Introduction

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1. Prosodic Morphology in the pre-1990's

One who consults[1] Chomsky and Halle's (1968) SUBJECT INDEX for entries beginning with *Pros* is exclusively referred to passages discussing *Prosodic features*. This is just one manifestation of this book's explicit claim that *hierarchy* has no direct role in the study of sound phenomena. Even though the input to the phonological component (a separate morphological component, including a lexicon, became available only later[2]) includes rich hierarchical information in that it is the output of the grammar's syntactic component, these structures are flattened out in a so-called intermediate readjustment component, resulting in completely non-hierarchical, flat, strings. These strings are sequences of sound-segments and non-segments. The individual sound segments represent the 'sounds' of a given morpheme or word in an abstract sense, namely through binary-valued phonological features. These features include the ones traditionally called "prosodic", such as [stress], [pitch] and [tone] (*SPE*, pp.376-377), but they have no special status *vis-à-vis* other features, just as for instance "cavity features" ([anterior], [coronal], [back], etc.) have no special status. Non-segments are the boundary symbols and the syntactic brackets, such as those occurring between a stem and an affix, between two words, between two phrases, and so on. Roughly speaking the number of boundary symbols and/or brackets between two morphemes reflects their degree of 'coherence' (or, conversely, their comparative degree of embedding in the syntactic tree), but this not a hard-and-fast rule: not only is it the task of the readjustment

component to flatten out hierarchical structure, but some of the rules of this component are as well allowed to manipulate (segments and) non-segments, resulting in derived representations from which the original syntactic structure cannot any longer be automatically read off.[3]

In sum, two aspects of *SPE*'s position on the linear nature of a phonological representation are relevant here. First, with respect to sound-segments: these are sequences of bundles of unstructured phonological features; this is what Goldsmith (1976a) has called the Absolute Slicing Hypothesis. Second, with respect to non-segments: these are part of the flat string, and they can be manipulated (by readjustment rules) and contextually referred to by the rules of the phonology. This, together with the first, is what Liberman and Prince (1977:333) have called the Linear nature of this account.

Non-linear phonology of the 1970's is a reaction to these claims of the standard theory.[4] *Prosodic* phonology can be seen as a subbranch of non-linear phonology, specifically that branch dealing with prosodic categories (although this narrowing down is not always maintained). In the research area of *Prosodic Morphology*, some of the interesting results of the study of prosodic phonology are applied to the study of morphology, in areas where the two appear to interact. Since morphology, in the sense of *word*-formation, is now standardly assumed to be situated in the lexicon (cf. fn.2), the prosodic categories typically employed in prosodic morphology are those from the word-level down, i.e. the mora, the syllable (and possibly some of its constituents, such as onset, nucleus and coda), the foot, and the prosodic morpheme and word.[5] Let us consider some examples.

Two major research areas within non-linear phonology are *autosegmental* phonology and *metrical* phonology. Although both are hierarchical or three-dimensional, they differ with respect to the empirical material they focus on. Although there is no *a priori* or

principled strict division of tasks between the two, autosegmental theory traditionally deals with phenomena such as tone (spreading) and various types of assimilation (prominently including vowel harmony), whereas metrical theory deals with syllable structure, stress and rhythm. The first work to turn doubts about absolute slicing into a theoretical framework of spreading and assimilation phenomena is Goldsmith (1976a,b)[6]: it introduces autosegmental phonology as a reaction to the linear *SPE* theory. As a brief description of the basic tenets of this framework, consider the following brief description of Igbo vowel harmony, comparing the *SPE* treatment with the autosegmental one by Clements (1976/80).

In a vowel harmony system characteristically all vowels within a word have the same value for a 'harmonic feature'. Usually, there can be identified within a word a source or trigger of the harmony, and there are two ways in which the pertinent feature value can spread throughout the word from this source. First, the feature can spread from the stem to all the affixes in a word; this is called symmetric or root-controlled vowel harmony. Second, the feature can spread from a fixed position (the leftmost or rightmost vowel of a certain quality) in one particular direction; this is called directional harmony. The West-African Igbo language has symmetrical harmony, and the *SPE* account assumes a relatively complicated set of three separate ordered rules to capture it (Chomsky and Halle 1968: 378-9). On the other hand, Clements's account looks (at worst) like this:

(1) Associate

The question is how autosegmental phonology enables one to accomplish this extreme descriptive reduction. Some simple Igbo facts are those below:

(2)	e-ke-le	‘don’t share’	a-zu-la	‘don’t buy’
	i-vu	‘to carry’	i-lu	‘to marry’

The property of Igbo harmony any analysis wants to account for is that vowels in a word are either [+ATR] or [-ATR], i.e. they have or they have not an ‘advanced tongue root’ (the underlined vowels in the lefthand words are all [+ATR]; this property is lacking ([-ATR]) from the vowels in the righthand words. An *SPE*-type derivational analysis with rules distinguish between three steps in this procedure. First, all affixal vowels are specified [-H]. This is a completely arbitrary ‘diacritic’ specification, which will have a phonological function only later in the derivation. Stems can be underlyingly specified either [+H] or [-H]. When the stem is intrinsically [-H] and all affixes are [-H] by the first step, we have come already a large part of the way towards accounting for harmony. When the stems is intrinsically [+H], however, a second rule specifies all vowels to the left and to the right of the stem (so: all affixal vowels again) as [+H] as well. Finally, a third rule gives a phonological interpretation to the arbitrary feature [H]: it says that the feature actually means [ATR], and that [+H] corresponds to [+ATR] and [-H] to [-ATR]. Reconsider the data in (2), the righthand words first, since the state of affairs in these words is simple: the stems *-zu-* and *-lu-* are [-H] underlyingly, all affixal vowels will become [-H], and at the final stage the [-ATR] interpretation is provided. The lefthand words are rather where the action is: three consecutive operations ([-H] on affixes, spreading o [-H] and phonetic interpretation) result in words that have [+ATR] vowels only.

One interesting type of data Chomsky and Halle apparently did not have the opportunity to have a look at, is the phenomenon of *opacity* in vowel harmony systems. This

means that certain vowels or certain affixes may block spreading the harmonic feature throughout the word: they interrupt the wave. In (3) below are some Igbo data:

(3) ...-bh<u>o</u>-w<u>a</u>-gh<u>i</u> ‘put-begin-emph.’

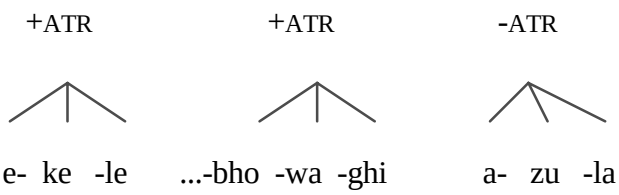
v<u>u</u>-si ‘distr.-carry’

...-bh<u>o</u>-si-ghi ‘put-carry-emph.’

The top example is a case of perfect harmony, involving the suffixes *-wa* and *-ghi*. The second example shows that the suffix *-si* exceptionally does not take part in harmony. The bottom form shows that the harmonic wave cannot reach the rightmost suffix *-ghi* across the exceptional suffix *-si*: it is as if, apart from being an exception, *-si* automatically has the property of inducing its own harmony, to the right. There is nothing in the linear account of (1) that hints at how this may come about, although opacity is a very common phenomenon in harmony languages.

What happens in an autosegmental account of these data? The crucial step in an autosegmental analysis can be compared to solving the puzzle of having to make three triangles with 6 matches: one is required to introduce hierarchy or multi-dimensionality. More specifically, we observe the ‘autosegmentalization’, or ‘setting apart’ of the harmony feature on a separate level or ‘tier’. Autosegmental representations of regular cases of Igbo harmony look as in (4):

(4)



Such representations are derived form underlying forms in which the autosegment, as it were, floats over the vowel of the stem, and affix vowels are unspecified for the harmony feature, i.e. representations such as (4) without any 'association lines' whatsoever, the latter being drawn as a result of the so-called Well-Formedness Condition on autosegmental representations. This WFC is a universal, and has the following form:

(5) (a) all vowels are associated to at least one autosegment.

(b) all autosegments are associated to at least one vowel.

(c) association lines may not cross.

(d) association of unassociated autosegments precedes drawing lines from associated autosegments.

The WFC derives (3) from (4), through (5a-b). The role of (5c-d) becomes clear from the way it allows opacity to be treated. An exceptional affix is underlyingly preassociated with its own harmony feature: in this way, [+ATR] can never reach vowels outside (to the left or to the right of) exceptional vowels, as association lines may not cross.

