Suffix Coherence and Stress in Australian Languages*

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1. Introduction

This paper offers a formal account of the diverse patterns of suffix coherence (the degree to which suffixes combine with other morphemes to form metrical feet) with respect to stress among Australian languages. In section 2, data is presented from five Australian languages which stress monomorphemic words in a similar fashion, but which differ with respect to suffix coherence. It is proposed that two distinct kinds of morphological boundary must be recognised: the boundary between a root and a suffix, and the boundary between two suffixes.

In section 3 an analysis is proposed in terms of Optimality Theory (OT, Prince and Smolensky 1993 and much work following on from this), and it is argued in concluding that this approach is essentially the one required to account for the data. These languages have all received some previous attention from phonologists, and previous attempts to account for their stress patterns with respect to suffix coherence are discussed briefly in section 4. It is argued that none of these accounts is entirely plausible. Most fail because they do not acknowledge the distinction between the two kinds of boundary proposed in section 2. Some fail because the specific approach taken has created a theory-internal paradox.

2. Suffix coherence in five Australian languages

The five languages discussed in this paper are Pintupi (section 2.1, data used here taken from Kenstowicz 1994:599), Diyari (section 2.2, data from Austin 1981:31 except where otherwise noted), Dyirbal (section 2.3, data from Dixon 1972 except where otherwise noted), Warlpiri (section 2.4, data from Nash 1980 and from Ken Hale and Mary Laughren by personal communication), and Jingulu (section 2.5, data from my own field notes, most of which can be found in Pensalfini 1997). The five languages can be characterised in the same way with respect to stress on monomorphemic words: stress falls on the first syllable and on every second syllable thereafter, but never on the final syllable (the distinction between primary and secondary stress is ignored).[1] None of

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[1] I have used the term 'syllable' throughout where, strictly speaking, 'stress-bearing unit' would be more appropriate. Some of the languages discussed may treat the mora rather than the syllable as the stress-bearing unit (see Pensalfini 1997 for such an argument for Jingulu, for instance), in which case references to 'syllable' in this context actually refers to 'mora'.

these languages allow adjacent stressed syllables. The most natural analysis for this is to propose trochees (binary left-headed feet) aligned toward the left edge of the word. This assumption is extended to polymorphemic words so that a stressed syllable is always assumed to head a trochee, and therefore forms a foot with the subsequent syllable.

2.1 Pintupi

Pintupi, illustrated in (1), effectively ignores morpheme boundaries for the purposes of stress assignment. Trochees are all aligned leftward, with words with an odd number of total syllables having one unfooted syllable at the right edge of the word.

(1) a. *(púl̲i-ng)(kà-la)-tju*
'we (sat) on the hill'

b. *(tjámu)(lì-mpa)(tjù-ngku)*
'our relation'

2.2 Diyari

Diyari, illustrated in (2), never allows a foot to contain nuclei from different morphemes at all. The result is that disyllabic suffixes will be stressed on their first syllable, while monosyllabic suffixes will never receive stress.

(2) a. *(kárna)-(wàra)*
man-PL

b. *(márda)-la-nhi*
hill-CHAR-LOC

c. *(kána)-nhi-(màtha)*
man-LOC-IDENT

d. *(pína)du-(wàra)*
old_man-PL

e. *(púlyu)da-nhi*
mud-LOC

The form in (2b) appears in Austin 1981:40, the stress calculated by Crowhurst (1994a) based on Austin's description, while (2d) appears in in Austin 1981:28, with the stress calculated by me, based on Austin's description.

Note the prosodic minimal pair formed by (2a) and (2b). Both words have four syllables, but in (2a) these constitute two disyllabic morphemes, and so there are two stresses, while in (2b), consisting of a disyllabic root followed by two monosyllabic suffixes, only the root is stressed.

2.3 Dyirbal

Dyirbal, illustrated in (3), allows a single foot to contain material from two suffixes, but never to contain one nucleus from the root and another from a suffix. This means that while a monosyllabic affix can be stressed if other affixes follow, a monomorphemic word with an odd number of syllables can never have its final syllable stressed.

