

Reduplication with Fixed Segmentism

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Fixed segmentism is the phenomenon whereby a reduplicative morpheme contains segments that are invariant rather than copied. We investigate it within Optimality Theory, arguing that it falls into two distinct types, phonological and morphological. Phonological fixed segmentism is analyzed under the OT rubric of emergence of the unmarked. It therefore has significant connections to markedness theory, sharing properties with other domains where markedness is relevant and showing context-dependence. In contrast, morphological fixed segmentism is a kind of affixation, and so it resembles affixing morphology generally. The two types are contrasted, and claims about impossible patterns of fixed segmentism are developed.

Keywords: correspondence, default, inventory, markedness, Optimality Theory, prosodic morphology, reduplication

1 Introduction

Reduplicative morphemes copy the base to which they are attached, but perfect copying is not always achieved. Incomplete copying for templatic reasons—that is, partial reduplication—has received much theoretical attention. Less has been said about cases where perfect copying is subordinated to *fixed segmentism*: invariant segments (or tones or features) that appear where copying might have been expected. For example, in Yoruba nominalizations (1), the reduplicative morpheme has the fixed vowel *i*, whatever the vowel of the base. In Kamrupi echo words (2), the initial consonant of the reduplicative morpheme is replaced by fixed *s*.

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- (1) *Yoruba* (Akinlabi 1984, Pulleyblank 1988)
- | | | |
|-------|-------------------|-------------------------------|
| gbóná | <u>gbí</u> -gbóná | ‘be warm, hot’/‘warmth, heat’ |
| dára | <u>dí</u> -dára | ‘be good’/‘goodness’ |
- (2) *Kamrupi* (Goswami 1955–6:164)
- | | | |
|-------|--------------------|------------------------------|
| gharā | gharā- <u>sarā</u> | ‘horse’/‘horse and the like’ |
| khori | khori- <u>sori</u> | ‘fuel’/‘fuel and the like’ |

The reduplicative morpheme, called the reduplicant, is underlined in these examples.

Building on proposals in McCarthy and Prince 1986, we will show that (1) and (2) represent distinct types of fixed segmentism. Fixed segmentism like (1) has a phonological basis. It falls under the Optimality Theory (OT) rubric of *emergence of the unmarked* (McCarthy and Prince 1994a), which provides a way to allow only unmarked structure in a domain like the reduplicant while permitting the corresponding marked structure to occur elsewhere in the language. The idea, then, is that noncopying of a base segment, with substitution of some fixed, default segment, decreases phonological markedness. This proposal is an evolution of ideas first implemented in underspecification terms by Akinlabi (1984:289ff.) and McCarthy and Prince (1986:sec. 3.2), which have been pursued within OT by Yip (1993), McCarthy and Prince (1994a,b), and Urbanczyk (1996b). It is also connected to proposals about markedness and reduplication in Shaw 1987 and Steriade 1988.

Fixed segmentism like (2), on the other hand, has a morphological basis. The added *s* is an affix that is realized simultaneously with the reduplicative copy, overwriting part of it (McCarthy and Prince 1986, 1990).¹

The main goal of this article, pursued in section 2, is to argue for a theory of phonological fixed segmentism within the wider context of OT (Prince and Smolensky 1993). Secondarily and more briefly, some suggestions about morphological fixed segmentism are presented in section 3. To complete the typological picture, differences between the two types are discussed.

Apart from their relevance to fixed segmentism, our results bear on two larger issues. First, because they depend crucially on constraint ranking and violability, they support OT itself, which supplies these key notions. Second, they advance the Prosodic Morphology program of seeking independent, general explanations for the properties of phenomena like reduplication (McCarthy and Prince 1994b, to appear). When fixed segmentism is attributed to special, otherwise unmotivated mechanisms like prespecification (Marantz 1982, Yip 1982, Kiparsky 1986, Lieber 1987, Clark 1990) or pretemplatic rewrite rules (Steriade 1988), independent explanations may be impossible. In contrast, the theory discussed here derives fixed segmentism of the type in (1) from the same source, modulo a difference in ranking, as restrictions on phonological inventories and processes, and fixed segmentism of the type in (2) from the same source, again modulo a difference in ranking, as affixation. There is no special apparatus to deal with fixed segmentism; it comes from the central premises of OT, constraint ranking and violability.