(6)

The correct direction of spreading (the dotted lines in (6)) follows from (5d). The language-specific information needed to trigger the procedure is that *-si* is an opaque (preassociated) suffix, and [ATR] is an autosegmental feature. All else simply follows from the universal WFC.

Then consider the next event, of crucial importance to this introduction. McCarthy (1979) applies the principles of autosegmental phonology to morphology, effectively establishing the field of PROSODIC MORPHOLOGY. He discusses the phenomenon of discontinuous affixation in Semitic morphological systems, specifically that of Arabic; in data such as those in (7) below, consonants play the role of stems (or *binyanim*) and vowels play the role of affixes.

(7)	katab	I	Perfective Active
	kaatab	III	id.
	ktabab	IX	id.
	ukaatab	III	Imperfective Passive
	kuutib	III	Perfective Passive
	ktanbab	XIV	Perfective Active
	aktanbib	XIV	Imperfective Active

McCarthy first shows how a linear account, more specifically that of Chomsky (1951) (but all others have the same relevant formal properties), deals with the discontinuities in such output forms. Given consonantal stem patterns (C_1-C_2-C_3) and affixal vowel patterns (V_1-V_2), a transformational rule of the following sort is required in order to derive the linear sequence of consonants and vowels in the output, for the first form of (7):

(8) $C_1 - C_2 - C_3 + V_1 - V_2 \rightarrow C_1\ V_1\ C_2\ V_2\ C_3$

Similar rules will be required for the other forms. But transformational rules are an extremely powerful device for morphology to incorporate (McCarthy 1979:358):

(9) Morphological transformations potentially allow any arbitrary operation on a segmental string. For example, transformational morphological rules of this sort can freely move particular segments an unbounded distance within the word, copy all and only the vowels in a word, or reverse strings of finite length.

This is a strong incentive to look for alternatives, and one such alternative lies in the strategy of seeking an analogy between autosegmental phonological phenomena and the morphological one under discussion.

Thus, just considering the top two forms of (9), the stem-consonants and affix-vowels can be seen to be exactly the same (and in exactly the same order), with only a single difference residing in the number of vowels occurring in the forms. McCarthy proposes to deal with these two cases in the following fashion. In so far as the mix of vowels and consonants in a given *binyan* is unpredictable, the shape of the *binyan* is specified in a so-called *syllabic skeleton* or *template*; for the two forms under discussion these templates look as in (11b) below. Then, in an autosegmental manner, stem- and affix-'melodies' are each specified on separate tiers ((11a) and (11c)), respectively), which in this case clearly have a morphological function. The WFC variant employed in order to establish the correct associations between template and melodies is that of (10). Notice the high degree of similarity between (10) and (5), which makes it desirable to assume a theoretical common denominator.

(10) (a) each slot in the skeleton must be linked with at least one segment in the melody.

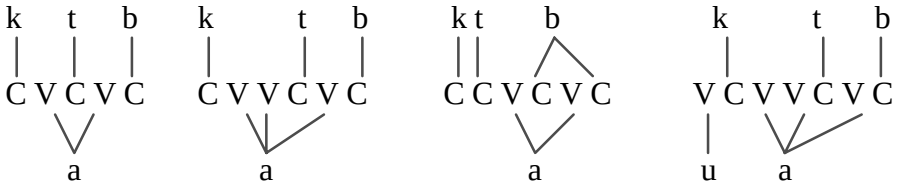
(b) linking lines must never cross.

(c) (unless otherwise stipulated) segments in the melody and slots in the skeleton are linked one-to-one from left-to-right.

(d) when a melody contains both linked and unlinked units, it is the latter that are spread to unfilled slots.

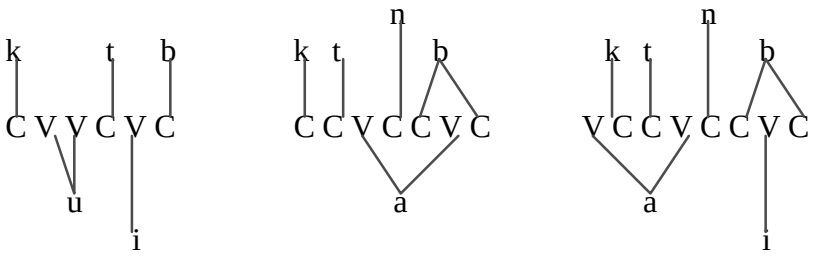
Immediately including the next two cases of (9), representations for the first four forms look as in (11), after application of the WFC of (10):

(11)



We have seen that in vowel harmony, (vowels of) affixes may be prespecified as opaque, by prelinking them. Exactly the same technique is a useful device in the remaining cases of (7), which either have an unpredictable vowel pattern or a consonantal infix in an unpredictable position, or both at the same time:

(12)



Without prelinking, the infix could go anywhere with respect to the stem consonants; and left-to-right association predicts that similar vowels will cooccur on the righthand side rather than the (in these cases empirically correct) lefthand side. There are many more intricacies to these Semitic morphological systems (see the remainder of chapter 4 of McCarthy's dissertation, and below), but the claim seems justified that prosodic morphology, leaning heavily on the earlier results of non-linear phonology, allows for both much more insightful and theoretically less powerful accounts.

As pointed out above, *metrical phonology* is a reaction to the analyses of the standard theory in the realm of stress, rhythm and syllable structure. The earliest work in the non-linear approach in these areas is represented by the mid-1970's PhD theses by Liberman (1975) and Kahn (1976). We take a syllable structure example from the latter, in fact one that has a classical structure: generalizations are lost when syllable structure is not directly available in phonological analyses (the position of the *SPE*-theory is of course the reverse: there is no need for fear that this is the case). The argument for the syllable is two-prongued. First, in standard phonological analyses a rule like that in (13a) below expresses a generalization via the curly bracket notation which two separate rules would fail to capture. Second however, the fact that an equally general abbreviated rule pair such as that in (13b) does not very frequently occur (if at all), argues against the bracket notation as the correct generalizing device for these cases.

(13) a. $/r/ \rightarrow \varnothing \; / \; \_\_\_ \begin{Bmatrix} \lceil C \rceil \\ \{ \# \} \\ \lfloor \; \rfloor \end{Bmatrix}$ b. $/r/ \rightarrow \varnothing \; / \; \_\_\_ \begin{Bmatrix} \lceil V \rceil \\ \{ \# \} \\ \lfloor \; \rfloor \end{Bmatrix}$

If this is so, we need something to replace these curly brackets. In fact, cases of type (13a) remind one strongly of the traditional notion of syllable; consider data such as those in (14) regarding the process of *r*-loss in many varieties of English:

(14) /r/ lost:

b a r k b a r k e r b a r (# is...)

/r/ retained:

r e d M a r y c o r r e c t b a ˑ r i s

In *SPE*-terminology, *r* is lost before a consonant or a word-boundary (but the latter not in relatively fast speech). Such a statement implies curly brackets; however, these can be eliminated when we say directly that *r* is lost when tautosyllabic with a preceding vowel.[7]

Once we assume, on the basis of a phenomenon such as English *r*-loss, and others like it, that the syllable is part of the basic linguistic vocabulary, one of the questions that arises is whether perhaps, just as segments (in as far as the notion of 'segment' survives an articulated theory of autosegmental phenomena[8]) are organized into syllables, syllables themselves are organized into higher units. The answer to this question has turned out to be an affirmative one, the relevant unit of organization one level up being the *foot*. The earliest arguments for this unit can be found in Selkirk (1978, 1980) and Vergnaud and Halle (1978). This time consider the phenomenon of French '*e* muet': in this process, schwas are optionally deleted, as long as the output does not contain a triliteral consonant-cluster.

