Phonology **14** (1997) 161–175. Printed in the United Kingdom
© 1997 Cambridge University Press

*Vowel-length in Warray and weight identity**

Toni Borowsky
University of Sydney

Mark Harvey
University of Newcastle

Correspondence is a relation between one representation and another (McCarthy & Prince 1993, 1994, 1995). This relationship may be between an underlying or lexical representation and a surface representation, that is: Input–Output forms; or between surface forms such as a reduplicant and its base (McCarthy & Prince 1995) or other derivationally related pairs (see for example Benua 1995, McCarthy 1995, Kenstowicz 1996) – i.e. Output–Output. Correspondence constraints over related words in a paradigm ensure uniformity within the paradigm. In earlier theories this effect was ensured by the Strict Cycle Constraint, which forbade structure-changing operations except in immediately derived environments and thus ensured that most of the base word stayed the same in derivation. In this paper we show that correspondence between derivationally related output forms (Benua 1995) is essential for the proper analysis of vowel length in Warray, a language of Northern Australia spoken near Darwin, and superior to an account making use of cyclicity. Correspondence constraints ensuring identity between output forms explain the pattern of vowel length in nouns, predicting both where long vowels occur as well as the apparently anomalous appearance of short vowels where long vowels might be expected.

One of the interesting results of Correspondence Theory is the fact that cyclic effects can be captured in the parallel system of Optimality Theory. Consider as an informal example the palatal [ʃ] in the English word *presidentiality*. This segment is derived from the coronal obstruent [t] in *president* by the regular palatalisation process in English which palatalises coronal obstruents in the environment / __ jV̆. Palatalisation is presumably a response to a constraint on sequences *tjV̆. When the morpheme *-ial* [-jəl] is attached to the word *president* this constraint is violated and a palatal appears in place of the /t/. However, in the word *presidentiality* there is no jod. The jod surfaces here as the corresponding vowel [i]. Furthermore the syllable following the palatal is stressed. [tiV] is an acceptable surface sequence (e.g. ***etiology***, ***beauteous***, ***tears***), yet the

https://doi.org/10.1017/S0952675797003400 Published online by Cambridge University Press

segment in *presidentiality* is palatal. Cyclicity accounts for the appearance of the palatal here as follows: palatalisation applies in the construction *president-ial* and is carried over on the next cycle of derivation to *presidentiality*. In terms of correspondence this may be accounted for thus: the two forms *presidential* and *presidentiality* must 'correspond' with each other. A possible surface form *presiden*[t]*iality* has a lesser degree of correspondence than the otherwise identical form except for the palatal [ʃ], because the one with the palatal is a better match to the nearest related derivative: *presidential*.

While cyclicity and correspondence might appear to be equally good accounts of the preceding example, the same cannot be said about the distribution of vowel length in Warray nouns. These facts, we shall show, are problematic for a cyclic account yet find a straightforward solution in terms of correspondence. In particular we see that a cyclic analysis predicts incorrectly that a short vowel should occur in certain compounded constructions in which a long vowel occurs; and conversely that a long vowel should occur where a short vowel does. We go on to show that in excorporated words, which we assume to be the result of back-formation, we see the same effects, and again the form of these is correctly predicted by correspondence.

1 The distribution of long vowels

Warray has no vowel-length contrast. Long vowels occur only in nouns which have the structure CV or CVC or in verbs of the form CV in the imperative construction where they are unaffixed. No other words ever have long vowels.

(1) a.	[lee]	'camp'	< le	*[le]
	[gee]	'paperbark'	< ge	*[ge]
b.	[buum]	'ant species'	< bum	*[bum]
	[yuul]	'ground'	< yul	*[yul]
	[wiik]	'water'	< wik	*[wik]
	[buul]	'trouble'	< bul	*[bul]

Since there is no vowel-length contrast in this language we assume that this length is derived in response to a minimum word constraint, which requires that all words must be bimoraic, in violation of a lower-ranked constraint forbidding long vowels.

The assumption that vowel length is derived is supported by alternations such as those shown in (2). Here we see long vowels occurring in unaffixed nouns alternating with short vowels occurring in derived nouns in the 'factitive' construction where a noun root is suffixed with *-bu*. The attachment of the affix to the root brings the mora count of the noun up to par, making vowel lengthening irrelevant.[1]

https://doi.org/10.1017/S0952675797003400 Published online by Cambridge University Press

(2)	jap	[jaap]	'road'	*vs.*	[japbu]	'to make a road'
	mak	[maak]	'message stick'		[makbu]	'to make a message stick'
	jurn	[juuɳ]	'spear thrower'		[juɳbu]	'to make a spear thrower'
	murl	[muul]	'yamstick'		[mulbu]	'to make a yamstick'

The long vowels found in CVC nouns suggest that the final consonant of nouns does not contribute to the mora count – it is extrasyllabic.

