed by the finite verb, with the whole compound stem forming a recursive PWord that renders the inner PWord phonologically opaque. Section 5 discusses compound verbs in which the base verb is not independent, noting that in these compounds the prosodic principle of word formation is more abstractly instantiated. This draws out the comparison with previous research that has described the verb morphotactics as a stipulative template. Section 6 briefly surveys the appearance of prosodic alignment in other types of morphology, in particular infixal derivation, and clitics. Section 7 presents an analysis of the data in Stratal Phonology, emphasising the distinct PWord phenomena encountered on distinct derivational levels, and the cross-linguistic diversity of such effects. Section 8 summarises the main points.

2 Prosodic words and verbal suffixes

The Murrinhpatha prosodic word (PWord) is co-extensive with morphologically simple words, and with finite verb stems that are inflectionally specified, but are not segmentable into agglutinative morphemes (Mansfield 2016b). The PWord is phonologically characterised by a bimoraic minimum quantity and predictable stress placement, and each of these provides evidence for a distinction between prosodically internal and external suffixes. Monosyllabic PWords bear stress on their single syllable, and when this syllable has no coda its vowel must be lengthened to satisfy the bimoraic minimum (1), in a similar way to other northern Australian languages (Baker and Harvey 2003; Harvey and Borowsky 1999). When an open monosyllabic stem hosts a suffix, the realisation of vowel length indicates whether the suffix is internal or external to the PWord domain. If the vowel is unlengthened, this indicates that the suffix syllable is also contributing to the bimoraic minimum—i.e. that the suffix is prosodically internal (2). But if the vowel is lengthened, this indicates that the stem alone constitutes the PWord—i.e. that the suffix is external (3).[1]

[1] A reviewer points out that phonetically lengthened vowels can also be associated with stem morphology, independent of bimoraic PWord satisfaction (Higuchi and Haraguchi 2006; Sugahara and Turk 2004). However the lengthening observed in Murrinhpatha is more likely to be a moraic PWord effect, given its convergence with evidence from penultimate stress positioning.

(1) [ké:]$_{PW}$
'nerite shell' (MJ, 2013-01-02)[2]

(2) [ná-ŋe]$_{PW}$
say.2SG.IRR-3SG.F.OBL
'tell her' (DP, 2015-07-01_AT)

(3) [t̪í:]$_{PW}$-nu
sit.2SG.IRR-FUT
'you will sit' (BB, 2012-07-11_PM)

For polysyllabic stems, evidence of PWord edges comes from penultimate stress placement.[3] All simple polysyllabic words have penultimate stress (4), while an internal suffix causes the stress to be reassigned (5) but an external suffix has no effect on stress (6).

(4) [kaɻáŋuk]$_{PW}$
'fly sp.' (DP, 2015-07-01_AT)

(5) [páta]$_{PW}$ [wuɾiní-ŋe]$_{PW}$-ða
good go.3SG.PST-3SG.F.OBL-PST
'he was good to her' (MnMn, 2011-07-30)[4]

(6) [wuɾíni]$_{PW}$-ða
go.3SG.PST-PST
'he went' (GM, 2011-07-25_3-1)

The PWord constituent determines predictable stress, but the application of stress occurs on a phrasal rather than word level. Stress applies only to the right-most PWord in a phonological phrase (PPh). Verbs usually form their own one-word phonological phrases, but noun phrases provide examples of the multi-word phonological phrase. Each PWord in such phrases requires a bimoraic minimum, but only the right-most realises stress (7).

(7) [[me:]$_{PW}$ [paŋu-ɖá-ŋu]$_{PW}$]$_{PH}$ [[me:]$_{PW}$ [kaɳ́-ŋu]$_{PW}$]$_{PH}$
[foot there-LOC-DIR]NP [foot here-DIR]NP
'a foot over there, a foot over here' (SeDu, 2015-07-09_SL)

Aside from stress and weight effects, the PWord constituent also determines some segmental assimilation effects that occur only within its scope (Mansfield 2014, pp. 158–175). Some of these are quite intricate, however the examples in this arti-

[2]Except where otherwise noted, corpus materials cited in this article are collected by the author, and can be accessed as collection JM4 at http://paradisec.org.au.

[3]Earlier, impressionistic accounts of Murrinhpatha stress further propose a variety of secondary stress marks, but these are not supported by acoustic evidence, and the different accounts vary in which syllables they claim to bear secondary stress (Clemens 2013; Mansfield 2014; Street and Mollinjin 1981; Walsh 1976, pp. 106–124). The proposal of predictable penultimate stress, on the other hand, is based on a robust pattern of pitch peaks confirmed in Praat (Boersma and Weenink 2012; Mansfield 2018).

[4]This example is from Joe Blythe's Murrinhpatha corpus at The Language Archive, https://tla.mpi.nl/.

cle involve only intervocalic voiceless obstruent lenition, which applies morpheme-initially within PWords, but not outside them (8), (9).

(8) mawáṭanu
[ma-paṭa]$_{PW}$-nu
use.hands.1SG.IRR-good-FUT
'I'll make it' (CM, 2011-07-21_3-16)

(9) puménaðapaḍi
[pume-na]$_{PW}$-ða-paḍi
say.3PL.PST-3SG.OBL-PST-BE.IMPF
'they were saying to him' (LTch, 2016-07-05)

2.1 Prosodic constituency of verb suffixes

It is the prosodic status of verbal suffixes that concerns us especially in this article. Some verb suffixes attach internally, whereas others are prosodically external. Under one analysis of morphological segmentation, we can make a consistent generalisation about morphosyntactic function and prosodic constituency: suffixes are internal if they introduce pronominal arguments, or if they are number markers adjacent to the pronominal arguments they co-index. Other suffixes are prosodically external. These include non-adjacent number suffixes (described below), and tense, aspect and adverbial suffixes (not described in this paper, but see Mansfield 2015; Nordlinger 2015). Various analytical alternatives are possible, but these create exceptions to the prosodic generalisation in one way or another, and thus require a stipulative statement regarding which number suffixes are internal, and which are external.[5]

Grammatical number in Murrinhpatha involves a cascading system of increasing specificity. Some morphological classes have just a SG/PL distinction, others further specify paucal number, and others further specify dual.[6] In under-specification, it is the greater number category that is used: i.e. dual or paucal referents are marked as PL in the most basic distinction, and dual referents are marked as PC in the three-way SG/PLUR/PC distinction (Mansfield 2018; but note alternative analysis in Nordlinger 2015). I gloss these different levels of specificity by using PL to indicate the broader type of plurality, and PLUR the more specific; PC to indicate broad paucal, and PAUC the more specific. The grammatical number categories and their containment relations are illustrated in Table 1.