(3) a. *(wánydyi)-ngu*
motion_uphill-REL

b. *(wánydyi)-(ngú-gu)*
motion_uphill-REL-DAT

c.	*(dyángga)-(ná-mbi)la* eat-ANTIPASS-LEST	d.	*(mánda)lay-m(bál-bi)la* play-COMIT-lest

Forms (3a-b) are taken from Dixon 1972:274, form (2c) from Dixon 1972:284, and (3d) is cited in Crowhurst 1994 as a personal communication from Dixon. From the above we see that Dyirbal is a language in which the boundary between suffixes is treated differently with respect to prosody than a boundary between root and suffix.

2.4 Warlpiri

Warlpiri, illustrated in (4), allows a foot to contain nuclei from different morphemes only if a run of three unstressed syllables would otherwise result. Disyllabic suffixes are always stressed on their first syllable. Monosyllabic suffixes are stressed only if followed by another monosyllabic suffix.

(4)	a.	*(wáti)ya* tree	b.	*(wáti)(yà-rla)* tree-LOC
	c.	*(wáti)ya-(rlà-rlu)* tree-LOC-ERG	d.	*(wáti)ya-(rlà-rlu)-ju* tree-LOC-ERG-TOP
	e.	*(wáti)(yà-rla)-(jùku)* tree-LOC-STILL	f.	*(yápa)rla-(ngùrlu)* grandmother-ELAT
	g.	*(yápa)-(rlàngu)-rlu* person-e.g.-ERG	h.	*(yápa-ng)ka-(rlàngu)-ju* person-LOC-e.g.-TOP

Stress on the final syllable of a root with an odd number of syllables, indicating a foot which contains one nucelus from the root and one from the first suffix (as in (4b) and (4e)), is avoided unless failure to do so would result in a sequence of three unstressed syllables. A foot containing two monosyllabic suffixes is preferred (as in (4c) and (4d)). A foot boundary never divides the nuclei of a disyllabic suffix. Note the minimal pair formed by (4f) and (4g), due entirely to the morphemic structure of the words in question.

2.5 Jingulu

Jingulu, illustrated in (5), behaves like Warlpiri with respect to the boundary between root and suffix (a foot only contains nuclei from both root and suffix if a sequence of three unstressed syllables would otherwise result), but freely allows feet to contain nuclei from two different suffixes.

(5)	a.	*(bárda)rda* younger_brother	b.	*(bàrda)(rdá-ni)* younger_brother-FOC
	c.	*(bàrda)rda-(ná-ni)* younger_brother-DAT-FOC	d.	*(jìka)ya-m(bíli)* lake-LOC
	e.	*(yùku)(lyàrri)-(nà-ngka)(mí-rni)* goat-DAT-ABL-FOC		

Unlike Warlpiri, a foot boundary may fall in the middle of a disyllabic suffix ((5e), contrast with (4h)). A monosyllabic affix is only stressed if it is not word-final.

3. A account of suffix coherence

The account offered in this section integrates the fundmental observations of Crowhurst's (1994) account (discussed in section 4.2), in which constraints against mismatching foot and morpheme boundaries play a role, and the accounts in section 4.4, in which roots and affixes exhibit different behaviour.

The constraints utilised in this account are:

(6)	PARSE	a syllable is parsed into a foot
	ALIGN(Ft, L, PrWd, L)	the left edge of a foot coincides with the left edge of a prosodic word
	RTINT	a nucleus from a root does not appear in the same foot as a nucleus from another morpheme
	AFXINT	a nucleus from an affix does not appear in the same foot as a nucleus from another morpheme
	LAPSE	two unstressed syllables must be separated by a foot boundary (Green and Kenstowicz 1995)

The RTINT and AFXINT constraints are markedness constraints, not correspondence constraints like those discussed in section 4.4, which is to say that they examine candidates purely on their structural well-formedness. Attempting to formalise these markedness constraints in terms of the structure to be avoided reveals that AFXINT may in fact be two constraints rather than one. RTINT can be expressed as $*(\sigma]_{RT}\ \sigma$, but AFXINT must be defined disjunctively as $*(\sigma]_{AF}\ \sigma$ and $*[_{AF}\ \sigma)$. Within OT, all constraints should express some general (universal) tendency, and these constraints are best viewed as expressing the generalisation that there is a preference for prosodic and morphological constituents not to overlap. Within OT, this is usually considered the domain of Alignment constraints (McCarthy and Prince 1993). However, as demonstrated in section 4.3, the data discussed here do not succumb readily to a straightforward analysis in terms of such constraints.