All other nouns in this language are bimoraic by virtue of being bisyllabic or larger, or because they have the structure CVCC. None of these nouns ever have long vowels.

(3) a.	[buɖu]	'tree species'	< burdu	*[buuɖu]
	[baɳɖi]	'tree species'	< barndi	*[baaɳɖi]
b.	[bulk]	'white ochre'	< bulk	*[buulk]
	[gaɽk]	'olive python'	< gaɽk	*[gaark]

The pattern shown above occurs also in suffixed nouns. That is, if the noun root would otherwise be subminimal it has a long vowel, even when suffixed. (Note that this is quite different from the forms derived with the *-bu* suffix.) Consider the examples in (4a). These are all marked with the locative suffix. Exactly the same pattern is found with all the other cases suffixes – examples are given in (4b).

(4) a.	/ge+lik/	'paperbark-LOC'	[gee-lik]	*[ge-lik]
	/wik+lik/	'water-LOC'	[wiik-lik]	*[wik-lik]
	/bulk+lik/	'white ochre-LOC'	[bulk-lik]	
	/baɳɖi+lik/	'tree species-LOC'	[baɳɖi-lik]	
b.	[gee-wu]	'paperbark-DAT'	[gee-yi]	'paperbark-ERG'
	[wiik-gu]	'water-DAT'	[wiik-yi]	'water-ERG'
	[gee-yiwu]	'paperbark-COM'	[gee-yaŋg]	'paperbark-ABL/CAUS'
	[gee-ba]	'paperbark-PERL'		

Given that the suffix brings along an extra mora, it is entirely conceivable that a minimal word constraint would be satisfied by the affixed form and that the noun could surface with a short vowel. However, this does not seem to be the case; **gelik* with a short vowel in the noun stem is ungrammatical. Alternatively, we might have expected the final consonant of the noun in these forms to be moraic because it is no longer extrametrical, thus again a short vowel could surface. Since neither of these is possible, we conclude that the long vowel in suffixed forms is due to lengthening in the bare noun after which the affix is attached. What we have here is the classic cyclic effect.

Apparently problematic, however, are the following constructions, which involve the compounding or incorporation of the class of body-part

https://doi.org/10.1017/S0952675797003400 Published online by Cambridge University Press

nouns. On the basis of the long vowel in the suffixed nouns we might have expected long vowels in these constructions. Surprisingly perhaps, there is *no* vowel length, as shown by the examples of compounds in (5a) and in incorporations in (5b):

(5) a.	[a-dúm-báli-wu] 'wide-eyed'	< a-dum-bali-wu I-eye-wide-OBL	*[a-dúum -báli-wu]
	[a-yél-gúbam-u] 'fleshy male'	< a-yel-gubam-u I-flesh-lots-OBL	*[a-yéel- gúbam-u]
	[a-mák-jériŋ-u] 'one ball (nickname)'	< a-mak-jerriny-u I-testicle-one-OBL	*[a-máak-jé riŋ-u]
b.	[at-dúm-jámiŋ-ji-ɲ] 'My eyes are blocked.'	< at-dum-jaminy-ji-ny 1SGS-eye-block-inch-PP	*[at-dúum- jámiŋ-jí-ɲ]
	[at-bám-bu-m] 'I hit him on the head.'	< at-bam-bu-m 1SGS-head-hit-PP	*[at-báam- bu-m]
	[ga-báɽ-jáp-ji] 'He is lying knees up.'	< ga-bart-jap-ji NP-knee-lie up-AUX.NP	*[ga-báaɽ- jáp-ji]

What is crucial to our understanding of the forms in (5) is the fact that these body-part nouns are bound morphemes. As we shall show below, they never occur as free-standing nouns but must obligatorily be prefixed with the prefix *an-*.