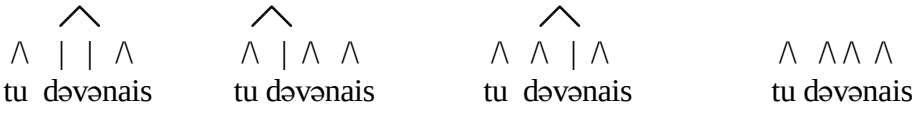
(15) a. souv(ə)nir pass(ə)ra

b. parvənir souffləra *pa[rv-n]ir *sou[fl-r]a

c. (tu) dəvənais, dəv-nais, d-vənais *[d-v-n]ais

The linear analysis of Dell (1973) mentions exactly the required condition as a constraint on the possible outputs of the rule, but such an addition (i.e., a "derivational constraint") functions as a "violation of the otherwise Markovian character of phonological deviations [sec]" (Vergnaud and Halle, 1978:32). A nonlinear account may run as follows. First, assume that full vowels have that property represented by a branching structure over them; second, assume that schwas count as full after two consonants, and optionally as full (or non-branching) otherwise. Finally, a non-branching syllable must be accomodated by its left neighbour into superordinate structure. One can easily make out that four structures will thus become available for the phrase *tu devenais*:

(16)



It is equally easy to see that the rule of schwa deletion can now be formulated, Markovianly, as in (17):

(17)

So much is clear: the name of the superordinate structure cannot be syllable; it is, rather, a sequence of syllables, organized in a particular fashion; it is the Foot.[9]

Syllable and foot are now known as 'prosodic categories', and the study of prosodic categories is a separate branch of (metrical) phonology. Lexical prosodic categories that have

been added more recently are the mora (a unit of phonological 'weight', especially in systems of stress and length) at a level lower than the syllable, and the (prosodic) word, as a unit in which feet are commonly organized. It may furthermore be useful to divide the syllable into the constituents of Onset and Rhyme (and the Rhyme into Nucleus and Coda).

An extremely interesting phenomenon in which notions from autosegmental and metrical theory have been argued to team up, is that of *Reduplication*, i.e. the type of morphology in which affixation takes place by repeating either the whole stem or part of the stem in the derived form. Influential in this area has been Marantz (1982). Consider from that article reduplication data from Agta (a Philippine language) such as those in (18).

(18)	bari	'body'	bar-bari (...)	'my whole body'
	saddu	'to leak'	(...) sad-saddu	'to leak in many places'
	wakay	'lost'	(...) wak-wakay	'many things lost'
	takki	'leg'	tak-takki	'legs'
	uffu	'thigh'	uf-uffu	'thighs'
	ulu	'head'	ul-ulu	'heads'

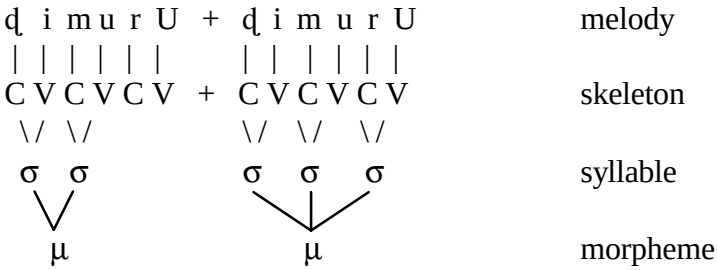
Referring to McCarthy's analysis of Semitic *binyanim*, Marantz argues that the reduplicative affix is a complete melodic copy of the stem, but the shape of the copy is ultimately constrained by a (morphological) templatic condition on CV-sequences. In the case at hand, this template has the shape CVC. Association takes place from left-to-right (for prefixes and in the mirror image fashion for suffixes):

(19)


An example in which the prosodic category of the syllable plays a role in a reduplication process is that of Yidin^{y} (Dixon 1977, Nash 1980, Marantz 1982: 453-6):

(20) ɖimurU	‘house’	ɖimu-ɖimurU	‘houses’
ɖaɖaman	‘to jump’	ɖaɖa-ɖaɖaman	‘to jump a lot’
gindalba	‘lizard’	gindal-gindalba	‘lizards’
ɖugarban	‘to have an unsettled mind’	ɖugar-ɖugarban	‘to have an unsettled mind for a long period’

Two observations are in order here: first, the reduplicative morpheme of Yidin^{y} is bisyllabic, and second, this morpheme does not necessarily use a consonant to close the final syllable, even if the opportunity arises (**dimur-dimurU*): this is where Yidin^{y} also differs from Agta:

(21)


Developments so far may be characterized as the application of autosegmental and metrical principles, which were both originally motivated in the domain of ‘phonology proper’, to the new domain of non-concatenative morphology. The central concept involved in this kind of morphology is the ‘template’: a skeletal morpheme that is segmentally unspecified except for information on the positions of consonants and vowels.

In the early eighties an increasing recognition arose of the key role of prosodic templates in syllabification (cf. Vergnaud and Halle 1978, Selkirk 1980, 1982, Itô 1986). Central in this 'prosodic-template-matching' approach was the idea that languages draw their syllable shapes from a narrow pool of universal possibilities. For example, languages may select the option 'onsets are obligatory', thereby imposing this as a well-formedness criterion on the outputs of all phonological processes that affect syllable structure. In their unpublished paper called "Prosodic Morphology" dating from 1986, McCarthy and Prince argued that this *prosodic* template approach should be extended to the domain of non-concatenative morphology, which had previously been analysed in terms of *segmental* templates and autosegmental association (McCarthy 1979, Marantz 1982). The landmark contribution of this 1986 paper was the elimination of segmental templates by prosodic templates, defined in terms of universal prosodic units such as the mora, syllable, and foot. This idea was stated as follows by McCarthy and Prince (1986:6):

> "Patterns of obligatoriness and optionality will follow in general from independent characterization of the prosodic units, both universally and language-specifically. [...] The fact that the templates are bounded by a language's prosody follows from their being literally built from that prosody."

The endpoint of this initial stage of the study of Prosodic Morphology can be found in McCarthy and Prince (1990). This paper is a combination of parts of the earlier mentioned unpublished paper, and original work on Arabic 'broken' plurals and diminutive formation. In it, the authors present "three fundamental theses" of the theory of Prosodic Morphology:[10]

(22) (i) *Prosodic Morphology Hypothesis*. Templates are defined in terms of the authentic units of prosody: mora, syllable, foot, prosodic word, and so on.

(ii) *Template Satisfaction Condition.* Satisfaction of templatic constraints is obligatory and is determined by the principles of prosody, both universal and language-specific.

(iii) *Prosodic Circumscription of Domains*. The domain to which morphological operations apply may be circumscribed by prosodic criteria as well as by the more familiar morphological ones. In particular, the *minimal word* within a domain may be selected as the locus of morphological transformation in lieu of the whole domain.

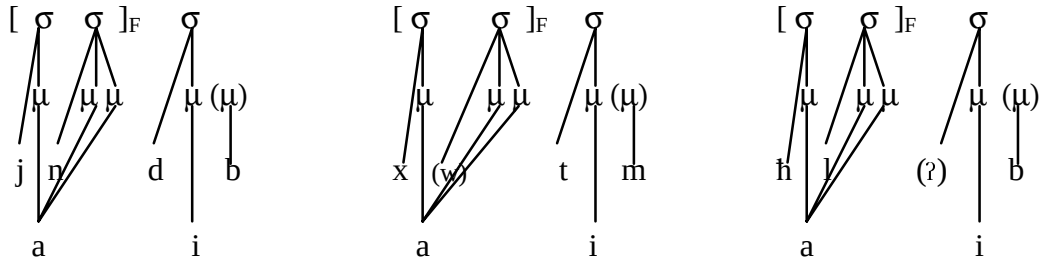
In this framework, Agta reduplication above is a case where the CVC reduplicative prefix is redefined as a heavy syllable ($\sigma_{\mu\mu}$). The analysis of Yidin^y is slightly more complicated. The authors start by noting that the unqualified notion of 'syllable' does not appear to be involved in cases of reduplication: "The curious property of Yidin^y reduplication is the way that the syllabification of the base is carried over, as if the initial disyllabic sequence were copied whole. A large amount of descriptive research has failed to turn up a reduplicative process that unambiguously *copies* a single syllable [...]. Why then should reduplication appear to copy *two* syllables but never just one?" (p.233) Within the theory of Prosodic Morphology in (22), the answer runs as follows. The first step is to select from the base (by a process called "prosodic circumscription") the so-called *minimal word*: in Yidin^y this is the bisyllabic - initial - foot (no stem may be monosyllabic). Then, on this minimal word, reduplication is simply complete.

Some relevant Arabic 'broken' plurals can be found in (23) below.

(23)	Sg.			Pl.	
		jundub	‘locust’		janaadib
		sultaan	‘sultan’		salaatin
		xaatam	‘signet ring’		xawaatim
		ħaluub(-at)	‘milch camel’		ħalaaʔib

From singulars to plurals we get by the following route. First, the *minimal word* is used in circumscription, and its contents is the bimoraic foot: thus, it contains either one heavy syllable or two light ones. Second, the minimal word is associated to an ‘affixal’ template, which is the unmarked iambic foot: $\sigma_{\mu}\sigma_{\mu\mu}$ (light-heavy). Third, the residue of phonological material outside the minimal word is maintained. Fourth, the vowels of the singular are overwritten by an *a-i* melody: *-a-* within the iambic foot, *-i-* outside it. Finally, ‘default’ insertion consonants may appear at the verge between vowels. Consider the following displays resulting from this analysis.