The constraints in (6) interact with PARSE and LAPSE, and all of these constraints are dominated by constraints requiring all feet to be trochaic (binary and left-headed), which are not shown in the tableaux here. The patterns of suffix coherence exemplified by the languages in section 2 are accounted for as illustrated in (7) through (11).

(7) Pintupi (from (1b))

/tjamuli-mpatju-ngku/	PARSE	ALIGN(Ft, L, PrWd, L)	RTINT	AFXINT[2]
a. ☞ (tjamu)(li-mpa)(tju-ngku)	√	******	*	***
b. (tjamu)li-m(patju-ng)ku	*!*	***	√	√

Violations of ALIGN(Ft, L, PrWd, L) are calculated by counting the number of syllables that intervene between the left edge of a foot and the left edge of the word. Thus, in (7a), the first foot is at the left edge of the word and incurs no violations, while the second foot is separated from the left edge of the word by the two syllables that constitute the first foot, and the third foot is separated from the left edge of the word by the four syllables that make up the first two feet, for a total of six violations of ALIGN(Ft, L, PrWd, L).

(8) Diyari

a. (from (2c))

/kana-ni-mata/	RTINT	AFXINT	PARSE	LAPSE
a. (kana)-(ni-ma)ta	√	*!	*	√
b. ☞ (kana)-ni-(mata)	√	√	*	√
c. (kana)-ni-mata	√	√	**!*	**

b. (from (2b))

/mada-la-ntu/	RTINT	AFXINT	PARSE	LAPSE
a. (mada)-(la-ntu)	√	*!*	√	√
b. ☞ (mada)-la-ntu	√	√	**	*

(9) Dyirbal (from (3d))

/mandalay-mbal-bila/	RTINT	PARSE	LAPSE	AFXINT
a. ☞ (manda)lay-(mbal-bi)la	√	**	√	**
b. (manda)(lay-mbal-)(bila)	*!	√	√	*
c. (manda)lay-mbal-(bila)	√	**	*!	√

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[2] A word is in order the evaluation of RTINT and AFXINT here. Candidate (a) in (7) violates RTINT because its final syllable appears in a foot with material from the first suffix /mpatju/. This candidate incurs three violations of AFXINT thus: (i) the first syllable of the suffix /mpatju/ appears in a foot alongside the final syllable of the root, (ii) the second syllable of /mpatju/ appears in a foot alongside the second suffix /ngku/, and (iii) the final suffix appears in a foot alongside the second syllable of the suffix /mpatju/. Admittedly, this is not the only possible way of evaluating violations of this constraint. One might simply look at each suffix to determine whether the suffix violates the constraint or not, or at each foot to determine whether the foot violates the constraint. As far as I can tell, the choice of evaluation metric will not affect the accuracy of the analysis for any of the languages considered here.

(10) Warlpiri

a. (from (4b))

	/watiya-rla/	LAPSE	RTINT	AFXINT	PARSE
a.	(wati)ya-rla	*!	√	√	* *
b. ☞	(wati)(ya-rla)	√	*	*	√

b. (from (4f))

	/yaparla-ngurlu/	LAPSE	RTINT	AFXINT	PARSE
a. ☞	(yapa)rla-(ngurlu)	√	√	√	*
b.	(yapa)(rla-ngu)rlu	√	*!	*!	*

c. (from (4d))

	/watiya-rla-rlu-ju/	LAPSE	RTINT	AFXINT	PARSE
a. ☞	(wati)ya-(rla-rlu)-ju	√	√	**!	* *
b.	(wati)(ya-rla-)(rlu-ju)	√	*!	**!*	√
c.	(wati)ya-rla-rlu-ju	*!**	√	√	* * * *

(11) Jingulu

a. (from (5b))

	/bardarda-ni /	LAPSE	RTINT	PARSE	AFXINT
a.	(barda)rda-ni	*!	√	* *	√
b. ☞	(barda)(rda-ni)	√	*	√	*

b. (from (5c))

	/bardarda-na-ni /	LAPSE	RTINT	PARSE	AFXINT
a. ☞	(barda)rda-(na-ni)	√	√	*	* *
b.	(barda)(rda-na)-ni	√	*!	*	*

c. (from (5e))