¹ Also see Uhrbach 1987, Steriade 1988, Bao 1990, and Yip 1992.

2 Fixed Segmentism as Phonology: Emergence of the Unmarked

In this section we treat the phonological type of fixed segmentism, relating it to other aspects of phonology, such as inventories, defaults, and phonological processes. For expositional clarity, throughout this section our statements and generalizations systematically ignore the morphological type of fixed segmentism, though we will return to it in section 3, offering specific diagnostics for the two types and showing how our claims are maintained in this larger context.

We begin by introducing the theoretical prerequisites and by developing the results abstractly. We then present case studies of Yoruba, Lushootseed, Tübatulabal, and Nancowry to illustrate the theory and confirm its predictions.

2.1 Theoretical Background

2.1.1 Emergence of the Unmarked In OT (Prince and Smolensky 1993) the grammar of a language is a ranking of universal constraints. This ranking resolves the fundamental tension between markedness and faithfulness constraints. Markedness constraints govern the form of linguistic structures; faithfulness constraints demand identity between underlying and surface forms. If a given markedness constraint M crucially dominates an appropriate faithfulness constraint F (and no constraint dominating M somehow vitiates its force), then no M-offending structure will appear in a surface form, even at the expense of imperfectly reproducing some underlying forms. Ranked the other way, faithfulness takes precedence, and the M-offending structure can be found in surface forms. Differences in ranking give differences in activity of markedness constraints. It is therefore possible to say that every constraint is present in the grammar of every language, though if a constraint is crucially dominated, its activity may be limited or nonexistent. The limited but nonetheless visible activity of dominated markedness constraints is essential to the theory of fixed segmentism.

Markedness constraints evaluate segments and other structures. A structure is marked with respect to some constraint M if it receives violation marks from M (Smolensky 1993). Some markedness constraints evaluate structure independently of context and some are context-sensitive. We assume that markedness constraints do not make morphological distinctions, so there is no such thing as a reduplicant-specific markedness constraint; morphological sensitivity is reserved to faithfulness constraints, as shown below. Markedness constraints may conflict among themselves, with conflicts resolved by ranking—usually language-particular ranking, but occasionally universal (e.g., (13) below).

Faithfulness constraints require one form to preserve the characteristics of another. Originally, faithfulness was posited for underlying-surface mappings (Prince and Smolensky 1993), but similar relations can be found in base-reduplicant pairings (McCarthy and Prince 1993, 1994a,b) and pairings of morphologically related surface forms (Benua 1995, 1997). Correspondence theory (McCarthy and Prince 1995) generalizes over these various types of faithfulness.

(3) Correspondence (McCarthy and Prince 1995:262)

Given two strings S_1 and S_2 related to one another as underlying and surface, base and

reduplicant, and so on, correspondence is a relation \mathfrak{R} between the elements of S_1 and S_2 . Elements $\alpha \in S_1$ and $\beta \in S_2$ are correspondents of one another when $\alpha \mathfrak{R} \beta$.

Each candidate comes with one or more correspondence relations that faithfulness constraints evaluate. The faithfulness constraints include, among others, MAX (correspondence from S_1 to S_2 must be complete), DEP (correspondence from S_2 to S_1 must be complete), and IDENT(F) (corresponding segments in S_1 and S_2 must agree in the feature or other attribute F).