(24)



from: [j u n]$_{\mu\mu}$ dub [x aa]$_{\mu\mu}$ tam [ħ a l u]$_{\mu\mu}$ ub

McCarthy and Prince support the prosodic morphological subparts of this analysis with a considerable amount of language internal evidence. Moreover, they support the theory of

Prosodic Morphology with an enormous amount of evidence from reduplication and other affixational phenomena from a wide range of natural languages.

The overriding force of prosodic factors in templatic and reduplicative morphology was emphasised by Steriade (1988:16), in the form of a major cross-linguistic observation that would become a focus of attention in later years: templates tend to have *unmarked syllable structure*[11]:

> "Prosodic templates frequently eliminate certain unmarked options from their syllabic structures. Although the language may in general allow complex onsets or consonantal nuclei, the template might specifically revoke these options.
>
> We observe the following range of syllabic simplification in prosodic templates: onset simplification (Tagalog *ta-trabaho, bo-bloaut* from McCarthy and Prince 1986:16); coda simplification (Sanskrit intensive *kan-i-krand* [...]); coda drop (cf. the French hypocoristisc *zabe, mini* from (*i*)*zabel*, (*do*)*minik*); elimination of consonantal nuclei (Sanskrit perfect *va-vr̥ma* [...])."

Steriade proposed that prosodically marked properties were *literally* cancelled from the reduplicant, which is in its initial state a *full copy* of the base - including its prosody. This full-copy-plus-cancellation model explains certain properties of reduplication that pose problems to Marantzian 'melody-copy-plus-association' models (assumed by McCarthy and Prince 1990). In particular it explains why syllabic roles of segments can be transferred under reduplication. Steriade's proposal also raised new questions: why are cancellations of prosodic markedness limited to reduplicants and truncations, both morphemes whose segmental content is dependent upon a basic stem form?[12] Why does reduplication never (unambiguously) *copy* a single syllable? We will return to these questions in §2.2 and 2.5.

Summarizing the developments in the late 1980's, we find that researchers came to recognize the major role played by prosodic well-formedness in what became appropriately known as 'Prosodic Morphology'. Although prosodic morphology was now firmly integrated with prosodic theory, questions remained with respect to the prosody-morphology *interface*. Most work published in the 1970's and 1980's assumed a strict division of labour between morphology and phonology.[13] In reduplication this was reflected as the *serial ordering* of a morphological operation (the affixation of a reduplicative template) before its construction specific phonology: the full copying (and cancellation of marked properties in Steriade's model). As we will see in the next section, precisely this 'serial' grammatical organization came under fire by developments in the 1990's.

2. Prosodic Morphology in the 1990's

In this section, we briefly discuss recent developments in Prosodic Morphology, those that have taken place in the 1990's, and especially those in the recent framework of Optimality Theory. Recall from the previous section that the main goal of the theory of prosodic morphology is an explanation of morphological patterns of reduplication, root-and-pattern morphology, etc., as these occur in different forms in a large number of languages, by the interaction of independent general principles. To state it, provocatively here, the field is ultimately self-destructive in the sense that morphology-specific properties are eliminated in favour of more general principles of phonological and morphological well-formedness. To the extent that such a reduction will turn out to be succesful, the field of prosodic morphology will be assimilated with the fields of 'prosody' and 'morphology'.

2.1 General ideas

OPTIMALITY THEORY (Prince and Smolensky 1993, McCarthy and Prince 1993ab) adopts a view of the prosody-morphology interface that is radically different from its rule-based ancestors. According to this view prosodic well-formedness requirements *directly interact* with morphological requirements. Interaction takes the form of *constraint domination*, the setting of priorities among conflicting constraints, which make general requirements about output forms. This new idea of the prosody morphology interface is embedded in a theory of language as a whole, which has the following characteristics.

The central idea of Optimality Theory is that language is the domain of conflicting requirements. Grammars are language-specific ways to resolve such conflicts, on the basis of a hierarchy of constraints. Constraints are violable, but violation must be minimal. The 'well-formedness' of an output form is a relative notion: it only means to convey that no other output forms are possible that are 'better-formed' as evaluated by the set of ranked output constraints. The *optimal* output form is the one that minimally violates high-ranked constraints, possibly at the expense of violations of lower-ranked constraints. The ranking of two constraints is demonstrated by comparing two (or any number of) candidate output forms, taking into account their violations of each constraint. This demonstration takes the form of a *tableau*: this lists all the candidates vertically, and the constraints horizontally, in a descending ranking from left to right, while the cells contain violation marks incurred by each candidate for a constraint:

(25)	C_1	C_2
a. ☞ *candidate 1*		**
b. *candidate 2*	*!	

The optimal candidate is (25a) since this has no violations of the highest-ranked constraint C_1, while its competitor (25b) has one. (This violation is fatal to 25b, hence a exclamation accompanying it.) Observe that the optimal candidate (25a) is far from impeccable: it has two violations of C_2, but this factor is insignificant, given that no candidate occurs that has no violations on neither constraint. This shows that domination is strict: a candidate that incurs violations of some high-ranking constraint (on which another candidate incurs no violations) is mercilessly excluded, regardless of its relative well-formedness with respect to lower-ranked constraints.

Constraints fall into different types. *Well-formedness* constraints enforce prosodic or segmental markedness, such as 'syllables must have onsets', or 'syllables must not have codas'. *Faithfulness* constraints militate against any divergences between an output form and its basic (underlying) form, such as 'input segments must be preserved in the output'. Well-formedness constraints provide the pressure for 'changes'; they inherently conflict with faithfulness constraints, which inhibit any 'changes'. Other constraint types enforce morpheme-specific requirements, mostly referring to the matching of morphological and prosodic edges. Among the morphological constraints are also those enforcing the identity between the reduplicant and the base, which is otherwise captured by the copying rules of Marantz (1982) and Steriade (1988).

A crucial property of the OT model, when it comes to the interface of phonology and morphology, is *parallelism*: constraints of different 'modalities' interact in a single

hierarchy. Parallelism predicts that morphological requirements may (in principle at least) be violated under pressure of dominating prosodic requirements, which is precisely what seems to be required in cases discussed so far. This constitutes an essential difference with the derivational model, which assumes a strict division of labour between morphology and prosody. Let us now find out how 'prosodic morphology' can be construed under the OT model.

2.2 Prosodic Morphology as constraint interaction: P » M

The OT-model of prosodic morphology shares with its derivational ancestor the driving idea that the patterns of reduplication, truncation, or infixation, as are observed in different languages, result from a combination of independent and general principles. The central idea of this model is that *prosodic* well-formedness constraints have priority over *morphological* requirements. The major change in perspective that became possible as a result of OT concerns the interaction between the independent and general principles principles alluded to above, which now takes the form of a competition between violable constraints, which are ranked in language-specific hierarchies.

For example, consider the cross-linguistically common situation of a reduplicant that is less prosodically marked than the basic form from which it 'copies' segments, as discussed by Steriade (1988). In Optimality Theory, this situation is analysed as a ranking of *prosodic well-formedness* constraints over morphological constraints which enforce the *identity* between the reduplicant and its base. Precisely this situation occurs in the pattern of reduplication of the Peruvian language Axininca Campa (Payne 1981, Spring 1990, McCarthy and Prince 1993ab). Reduplication copies the entire root (26a), except in the case of a root starting with a vowel, which is left uncopied (26b).

(26) Axininca Campa Reduplication

a. /kawosi + RED/kawosi-<u>kawosi</u> ‘bathe’

b. /osampi + RED/ osampi-<u>sampi</u> ‘ask’ *not* *osampi-<u>osampi</u>

A partial reduplicant -<u>sampi</u> that has an onset (an unmarked prosodic structure) is chosen instead of a full reduplicant -<u>osampi</u> that lacks an onset (a marked prosodic structure). McCarthy and Prince (1993b) analyse the pattern as an interaction between a morphological constraint which requires that reduplication be total[14], which is dominated by a prosodic constraint, which requires that syllables must have onsets:

(27) **MAX**

Reduplicant = Base

(28) **ONSET**

Syllables must have onsets.