It is not the case that vowel length is simply prohibited in compounds or incorporations. We find long vowels in these constructions in two circumstances. Firstly, if the noun concerned is an open monosyllable the vowel will be long, as can be seen in the forms in (6):

(6)	[a-gíi-búɽuyu] 'long-nosed'	< a-gi-buruyu I-nose-long	*[a-gí-búɽuyu]
	[at-gíi-jámiŋŋ-ji-ɲ] 'My nose is blocked.'	< at-gi-jaminy-ji-ny 1SGS-nose-block-inch-PP	*[at-gí-jámiŋ-ji-ɲ]
	[at-ɲíi-múy-iŋ] 'I forgot his name.'	< at-nyi-muy-iny 1SGS-name-lose-PP	*[at-ɲí-múy-iŋ]

Secondly, long vowels also occur in a small set of cases in which monosyllabic nouns which are not body-part nouns occur in these constructions:

(7)	[at-wíik-lági-ɲ] 'I threw it in the water'	< at-wik-lagi-ny 1SGS-water-throw-PP	*[at-wík-lágiŋ]
	[yúul-délʔ-bu-m] '(the bird) burrowed into the ground'	< yul-delh-bu-m ground-open-AUX-PP	*[yúl-délʔ-bu-m]

https://doi.org/10.1017/S0952675797003400 Published online by Cambridge University Press

These examples provide interesting evidence for one of the many advantages of Optimality Theory (OT). OT allows various means of satisfaction of a constraint. Consider the long vowels in the examples in (6) and (7); these show that the minimum word constraint must be satisfied in these constructions. On this basis we might assume that in the cases in (5) it is also satisfied. If this is so, it must be satisfied by the word-final consonant since there are no long vowels. Since both compounding and incorporation involve the concatenation of words, the fact that these nouns satisfy the minimum word constraint is not unexpected. The stress patterns also indicate that the nouns in question are independent prosodic words.[2] There are therefore two distinct ways of satisfying the constraint, vowel length or a final moraic consonant. The choice between these two ways is determined by other aspects of the system all interacting to ensure the optimal solution for every situation.

Why should the examples in (7) have long vowels when, like those in (5) which have short vowels, they have closed syllables? Or alternatively, why should the cases in (6) have long vowels when the forms in (5) have short vowels? As we shall show, this is because satisfaction of a correspondence constraint governing identity makes these forms preferable to the alternative with a short vowel, just as it prefers the short vowel in (5).

2 Plain nouns

Before we show how the Correspondence Theory analysis of these forms works, we show how vowel length is accounted for in the straightforward case: the plain nouns.

Monosyllabic nouns in Warray always have one of the following shapes: CVV, CVVC, CVCC, e.g. [lee] 'camp', [buum] 'ant species', [bulk] 'white ochre'. Long vowels never occur in CVCC nouns or in larger nouns. Thus we see that nouns in Warray must be minimally bimoraic.

(8) MinWd = $\mu\mu$

The long vowels in these words are the only long vowels in the language, so we must assume as well a constraint forbidding long vowels:

(9) NoLongVowels: *VV

Vowel length ensures bimoraicity in subminimal nouns.

The fact that monosyllabic nouns have long vowels shows that the MinWd constraint outranks *VV. The tableau in (10) illustrates the interaction of these two constraints and shows how they identify the best candidate. (Note that in all tableaux below, the bold segments in the candidate set indicate segments which are moraic.)

(10)

/ge/	MinWd	*VV
a. **ge**	*!	
☞ b. **gee**		*

https://doi.org/10.1017/S0952675797003400 Published online by Cambridge University Press

The first candidate incurs a fatal violation of the dominant MINWD constraint. The second candidate violates the lower-ranked *VV constraint, which prohibits the insertion of a mora, but because it is lower-ranked this violation is sanctioned.

As noted above, final consonants in nouns do not contribute to the mora count and CVC nouns always have long vowels. If the monosyllabic noun ends in a consonant cluster there is never a long vowel, e.g. /bulk/ → [bulk] *[buulk] 'white ochre'.[3] We take this to indicate that the first consonant in the cluster is moraic and nouns of this structure satisfy the minimal word constraint as is.

In order to capture the extrasyllabicity of final consonants, we propose the constraint *FINALC$_\mu$. This constraint forbids coda consonants to be moraic at the right edge of a word and thus encapsulates the notion of extrasyllabicity for our purposes.

(11) *FINALC$_\mu$: Final consonants may not be moraic.[4]

*FINALC$_\mu$ comes into play in assessing closed syllabled nouns. To ensure that the final consonant cannot be moraic, this constraint must be ranked above *VV. (We shall see below that it is ranked lower than MINWD on the basis of the fact that another constraint intervenes between the two.)

(12)

/bum/	MINWD	*FINAL C$_\mu$	*VV
a. **bum**		*!	
☞ b. **buum**			*
c. **bum**	*!		

In the first candidate the final consonant is moraic,[5] which violates *FINALC$_\mu$, though satisfying MINWD. The second candidate wins, because although the vowel is lengthened this form is preferable to the one that violates the higher-ranked *FINALC$_\mu$. The last candidate fails to satisfy MINWD.