Pronominal arguments use underspecified number categories, with number suffixes adding specificity. The non-segmentable verb stem is inflected for subject

[5]The main alternatives involve reduced segmentation, exchanging /-ŋan-ŋku/-1PL.OBJ-PC.OBJ for /-ŋanku/-1PC.OBJ, and /-ŋa-ru/-1PL.OBL-PC.OBL for /-ŋaru/-1PC.OBL, *etc*. In this analysis, the DUAL suffix becomes adjacent to the pronominal it co-indexes, but since it is prosodically external, it breaks the function/prosody pattern. Less segmented analyses have been used, without extensive discussion, in previous work on the Murrinhpatha verb (e.g. Blythe 2009; Forshaw 2016; Mansfield 2014; Nordlinger 2010; Walsh 1976).

[6]In some contexts there is also a category specifically for dual, same-sex classificatory siblings (Blythe 2013). However this is omitted from the discussion as it has no bearing on prosodic structure.

Table 1 Labels for number categories with varying degrees of specificity

SING	Singular	One exactly (for humans); animals and inanimates are usually marked SG for any number
PL	Plural (broad)	Any number greater than one
└PLUR	Plural (specific)	More specifically, greater than paucal
└PC	Paucal (broad)	Greater than one, but not as many as plural
└PAUC	Paucal (specific)	More specifically, greater than two
└DUAL	Dual	Two exactly

Table 2 Murrinhpatha pronominal suffixes (cf. Street 1987, p. 99; Walsh 1976, pp. 205–209)

		Object suffix	Oblique suffix	RR suffix
SING	1	-ŋi	-ŋa	
	2	-n̠i	-mpa	
	3		-n̠e FEM -na MASC	-nu (*all pers/num*)
INCL	1/2	-n̠i	-n̠e	
PL	1	-ŋan	-ŋa	
	2	-nan	-na	
	3	-(wu)n[a]	-(wi)	

[a] Portions in parenthesis are deleted post-vocalically; this means that post-vocalic 3PL.OBJ and 3PC.OBJ are effectively marked by the accompanying PL.OBJ and PC.OBJ number suffixes

pronominal (e.g. /pirini/ sit.3PL.PST), while suffixes may add an object or oblique pronominal argument, or a "pseudo-pronominal" reflexive/reciprocal (RR) /-nu/, used to mark RR valency for any person/number category.[7] Pronominal suffixes are always prosodically internal, as evidenced by penultimate stress and lack of bimoraic lengthening on CV stems (2). Table 2 presents the paradigm of pronominal suffixes. Table 3 presents the suffixes used to further specify number categories. Note that 3SG.OBJ arguments are not morphologically marked: the adjacency pattern described below implies that for 3SG.OBJ there is an *absence* of pronominal morphology, rather than a phonologically empty morpheme.

Number suffixes follow pronominal morphology, and are prosodically internal when they are adjacent to the pronominal argument that they co-index; otherwise they are prosodically external. The outcomes of this co-indexation pattern are somewhat complex, but worth describing because they will provide the crucial evidence for prosodic compounding (Sect. 4). The number suffixes /-ŋku, -ɾa, -ɾu/, which are specific to object, oblique and RR pronominals, are always adjacent to their pronominal arguments, and are always prosodically internal (10), (11). The object pronominal occurs only with compound verbs (12), to be described below. The suffix /-ka/ PC.SUBJ is prosodically internal when no pronominal suffix intervenes between it and the subject-marking verb stem (13). Otherwise it is blocked from appearing at

[7] In Murrinhpatha's sister language Ngan'gi, reflexive/reciprocal valency is encoded by adding an oblique pronominal suffix (Reid 1990, p. 133). I hypothesise that this was also the case in an earlier form of Murrinhpatha, before the /-na/ 3SG.M.OBL became conventionalised into the general RR suffix /-nu/.

Table 3 Suffixes used to further specify number categories

Pronominal co-indexed	Suffix	Gloss	Prosody
Any	-ŋime / -neme	PAUC.F, PAUC.M	External
	-ŋiɲ̪ta / -niɲ̪ta	DUAL.F, DUAL.M	Internal / external (see below)
Subject	-ka	PC.SUBJ	Internal
Object, RR	-ŋku	PC.OBJ	Internal
Oblique	-ɾa	PLUR.OBL	Internal
	-ɾu[a]	PC.OBL	Internal

[a] For younger speakers (who provide most of the corpus examples below), the /-ɾa, -ru/ distinction has merged to /-ɾa/ PL.OBL

all (it cannot prosodify externally), though the functional fallout is mitigated by further PAUC suffixes (14). The more specific /-ŋime, -neme/ PAUC.F, PAUC.M appear only after broad PC number suffixes, or co-indexing a non-adjacent subject, and are therefore always prosodically external (10)–(14).

(10) [mam-wí-ɾa]$_{PW}$-ŋime
say.3SG.NFUT-3PL.OBL-PL.OBL-PAUC.F
'she told them (pauc)' (SD, 2015-07-09)

(11) [pumem-nú-ŋku]$_{PW}$-ŋime
say.RR.3PL.NFUT-RR-PC.OBJ-PAUC.F
'they (pauc) said to each other' (LK, 2000-11-10)[8]

(12) [[piɾim-wun-ŋkú]$_{PW}$-baṯ̪]$_{PW}$-neme
stand.3PL.NFUT-3PL.OBJ-PC.OBJ-watch-PAUC.M
'they are watching them (pauc)' (JT, 2015-07-08_AM)

(13) [pumám-ka]$_{PW}$-ŋime
say.3PL.NFUT-PC.SUBJ-PAUC.F
'they (pauc) said' (LP, 2012-06-30)

(14) [[dɻáf]$_{PW}$]$_{PH}$ [[pumám-ŋa]$_{PW}$-neme]$_{PH}$
draft do.3PL.NFUT-1SG.OBL-PAUC.M
'they (pauc) drafted me' (MAK, 2013-07-11_03)

The suffixes /-ŋiɲ̪ta, -niɲ̪ta/ DUAL.F, DUAL.M may be prosodically internal or external, depending on co-indexing. These may co-index either subject or RR pronominals in an adjacent position, thus prosodifying internally (15), and in the case of RR valency, attaching either to the subject-marked stem, or to the RR pseudo-pronominal (16). When they co-index object or oblique arguments, PC suffixes intervene, and thus they are prosodically external (17). When they co-index the subject

[8] This is from a telling of the Kanamkek-Thiniminh story, recorded by Mark Crocombe and held at the Wadeye Aboriginal Language Centre in Wadeye, Northern Territory, Australia.

argument, and an object or oblique pronominal intervenes, they are again prosodically external (18).