The interaction of these constraints is captured by a simple ranking statement in (29):

(29) ONSET » MAX

This interaction is shown in tableau (30):

(30) Input: /osampi-RED/	ONSET	MAX
a. ☞ osampi-<u>sampi</u>	*	o
b. osampi-<u>osampi</u>	**!	

The optimal reduplicant in (30a) may be 'imperfect' in terms of completeness of copying, but this it enjoys the important advantage of being prosodically unmarked. The grammar of Axininca assigns more importance to the latter (prosodic) factor than to the former (morphological) factor. This ranking of prosody over morphology **P » M** is, according to McCarthy and Prince (1993b), the true hallmark of 'prosodic morphology'.

A preliminary explanation can now be given of Steriade's important finding that 'cancellation' of marked prosody is typical of templatic morphology. This explanation is based on the interaction of the configuration ONSET » MAX with a third constraint, PARSE, a *faithfulness* constraint which militates against the loss of segments from the input:

(31) **PARSE**

'Input segments must appear in the output.'

When ONSET ranks above PARSE, then vowels may be deleted in order to create unmarked syllables with onsets. But when PARSE is ranked above ONSET, as is the case in Axininca Campa, then no vowel is deletable from a root's input form in order to avoid an onset-less syllable in the output. In tableau (32) this is shown in the form of fatal violation marks in the cells of candidates c-d in the column headed by PARSE:

(32) Input: /osampi-RED/	PARSE	ONSET	MAX
a. ☞ osampi-<u>sampi</u>		*	o
b. osampi-<u>osampi</u>		**!	
c. sampi-<u>sampi</u>	o!		
d. sampi-<u>osampi</u>	o!	*	

Note that no logically possible ranking of these three constraints will produce the effect that the reduplicant retains the input /o/, while the base drops it. That is, candidate (32d) is necessarily dispreferred to any of the other candidates, regardless of constraint ranking. This explains why a difference in prosodic markedness between the base and reduplicant is *always in the favour of the reduplicant*: only the base, not the reduplicant, is subject to faithfulness to the input. Observe that this explanation is based on a minimal assumption about reduplication that has to be made under any theory, which is that the reduplicant morpheme has no input segments affiliated with it in its input form. Segmental emptiness of the input is what exempts the reduplicant from faithfulness constraints (e.g. PARSE)[15].

This interaction of input faithfulness (PARSE), prosodic well-formedness (ONSET) and reduplicative identity (MAX) is what McCarthy and Prince (1994) have referred to as an '*emergence of the unmarked*'. Well-formedness constraints may seem to be 'inactive' in a language, but in fact they are only 'hidden' behind higher-ranking faithfulness constraints. Well-formedness suddenly jumps into activity in situations where faithfulness has no grip. In Axininca Campa PARSE (a faithfulness constraint) dominates ONSET (a well-formedness constraint), ruling out deletion of input vowels as a strategy to avoid onsetless syllables. But in reduplicants, where input faithfulness plays no role (as reduplicants have no input segments), ONSET takes its effect (be it at the expense of

reduplicative identity). This result is typical for OT since the 'hide-and-emerge' effect is predicted by constraint domination.

Next consider the pattern of *um*-infixation in Tagalog (French 1988), which serves as a further illustration of the domination of prosodic constraints over morphological ones. The generalization is that *-um-* is infixed directly after the onset of the word (cf. 33b-c), if it has one; if the word has no onset, *-um-* becomes a prefix (cf. 33a):

(33) Tagalog Prefixal Infixation

a.	um+abot	→ <u>um</u>-abot	
b.	um+tawag	→ t-<u>um</u>-awag	'call, pf., actor trigger'
c.	um+gradwet	→ gr-<u>um</u>-adwet	'graduate'

The prefix skips over the initial onset, settling itself between a consonant and vowel in the base, with which it integrates into a 'well-formed' sequence of syllables. What is avoided is an output form in which the vowel of *-um-* lacks an onset, while its consonant syllabifies as a coda, as in **um-tawag*. In sum, the creation of well-formed syllables is what drives *-um-*infixation: we observe a dependence of morphology on the prosody of the output.

The analysis by Prince and Smolensky (1993) of this pattern is strikingly simple, since it directly encodes the dominance of prosody over morphological requirements. The constraint that comes into play here is stated in (34), and it militates against codas:

(34) **NO-CODA**

Syllables do not have codas.

This prosodic well-formedness constraint interacts with a morphological constraint that expresses the status of *-um-* as an affix which must be as close as possible to the left edge of the word:

(35) **EDGEMOST** (*um*; L)

The item *um* is situated at the left edge of the word

In fact, this is nothing but the requirement that '*-um-* is a prefix'. As other constraints, this morphological constraint is in principle violable. And in Tagalog, it actually is violated in cases where *-um-* is adjoined in a position that is not strictly at the beginning of the word.

The constraint ranking producing the mixed effect of 'infixation' in some contexts, and of 'prefixation' in other contexts, is stated in (36):

(36) **P-constraint » M-constraint**

NO-CODA » EDGEMOST (*um*; L)

That is, Tagalog assigns more importance to the avoidance of codas than to the prefixal status of the affix *-um-*. However, the prefixal status of *-um-* still asserts itself maximally in the sense that it stands *as close as possible* to the left edge of the word, respecting the superordinate requirements of prosody. This analysis is illustrated by the tableau of *gr-um-adwet*:

(37) Input: {um, gradwet}	NO-CODA	EDGEMOST (*um*; L)
a. **um**.grad.wet	***!	# ∅
b. g**um**.rad.wet	***!	# g
c. ☞ gr**u**.**m**ad.wet	**	# g r
d. gra.**um**.dwet	**	# g r a!
e. gra.d**um**.wet	**	# g r a! d
f. grad.w**u.m**et	**	# g r a! d w
g. grad.we.**um**t	**	# g r a! d w e
h. grad.we.t**um**	**	# g r a! d w e t

Observe that the prefixational candidate (37a) violates NO-CODA more than is necessary (for a base of the skeletal type *gradwet* this amounts to two violations). No improvement with respect to NO-CODA is reached in candidate (37b), which infixes *-um-* between the first and second consonants of the base. Each of the remaining candidates (37c-h) incurs two violations of NO-CODA. Among these the one is selected that minimally violates the next constraint down the hierarchy, which is EDGEMOST (*um*; L). Violations of EDGEMOST are marked by segments lying between the left word edge and the affix *-um-*. The optimal output is (37c), since this has the smallest number of violations of this constraint, and it can be said to maximally respect the prefixal status of *-um-*. All remaining infixational candidates (37c-e) violate EDGEMOST (*um*; L) to a larger degree than is strictly necessary. (Recall one of the basis principles of OT: constraint violation is minimal.) This analysis is based on the *parallel* evaluation of prosodic and morphological constraints.

Now compare the way in which *serial* theory might deal with the Tagalog pattern. This would involve 'prosodic circumscription', a device proposed by McCarthy and Prince (1990), which was briefly mentioned in §1. The first step would be the circumscription of the word onset (on the assumption that this is a prosodic unit). Next, *-um-* is prefixed to the residue of circumscription (the base minus the word onset), which begins with a vowel. Finally, the word onset is put back in its place, producing the effect of '*um*-infixation'. But this analysis leaves unexpressed the relation betweeen the prosodic shape of the affix *-um-* (VC), and its surface distribution, directly after the word onset. Circumscription theory is unable to make this connection, as it separates circumscription from the morphological operation that it 'potentiates'. In retrospect, circumscription was a mechanism 'without a cause'.[16]

2.3 The notion of 'template' in OT prosodic morphology

The key idea that 'prosodic morphology' involves the domination of prosodic constraints over morphological constraints was elaborated in McCarthy and Prince (1993b). This 184p. manuscript dealt mainly with aspects of the prosodic morphology of Axininca Campa, of which we have already seen an example above. A recurrent theme of this manuscript is that templatic requirements are only satisfied maximally, within the limits imposed by the superordinate requirements of the language. Violability of templatic constraints is in fact predicted by OT, given the assumption of *parallelism*, according to which morphological constraints are ranked in a single constraint hierarchy together with universal prosodic constraints.