	/ yukulyarri-na-ngkami-rni/	LAPSE	RTINT	PARSE	AFXINT
a. ☞	(yuku)(lyarri)-(na-ngka)(mi-rni)	√	√	√	* * * *
b.	(yuku)(lyarri)-na-ng(kami)-rni	√	√	*!*	√

4. Previous analyses - an overview

In this section we will look at previous metrical accounts of (subsets of) the data introduced in the preceding section. The first, in section 4.1, will be my own attempt, in Pensalfini 1997, to account for the data from the perspective of cyclic lexical phonology. Within such an approach, as we will see, it is necessary to posit 'anti-cyclic' explanations for Warlpiri and Jingulu at least, wherein the suffix string is treated as a domain for stress assignment prior to its affixation to the host root. The remaining analyses are all within the framework of OT, Crowhurst's (1994) being the first such attempt. Crowhurst's analysis, discussed in section 4.2, is well-suited to explaining the patterns found in Pintupi (section 2.1), Diyari (2.2) and Dyirbal (2.3), but can not be extended to Warlpiri (2.4) and Jingulu (2.5). Kager's (1995) account, discussed in section 4.3, is found wanting on two grounds. It makes incorrect predictions for Warlpiri, and the notion of 'prosodic word' it introduces seems counter-intuitive. The correspondence approach developed by Kenstowicz (1994) and also found in Pensalfini (1997), discussed in section 4.4, makes use of the notion of uniform exponence, and is the first to really separate roots from affixes with respect to the stress data. As such, it represents a major step in the right direction, and seems to account for all the data accurately. However, I argue that it also introduces a paradox into the OT framework.

4.1 Ordered rule application (Pensalfini 1997)

The rule-based account proposed in Pensalfini 1997 is based on the bracketed grid system of Idsardi (1992) and Halle and Idsardi (1995). Monomorphemic words are accounted for in a straightforward fashion, with binary feet constructed proceeding from the left edge of the word toward the right. Pintupi (section 2.1) poses no problem. The foot construction rules applying only after all suffixes have been added. Diyari (section 2.2) involves cyclic application of the rule. Foot formation affects the root alone, then suffixes are added one at a time, with foot formation applying after the addition of each new suffix. Application of the rule on a particular cycle can not affect the material present prior to addition of the current suffix. This is illustrated for the form (2c) in (12).

(12)		*kana*	root
		(kana)	foot formation
		[(kana)]-ni	addition of first suffix
		----------	foot formation
		[[(kana)]-ni]-mata	addition of second suffix
		[[(kana)]-ni]-(mata)	foot formation

Dyirbal (section 2.3) only applies the foot formation rule twice: once on the root cycle, and once at the word level when all the suffixes have been added. This is illustrated below for the forms in (3c) and (3d):

(13)	a.	*dyangga*	root
		(dyangga)	foot formation
		[(dyangga)]-na-mbila	addition of suffixes
		[(dyangga)]-(na-mbi)la	foot formation
	b.	*mandalay*	root
		(manda)lay	foot formation
		[(manda)lay]-mbal-bila	addition of suffixes
		[(manda)lay]-(mbal-bi)la	foot formation

This account, however, runs into serious problems with Warlpiri (section 2.4) and Jingulu (section 2.5). The problem in each of these cases is that the final syllable of roots with odd numbers of syllables can form a foot with the first suffixal syllable, but only if that suffixal syllable is not able to form a foot with another suffixal syllable. This requires that the footing of suffixes precede the footing of the word as a whole. Mechanically, this can be achieved, as illustrated in (14) for Warlpiri and (15) for Jingulu. In Warlpiri, but not in Jingulu, disyllabic suffixes always form a foot unto themselves, and this requires that Warlpiri apply the footing rule to individual suffixes prior to its application to the string of suffixes as a whole.