In a monosyllabic noun with a final consonant cluster, the vowel is short. This is because the first member of the consonant cluster satisfies the MINWD constraint. This consonant may be moraic, because it is not final. The candidate with the long vowel is out because it violates *VV.[6]

(13)

/bulk/	MINWD	*FINAL C$_\mu$	*VV
☞ a. **bulk**.			
b. **buulk**.			*!

3 Vowel-length correspondence

Now let us move on to consider the surface-to-surface identity effects shown by base words and their affixed counterparts.

https://doi.org/10.1017/S0952675797003400 Published online by Cambridge University Press

Monosyllabic nouns have long vowels when suffixed, as well as when unsuffixed. Consider the following examples, repeated from (4): [gee-lik] 'paperbark-LOC', [gee-wu] 'paperbark-DAT', [wiik-lik] 'water-LOC', [wiik-gu] 'water-DAT'.[7]

In principle, we might assume that a short-vowelled noun with a suffix would be a well-formed word by virtue of the additional suffix mora: *[gelik]. Similarly, we might think that *FINALC$_{\mu}$ is not violated if the final consonant is moraic in these forms, because once the word is suffixed the last consonant is no longer final. So in *[wik-lik] the suffix would be attached to a bimoraic base. Neither of these possibilities is correct, however. All suffixed monosyllabic nouns must have long vowels. This, we claim, is because the free-standing unsuffixed nouns have long vowels. The well-formedness of the affixed surface form depends on the degree of correspondence to its related base. If it is to be maximally similar to the bare noun it must have the same vowel length.

To account for this we must formalise an identity constraint which governs vowel length: VOWELWEIGHTIDENTITY (VWT-ID).[8] This constraint ensures that every mora of an output vowel has a correspondent mora in the input vowel. Following McCarthy (1995), we formulate this constraint below:

(14) VWT-ID[9]
If $\alpha \in$ Domain(f) and α is a vowel,
if α is monomoraic, then f(α) is monomoraic. (No vowel lengthening.)
if α is bimoraic, then f(α) is bimoraic. (No vowel shortening.)

For instance, the correspondents in (15) satisfy this constraint since the mora count of the input vowels is identical to that of the output vowels:

(15) $\mu\ \mu \leftrightarrow \mu\ \mu$
[bum]$_{\text{Base}}$ [bum-lik]$_{\text{Affixed}}$

The correspondents in (16) do not satisfy VWT-ID, because the output vowel lacks a mora which was associated with the input vowel (see note 8):

(16) $\mu\ \mu \leftrightarrow \mu\ \mu$
[bum]$_{\text{Base}}$ [bum-lik]$_{\text{Affixed}}$

The tableaux in (17) illustrate the operation of VWT-ID. In the first candidate of (17a) MINWD is satisfied because of the mora of the suffix

https://doi.org/10.1017/S0952675797003400 Published online by Cambridge University Press

vowel. VWT-ID is the deciding constraint. The same can be seen in (17b):[10]

(17) a.

gee~gee + lik	MINWD	VWT-ID	*FINAL C_μ
ge-lik		*!	
☞ gee-lik			

b.

wiik~wiik + lik	MINWD	VWT-ID	*FINAL C_μ
wik-lik		*!	*
wik-lik		*!	
☞ wiik-lik			

c.

bulk~bulk + lik	MINWD	VWT-ID	*FINAL C_μ
☞ bulk-lik			
buulk-lik		*!	

Identity, specifically VWT-ID, requires that the suffixed noun have a long vowel, and thus bars the affix from attaching to anything that is less than a word.

The pivotal case providing evidence for these identity effects and against a cyclic analysis of these facts is provided by comparing the CV and CVC body-part nouns in incorporated and compounded structures. CVC body-part nouns surface with short vowels rather than long vowels, e.g. the compound *adumbaliwu* 'wide-eyed' (**aduumbaliwu*) and the incorporation *atdumjaminyjiny* 'my eyes are blocked' (**atduumjaminyjiny*), while CV body-part nouns surface with long vowels in the same constructions.

Incorporations are a type of word + word compound. In both constructions each member of the compound is a prosodic word. We know this from their stress patterns. Stress occurs on the first syllable of the incorporated noun which immediately precedes the verb as well as on the first syllable of the verb. This is what we would expect if the two morphemes received stress as independent words. No other circumstances would produce two adjacent stresses in this language.