As a second modification of the notion of 'template' McCarthy and Prince (1993b:82) argue that templates are *constraints on the prosody/morphology interface*, which assert the coincidence of morphological and prosodic constituents:

> "[...] the classical notion of template and template-satisfaction needs to be generalized. Optimality Theory provides a means of dealing effectively with the violability of the constraint; this is entirely expected behavior, in the general context of the theory. [...]. The place to look for generalization of the notion of template, we propose, is in the family of constraints on the prosody/morphology interface, such as ALIGN. The idea is that the Reduplicant must be in a particular alignment with prosodic structure. The strictest such alignments will amount to classical templates."

The notion of 'template' is integrated with the notion of 'alignment' of morphological and prosodic edges (McCarthy and Prince 1993a):

(38) Constraint schema for classical templates

MCAT=PCAT

where **Mcat** ≡ Morphological Category ≡ Prefix, Suffix, RED, Root, Stem, LexWd, etc.

and **Pcat** ≡ Prosodic Category ≡ Mora, Syllable (type), Foot (type), PrWd (type), etc.

A related change is the decomposition of the 'template' into different constraints, each of which having its own position in the ranking. Earlier work, starting with McCarthy (1979) and Marantz (1982), assumed that the template is a segmentally empty morpheme combining in it the full set of properties defining prosodic 'shape-invariance'. McCarthy

and Prince (1993b:82) argue instead that the template is not a monolithic entity, and that it is in fact not a theoretical primitive at all. What was formerly attributed to a 'template' now follows from the interaction of multiple constraints on the size, shape, and position of morphemes.

In Axininca Campa, for example, four constraints are responsible for defining the reduplicant's shape. These four constraints are stated in pre-theoretical terminology below.

(39) a. **DISYLL** 'The Reduplicant is at least disyllabic.'

b. **R=SFX** 'The Reduplicant is a suffix - not an independent PrWd.'

c. **R≤ROOT** 'The Reduplicant consists of material drawn from the root alone.'

d. **MAX** 'Reduplication is total.'

Each of these constraints is known to absolutely govern properties of reduplication in other languages. But in Axininca Campa all of these 'templatic' constraints are literally 'untrue', that is, dominated by other constraints. See for example the following tableaux, each of which demonstrates the dominated status of a templatic constraint.

A monosyllabic reduplicant that has no epenthetic segments is preferred over a disyllabic reduplicant with epenthetic segments (indicated by '**TA**'):

(40) Input: /naa-RED/	FILL	DISYLL
a. ☞ naa-naa		*
b. naa**TA**-naa**TA**	*!***	

A disyllabic reduplicant containing non-root material (the prefix *no-*) is preferred over a monosyllabic reduplicant containing only root material:

(41) Input: /no-naa-RED/	DISYLL	R≤ROOT
a. ☞ no-naa-nonaa		*
b. no-naa-naa	*!	

A partial reduplicant containing only root material is preferred over a full reduplicant containing non-root material (the prefix *noŋ-*):

(42) Input: /noŋ-kawosi-RED/	R≤ROOT	MAX
a. ☞ noŋ-kawosi-kawosi		noŋ-
b. noŋ-kawosi-noŋ-kawosi	*!	

Both modifications of the 1986 theory (violability of templatic requirements, and a compositional, alignment-based, notion of template) are integrated into the revised version of the principles of Prosodic Morphology:

(43) New Prosodic Morphology (McCarthy and Prince 1993b:138)

a. Prosodic Morphology Hypothesis

Templates are constraints on the prosody/morphology interface, asserting the coincidence of morphological and prosodic constituents.

b. Template Satisfaction Condition

Templatic constraints may be undominated, in which case they are satisfied fully, or they may be dominated, in which case they are violated minimally, in accordance with general principles of Optimality Theory.

c. Ranking Schema:

P » M

2.4 Correspondence theory

A major change which the OT framework underwent was 'correspondence theory' (CT, McCarthy and Prince 1995, this volume). Its general main is that *faithfulness to the input* and *reduplicant-base identity* are two instantiations of a similar kind of requirement: that a pair of representations must be *identical*. In the case of input faithfulness, the requirement of identity is imposed on the input and output, while in the case of reduplication, the base and reduplicant are required to be identical.

An example of an identity requirement which is expressed by both a faithfulness constraint and a base-reduplicant identity constraint is MAXIMALITY.

(44) **MAXIMALITY**

Every element in S_1 must have a correspondent in S_2.

In reduplication this constraint enforces *total* reduplication. (Then the string S_1 represents the base, while the string S_2 is the reduplicant.) A similar requirement, that every element in a 'basic' string must be matched by some element in a 'derived' string, also holds for the relationship between input and output. If S_1 is an input string, and S_2 an output string,

then MAX boils down to the requirement that no element of the input may be deleted. We see that faithfulness constraints which enforce identity of the input and output are related (in their format) to constraints which enforce base-reduplicant identity. The notion that is shared between both is correspondence.

Correspondence theory is not restricted to MAXIMALITY. It encompasses a set of correspondence constraints, each of which is responsible for checking a specific aspect of identity between representations, for example in the presence of segments, their featural composition, linear order, etc. All correspondence constraints are generalised versions of constraints that were previously part of the theory of reduplication (stated informally):

(45) **MAXIMALITY** Elements in S_1 must have correspondents in S_2.

DEPENDENCE Elements in S_2 must have correspondents in S_1.

IDENTITY[ξF] Corresponding elements must have identical values for [F].

ANCHORING Corresponding elements have identical positions relative to edges.

LINEARITY Linear order of sets of correspondening elements are preserved.

CONTIGUITY Adjacency between sets of corresponding elements is preserved.

Correspondence is a highly general relation between elements in two strings. Two elements are correspondents when one element is part of S_1, while the other is part of S_2, and both elements are coindexed: one element is the *image* of the other. The generator component of the grammar, *Gen*, supplies different output candidates including relations of correspondences. The evaluation of these correspondence relations is implemented by constraints, for example:

(46)	S_1	S_2	MAX	DEP	IDENT[high]	LINEARITY
a.	$a_1\, b_2\, i_3$	$a_1\, b_2\, i_3$				
b.	$a_1\, b_2\, \mathbf{i}$	$a_1\, b_2$	*			
c.	$a_1\, b_2\, i_3$	$a_1\, b_2\, i_3\, \mathbf{m}$		*		
d.	$a_1\, b_2\, \mathbf{i}_3$	$a_1\, b_2\, \mathbf{e}_3$			*	
e.	$a_1\, \mathbf{b}_2\, \mathbf{i}_3$	$a_1\, \mathbf{i}_3\, \mathbf{b}_2$				*

As other constraints, correspondence constraints are violable - but violation is minimal.

By conceiving of faithfulness as a set of constraints on correspondence relations between elements in the input and the output, correspondence theory abandons the notion of 'containment' that was part of the original model (Prince and Smolensky 1993):

(47) **Containment**

"No input element may be literally removed."

Potential arguments against containment are based on patterns of epenthesis and deletion. First, it has been observed that *epenthetic elements* may be phonologically active, in the sense that their feature content participates in phonological patterns (of vowel harmony, OCP, etc.). This argues for a featurally full-fledged representation of epenthetic segments, and against a 'containment' theory which considers them to be mere phonetic spell-outs of empty prosodic positions.[17] With respect to deletion, CT holds analogous consequences: elements are genuinely removed from the output, rather than represented in the output as prosodically 'underparsed'. It follows from this that deleted segments are phonologically

inactive. Whether or not this prediction should be counted as an argument in favour of CT depends on the relative success by which this theory will be able to reanalyse cases that were known in derivational theory as 'counter-bleeding' rule ordering: an input segment triggering some structural change is lost from the output.

2.5 Unresolved issues

Below we will identify some unresolved issues which we (and other authors, as we judge from the literature), consider important. Both issues are related to the prosody morphology interface, hence to prosodic morphology.

First, the stratal organisation of the grammar. A strong non-derivational version of Optimality Theory would say that grammars are strictly mono-stratal, and hence allow no feeding of output forms into *Gen*. However, this position is not shared by McCarthy and Prince (1993b), whose analysis of Axininca Campa involves a bifurcation of the grammar into two levels, as in Lexical Phonology (Kiparsky 1982). The interface between levels is defined as *Bracket Erasure* (Pesetsky 1979, Inkelas 1989). Do the important results about reduplication (such as the emergence of the unmarked, or reduplicative identity as surface correspondence) still follow from a model that allows this multi-stratal organisation?