(14)	a. (from (4e))	*-rla*	foot formation - suffix 1
		-(juku)	foot formation - suffix 2
		-rla-(juku)	suffix concatenation
		------------	foot formation
		watiya-rla-(juku)	suffixation
		(wati)(ya-rla-)(juku)	foot formation
	b. (from (4d))	*-rla*	foot formation - suffix 1
		-rlu	foot formation - suffix 2
		-ju	foot formation - suffix 3
		-rla-rlu-ju	suffix concatenation
		-(rla-rlu)-ju	foot formation
		watiya-(rla-rlu)-ju	suffixation
		(wati)ya-(rla-rlu-)ju	foot formation
(15)	a. (from (5e))	*-na-ngkami-rni*	suffix concatenations
		-(na-ngka)(mi-rni)	foot formation
		yukulyarri-(na-ngka)(mi-rni)	suffixation
		(yuku)(lyarri)-(na-ngka)(mi-rni)	foot formation

From the above it appears that foot formation is a cyclic rule in at least Warlpiri (14), where the addition of each new suffix triggers another application of foot formation. According to generally accepted versions of lexical phonology (see, for instance, Kenstowicz 1994), the output of a cyclic rule should always be a word. However, in the above analysese of Warlpiri (14) and Jingulu (15), the output of foot formation is not a word.

4.2 Morpheme Integrity (Crowhurst 1994)

Crowhurst's (1994) analysis accounts for Diyari (section 2.2) and Dyirbal (section 2.3) within OT. The Diyari pattern is a result of the high ranking of the constraint TAUTO-F, which rules out feet containing material from more than one morpheme. An example is given in (17). The constraints used in Crowhurst's account, other than those familiar from section 3, are defined in (16). None of the accounts discussed in this paper suggest that feet are ever anything other than trochees in the five languages under discussion. I therefore have not shown the constraints which require all feet to be trochees (binary and left-headed), but these can be assumed to outrank all the constraints which are explicitly discussed.

(16) TAUTO-F a foot does not contain nuclei from more than one morpheme[3]

ALIGN(Morph, L, Ft, L) the left edge of a morpheme coincides with the left edge of a foot

(17) (from (2c))

/kana-ni-mata/	TAUTO-F	ALIGN(Morph, L, Ft, L)	PARSE
a. (kana-)(ni-ma)ta	*!	*	*
b. ☞ (kana)-ni-(mata)	√	*	*

Dyirbal (section 2.3) is superficially quite similar to Diyari, so one might suppose that TAUTO-F can also be held partially responsible. However, according to Crowhurst's analysis, TAUTO-F is ranked very low in Dyirbal, with the most important constraints being those which demand placement of a foot at the left edge of each morpheme, and leftward alignment of feet within the word. This prevents the final syllable of trisyllabic roots, for instance, from being footed. For example:

(18) (from (3d))

/mandalay-mbal-bila/	ALIGN(Morph, L, Ft, L)	PARSE	ALIGN(Ft, L, PrWd, L)
a. (manda)(lay-mbal-)(bila)	*!	√	******
b. (manda)lay-(mbal-bi)la	*!	**	***
c. ☞ (manda)lay-mbal-(bila)	√	**	****

Crowhurst's analysis can not be extended to Warlpiri (section 2.4) or Jingulu (section 2.5). Looking at the Warlpiri data, for example, we see that if TAUTO-F dominates PARSE, the form in (4e) can not be derived. If dominates TAUTO-F, on the other hand, the forms in (4d) and (4h) cannot be accounted for (as each involves two unparsed syllables which could be parsed by building feet from the left edge, without any worse violation of ALIGN(Morph, L, Ft, L)).

4.3 'Word' as a plastic notion (Kager 1995)

In order to account for data from Diyari, Dyirbal, and Warlpiri, Kager (1995) allows for multiple occurrences of the prosodic category 'prosodic word' within what we might intuitively consider a word. This notion is not new: lexical phonology, for example, incorporates the notion that the output of a cyclic rule must be a word, even if that 'word' then undergoes further affixation to create a larger word. This indicates that the notion of 'word' is at the very least iterable. This iterability is what accounts for the Diyari (section 2.2) pattern within Kager's approach. An undominated constraint ALIGN(Stem, R, PrWd, R) demands that the right edge of any morpheme which creates a new stem

[3] One *ALS* reveiwer expressed concern that this constraint seemed rather stipulative and unmotivated within the OT framework. I believe, however, that like the RTINT and AFXINT constraints of section 3, TAUTO-F captures the generalisation that prosodic and morphological constituents coincide where possible.

coincide with the right edge of a prosodic word. An example is given in (19). This may be seen as an OT equivalent of the cyclic account described in section 4.1. Square brackets indicate prosodic word boundaries (while parentheses continue to indicate foot boundaries). A foot may not 'straddle' a prosodic word boundary because this would violate the (presumably undominated) prosodic hierarchy, which demands that feet be constituents of words.