There are separate correspondence relations depending on how S_1 and S_2 are related to one another, and there are separate but similar faithfulness constraints on each correspondence relation. In classic faithfulness S_1 is the underlying form and S_2 is the surface form. This relation is called *IO correspondence* (for *input* and *output*), and the constraints regulating it are annotated with an IO subscript: MAX_{IO} (no deletion), DEP_{IO} (no epenthesis), and so on. In *BR correspondence*, S_2 is a *reduplicant* and S_1 is the string it is affixed to, called the *base*.² The BR correspondence constraints include MAX_{BR} (copying is complete), DEP_{BR} (the reduplicant contains no fixed segmentism), and so on.

Language typology is obtained by permuting these constraints. If some markedness constraint M is crucially dominated by all relevant IO faithfulness constraints F_{IO}, then satisfaction of M cannot produce unfaithfulness in the IO mapping, and some M-violating surface forms will be observed. But if the same M crucially dominates a faithfulness constraint, F_{BR}, that governs the BR correspondence relation, then M will be obeyed in the reduplicant, even at the expense of inexactly copying the base. This situation is called *the emergence of the unmarked* (TETU): the normally inactive markedness constraint M reveals itself in BR mappings where IO faithfulness is not relevant (McCarthy and Prince 1994a). The following is a general schema for reduplicative TETU:

- (4) *Ranking schema for reduplicative TETU* (McCarthy and Prince 1994a)

$$\text{Faith}_{\text{IO}} \gg M \gg \text{Faith}_{\text{BR}}$$

TETU is not limited to reduplication, so (4) has parallels where constraints on other correspondence relations replace low-ranking Faith_{BR} (see, e.g., Benua 1995, Itô, Kitagawa, and Mester 1996).

Concretely, suppose M in (4) is a constraint on prosodic structure, such as No-CODA, and the faithfulness constraint is MAX (ignoring DEP for simplicity). The TETU ranking, then, is MAX_{IO} \gg No-CODA \gg MAX_{BR}. Codas are permitted in the language as a whole because No-CODA is crucially dominated by MAX_{IO}. But because No-CODA dominates MAX_{BR}, the reduplicant will not copy a segment into coda position. In this way, No-CODA imposes a prosodic condition on the reduplicant, and only the reduplicant, just like a classical template of Prosodic Morphology. Rankings like this are the core of Generalized Template Theory (GTT; McCarthy and Prince 1994a,b, to appear).³ GTT captures the insight of Shaw (1987) and Steriade (1988) that templates

² The base is the string immediately following a prefixed reduplicant or immediately preceding a suffixed reduplicant up to the next word edge (McCarthy and Prince 1993, Urbanczyk 1996b).

³ On GTT, also see Carlson, to appear, Downing 1994, to appear, Futagi, to appear, Gafos 1996, 1998, Itô, Kitagawa, and Mester 1996, Moore 1996, Spaelti 1997, Urbanczyk 1995, 1996a,b.

implement markedness restrictions, but with a difference: GTT uses exactly the same constraints that determine markedness elsewhere in phonology, rather than some special template-specific apparatus.

If instead M in (4) is a constraint on segments or features, then it will affect the segmental structure of the reduplicant. This is the source of phonological fixed segmentism: a TETU ranking where a segmental or featural constraint emerges (McCarthy and Prince 1994a:366, Urbanczyk 1996b). Therefore, both fixed segmentism and templatic restrictions arise from rankings like (4), differing only in the types of markedness constraints that are involved.

The TETU ranking schema (4) also has implications for the theory of inventories. In OT, inventories are derived by markedness/faithfulness interactions from underlying forms that are not subject to language-particular restrictions—there are no morpheme structure constraints, language-particular underspecification, or similar devices (Prince and Smolensky 1993:chap. 9; see also Itô, Mester, and Padgett 1995, Kirchner 1997, McCarthy and Prince 1995). The term *inventory* is often used to refer to the set of segmental phonemes in a language. Here we extend its sense to refer to all systematically permitted phonological structures.