Second, morphological and prosodic limitations on the correspondence relation. In what morphological relationship must a pair of representations stand for a correspondence relation between their composing elements to be possible? Recently correspondence theory has been extended to relationships between separate words, for example a truncated form and its morphological base, or an affixed form and its base (Burzio 1994, Benua 1995, McCarthy 1995). Left unconstrained, 'output-to-output' correspondence is a very powerful instrument that allows an output form to be affected by phonological properties of any

morphologically related word. Similarly, are there limitations on elements of phonological structure that are in a relation of correspondence? It seems clear that to account for the full array of phenomena that previous autosegmental theories covered, correspondence must be allowed between units that cannot be identified as segments. Correspondence of features is required for stability phenomena involving floating features (Zoll 1995); correspondence of moras for stability phenomena involving quantity, such as compensatory lengthening (Hayes 1989). Indeed vowel length and syllable weight may be copied under reduplication (Clements 1985, McCarthy and Prince 1986, 1988, Steriade 1988). This suggests that other prosodic units, such as the syllable the and foot, similarly participate in correspondence relations. Yet, there is a remarkable lack of evidence for the transfer of syllables and feet in reduplication (Moravcsik 1978, Marantz 1982). From the viewpoint of correspondence theory, there is an interesting parallel here with faithfulness: no languages are known to have distinctive syllabification; that is, the syllable is remarkably absent in correspondence relations between the input and output.[18]

3. The contributions to this volume

Using the text of the previous two subsections as a background, we present summaries[19] of the contributions to this volume below, arranged in their order of appearance.

Stuart Davis: *On the moraic representation of underlying geminates*

D. discusses the role that geminates play in determining syllable weight, bringing new evidence to bear on this issue both from phonology proper and from prosodic morphology. He shows that situations occur in which syllables closed by the left half of a geminate are heavy, while other closed syllables are not. The point of departure is Hayes's (1989) proposal that geminate consonants are underlyingly moraic. This indeed predicts that there should be languages in which a syllable closed by the first part of a geminate (henceforth CVG) behaves as heavy, like a CVV syllable, but other types of closed syllables (henceforth CVC) behave as light, like a CV syllable. Several linguists (Selkirk, Koreman and Lahiri, and Tranel) have argued that this prediction is problematic since it is not so clear that stress systems exist which treat CVG syllables as heavy while treating other types of closed syllables as light.

To support the prediction of Hayes's proposal, D. argues presents phonological evidence from such phenomena as umlaut blocking, closed syllable shortening, and stress. He also presents prosodic morphological evidence from Hausa and Sinhala supporting the predicted distinction. In a certain class of plurals in Hausa, roots with CVV or CVG (where G stands for lefthalf of geminate) syllables take one type of plural affix while roots with CV or CVC syllables require another. In Sinhala, both genitive allomorphy and inanimate plural formation distinguish CVG and CVV syllable types from CV and CVC. D. also discusses the behaviour of syllables closed by nasal consonants that are homorganic with a following obstruent. It is concluded that the evidence presented does support the view that geminate consonants are underlyingly moraic.

D. proposes a combination of Prosodic Morphology and Optimality Theory. The article challenges the Prosodic Morphology Hypothesis (22.i) by showing that the templatic shape of reduplicants may be defined in terms of non-metrical constituents, thus D. proposes that the inventory of constituents which are active in prosodic morphology must include morpho-prosodic constituents like Canonical Stem and Prosodic Stem. The second contribution of this article is that it demonstrates that infixing reduplications with vowel-initial bases can be analyzed in terms of a familiar constraint that syllables must have onsets (cf. 28). This account generalizes earlier work on infixation by McCarthy and Prince, and eliminates template-specific vowel extraprosodicity which is now understood as prosodic misalignment.

The empirical basis for the discussion is formed by reduplication patterns of SiSwati, KiNande and Kikuyu. In all three languages, the reduplicant is a disyllabic prefix to the verb stem, but there are differences in the treatment of monosyllabic stems and vowel hiatus before vowel initial stems that she shows can straightforwardly be accounted for by the factorial typology predicted by OT. Reranking the same small set of constraints predicts the observed variation for these properties across the 3 languages. However, she also argues that some of the variation among the 3 languages can only be accounted for by modifying some claims of OT. Kikuyu and KiNande are best analyzed by assuming that a morpho-prosodic constituent, the Canonical Verb Stem, is the reduplicative template, since this accounts for why the reduplicant always ends in the vowel /a/, which is identical to the theme vowel of the canonical verb stem. For SiSwati and KiNande D. argues that defining a morpho-prosodic constituent, the Prosodic Stem, as the base for reduplication is the most straightforward way to account for infixation of the reduplicant before longer

vowel-initial stems. Requiring the left edge of the Prosodic Stem to be aligned with the left edge of an optimal, onset-ful syllable makes the stem-initial vowels extraprosodic.

Larry M. Hyman and Al Mtenje: *Prosodic morphology and tone: the case of Chichewa*

This article address the interaction of verbal reduplication and tonal transfer in Bantu languages, more specifically two dialects of Chichewa. It is argued that these data cannot be satisfactorily analysed within a 'cyclic' level-ordered model of the morphology-phonology interface, and instead require a model in which inner domains (stems) and outer domains (prefixed stems) are accessible in parallel. The analysis takes the form of a 'direct mapping' model, which is motivated in two ways. First, reduplication only copies segmental material from the inner domain, and crucially never from the outer one. And second, the effects of tonal rules applying to the 'outer' domain tend to be copied along in the reduplicant, more specifically base-reduplicant indentity cannot be established until word-level prefixes have interacted with the base tones. The need to refer to larger domains before or simultaneous with reference to smaller domains is compatible with a constraint-based model such as OT.

Sharon Inkelas: *Stress-attracting suffixes in Turkish: representations versus the grammar*

I. offers a detailed analysis of certain aspects of Turkish stress. The analysis is presented in the context of a discussion on the proper way of representing exceptional behaviour of stems and affixes in the Optimality Theoretic model. I. contrasts an approach using templatic metrical structure with one that states morpheme-specific alignment constraints, ultimately arguing in favor of the former. Both accounts reach descriptive adequacy. The prespecification account, however, is argued to be superior because it is both more

economical and more explanatory: it reveals the naturalness of the set of exceptions whose members form a natural class. In addition, the prespecification uniformily appeals to a binary trochaic foot. On the methodological side, this study shows the importance of taking into account the exceptional cases.

Junko Itô and Armin Mester: *Realignment*

This article deals with syllable theory. It pursues two independent but interrelated lines of inquiry into Alignment theory. First, it shows that a small extension of the theory of alignment results in the subsumption of a significant part of traditional syllable theory, including various conditions on syllable structural complexity (such as conditions on codas, complex onsets, complex nuclei, and complex codas). More specifically, it offers some speculations regarding an alignment-theoretic approach to classical sonority theory in terms of grid alignment. This move allows I. and M. to unite several seemingly unrelated constraints. The second half of the article, then, discusses a modification of the theory of alignment, Here, the article takes up a problem arising for the concept of Alignment (as defined in McCarthy and Prince 1993a) in connection with the multiply linked structures that are the hallmark of nonlinear phonological representations. The central idea is that, different from the standard view, Alignment per se must be decoupled from the requirement that prosodic categories need sharp edges, not blurred by double linking. This requires a formal notion “CrispEdge” for prosodic categories and concomitantly a revised definition of Alignment.

John J. McCarthy and Alan S. Prince: *Faithfulness and Identity in Prosodic Morphology*

The goal of the theory of Prosodic Morphology is to provide independent, general explanations for the properties of phenomena like reduplication, infixation, root-and-pattern morphology, observed word minima and other restrictions on canonical form. This article contributes to the realization of that goal in the domain of base-reduplicant identity. It specifically addresses the well-known issues of 'underapplication' and 'overapplication' in cases of reduplication. The proposal is that base-reduplicant identity is connected with input-output faithfulness through Correspondence Theory (McCarthy and Prince, 1995), which provides a general means of regulating similarity between linguistic representations within Optimality Theory. In particular, so-called constraints of faithfulness (PARSE/FILL) are replaced with a more general notion of 'correspondence', potentially holding between linguistic representations, including base and reduplicant, but also others.