(15) [pirim-nínn̪ta]$_{PW}$
stand.3SG.NFUT-DUAL.M
'the two of them are standing' (SD, 2015-07-09_AM)

(16) a. [[kík]$_{PW}$]$_{PH}$ [[mem-ninn̪tá-nu]$_{PW}$]$_{PH}$
kick do.RR.3SG.NFUT-DUAL.M-RR
'two people kicked each other' (ClW, 2015-07-13_AM2)
b. [[dirim-nu-ninn̪tá]$_{PW}$-bat̪]$_{PW}$
watch.RR.3SG.NFUT-RR-DUAL.M-look-SIT.IMPF
'two people are looking at each other' (MN, 2015-07-06_AM2)

(17) [mam-wí-ra]$_{PW}$-ninn̪ta
say.3SG.NFUT-3PL.OBL-PL.OBL-DUAL.M
'she says to the two of them' (SL, 2011-08-08_3-1)

(18) [[kík]$_{PW}$]$_{PH}$ [[pumám-ŋa]$_{PW}$-ninn̪ta-paɳam]$_{PH}$
kick do.3PL.NFUT-1SG.OBL-DUAL.M-IMPF
'two men are kicking me' (JaM, 2015-07-01_AM)

External verb suffixes have variable sequencing (Mansfield 2015), so where DUAL is relegated to external status, other external suffixes variably precede it (19), (20). This is in contrast to prosodically internal morphology which, like most morphology, has a fixed morphotactic sequencing.[9]

(19) [[rikúdiŋ]$_{PW}$]$_{PH}$ [[ma-ná-ra]$_{PW}$-ninn̪ta-nu]$_{PH}$
record do.1SG.IRR-2PL.OBL-PL.OBL-DUAL.M-FUT
'I'll record you two' (DP, 2012-06-20_25)

(20) [[maɲe]$_{PW}$ [páta]$_{PW}$]$_{PH}$ [[ma-ná-ra]$_{PW}$-nu-ŋinn̪ta-puru]$_{PH}$
manner good do.1SG.IRR-2PL.OBL-PL.OBL-FUT-DUAL.F-IMPF
'he will treat you two well' (Street 1982: Lk2:22-38-011)

The variable sequencing and prosodic externality of the outer suffixes means they have two properties that are typically associated with clitics (Anderson 2005; Spencer and Luis 2012). However, they also have some of the core properties of inflectional affixes: they attach exclusively to the verbal word, for which they encode obligatory inflectional categories. Therefore to propose an analysis of them as clitics would come at the cost of significantly distorting the notion of clitic-hood, which in any case lacks a consensual definition (Haspelmath 2015; Spencer and Luis 2012, p. 220). A related, but more formally rigorous question can be raised about whether external suffixes belong to a distinct level of derivation from the internal suffixes. I explore but ultimately reject this possibility in the discussion section (Sect. 7.3).

[9]There are several hundred corpus examples of internal inflectional suffixes, which are sufficiently consistent in their sequencing to support a general statement of fixedness. However, as noted, in dual RR verbs, the dual suffix may attach to either verb or to the RR suffix. This is perhaps not surprising, given that dual in this instance co-indexes simultaneously the subject-marking verb stem, and the RR pseudo-pronominal. In either order, the two suffixes are prosodically internal.

In summary, inflectional suffixes on the verb may be prosodically internal or external, and this prosodic status is determined by pronominal arguments and number co-indexing. In the case of the DUAL suffix, these dependencies result in alternation between internal and external status. This will provide important evidence for our analysis of coverb compounding below.

3 Simple and compound verbs

The finite verbs exemplified in the previous section only account for a small part of the Murrinhpatha verb lexicon. There are only 39 finite verbs,[10] while the rest of the verbal lexicon is produced by combination with *coverbs*, an open class of lexemes that denote actions and events, but depend on verbs for encoding inflectional categories. This combination may be realised either as a phrasal verb with coverb preposed on the left (21) or a compound with the coverb adjoined on the right (22):

(21) wilíli wúran
walk go.3SG.NFUT
'she's walking'

(22) wuran-líli
go.3SG.NFUT-walk
'she's walking'

Coverb + finite verb combinations are a common form of verbal predication throughout north-western Australia, though in most languages the combinations take the phrasal rather than compound form (McGregor 2002; Nash 1982; Schultze-Berndt 2003). In both Murrinhpatha and in other north-western languages, the coverb class has considerable overlap with nominals (either nouns or adjectives, which may themselves not be very syntactically distinct). The coverb class, unlike the finite verb class, is open to lexical borrowing; but borrowed coverbs are generally used only as independent words, and not in compounds (Mansfield 2016a).

The majority of the inherited verbal vocabulary appears only in compounds. Most coverbs, and 29 of the 39 finite verbs, are only attested in this bound form (cf. Laughren 2010; Reid 1990, p. 102). Some of the compounds are semantically compositional (23a, b), while others are not (24).

(23) a. muŋam-paḷ
coerce.3SG.NFUT-break
{Verb-Coverb}
'she broke it off'

b. dim-paḷ
sit.3SG.NFUT-break
{Verb-Coverb}
'it's broken'

[10]The exact number of finite verbs in Murrinhpatha depends somewhat on the analysis applied. The count cited here follows the analysis in Mansfield (2018, 2016b).

(24) mem-biɭ
do.RR.3SG.NFUT-open.eyes
{Verb-Coverb}
'she turned to look'

Verb compounding is so deeply established in the lexicon that some finite verbs no longer have any clear meaning. In this respect they are similar to the equally limited set of verb roots in Udi (A. C. Harris 2002, p. 74; Spencer and Luis 2012, p. 210). Being without a clear meaning makes some Murrinhpatha finite verbs rather unlike typical "verbs", which are canonically expected to be independent words that denote event semantics. Those that appear only in compounds presumably lack their own lexical entries, but instead appear only in a range of complex entries such as [[ba]$_{V}$ [ŋkaɖu]$_{CV}$] "see". In this article I nonetheless refer to them as "verbs" since all of them, independent or bound, behave identically in compound verb formation.

Coverbs presented in this paper are all morphologically simple, though there are also morphologically complex coverbs. These involve either reduplicative marking of a pluractional event (e.g. *mel* "squash", *melmel* "squash many times") (Walsh 1976, pp. 240–243), or compounding with a body part nominal that references an object or instrument (e.g. *lip* "hit", *pelip* "hit on the head") (Walsh 1996). Complex coverbs of these types behave as a fused unit when adjoined to a compound verb. Therefore the discussion of coverbs in this article applies equally to complex coverbs, though illustrative examples use simple coverbs to maximise clarity.