(19) (from (2c))

/kana-ni-mata/	ALIGN(Stem, R, PrWd, R)	PARSE	ALIGN(Ft, L, PrWd, L)
a. [[(kana-)](ni-ma)ta]	*!	*	**
b. ☞[[[(kana)]-ni]-(mata)]	√	*	***
c. [[(kana)]-ni-(mata)]	*!	*	***

Candidates (19a) and (19c) violate ALIGN(Stem, R, PrWd, R) because the stem produced by affixation of /ni/ to the root /kana/ does not coincide with the right edge of a prosodic word.

In Dyirbal (section 2.3), on the other hand, the relevant active constraint is ALIGN(Root, R, PrWd, R), which demands that only roots have their right edges aligned with the right edges of prosodic words. An example is given in (20). Once again, this is more-or-less an OT equivalent of the approach outlined in section 4.1.

(20) (from (3d))

/mandalay-mbal-bila/	ALIGN(Root, R, PrWd, R)	PARSE	ALIGN(Ft, L, PrWd, L)
a. ☞[[(manda)lay]-(mbal-bi)la]	√	**	***
b. [(manda)(lay-mbal-)(bila)]	*!	√	******
c. [[[(manda)lay]-mbal]-(bila)]	√	**	****!

Kager's account of Warlpiri (section 2.4) involves treating polysyllabic morphemes as prosodic words unto themselves. This is achieved by the ranking ALIGN(Morph, L, PrWd, L) (the left edge of every morpheme coincides with the left edge of a prosodic word) below ALIGN(PrWd, L, Ft, L) (the left edge of every prosodic word coincides with the left edge of a foot). A single monosyllabic suffix will not be able to form a prosodic word alone as it can not host a disyllabic foot. However, it will be able to form a word with a following monosyllabic affix. Some examples are illustrated below:

(21) a. (from (4b))

/watiya-rla/	ALIGN(PrWd, L, Ft, L)	ALIGN(Morph, L, PrWd, L)	PARSE
a. [(wati)ya-[rla]]	*!	√	**
b. ☞ [(wati)(ya-rla)]	√	*	√
c. [[(wati)ya-]rla]	√	*	**!

b. (from (4f))

/yaparla-ngurlu/	ALIGN(PrWd, L, Ft, L)	ALIGN(Morph, L, PrWd, L)	PARSE
a. ☞ [(yapa)rla-[(ngurlu)]]	√	√	*
b. [(yapa)(rla-ngu)rlu]	√	*!	*

c. (from (4c))

/watiya-rla-rlu/	ALIGN(PrWd, L, Ft, L)	ALIGN(Morph, L, PrWd, L)	PARSE
a. ☞ [(wati)ya-[(rla-rlu)]]	√	*	*
b. [(wati)(ya-rla)-rlu]	√	**!	*
c. [(wati)ya-[rla]-[rlu]]	*!*	√	***

However, this analysis makes the wrong prediction for the form in (4d):

(22) (from (4d))

/watiya-rla-rlu-ju/	ALIGN(PrWd, L, Ft, L)	ALIGN(Morph, L, PrWd, L)	PARSE
a. [(wati)ya]-[(rla-rlu)-ju]	√	**	*!*
b. [(wati)(ya-rla-)][(rlu-ju)]	√	**	√
c. [(wati)ya-[rla]-[rlu]-[ju]]	*!**	√	****

The predicted winner, candidate (a) in (22), is not the actual form. The actual form is the less thoroughly parsed candidate (b). In fairness to Kager, it should be pointed out that no form of this kind appears in Nash 1980 (the source for Kager's analysis), but that it was provided to me by Ken Hale (personal communication). However, the fact remains that Kager's analysis predicts that whenever an odd number of syllables are suffixed to a root which also has an odd number of syllables, the final syllable of the root will be footed with the first syllable of the suffixes. This is not the case.