Joe Pater: *Austronesian nasal substitution and other NC effects*

The framework of this article is that of Optimality Theory, and the subtheories of Correspondence and of morphology-phonology interaction play a central role. Phenomena of prosodic morphology are characterized by McCarthy and Prince (1993b) as involving the crucial domination of a morphological constraint by a prosodic one. P. argues that this characterization of the interaction between morphology and phonology is not in any way limited to the prosodic domain, however: any phonotactic constraint could potentially affect the shape of affixes. He examines a set of morphophonological and phonological processes that are driven by a sequential constraint against nasal/voiceless obstruent sequences, *NC. These processes, all well-attested in a number of language families, include nasal substitution, postnasal voicing, nasal deletion, and denasalization. In OT,

these ‘NC effects’ can be generated by varying the ranking of *NC relative to the faithfulness constraints of McCarthy and Prince (1995); morphonological processes are captured by the introduction of morpheme specific faithfulness constraints. In examining these data, however, we find that the original formulation of Identity constraints must be amended, so as to differentiate between Input-to-Output, and Output-to-Input faithfulness.

Sam Rosenthall: *The prosodic base of the Hausa plural*

R. discusses root augmentation in Hausa. The analysis combines elements from two theoretical domains. The first, Prosodic Morphology, hypothesises that morphological templates can be defined in terms of prosodic categories. In Hausa, this is instantiated by the base of the plural, which must be an iambic foot. The second, Optimality Theory asserts that the surface form is the best possible output, given a hierarchy of conflicting constraints. Rosenthall shows that the various augmented forms of the Hausa plural (e.g. consonant gemination, breaking up of consonants clusters in the root by long vowels) arise as a consequence of constraints that cannot be simultaneously satisfied. The conclusion is that templatic requirements can be violated under duress of higher-ranking requirements. Hausa plural formation has associated with it a number of phonological phenomena called “root augmentation” (Newman 1972). Root augmentation in the different plural classes is shown here to follow from the satisfaction of prosodic requirements on the base for the plural morpheme. The prosodic requirement in Hausa plural formation is that the plural must attach to a base that is equal to an iambic foot, but, as will be shown, the particular expansion of the iamb is subject to variation. The prosodic requirement is one of a number of constraints on the base of the Hausa plural.

Grazyna Rowicka: *Prosodic optimality and prefixation in Polish*

G. proposes an Optimality Theory analysis of yer, surfacing in prefixed words in Polish. The article puts forward a prosodic interpretation of yers as 'weightless nuclei'. To account for the fact that yers surface only if there is a sequence of them within one Prosodic Word, and that a surface yer must always be followed by a non-surfacing one, it is proposed that yers are weight-insensitive bisyllabic feet. Heads of such feet surface and participate together with proper vowels in moraic foot structure.

Prefixed verbs are argued to have a different prosodic structure, depending on whether their root does or does not contain a yer. If it does, the prefixed verb is parsed as a single Prosodic Word, as evidenced by yer surfacing in the prefix. If it does not, the prefix is parsed separately from the root, as evidenced by (the blockage of) Palatal Assimilation. It is argued that the selection of different parsings follows from the interaction of various requirements on the alignment between prosodic and morphological categories (specifically, root to prosodic word and prosodic word to foot). Sequences of yers are parsed into feet of their own and the nuclei in foot head positions surface. The location of yer feet can also be influenced by the prosodic alignment constraints. This is the case in doubly-prefixed verbs with yer-containing roots. There a yer foot is formed on the first two yers, rather than the last two, so that the whole sequence begins with a pedifiable syllable.

Suzanne Urbanczyk: *Double reduplications in parallel*

The article examines words formed with two reduplicative morphemes in Lushootseed (Central Coast Salish). Double reduplications raise the issue of whether these are evaluated by constraints in parallel, or serially, assuming a cyclic derivation. Irregularities in the

shape and segmental content of one set of stems are shown to follow automatically from assuming that each doubly reduplicated stem is formed in parallel, that is, non-serially. The main argument for parellellism is that the outer layer of reduplication may influence the inner layer, an "over-application" effect that is difficult to model under serial evaluation. In parallel Optimality Theory, the adjacency of reduplicant and base in the output obviates the need for cyclicity. This contrasts with other models of reduplication, in which the formation of doubly reduplicated words require cyclic copying (cf. Broselow 1983). Furthermore, the interest of the Lushootseed data is that there is a phonological irregularity in the shape and segmental content of one set of doubly reduplicated stems. These irregularities are explained as instances of anti-gemination and over-application.

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[1] We are grateful to Jan Don and Mieke Trommelen for elaborate comments on an earlier version of this section.

[2] Cf. Halle (1973).

[3] As in the well-known example *This is the cat that caught the rat that stole the cheese*, cf. *SPE*, p.372; see also pp.365-370.

[4] In 1979, two of us co-organized (Van der Hulst) and attended (Zonneveld) a lecture by Jean-Roger Vergnaud (then University of Massachusetts at Amherst) at the Linguistics department of the University of Amsterdam on Semitic *binyanim* (cf. Halle and Vergnaud 1980). Right in the middle of what at least part of the audience perceived as an extremely exciting but highly technical account, the speaker added a clarification on the blackboard: *C V. Three Dimensional Phonology* had arrived in the Old World.

[5] The 'prosodic hierarchy' continues above the post-lexical wordlevel, including categories such as (possibly) the Clitic Phrase, the Phonological and Intonation Phrases, and the Utterance. These, however, are not usually targeted by prosodic morphological studies. For discussion, see Selkirk (1984), Nespor and Vogel (1986), and the papers in Inkelas and Zec (1990).

[6] Early generative predecessors are Harms (1973/8), Williams (1971/6), Leben (1973), and Anderson (1975/6).

[7] Or: lost if /r/ is at the end of a syllable, assuming an additional consonant such as the *k* of *bark* is 'extrametrical', i.e. not part of the syllable proper (cf. Hayes 1983); or: lost from a coda, if the consonant(s) following the vowel in a syllable are allowed to go by that common denominator.

[8] For a lucid discussion, cf. Kaye (1989), Chapter 5.

[9] For an overview of later analyses of French *e-muet*, cf. Charette (1991) and references cited there.

[10] Of these, principles (22.i-ii) were stated earlier in the 1986 ms.

[11] For the notion of syllabic markedness, see Jakobson (1962), Kaye and Lowenstamm (1981), among others. Similar observations on templates, less explicitly, were made in earlier work, e.g. Yip (1982:647).

[12] However, Steriade's footnote 10 makes a very interesting suggestion, which has later been elaborated by various researchers: "This cancellation of marked syllabic options may be more generally a property of affixes. For instance, the Sanskrit affixal syllables are, with very few exceptions, of the form CV(C), in contrast with the stem morphemes, which frequently allow up to three consonants in the onset and extra-heavy rhymes of VVC or VCC shapes".

[13] There were some notable deviations from this view of the interface, see for example Anderson (1975).

[14] The constraint dubbed 'MAX' was originally part of the set of universal principles of association in the template-plus-association theory (McCarthy 1979, Marantz 1982, McCarthy and Prince 1986) discussed in §1, together with a predecessor of the constraint LINEARITY (both have their origins in autosegmental phonology, Goldsmith 1976b).

[15] This result must be relativized somewhat, however, since cases of reduplication occur in which the reduplicant contains segments which do not occur in the base, yet which can be shown to be morphologically sponsored by the input. An example is the interaction of reduplication and syncope in Southeastern Tepehuan (Kager 1997).

[16] Under this analysis the fact that the infix has the skeletal shape VC is an arbitrary property, and this shape might just as well have been different. For example, such an analysis equally easily handles hypothetical data based on a (hypothetical) infix *-mu-*, as in *mu-abot*, *t-mu-awag*, *gr-mu-adwet*. One might argue that such outputs never arise because they would seriously violate the phonotactic principles of the language (more specifically, the requirements that onsets be maximally binary, and that hiatus is ill-formed). However, this is precisely the point that can be made against the circumscriptional analysis: it fails to

express the overall contribution of prosodic well-formedness to the distribution of the infix *-um-*.

[17] The observation that epenthetic segments tend to be segmentally unmarked (in underspecification terminology: 'maximally underspecified') is attributed to featural markedness constraints. Epenthetic segments are 'unmarked' as a consequence of the fact that they are 'morphologically unsponsored', hence lack input correspondents. That is, unlike morphologically sponsored segments epenthetic segments are outside the scope of faithfulness constraints such as IDENTITY[ξF].

[18] In the same line of thought, it has been argued by McCarthy and Prince (1988) that only distinctive properties (such as length, but crucially not syllabification) may be transferred under reduplication. However, this hypothesis has been disconfirmed by cases of reduplication which involve the transfer of 'allophonic' phonology, as was observed by Kiparsky (1986) and Steriade (1988).

[19] In preparing the brief summaries in this section we received help from Harry van der Hulst and the contributors, but we take responsibility for the text presented here.