4 Morpho-prosodic structure of compound verbs

In compound verbs, the coverb does not attach at either of the expected morphotactic locations, i.e. at the edge of the verb stem, or the edge of the whole inflected verbal word. Rather, it attaches amidst the inflectional morphology, at the right edge of the PWord constituted therein—or at least, the right edge of where the PWord would be in the lexically simple verb. The PWord constituents formed in lexically simple verbs do not surface phonologically in compound verbs; their role is limited to morphotactic positioning of the coverb. Surface phonology of the compound verb is instead determined by a recursively formed PWord that encompasses both head PWord and the compounded coverb (25).

(25) [[pumam-ŋa]$_{PW}$-pá̪t̪a]$_{PW}$-ni̪n̪t̪a-pibim
use.hands.3PL-1SG.OBL-make-DUAL.M-STAND.IMPF
'the two of them are making it for me' (JT, 2015-07-08_AM)

Thus the coverb is positioned to the right of inflectional suffixes that are internal to the verb-headed PWord, either pronominals, or internal number suffixes (26)–(29).

(26) [[ŋuɖɖam-ká]$_{PW}$-wuɭ]$_{PW}$-nime
IMPEL.RR.1PL.NFUT-PC.SUBJ-return-PAUC.F
'we (paucal, masc) returned' (PP, 2013-06-22)

(27) [[dem-ŋi]$_{PW}$-maɖáɻur]$_{PW}$
PIERCE.RR.3SG.NFUT-1SG.OBJ-anger
'I'm angry' (Street 2012, *-mardarurr*)

(28) [[dɪrɪm-nu]$_{PW}$-baṯ]$_{PW}$-dim
watch.RR.3SG.NFUT-RR-look-SIT.IMPF
'he's looking at himself' (JeTu, 2015-06-27_AM)

(29) [[ŋɐram-nu-ŋku]$_{PW}$-baṯ]$_{PW}$-nime-ŋibim
watch.1PL.RR.NFUT-RR-PC.OBJ-hold-PAUC.M-STAND.IMPF
'we (pauc, masc) are looking at each other' (LP, 2015-06-27_AM-02)

By contrast, the coverb is positioned to the left of inflectional suffixes that adjoin outside the verbal PWord (30).

(30) [[ɻúː]$_{PW}$]$_{PH}$ [[[pumá]$_{PW}$-ðap]$_{PW}$-nu-ŋime-puru]$_{PH}$
fighting use.hands.1INCL.IRR-stop-FUT-PAUC.F-GO.IMFP
'we will stop fighting' (AMN, 2015-01-29_PrT2SC1)

However the most striking evidence comes from the /-ŋiṇṭa/ DUAL suffix, which as we saw above, is prosodically internal where it co-indexes an adjacent argument, but otherwise relegated to prosodic externality. Coverb positioning again conforms to the PWord right edge, which is to the right of internal DUAL, and to the left of external DUAL (31)–(33).

(31) [[dam-niṇṭá]$_{PW}$-wa]]$_{PW}$
PIERCE.3SG.NFUT-DUAL.M-spear
'two men speared him' (CW, 2015-07-13)

(32) [[dɪrɪm-nu-niṇṭá]$_{PW}$-baṯ]$_{PW}$
watch.RR.3SG.NFUT-RR-DUAL.M-look-SIT.IMPF
'two people are looking at each other' (MN, 2015-07-06_AM2)

(33) [[param-ŋí]$_{PW}$-wa]]$_{PW}$-niṇṭa
PIERCE.3PL.NFUT-1SG.OBJ-hit-DUAL.M
'two men speared me' (JT, 2015-07-08)

As mentioned above, however, the PWord constituent that determines coverb positioning does not determine PWord phonological phenomena. Recalling that PWords are phonologically realised with a penultimate stress, we find that stress is penultimate to a unit encompassing the finite verb, internal inflections and the coverb, as marked in examples above. "Recursive PWord" phenomena of this type have been widely discussed for various Indo-European languages (e.g. Booij and Lieber 1993; Inkelas 1989; McCarthy 1993; Peperkamp 1996). However PWord recursion usually involves the same phonological effects being determined by inner and outer PWords; but in Murrinhpatha the head PWord, encompassing the finite verb and internal inflections, does not determine either bimoraic minimal weight or stress assignment. Absence of stress marking in the head PWord is reflected in the examples above, while absence of bimoraic minimal weight is evident in compounds where the finite verb is just an open monosyllable and has no internal inflections. In such cases, the /CV/ head PWord does not undergo the vowel lengthening associated with the bimoraic minimum (34). The head PWord in compound verbs is not phonologically realised, but instead has a purely morphological role in determining coverb positioning.

(34) [[t̪í]$_{PW}$-ku]$_{PW}$
sit.2SG.IRR-RUN
'go away!' (DP, 2012-06-20_25)
*[[t̪í:]$_{PW}$-ku]$_{PW}$

5 Templatic conventionalisation

It was noted above that 29 of Murrinhpatha's 39 finite verbs are used only as the heads of compounds, they are *bound verbs*. This has an important consequence for prosodic alignment of coverbs, because the absence of lexically simple forms for these finite verbs means that the PWord determining coverb positioning is never phonologically realised. For a compound verb such as (35), (36), the finite verb never appears independently, and the meaning assigned to it in glossing is an approximation based on semantic commonalities among some or all of the compounds in which it appears.

(35) [[dɪraŋan-ŋi]$_{PW}$-ŋá[a]]$_{PW}$-kanam
look.3SG.NFUT-1SG.OBJ-bark.PLRCT-BE.IMPF
'the dog is barking at me, glaring' (Fieldnotes, 2014-09)

(36) *[diraŋán-ŋi]$_{PW}$ *not attested as an independent verb*
look.3SG.NFUT-1SG.OBJ
'?he is looking at me'

The central claim of this paper is that the right margin of the head PWord is the anchor point for coverb compounding. However for compounds such as (35), for which the finite verb never appears independently, there is no direct evidence (stress, vowel lengthening) about the location of the right boundary of the head PWord. Learners of Murrinhpatha would not be able to acquire the prosodic compounding principle from these verbs. Therefore, learners must acquire the principle from finite verbs that *do* appear independently, and somehow extend it to all verb compounds whether the finite verb appears independently or not. This may be conceptualised as an "abstract PWord" that is not necessarily phonologically realised, comparable to other abstract structures in generative phonology that are not pronounced in surface phonetics. Alternatively, it may be conceptualised as a set of morphotactic templates that are abstracted from the prosodic principle that determines them. These sequencing templates can be thought of as *morphological constructions* (Booij 2010), such as (37), (38). As well as generalised templates, there may also be lexically specific templates representing the fact that only particular verb–coverb combinations are used as compounds (39), (40). (Where [$\sqrt{\text{ma}}$]$_V$ represents some finite form of the verb /ma/ "use hands".) Booij proposes that such lexical constructions account for lexically specific compositionality, while maintaining an inheritance relationship with properties defined by more general templates (Booij 2010, pp. 206–207).