Crucial to our understanding of these forms is the fact that the body-part nouns occurring in these constructions are bound morphemes. While other nouns in Warray are free-standing, these nouns and others like them are not. If these nouns are monomoraic and occur as a plain noun, they are obligatorily prefixed with the prefix *an-*, which functions as a class marker.[11] Examples are given in (18).

(18)

-gum	'back of neck'	an-gum
-bam	'head'	an-bam
-jen	'tongue'	an-jen
-ji	'liver'	an-ji
-nyi	'name'	an-nyi
-gi	'nose'	an-gi

https://doi.org/10.1017/S0952675797003400 Published online by Cambridge University Press

The addition of the prefix to the monomoraic root adds the required second mora, which makes these nouns well-formed bisyllabic nouns:

(19) μ μ
| |
an + gum

Both compounding and incorporation occur most productively in this language with the class of body-part nouns. While it is possible to incorporate other nouns, as for example in (7), we have not found very many.[12]

When body-part nouns are incorporated or compounded only the bare root is compounded. (Since the prefix is not realised on any viable candidates we will not concern ourselves with its loss here.[13]) Nevertheless, in both structures the noun root carries a stress as if it is a word, and appears to function in every way like a word. The only difference is, of course, the short vowel. We claim that the short vowel in these cases is due to the fact that the related base word *andum* also has a short vowel. In other words, the correspondence relation here holds between the prefixed word and the incorporated/compounded word. The best match between the compounded form and the base is the form with a short vowel. There is no form of these nouns which has a long vowel.

(20)

andum~a-dúm-báli...	MinWd	VWt-Id	*Final C_μ
☞ a. a-d**úm**-báli-wu			*
b. a-d**úu**m-báli-wu		*!	

Now compare the forms which do have a long vowel in these constructions. The appearance of this long vowel is exactly what we'd expect and provides further evidence for our account. These forms are different from the body-part examples because the incorporated noun occurs also as a free-standing noun. As free-standing nouns, these words have long vowels, as we have shown above. To be maximally similar in any derived counterpart, these nouns must also have long vowels there, thus:

(21)

wíik~at-wíik-lági-ɲ	MinWd	VWt-Id	*Final C_μ
☞ a. at-w**íi**k-lági-ɲ			
b. at-w**ík**-lági-ɲ		*!	*
c. at-wík-lági-ɲ	*!	*	

The first two candidates in (21) satisfy MinWd; the second candidate satisfies it with a moraic final consonant. The short-vowelled form violates VWt-Id, but the long-vowelled form satisfies the constraint.

Thus the appearance of long vowels in words which involve the compounding or incorporation of free-standing nouns may be accounted for in terms of surface correspondence.

https://doi.org/10.1017/S0952675797003400 Published online by Cambridge University Press

So far, the facts discussed can be accounted for cyclically as well as in correspondence terms. The strongest argument against a cyclic account comes from the next set of cases: the open-syllabled subminimal body-part nouns in (18) which have long vowels in compounded constructions.

(22)

an-gi~a-gii-buruyu	MinWd	VWt-Id	*Final C_{μ}
☞ a. a-gíi-búruyu		*	
b. a-gí-búruyu	*!		

Here the optimal form actually violates VWt-Id under pressure from the higher-ranked MinWd. The second candidate, which is a better match correspondence-wise, fails, because it violates dominant MinWd. Notice that these forms provide further evidence that the compounded/incorporated body-part root is a word-like entity – a prosodic word even if not a lexical word. However, it is only in these constructions that it may surface as a word. Everywhere else it must be prefixed and will have a short vowel.

This example provides the crucial argument against cyclicity. If we were to attempt to derive a form like this cyclically we would surely expect a short vowel, because the root has a short vowel in its prefixed form. Alternatively, if the vowel is long in the compounded form then we would expect it to be long in the prefixed form as well.

In (23a) and (b), we compare possible derivations of closed syllable monosyllabic body-part forms, given in (18) above, with the related non-body-part examples and the open syllabled body-part form. We see that it is impossible to derive the correct outcome for all sets of forms, no matter how the various processes are ordered or applied. If we apply V lengthening to words at the word level, where we would expect it to apply, then it will correctly fail to lengthen the vowels in the forms involving body-part nouns, because they are bimoraic by virtue of their prefix. The result of this is a short vowel in the compounded form, which is correct for consonant-final forms but incorrect for vowel-final forms. Forcing application on the body-part forms before compounding gives incorrect forms all round (23b).