Aside from this empirical shortcoming, there is a conceptual problem with Kager's approach. By allowing suffixes, or sequences of suffixes, to constitute a prosodic word, it is no longer clear how the notion of prosodic word is to be understood. The iteration of the category of prosodic word proposed for Diyari (19) and Dyirbal (20) is not problematic, as here the root constitutes a prosodic word, and then the root plus suffixes (iteratively, as in Diyari, or collectively, as in Dyirbal) constitute a larger prosodic word. This is the familiar notion of 'a word within a larger word', and each prosodic word thus created can stand alone. However, in the approach to Warlpiri (21), the notion of prosodic word is extended to disyllabic suffixes or to pairs of monosyllabic suffixes, which can never stand alone or form 'words' in any familiar sense.

4.4 Correspondence theory (Kenstowicz 1997, Pensalfini 1997)

Correspondence Theory is the branch of OT that deals with correspondence between forms. In early versions of OT, the only correspondence relationships referred to by constraints were those between input (underlying form) and a candidate or, as in the case of reduplication, between substrings of a single candidate form. Later work, led by Benua (1995), allowed constraints to refer to the correspondence between a candidate and another grammatical output form (output-output correspondence). The approach to the Australian stress data developed jointly by myself and Michael Kenstowicz, appearing separately in Kenstowicz 1997 and Pensalfini 1997, hinges on the notion of uniform exponence, which requires elements to appear in the same form (in this case stressed versus unstressed) no matter what words they appear in.

The version of the correspondence account offered here differs minimally from both Kenstowicz (1997) and Pensalfini (1997), but not in any major details. The new constraints introduced are:

(23) UNIEXP$_{RT}$ a root appears in the same form everywhere
UNIEXP$_{AF}$ an affix appears in the same form everywhere

The interpretation of UNIEXP$_{RT}$ for the purposes of this article is that if a root appears with a particular stress pattern when unaffixed, it should appear with that same stress pattern when it bears affixes of whatever number and kind. The best way to understand UNIEXP$_{AF}$ for our purposes is that if an affix is generally unstressed (as with all monosyllabic affixes in the languages we are considering) then it must always be unstressed, while if an affix usually bears, for example, stress on its first syllable, it must always do so. The Uniform Exponence constraints are output-output constraints, and can be understood as demanding surface invariance of the morphemes to which they refer.

Pintupi (section 2.1) clearly does not place much stock on the uniform exponence of its morphemes, demanding the most thorough parsing of syllables into feet available, with odd syllables stranded at the right edge of the word. This is achieved by ranking the UNIEXP constraints below constraints such as PARSE and ALIGN(Ft, L, PrWd, L). Diyari (section 2.2), places great importance on uniformity of exponence. The prohibition on feet containing nuclei from different morphemes means that disyllabic affixes are always stressed on their first syllable, monosyllabic affixes are never stressed, and roots are stressed in the same manner whether they are affixed or not. This is achieved by having the constraints UNIEXP$_{RT}$ and UNIEXP$_{AF}$ undominated. Dyirbal (section 2.3) differs from Diyari in that while roots always appear with the same stress pattern, affixed or not, indicating that is UNIEXP$_{RT}$ is undominated, stress may appear on affixes in any number of ways. This is achieved by ranking LAPSE above UNIEXP$_{AF}$, as illustrated in (24).

(24) (from (3d))

/mandalay-mbal-bila/	UNIEXP$_{RT}$	PARSE	LAPSE	UNIEXP$_{AF}$
a. ☞ (manda)lay-(mbal-bi)la	√	**	√	**
b. (manda)(lay-mbal-)(bila)	*!	√	√	√
c. (manda)lay-mbal-(bila)	√	**	*!	√

Candidate (b) in (24) violates UniExp$_{RT}$ because its final syllable is stressed, whereas in the unaffixed form this syllable does not bear stress. Candidate (a) violates UniExp$_{AF}$ twice because the monosyllabic suffix is stressed and the first syllable of the disyllabic suffix is unstressed.