(37) [[_]$_V$ [-ŋi̪n̪t̪a] [_]$_{COV}$]$_V$ "two of them V-COVed"

(38) [[_]$_V$ [_]$_{OBL}$ [_]$_{COV}$ [-ŋi̪n̪t̪a]]$_V$ "two of them V-COVed for OBL"

(39) [[[$\sqrt{\text{ma}}$]$_{\text{V}}$]$_{\text{V}}$[-ŋi̪n̪t̪a] [pa̪t̪a]$_{\text{COV}}$]$_{\text{V}}$ "two of them made it"

(40) [[[$\sqrt{\text{ma}}$]$_{\text{V}}$]$_{\text{V}}$[_]$_{\text{OBL}}$ [pa̪t̪a]$_{\text{COV}}$ [-ŋi̪n̪t̪a]]$_{\text{V}}$ "two of them made it for OBL"

Previous work on Murrinhpatha verb morphology has proposed stipulative morphotactic templates as the only possible mechanism for word formation, focusing on evidence such as the non-adjacency of the verb stem and coverb, and the alternation of DUAL positioning either before or after the coverb (Nordlinger 2010). While the morphological constructions above are broadly in line with these suggestions, previous work has given an incomplete account by missing the generalisation about prosodic constituency. Another problem with the purely templatic account is that it focuses exclusively on compound verbs, without any discussion of lexically simple verb forms—thus overlooking precisely those forms in which the principles of prosodic constituency are revealed.[11] In the last section of this paper, a more detailed account is given of the prosodic compounding mechanism (Sect. 7), in which head PWords are represented as part of a stratal derivation. The example used there is headed by a finite verb that does appear independently, and thus has direct evidence for head PWord constituency. The analysis is agnostic, however, as to how this is extended to other verb compounds.

6 Other types of prosodically anchored of morphology

The observation of a prosodic edge determining morphotactics is not in itself unexpected. However previous accounts of prosodically anchored morphology deal with inflectional material, while prosodic alignment of a lexical stem is unattested.

One widely attested form of prosodic alignment for morphology is clitic positioning. Familiar examples can be adduced from Indo-European languages, where clitics realise inflectional categories such as agreement or definiteness on a phrase, and position the inflection according to various morphosyntactic or prosodic categories, in some cases using the first PWord in the phrase as an anchor (Anderson 1992, pp. 198–223, 2005; Bennett et al. 2016). For example, (41) shows the definiteness clitic in Bulgarian attaching to noun phrases, selecting a prosodic constituent for attachment (the first PWord), rather than any particular morphosyntactic constituent. Another potential case of prosodic alignment for inflection is in Chintang, where inflectional prefixes have variable sequencing (Bickel et al. 2007). The evidence for prosodic alignment here is less direct, but Bickel and colleagues argue that the variability of morphotactic sequencing can be explained by prosodic alignment, with multiple nested PWords providing the variation of anchor points.

(41) a. [knigi]$_{\text{PW}}$=te
books=DEF
'the books'

[11] Adam Albright (p.c.) points out that the prosodic compounding account may also be seen as more natural from an acquisitional point of view, since its principles can be learnt from simpler verb forms. The purely stipulative template, by contrast, can only be deduced from highly complex verb forms, which are presumably acquired late.

b. [interesni]$_{PW}$=te [knigi]$_{PW}$
interesting=DEF books
'the interesting books'
c. [mnogo]$_{PW}$=to [interesni]$_{PW}$ [knigi]$_{PW}$
many=DEF interesting books
'the many interesting books' Bulgarian (Anderson 2005: 111)

Infixation is another type of morphology that exploits prosodic structure, aligning to foot and syllable constituents at the left or right edge of a word (Anderson 1992, p. 206ff.; Moravcsik 1977; Yu 2007). However, infixation generally involves either derivational or inflectional morphology, rather than lexical stems. For example, in Semelai (Austronesian: Kruspe 2004), roots are phonologically either monosyllabic CV(C) or sesquisyllabic C.CV(C). Various derivational infixes, such as <ra> verbal comparative, are anchored at the left edge of the full syllable (42), (43) (Kruspe 2004, p. 69).

(42) sej ɟ.ləŋ
'be thin' 'be long'

(43) ra.sej ɟ.ra.ləŋ
'be thinner' 'be longer'

The only previous example of lexical infixation that I am aware of is the infixation of expletives before the right-most foot in English adjectives, as in *fan-fucking-tástic* (McCarthy 1982a). However this is a rare and ludic phenomenon in English, limited to a handful of intensifying infixes. The prosodic alignment of coverbs in Murrinhpatha is, by contrast, a core word-formation strategy in the grammar.

Finally, reduplication is a form of morphology that exploits prosodic structure, however it is somewhat different from prosodic alignment in that it involves the deployment of a prosodic template as a morphological exponent, filled out by segmental material copied from the host lexeme (McCarthy 1982b; McCarthy et al. 2012). Prosodic alignment, by contrast, involves the targeting of an existing prosodic constituent as the anchor for an independently defined phonological exponent.

7 A Stratal Phonology account of prosodic alignment and stem recursion

The alignment of the coverb to a prosodic constituent, which is opaque to surface phonology, implies a cyclic/stratal model in which a structure may be active on one derivational stratum, and inactive on another. What makes Murrinhpatha compound verbs unusual among stratal models of morpho-phonological interaction is that the PWord controls morphotactic positioning, and controls it as part of recursive stem formation—that is to say, a stem that is formed using a complete inflected word as a base. I begin the following discussion by giving a brief overview of stratal word formation following the model of Bermúdez-Otero (2016), then show how this model provides a cogent account of Murrinhpatha compound verb phenomena, drawing on known phenomena from the literature, but filling a typological gap in the interaction of PWord constituency and word-formation strata.

7.1 Stratal word-formation

While various earlier grammatical traditions observed that different types of affixes have different phonological properties, it was Lexical Morphology and Phonology that explicitly introduced the concept of distinct morpho-phonological strata (Booij and Rubach 1987; Kiparsky 1982; Mohanan 1986). The core of the theory is that morphological word structure is built in incremental cycles, some of which lead to cycles of phonological computation—in particular, adjustment of segmental form or allocation of stress features. Morpho-phonological cycles are grouped into levels or *strata*, these being the cycles that share a phonology. Earlier accounts of cycles and strata made limited reference to prosodic constituents, however more recent formulations such as Stratal Phonology (Bermúdez-Otero 2016) incorporate prosodic phonology, with prosodic constituents formed and re-formed in phonological computations. Since different phonological processes apply on different levels, prosodic constituents may have different effects on different levels. This has not been a focal point in Stratal Morphology, but as we will see below, the possibility is implicit in some of Bermúdez-Otero's analyses, and it is crucial for our account of Murrinhpatha verb compounding.