(23)

	[a-gii-buruyu]	[a-dum-bali-wu]	[at-wiik-lagi-ŋ]	
a.	/-gi/	/-dum/	/-wik/	
cycle	√an + gi	√an + dum	wiik	
	n/a	n/a		*V lengthening*
cycle	*a-gi-buruyu	√a-dum-bali-wu	√at-wiik-lagi-ŋ	*compounding*
b.	/-gi/	/-dum/	/-wik/	
cycle	an + gi	an + dum	an + dum	
	*angii	*anduum	√wiik	*V lengthening*
cycle	√a-gii-buruyu	*a-duum-bali-wu	√at-wiik-lagi-ŋ	

https://doi.org/10.1017/S0952675797003400 Published online by Cambridge University Press

Applying V lengthening after compounding makes it impossible to distinguish the body-part form from the non-body-part form. Either both should emerge with a long vowel, or neither should.

(24)	/-gi/	/-dum/	/-wik/	
cycle	an + gi	an + dum		
	angi	andum	*wik	
cycle	√a-gii-buruyu	√a-dum-bali-wu	*at-wik-lagi-ɲ	*V lengthening*
		n/a	n/a	
or	√a-gii-buruyu	*a-duum-bali-wu	√at-wiik-lagi-ɲ	*V lengthening*

An anonymous reviewer suggests that a cyclic account would not fail if vowel lengthening is permitted to apply on more than one level or cycle: first to the word, and then again after compounding. The rule can then apply to *gii* after compounding, but would not apply to *dum* because the final consonant could be construed as no longer extrametrical. V lengthening would apply at the word level to *wiik* and that length would carry over to the compounded form.

(25)	/-gi/	/-dum/	/-wik/	
cycle	an + gi	an + dum		
	angi	andum	wiik	*V lengthening*
	n/a	n/a		
cycle	a-gi-buruyu	a-dum-bali-wu	at-wiik-lagi-ɲ	*compounding*
	√a-gii-buruyu	√a-dum-bali-wu	√at-wiik-lagi-ɲ	*V lengthening*
		n/a	n/a	

The vowel-lengthening process, as we noted above, is a response to a minimum word constraint. This suggests that it must apply to words and thus at the word level of the phonology. Halle & Mohanan (1985), Booij & Rubach (1987) and Borowsky (1993), among others, all argue that phonological rules only apply once at the word level. This would seem to suggest that the reviewer's idea, while it would account for the facts, is incorrect, as well as being incompatible with accepted views of the organisation of cyclic rules.

We conclude that no serial account can be provided which will predict a short vowel in the prefixed form of the CV body-part nouns and a long vowel in the compounded/incorporated form, as well as short vowels in both constructions for the CVC body-part nouns. The crucial observation here is that while the CVC body-part forms are prosodic words in the compounded constructions, they are not stand-alone words in any other construction. They therefore will be acceptable prosodic words in compounds, because their only related counterparts, the prefixed nouns, also have short vowels. The CV forms fail to be good prosodic words without their prefix and thus must have long vowels. Surface-to-surface cor-

https://doi.org/10.1017/S0952675797003400 Published online by Cambridge University Press

respondence predicts exactly this array and explains why it is only the bound roots which exhibit these patterns.

On the basis of our analysis, we predict that any other bound noun root entering into one of these constructions should have a short vowel as well. There are no examples in Warray of compounds involving a bound monosyllabic CVC root other than the body-part examples discussed above. There are, however, a few such examples of incorporations, and as expected the vowels in these forms are short. For example, consider the form in (26), in which the root *bul-* 'water' (a rare suppletive variant of *wik* 'water') is incorporated. Again, since there are no corresponding independent word forms with long vowels these forms surface with short vowels.

(26) ga-bul-murluk-murluk-ma-rl [ga-bùl-mù⌊uk-mú⌊uk-ma-⌊]
NP-water-ITER-wave-AUX-NP *[ga-bùul-mù⌊uk-mú⌊uk-ma-⌊]
'The water is waving.' *[gá-bul-mú⌊uk-mú⌊uk-ma-⌊]
(lit. 'There are waves on the water.')

Consider also a second example involving the root *wok* 'heavily':

(27) ga-wok-ngirh-ma-rl [ga-wók-ŋíɽʔ-ma-⌊]
NP-heavily-breathe-AUX-NP *[ga-wóok-ŋíɽʔ-ma-⌊]
'He is breathing heavily.' *[gá-wok-ŋíɽʔ-ma-⌊]

This form may also be expressed by the alternative construction in (28), in which *wok* is excorporated out of the incorporated verbal complex. Excorporation seems to be a type of back-formation. Interestingly, the identity effects in this excorporated form bear a strong resemblance to those found in the truncations discussed in Benua (1995).