Warlpiri (section 2.4) prizes uniform exponence, but unlike Diyari will sacrifice it in order to avoid a sequence of three unstressed syllables. This is achieved by ranking Lapse above both UniExp$_{RT}$ and UniExp$_{AF}$:

(25) a. (from (4b))

/watiya-rla/	Lapse	UniExp$_{RT}$	UniExp$_{AF}$	Parse
a. (wati)ya-rla	*!	√	√	**
b. ☞ (wati)(ya-rla)	√	*	√	√

b. (from (4f))

/yaparla-ngurlu/	Lapse	UniExp$_{RT}$	UniExp$_{AF}$	Parse
a. ☞ (yapa)rla-(ngurlu)	√	√	√	*
b. (yapa)(rla-ngu)rlu	√	*!	*!	*

c. (from (4d))

/watiya-rla-rlu-ju/	Lapse	UniExp$_{RT}$	UniExp$_{AF}$	Parse
a. ☞ (wati)ya-(rla-rlu)-ju	√	√	*	**
b. (wati)(ya-rla-)(rlu-ju)	√	*!	*	√
c. (wati)ya-rla-rlu-ju	*!**	√	√	****

Recall that the form in (25c) is the one for which Kager's analysis (section 4.3) made the wrong prediction (see (22)).

Jingulu (section 2.5) differs from Warlpiri only in so far as it freely allows foot boundaries to separate the syllables of a bisyllabic suffix. In terms of this analysis, this means that Jingulu ranks UniExp$_{AF}$ below Parse, but otherwise is the same as Warlpiri.

This account, therefore, predicts all of the results correctly. However, there is a major theory-internal problem with the UniExp constraints. In explaining how an output-output constraint can operate within the framework of OT, Benua (1995) says that some output forms (bases, unaffixed forms) are prior to derived forms in the same way that an input is prior to an output, and that therefore the base form is available to the computation of derived forms for comparison. In other words, it may be necessary to compute the unaffixed form of a root, the minimal word in that root's paradigm, prior to computation of a more complex form. Once again, this is parallel to the operation of cyclic rules in lexical phonology, and explains how it may be possible for a constraint like UniExp$_{RT}$ to exist within OT. The difficulty with such output-output constraints arises in languages where roots never appear without substantive inflection (such as with Jingulu verbs). A further problem arises when we try to define how UniExp$_{AF}$ operates. While the output form of comparison for UniExp$_{RT}$

would be the unaffixed (or minimally affixed, in langauges which never have unaffixed roots) form of the root, it is unclear what the form of comparison could be for UNIEXP$_{AF}$. There is no such thing as the 'minimally affixed' form of an affix. One might propose that the relevant form involves a case in which the affix is the only affix attached to a root which constitutes a minimal word (in the case of all the languages considered here, a disyllabic root). However, it is not clear that this form is in any way logically prior to the candidates under consideration, in the way that one might argue that an unaffixed root is prior to an affixed root. There appears to be no way of implementing a constraint like UNIEXP$_{AF}$ within the framework of OT, and neither Kenstowicz 1997 nor Pensalfini 1997 provides a satisfactory answer to this question.

5. Conclusion - empirical adequacy

Many articles written about phonology today utilise OT analyses. In some cases, the choice of this framework over others appears to be quite arbitrary, and it often seems as though OT is chosen because the author perceives that it has become the standard in phonology today. From time to time, however, a case can be made that one framework is inherently better suited to accounting for the data at hand, and I believe this to be the case with the data in this article. This is not to say that I believe that OT, in any of its current forms, is in general a better framework than competing ones. As a matter of fact, I have argued elsewhere (Breen and Pensalfini 1999, for example) that ordered rules are better suited to handling a particular set of data. But it would appear that an OT account, one which utilises ranked violable constraints, is better-suited to handling the differing degrees of suffix coherence found among Australian languages than an account which derives the surface forms stepwise.

Perhaps the best evidence in favour of an OT account comes from the nature of the description of the Warlpiri and Jingulu facts themselves. The data have to be described in terms of satisfying certain requirements over others. The Warlpiri data, for instance, are most concisely described by saying "always stress the initial syllable of a polysyllabic morpheme, and never stress monosyllabic morphemes or the final syllable of morphemes with an odd number of syllables *unless* a sequence of three unstressed syllables would result". The very nature of the description thus lends itself to an analysis in terms of ranked violable constraints, a system such as that of OT.

Future work might attempt to extend the analysis proposed here to affix coherence and stress among the prefixing languages of Australia.

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