Stratal Phonology proposes three phonological strata: stem, word and phrase. Stems are complete lexemes, though not inflectionally complete. Stems may be formed recursively from other stems, in which case stem phonology applies in successive cycles, unlike word phonology, which applies just once to the complete syntactic word.[12] Word phonology applies to a complete word including all morphology required for marking inflectional categories. At the lowest level of the hierarchy, there are also morphological root elements, which may not be complete lexemes (and may therefore lack psychological reality for speakers), but instead form stems only as part of morphological constructions.[13]

Belfast English furnishes an example of a phonological pattern that applies on the stem level, but not the word level. The coronal consonants /t, d, n, l/ take on a dental realisation before /əɹ/, if this sequence occurs in a stem constituent (44). But if the sequence is formed only at the word level, for example with the comparative /-əɹ/, the rule is no longer applicable and the coronal is alveolar (45) (J. Harris 1985, p. 211; cited in Bermúdez-Otero 2011, p. 2022).

(44) $[[\text{ma}\underset{\text{n}}{\text{t}}\text{əɹ}]_{\text{SL}}]_{\text{WL}}$ 'matter'

(45) $[[\text{fat}]_{\text{SL}}\text{-əɹ}]_{\text{WL}}$ 'fatter'

Similarly, the application of voiceless obstruent lenition in Murrinhpatha verbs can be represented as an effect of stem-level versus word-level phonology. The lenition applies when a morpheme-initial voiceless obstruent is preceded by a vowel as part of stem formation (46), but not when the same segmental sequence is created as

[12] Cyclicity of phrase-level phonology is not explicitly discussed by Bermùdez-Otero, and is not pertinent to the current analysis.

[13] Bermúdez-Otero argues that roots, unlike stems, are not independently stored in the mental lexicon, and that the degree to which speakers are able to access roots as linguistic units varies across languages (Bermúdez-Otero 2013, 2016).

part of word formation (47). In the next section, we further elaborate this analysis of morphological strata to include *recursive* stem formation.

(46) maẉáṯanu
[[ma-paṯa]$_{SL}$-nu]$_{WL}$
use.hands.1SG.IRR-good-FUT
'I'll make it' (=8)

(47) puménaðapaḍi
[[pume-na]$_{SL}$-ða-paḍi]$_{WL}$
say.3PL.PST-3SG.OBL-PST-BE.IMPF
'they were saying to him' (=9)

An example from Quito Spanish involves formation of syllable constituents on the word level, and re-formation on the phrase level. In the phrase *gas acre* "acrid gas", coda sibilant voicing affects /s/ on the word level. Separate evidence from emphatic /r/ → [r] pronunciations indicate that prevocalic codas are resyllabified as onsets on the phrase level, however the voicing effect produced on the word level for *gas acre* is maintained despite phrasal resyllabification (48). Coda sibilant voicing and emphatic trilling are therefore determined by syllable constituency on distinct morpho-phonological strata (Bermúdez-Otero 2011, p. 2029ff.).

(48) [[[gas]$_{SL}$]$_{WL}$ [[akre]$_{SL}$]$_{WL}$]$_{PL}$
gà.zá.kre 'acrid gas'

In most stratal accounts of morpho-phonology, although the strata STEM → WORD → PHRASE are ordered in their relationship to the eventual phonological form of the utterance, a derivation may nonetheless loop back from one stratum onto the previous, at least with respect to word and stem levels. Stratal Phonology is not explicit on this point, which is however explored elsewhere in some detail (e.g. Caballero and Inkelas 2013). "Regressive" derivational steps are important for our account of Murrinhpatha compound verbs, which loop back to compound stem formation after inflectional word-level morphology has been formed.

7.2 Stratal derivation of Murrinhpatha compound verb

Prosodically aligned compounding in the Murrinhpatha verb implies that the verb stem undergoes word-level inflectional morphology, which is assigned a prosodic structure, before recursively returning to stem-formation with the coverb compounding operation. Recursive stem-formation using a fully inflected word as a base is widely attested for endocentric compounds (Anderson 1992, p. 294ff.; Stump 2001, p. 96ff.), and the general form of Murrinhpatha compound verbs can also be considered endocentric, with the finite verb defining a broad type of action, and the coverb providing specificity (Mansfield 2014, p. 284ff.; Nordlinger 2015). The stratal derivation of a Murrinhpatha compound verb begins with an abstract root, which undergoes unpredictable stem-level morphological exponence (including vowel and consonant alternations) to form a pronounceable verb stem (49a, b). This is then subject to predictable, word-level morphology that fully encodes all inflectional categories (c–e).

Compounding loops back through another stem cycle, producing a compound stem that is prosodified with a reassigned PWord and accompanying lenition effects (f). The compound surfaces without further morphology on the word level (g), but stress is realised only at the phrase level, as evidenced by multi-word noun phrases hosting a single stress (h, Sect. 2).

(49)

(a)	Root		$\sqrt{\text{ma}}$
(b)	Stem cycle	*inflection*	pu-$\sqrt{\text{ma}}$[+FRONT]-ø
		phonology	[pume]$_{\text{PW}}$
(c)	Word cycles	*inflection*	[pume]$_{\text{PW}}$-ŋa
(d)		*inflection*	[pume]$_{\text{PW}}$-ŋa-ŋiɲ̟ta
(e)		*inflection*	[pume]$_{\text{PW}}$-ŋa-ŋiɲ̟ta-ða
		phonology	[pumeŋa]$_{\text{PW}}$ŋiɲ̟taða
(f)	Stem cycle	*compounding*	[pumeŋa]$_{\text{PW}}$-paṯa-ŋiɲ̟taða
		phonology	[pumeŋawaṯa]$_{\text{PW}}$ŋiɲ̟taða
(g)	Word cycle	–	[pumeŋawaṯa]$_{\text{PW}}$ŋiɲ̟taða
(h)	Phrase cycle	*phonology*	[[pumeŋawáṯa]$_{\text{PW}}$ŋiɲ̟taða]$_{\text{PH}}$
			'the two of them built it for me'