(28) wok ga-ngirh-ma-rl [wók ga-ŋíɽʔ-ma-⌊]
heavily-NP-breathe-AUX-NP *[wóok ga-ŋíɽʔ-ma-⌊]
'He is breathing heavily.'

The excorporated word has a short vowel because it matches the incorporated form to which it must correspond. The salient point here is the fact that the root *wok* does not occur independently except in this excorporation. The incorporated form requires a short vowel because the only matching base is the bound root /-wok-/, which occurs in the incorporated form.

There is one further advantage of our interpretation of these forms. While compounding and incorporation are supposed to involve concatenation of word elements, the body-part nouns are in fact not word elements. Under RICHNESS OF THE BASE in OT, concatenation of any morphological elements will occur, including non-word morphemes. It is up to the system of constraints to rule out ill-formed concatenations in the usual way. Given this, it is not surprising to find the bound form /-dum/ occurring in compounds. In examples like *a-dum-bali-wu* the root form is permitted in the compound because the root is a well-formed word *in this construction* by virtue of the moraicity of its final consonant. The element

https://doi.org/10.1017/S0952675797003400 Published online by Cambridge University Press

does not have to be a word in order to be compounded, it has to be a word when it is *in* the compound. Prosodic conditions on morphological structures are satisfied at the surface. It is hard to imagine a cyclic account of such cases which could correctly stress the bound root and generally ensure its well-formedness as a word in the compounded structure.

In conclusion, we have shown that surface-to-surface correspondence allows us to account for the correct distribution of vowel length in Warray without recourse to cyclicity or derivation.

NOTES

* This paper is based on information provided by Doris White and Elsie O'Brien, both now deceased, over the period 1980–1993. We acknowledge a great debt to them. We are also grateful to Jane Simpson for her encouragement and to Colin Ewen and Ellen Kaisse as well as the three anonymous reviewers whose comments helped make this a better paper. Special thanks too to John McCarthy, Laura Benua and Caroline Jones for clarifying some issues concerning Correspondence Theory. Our research was made possible by an Australian Research Council Institutional Grant at the University of Sydney.

Warray words are given in orthographic form as well as in phonetic transcription. The digraphs *rd*, *rl*, *rn* stand for the retroflex consonants [ɖ], [ɭ], [ɳ]; the sequence *ny* is a palatal nasal [ɲ].

[1] Similar vowel-length alternations are also found in verb derivation: compare [naa] 'see-IMP' with related suffixed or prefixed forms: [na-yi] 'you (SG) watch yourself' and [ba-na] 'you (PL) look', [na-na] 'you (PL) watch out'.

[2] Warray also has noun root + verb root compounds which form denominal verbs. These compounds have only a single stress on the first syllable of the compound, suggesting that they form a single prosodic word. These forms have a short vowel, on the basis of the fact that the whole construction satisfies MINWD. Consider the following example, involving the noun root *-nyi* 'name' and the causative auxiliary *-wu*:

(i) [gan-a-nyí-wu] < gan-a-nyi-wu/ *[gan-a-nyíi-wúu]
'Don't name him!' IRREALIS-2PLS-name-CAUS

[3] It might be suggested that all liquids are moraic, since only liquids occur as the first member of a coda cluster in Warray. However, as the example /yul/ → [yuul] 'ground' shows, this is not the case. Word-final liquids are not moraic; if they were then nouns like this would not undergo vowel lengthening. It is clearly the position occupied by the consonant that makes it moraic, and not some intrinsic property of the consonant itself.

[4] We recognise that this constraint is not much more than a translation of extrasyllabicity and does not offer anything further in terms of explanation, but it is justified in that it captures a well-known observation within the bounds of the current model. With luck further research will provide us with a more explanatory constraint.

[5] We assume that the association of a mora with a consonant violates a constraint on consonant weight; let us call this *C_μ. Any effects it might have in our data are obliterated by the higher-ranked *FINALC$_\mu$. We do not consider this constraint here, but see below:

(i)

	MINWD	*FINAL C_μ	*VV	*C_μ
a. bum		*!		*
☞ b. buum			*	

https://doi.org/10.1017/S0952675797003400 Published online by Cambridge University Press

[6] As observed in note 5, the association of a mora with a consonant invokes a violation of $*C_{\mu}$, but still surfaces as the optimal candidate:

(i)

	MinWd	*Final C_{μ}	*VV	*C_{μ}
☞ a. bulk				*
b. buulk			*!	

[7] The dative case suffix has three allomorphs: *-wu* after a vowel; *-u* after a sonorant and *-Cu* after a stop, where C is homorganic with the word-final stop.