Because IO and BR faithfulness are regulated by distinct constraints, ranking permutation allows the same markedness constraint to have inventory consequences for a whole language in one case and for just the reduplicant in another. Assume there is a markedness constraint $M(\zeta)$ militating against the segment or structure ζ and faithfulness constraints $F_{IO}(\zeta)$ and $F_{BR}(\zeta)$ supporting its preservation. Assume also that no higher-ranking constraint conflicts with any of them, so the effects of permuting these constraints can be studied in isolation from the rest of the constraint hierarchy.⁴ Since $F_{IO}(\zeta)$ and $F_{BR}(\zeta)$ do not interact, there are four permutations to consider.

(5) *Inventory consequences of elementary markedness-faithfulness interaction*

- a. Barring ζ from inventory of whole language (including reduplicant)
 $M(\zeta) \gg F_{IO}(\zeta), F_{BR}(\zeta)$
- b. Barring ζ from inventory of reduplicant only (= (4))
 $F_{IO}(\zeta) \gg M(\zeta) \gg F_{BR}(\zeta)$
- c. Permitting ζ in inventory of whole language (including reduplicant)
 $F_{IO}(\zeta), F_{BR}(\zeta) \gg M(\zeta)$
- d. Barring ζ from inventory of whole language (and reduplicant by proxy)
 $F_{BR}(\zeta) \gg M(\zeta) \gg F_{IO}(\zeta)$

If $M(\zeta)$ dominates faithfulness on both the IO and BR dimensions, as in (5a), then ζ is barred from the inventory entirely. The TETU ranking in (5b) prohibits ζ in the inventory of the reduplicant only, permitting ζ to appear elsewhere in the language. The ranking in (5c) allows ζ to occur in the inventory of reduplicants and nonreduplicants alike. Finally, the ranking in (5d) is effectively the same as (5a). Because $M(\zeta)$ dominates $F_{IO}(\zeta)$ in (5d), the structure ζ is absent from the

⁴ So the rankings in (5) give only *necessary* conditions for the stated inventory restrictions. For *sufficient* conditions, interactions with other constraints, as in (6), must be considered.

language generally. This means that no reduplicative base ever contains a ζ to copy, so vacuous satisfaction of $F_{BR}(\zeta)$ is guaranteed. In summary, permuted ranking gives unrestricted presence of ζ in the inventory (5c), complete exclusion of ζ from the inventory (5a,d), and something in between: presence of ζ in the inventory of the language generally but not the reduplicant (5b).

The effect of the last ranking, (5d), changes significantly when additional markedness constraints are included.⁵ Suppose that $M(\zeta)$, which militates against ζ generally, is also dominated by $M(\zeta')$, which favors ζ in some specific context.

(6) *Domination of $M(\zeta)$ by markedness and BR faithfulness*

$$M(\zeta'), F_{BR}(\zeta) \gg M(\zeta) \gg F_{IO}(\zeta)$$

McCarthy and Prince (1995, to appear) show that this ranking is the basis of *underapplication* (Wilbur's (1973) term), where an otherwise general phonological process is blocked in the reduplicant in order to maintain similarity with the base; Takeda (1997), discussing a variant of (6), calls it *emergence of the marked*, emphasizing its potential effects on inventories. Informally, if $M(\zeta) \gg F_{IO}(\zeta)$ characterizes some general ζ -eliminating phonological process, then high-ranking $M(\zeta')$ and $F_{BR}(\zeta)$ can together cause it to “underapply,” allowing ζ to appear in the reduplicant though it is not attested elsewhere in the language. In accordance with (6), this expansion of the inventory in the reduplicant leads to improvement on some dimension of markedness (by satisfying $M(\zeta')$) and better reduplicative copying (by satisfying $F_{BR}(\zeta)$).

These ranking schemata can be related to the generalizations in (7)–(9). We introduce these generalizations now and will refer back to them throughout our case studies. (Recall that, here and throughout section 2, only the phonological type of fixed segmentism is under discussion. In section 3.2 we will discuss the two types together.)