PWord constituency is formed at the stem level, as evidenced by the recursive PWord formed in response to the compound stem (f), and also at the word level, as evidenced by PWord constituency selectively incorporating some inflectional affixes (e, Sect. 2). In this representation the PWord constituent that anchors the coverb on recursive stem formation is not treated as persisting through the phonology cycle, as in [[pumen]$_{\text{PW}}$-paṯa]$_{\text{PW}}$ŋiɲ̟taða, since it does not provoke any phonological effects (i.e. stress, bimoraic length, assimilations) in this or subsequent cycles. It is subject to *bracket erasure*, though of a prosodic type, rather than the more familiar morphological type (Orgun and Inkelas 2002). Prosodic bracket erasure has been posited for syllable constituents, in analyses that propose cyclic "re-syllabification" (e.g. the Quito Spanish example above). While PWord bracket erasure is not widely discussed in the literature, such an analysis may replace parallel analyses of recursively nested PWords (e.g. McCarthy 1993; Peperkamp 1996, 1997), if we assume that the phonological features determined by a lower-cycle PWord constituent persist, even though the PWord itself is overwritten. One analysis in which PWord bracket erasure *is* explicitly proposed is for Axininca (Arawakan: McCarthy and Prince 1993b). PWords are assigned at a stem level, where they produce bimoraic minimal weight. For a monosyllabic stem the bimoraic minimum is met by an epenthetic /-ta/ suffix (50), (51).[14]

(50) [[no-na]$_{\text{PW}}$-piro]$_{\text{PW}}$
[[1SG-carry.on.shoulder]$_{\text{ST}}$-truly]$_{\text{ST}}$
'I truly carry on shoulder'

[14] A competing analysis of the Axininca data proposes that the /t/ is part of the verb stem, rather than epenthetic (Staroverov 2015). It is not clear whether this analysis retains any basis for positing PWord formation on the stem level.

(51) [[na-ta]$_{PW}$-piro]$_{PW}$
[[carry.on.shoulder-TA]$_{ST}$-truly]$_{ST}$
'truly carry on shoulder' (McCarthy and Prince 1993b, p. 24)

At word level, PWord structure is re-assigned, and at this level the PWord determines stress. Any epenthetic segmental material produced by the lower PWord persists, but lower PWords do not determine stress placement (52), and thus are interpreted as undergoing bracket erasure.

(52) (nomà)(napì)(tačáa)ri
[[[no-mana]$_{PW}$-pitačaa]$_{PW}$-ri]$_{PW}$
'I will hide to see him' (McCarthy and Prince 1993b, p. 147)

The Murrinpatha PWord's bimoraic minimum is not evidenced in the above example, but relevant forms indicate that, like stress, it is assigned at the phrase level. Evidence from compound verbs with a monomoraic /CV/ finite verb shows that it is not assigned at the stem or word level, since the zero-inflected stem does not undergo vowel lengthening to meet the requirement (53c), i.e. */na:/. However if a monomoraic verb undergoes neither compounding, nor hosts any prosodically internal inflectional suffixes, it does undergo lengthening (54d).

(53)

(a)	Root		$\sqrt{\text{ma}}$
(b)	Stem cycle	*inflection*	ø-$\sqrt{\text{ma}}$[+APICAL]-ø
		phonology	[na]$_{PW}$
(c)	Word cycle	–	[na]$_{PW}$
(d)	Stem cycle	*compounding*	[na]$_{PW}$-pu[
		phonology	[napu[]$_{PW}$
(e)	Word cycle	–	[napu[]$_{PW}$
(f)	Phrase cycle	*phonology*	[[nápu[]$_{PW}$]$_{PH}$

(54)

(a)	Root		$\sqrt{\varnothing}$
(b)	Stem cycle	*inflection*	ṯi-$\sqrt{\varnothing}$[+DEF]-ø
		phonology	[ṯi]$_{PW}$
(c)	Word cycle	*inflection*	[ṯi]$_{PW}$-nu
		phonology	[ṯi]$_{PW}$nu
(d)	Phrase cycle	*phonology*	[[ṯí:]$_{PW}$nu]$_{PH}$

7.3 An alternative analysis with two inflectional strata

There is an almost unlimited range of alternative stratal analyses that could be applied to the Murrinhpatha data, but one in particular deserves to be considered. This is an analysis in which the inflectional suffixes of the verb are not all part of word-level morphology, but are instead split into stem-level and word-level affixes to align with their PWord-internal and external prosodic statuses. This analysis averts the need to posit a prosodic anchor for the coverb, thus saving us from an apparent typological anomaly. However, I will argue that it comes with much more serious flaws, in its failure to align naturally with the morphosyntactic structure of the verb.

If we allow that some inflectional suffixes are stem-level, and others are word-level, then the compounding operation can be posited as the last cycle of the stem

stratum, thus layering in the more familiar way to the outside of preceding morphological cycles (55d). Prosodic alignment is thus not required, and PWord constituency becomes a predictable property of stem-level derivation, but never of word-level derivation.

(55)

(a)	Root		$\sqrt{\text{ma}}$
(b)	Stem cycles	*inflection*	pu-$\sqrt{\text{ma}}$[+FRONT]-ø
		phonology	[pume]$_{\text{PW}}$
(c)		*inflection*	[pume]$_{\text{PW}}$-ŋa
		phonology	[pumeŋa]$_{\text{PW}}$
(d)		*compounding*	[pumeŋa]$_{\text{PW}}$-paṭa
		phonology	[pumeŋawaṭa]$_{\text{PW}}$
(e)	Word cycles	*inflection*	[pumeŋawaṭa]$_{\text{PW}}$-ŋiṉṉa
(f)		*inflection*	[pumeŋawaṭa]$_{\text{PW}}$-ŋiṉṉa-ða
		phonology	[pumeŋawaṭa]$_{\text{PW}}$ŋiṉṉaða
(g)	Phrase cycle	*phonology*	[[pumeŋawáṭa]$_{\text{PW}}$ŋiṉṉaða]$_{\text{PH}}$
			'the two of them built it for me'

However this derivation does not follow naturally from the morphosyntactic roles of the suffixes involved. It arbitrarily assigns suffixes to stem and word strata for the sake of maintaining "typological normalcy". In particular, this derivation has morphosyntactic number features being realised either in the stem-level or word-level morphological cycles according to morphological dependencies (Sect. 2). Whatever model we propose for Murrinhpatha verbs requires some complexity in accounting for these dependencies. It seems highly unnatural to propose an inflectional system split over stem and word strata, given the deep interdependency of these suffixes in exponing morphosyntactic categories. This would also require that the /-ŋiṉṉa/ DUAL suffix would be analysed as "both-levels" suffix, appearing sometimes in word derivation (55e), and sometimes in stem derivation (56c), according to the presence or absence of a pronominal suffix.