[8] Other constraints on identity are required. In our discussion we confine ourselves to discussion of the vowel-length correspondence only. One such constraint would be Dep_{μ}, which forbids the addition of moras, and differs from the VWt-Id constraint, which forbids the addition/deletion of a mora *to vowels*, increasing/decreasing their existing mora count.

[9] McCarthy's Wt-Ident constraint (1994: 43) is a general constraint governing all segments:

(i) If $\alpha \in$ Domain(f),
if α is monomoraic, then f(α) is monomoraic. (No lengthening.)
if α is bimoraic, then f(α) is bimoraic. (No shortening.)

[10] *FinalC_{μ} is irrelevant here, because the tableau is assessing the correspondence between the bare noun and the affixed noun, so while *FinalC_{μ} may appear to be picking out the correct form in (b), it is not saying anything about whether it is a good match to the base word. Nonetheless, the other two forms in which *FinalC_{μ} plays no part show that VWt-Id is indeed the crucial constraint in these forms.

We might also assume that there is no violation of *FinalC_{μ} because the consonant is not final once affixed. Nothing crucial hands on our assumption. A reviewer suggests that this constraint is a member of the family of edge constraints which is similar to but not identical with extrasyllabicity.

[11] There are four noun classes in Warray, each with its own prefix: /al-/ (fem), /a-/ (masc), /an-/ (body-part) and /∅-/, a residual class which includes most of the nouns in the language. Class marked nouns have the structure [Class Marker + Root]. Case suffixes attach to this structure, thus [[Class Marker + Root] + suffix]..

[12] A reviewer pointed out that if these forms are rare, perhaps they should be considered exceptional. We note that while the small number of such forms might suggest that they are rare, or indeed exceptional, we cannot be certain that they are. In the fieldwork situation, where one is not working with a complete grammar, small numbers of forms do not reliably indicate exceptionality. It is entirely possible that many more such forms exist. On a different tack, however, it does seem to us that dismissing forms as exceptions on the basis of their small numbers is a mistake. As we show, these forms are not exceptional; they behave quite systematically.

[13] The observant reader should be asking why it is that the prefix does not surface in these constructions. In fact, the prefix never surfaces. The base under scrutiny is only the noun root and not the prefix + root. Inflectional morphology is usually stripped off in compounds and incorporations. Following a suggestion by an anonymous reviewer, we assume that the lack of prefix is due to a low-ranking Max constraint on the surface-to-surface correspondence relation. The important thing for our purposes is that there is no instantiation of these roots with a long vowel anywhere – neither as a root nor as a word. It is also worth noting that the loss of the prefix is a problem in anyone's theory.

REFERENCES

Beckman, J. N., L. Walsh Dickey & S. Urbanczyk (eds.) (1995). *Papers in Optimality Theory*. Amherst: GLSA.

https://doi.org/10.1017/S0952675797003400 Published online by Cambridge University Press

Benua, Laura (1995). Identity effects in morphological truncation. In Beckman *et al.* (1995). 77–136.

Booij, G. & J. Rubach (1987). Postcyclic versus postlexical rules in Lexical Phonology. *LI* **18**. 1–44.

Borowsky, T. (1993). On the Word level. In S. Hargus & E. M. Kaisse (eds.) *Studies in Lexical Phonology*. San Diego: Academic Press. 199–234.

Halle, M. & K. P. Mohanan (1985). Segmental phonology of Modern English. *LI* **16**. 57–116.

Kenstowicz, M. (1996). Base-identity and uniform exponence: alternatives to cyclicity. In J. Durand & B. Laks (eds.) *Current trends in phonology: models and methods*. Vol. 1. Salford: ESRI, University of Salford. 365–395.

McCarthy, J. (1995). Extension of faithfulness: Rotuman revisited. Ms, University of Massachusetts, Amherst.

McCarthy, J. & A. Prince (1993). *Prosodic Morphology I: constraint interaction and satisfaction*. Ms, University of Massachusetts, Amherst & Rutgers University.

McCarthy, J. & A. Prince (1994). The emergence of the unmarked: optimality in prosodic morphology. *NELS* **24**. 333–379.

McCarthy, J. & A. Prince (1995). Faithfulness and reduplicative identity. In Beckman *et al.* (1995). 249–384.

Prince, A. & P. Smolensky (1993). *Optimality Theory: constraint interaction in generative grammar*. Ms, Rutgers University & University of Colorado, Boulder.

https://doi.org/10.1017/S0952675797003400 Published online by Cambridge University Press