(7) *Reduplicant/Inventory relation I*

Except when copying the base, the reduplicant's inventory is a proper subset of the whole language's.⁶

Moreton (1996) observes that, since OT posits only faithfulness and markedness constraints, input→output mappings must either be faithful or improve markedness. According to (7), the same is true for base→reduplicant mappings. The force of BR faithfulness can produce identical inventories in reduplicant and base (5a,c,d) or even an expanded inventory in the reduplicant (6).⁷ But the reduplicant's imperative to copy the base can be overruled by high-ranking markedness

⁵ We are grateful to an anonymous reviewer for raising this issue and to Alan Prince for discussion.

⁶ A significant qualification, brought to our attention by Alan Prince, is that the inventory-contracting effect of (5b) is not ensured unless the inventory of the base is harmonically complete. Harmonic completeness is implicational markedness: the presence of ζ in a harmonically complete inventory implies the presence of all structures less marked than ζ (Prince and Smolensky 1993:chap. 9). If the inventory of the base were harmonically incomplete, then the reduplicant could improve on the markedness of the base, without a subset relation, by replacing the base's harmonically incomplete inventory with a harmonically complete one.

⁷ BR faithfulness can even cause the phonology of the reduplicant to be imposed on the base, in what McCarthy and Prince (1995, to appear) call *back-copying*.

(5b), and then the reduplicant's inventory will be a subset of the whole language's. All of the case studies below exemplify this effect.

(8) *Reduplicant/Inventory relation II*

Any phonological restriction on the whole of one language is a possible restriction on the reduplicant of another language.

(9) *Reduplicant/Inventory relation III*

Any phonological restriction on the reduplicant of one language is a possible restriction on the whole of another language.

These statements, which are supported by the case studies of Lushootseed, Tübatulabal, and Nancowry below, follow from the core premises of OT: language-universality of constraints and language-particularity of constraint ranking. Because all constraints are universal, if $M(\zeta)$ is in the grammar of some language, it is in the grammar of all languages. Thus, if $M(\zeta)$ defines the inventory of some whole language through a ranking like (5a), it can also be ranked as in (5b) and so define the structure of the reduplicant only. Likewise, if $M(\zeta)$ defines the structure of the reduplicant in some language, it is ranked somewhere in all languages, and it may limit the whole inventory of some of them through the ranking in (5a).

The generalizations in (8) and (9) might seem too strong for two reasons. First, some very small reduplicant inventories, such as the *i* vowel inventory of the Yoruba reduplicant in (1), are never imposed on a whole language. This is an instance of a familiar problem in markedness theory: markedness favors small inventories, but some inventories are *too* small. Markedness theories of the *SPE* type take special precautions to enforce a lower bound on inventory size (Chomsky and Halle 1968:409ff., Kean 1975:52ff.). A better idea is to admit that very small inventories are formally possible but unattested for functional reasons, since they excessively restrict the vocabulary (cf. Gnanadesikan 1996 on the relevance of this factor in acquisition). Second, some reduplicants, such as the heavy-syllable reduplicant in Illokano (McCarthy and Prince 1986, Hayes and Abad 1989), appear to respect restrictions that are never imposed on a whole language. The key to understanding these cases is getting the restriction on the reduplicant right; it is not “Syllables are heavy” but “External affixes are footable domains,” hence bimoraic (McCarthy and Prince 1994b). The same restriction is active generally in English, where external prefixes must be heavy syllables (*prē-board, non-linguistic*).

We turn now from the theory of inventories to that of default segments, which often emerge in epenthesis or neutralization. Underspecification models analyze defaults as the result of spelling out the features of incomplete segments (Archangeli 1984:36, 1988, Broselow 1984, Herzallah 1990, Paradis and Prunet 1991, Pulleyblank 1988). In OT, default segments are determined by the same markedness constraints that characterize inventories (Prince and Smolensky 1993:chap. 9, Smolensky 1993). A default is simply the least marked structure in some context.