(56)

(a)	Root		$\sqrt{\text{ma}}$
(b)	Stem cycles	*inflection*	ø-$\sqrt{\text{ma}}$[+FRONT]-ø
		phonology	[me]$_{\text{PW}}$
(c)		*inflection*	[me]$_{\text{PW}}$-ŋiṉṉa
		phonology	[meŋiṉṉa]$_{\text{PW}}$
(d)		*compounding*	[meŋiṉṉa]$_{\text{PW}}$-paṭa
		phonology	[meŋiṉṉawaṭa]$_{\text{PW}}$
(e)	Word cycles	*inflection*	[meŋiṉṉawaṭa]$_{\text{PW}}$-ða
		phonology	[meŋiṉṉawaṭa]$_{\text{PW}}$ða
(g)	Phrase cycle	*phonology*	[meŋiṉṉawáṭa]$_{\text{PW}}$ða
			'the two of them built it'

There is nothing unusual about inflectional exponence being split over stem/word levels as such. This is quite familiar from cases of stem alternation, e.g. *wife, wive-s*, or stem grade systems in any number of languages (including the unpredictable stem forms of Murrinhpatha (Mansfield 2016b)). However these cases are characterised by unproductive, lexically specified stem allomorphy; to posit a stem/word split among

the completely productive inflectional suffixes of Murrinhpatha would be quite another matter. Indeed given the lack of any natural morphological distinction between the prosodically internal/external suffixes, analysing them as a stem/word split would render the concept of morphological levels vacuous in this instance, reducing it to a prosodic distinction.

Similarly, "both-levels" suffix analysis is not unprecedented, for example in discussion of the English derivational /-əbl/ (Bermúdez-Otero 2016). However, such analyses again depend on lexically specific associations—with either roots or stems—whereas a both-levels analysis of /-ŋi̪n̪t̪a/ would require an unprecedented claim of an affix appearing on alternate morphological levels depending on other inflectional morphology.

7.4 Cross-linguistic comparison of stratified PWord phenomena

If the prosodic compounding analysis is the one that follows most naturally from the Murrinhpatha data, how does it fit with our understanding of the PWord as a linguistic phenomenon? I suggest that it fills a typological gap, given other PWord effects attested in the literature.

PWords have both phonological and morphotactic properties. They are most commonly associated with segmental patterns that must be satisfied within, or at the edges of, the PWord constituent; and with stress patterns that are determined by the PWord domain. However, we have seen above (Sect. 5) that PWords also determine the positioning of morphological exponents. In stem derivation, foot or syllabic constituents control morphotactic alignment in infixation phenomena. In phrasal morphology, PWord alignment is familiar from clitic placement. Murrinhpatha compound verbs fill a gap in this series, showing that PWords may also have a morphotactic effect in the formation of recursive compound stems.

Prosodic constituency is often not explicitly marked in stratal analyses, such as the Belfast English /maṯ̪ɪ, fatɪ/ example above. I assume, however, that all phonological computations involve the formation of prosodic constituents, and indeed that segmental, stress and weight effects are mediated by prosodification. Therefore effects such as the "stem-internal" /tɪ → t̪ɪ/ effect can be reinterpreted as "PWord-internal", assuming that stem constituents are prosodified as PWords. From this point of view, segmental PWord effects are provoked as part of stem formation in most or all languages subject to stratal analysis (e.g. Malayalam sub-compounds Mohanan 1986), or indeed prosodic analysis (e.g. Neapolitan open vowels Peperkamp 1996). Stress effects on both stem and word levels can also be analysed in terms of PWord formation (e.g. Indonesian Bermúdez-Otero 2016). As for morphotactic PWord effects, we have seen above this has been posited previously in phrasal inflection (Bulgarian clitics Anderson 2005). Murrinhpatha compound verbs show the same effect in a different morphological process, i.e. lexical compounding. This leaves open the question of whether word-level affixation may also attach to a PWord edge. On this point we lack either positive or negative evidence, because word-level inflectional affixes almost universally attach to the edge of the stem, which is simultaneously the morphosyntactic base, and a PWord constituent. This is normally assumed (without discussion) to be morphosyntactic alignment, but in fact it could equally be interpreted as prosodic alignment.

Further exploration of Stratal PWord typology is limited by the paucity of languages for which prosodic domains and stratal morphology have been analysed. Stratal morphology, in particular, has been dominated by analysis of English and other Indo-European languages, with rather sparse coverage of other language types (but see e.g. Baker and Harvey 2003; Jones 2014; Mohanan 1986). This is particularly limiting because it has focused analysis on the rich derivational stem formation of Indo-European languages (e.g. *ungrammaticality*), with far less attention on complex inflectional morphology. Outside of stratal morphology, however, there are several cross-linguistic analyses of constituent alignment (McCarthy and Prince 1993a) and prosodic words (Bickel et al. 2009; Nespor and Vogel 2012; Schiering et al. 2010; papers in Dixon and Aikhenvald 2002). Some of the latter data may be amenable to reanalysis in a stratal account. For example, it has been proposed that Limbu (Tibeto-Burman: Schiering et al. 2010) has distinct "minor PWord" and "major PWord" constituents, the former determining segmental effects and the latter stress. But a stratal alternative might posit PWord formation on both stem and word morphological strata, with distinct phonological effects being determined on each stratum, as in Murrinhpatha. This would exchange a "two prosodic constituents" analysis for a "two phonological strata" analysis. If we accept other sources of evidence for the necessity of stratal phonology (e.g. Bermúdez-Otero 2011), then this would provide a more parsimonious analysis.

8 Conclusion

In this article I have described phonological and morphological phenomena associated with the PWord constituent in Murrinhpatha. In particular, PWord constituency in verbs is characterised by the mixed internal/external prosodic status of inflectional suffixes. Binding of prosodically internal number suffixes is controlled by adjacency to the co-indexed pronominal argument, which results in the DUAL suffix alternating between internal/external prosodification.

Compound verbs add a coverb to the base verb, and the position of the coverb is at the right edge of the PWord headed by the verb. Since the PWord constituent encompasses some inflectional suffixes but not others, the morphotactic position of the coverb may be amidst a series of suffixes. "Prosodic compounding" such as this has not previously been described, though this may be for want of prosodic analysis in languages with complex inflectional morphology. The PWord constituent that anchors coverb compounding does not determine stress or bimoraic weight effects in the whole unit. Surface phonology is instead determined by a recursive PWord encompassing the base verb and coverb. The head PWord is therefore phonologically opaque, suggesting a cyclic model of word derivation. I have sketched such a model in Stratal Phonology (Bermúdez-Otero 2016), highlighting the fact that PWords are formed and reformed on distinct levels of the derivation, and determine distinct phenomena (morphotactics, stress and weight) on stem and phrase levels respectively. Although PWords' role as morphotactic anchors in compound stem formation has not been previously attested, it is not typologically unexpected, given that prosodic sub-constituents play such a role in phenomena such as infixation and cliticisation.

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