(10) *Defn.: Default*

A set of segments or structures α is the *default* relative to the set S in context K in a language L iff

- a. $\alpha \subset S; \bar{\alpha}$ (the complement of α in S) $\neq \emptyset$,
- b. all members of α fare equally well on some markedness constraint(s) M in K , and all members of α fare better than any member of α on M in K , and
- c. there is no markedness constraint C such that $C \gg M$ in L , some element of α violates C , and some element of α obeys C .

Most of this definition reflects familiar assumptions about defaults, though without the orientation of underspecification theory. A segment (or other structure) is a default relative to some larger set of which it is a member; hence, one sees informal statements like “Voiceless is the default for obstruents” or “- is the default consonant.” Defaults may be contextually determined, because Universal Grammar (UG) includes markedness constraints that are context-sensitive as well as context-free; hence, one finds informal statements like “Vowels are oral by default” modified by “Vowels are nasal by default next to a nasal consonant.” Because markedness constraints conflict, language-particular ranking of markedness constraints can lead to differences in what the default is. For example, the default syllable is normally open, as syllabic augmentation in Lardil demonstrates (Prince and Smolensky 1993), but it is closed word-finally in Makassarese (McCarthy and Prince 1994a).

Fixed segments derived by TETU rankings are also defaults. TETU rankings cause the reduplicant to improve on the base in markedness. This improvement is always relative to some language-particular constraint hierarchy. Since the same hierarchy is responsible for both fixed segmentism and classic defaults, it follows that fixed segmentism and classic defaults should not present an inconsistent picture.

(11) *Reduplication-default connection*

Where not copied, reduplicants are like defaults.

Where reduplicative TETU and classic default phenomena coexist in a language, they cannot show attraction to different targets, assuming that all relevant conditions, such as context and class of affected segments, are the same. All of our case studies below support this claim.

This brings us to a final generalization derived from the TETU ranking (5b): fixed segmentism need not be “fixed” at all, but may in fact vary depending on details of the form under evaluation and the language’s constraint hierarchy (see also Spaelti 1997).

(12) *Potential variability of fixed segmentism*

Fixed reduplicative segmentism may alternate across different realizations of the reduplicative morpheme.

Our analyses include two principal types of alternating “fixed” segmentism. In Tübatulabal, Nancowry, and Igbo, fixed segmentism alternates contextually simply because the emergent markedness constraint ($M(\zeta)$ in (5b)) evaluates segments relative to context. In Lushootseed and again in Igbo, $M(\zeta)$ is ranked above the general BR faithfulness constraints MAX_{BR} and DEP_{BR} , but below other more specific BR faithfulness constraints. In these cases, the force of $M(\zeta)$ is felt only when the higher-ranking BR constraints cannot be satisfied (“Copy this way, else substi-

tute fixed segmentism’’). Although true invariance of fixed segmentism is also possible, the circumstances leading to variance are of particular interest, and we call attention to them below.

2.1.2 Markedness Theory In order to illustrate our claims about fixed segmentism and TETU, we need a theory of universal markedness constraints. Since a comprehensive theory of markedness would be tantamount to a comprehensive theory of phonology, our proposals are necessarily incomplete and tentative. We also mention various alternatives to emphasize that other substantive assumptions about markedness are equally compatible with the model presented in the previous section.

Place of articulation is an important determinant of markedness in consonants. Coronals occasionally appear as defaults (Paradis and Prunet 1991), though the laryngeals, especially ‐ , are probably the most common default consonants. To express these observations formally, Prince and Smolensky (1993:chap. 9; see also Smolensky 1993) propose a metaconstraint, a universal nonpermutable constraint hierarchy, which asserts that coronal place is less marked than dorsal or labial. Lombardi (1997) extends this hierarchy at the lower end, designating pharyngeal (which includes laryngeal) place as less marked than coronal.

- (13) *Place-markedness hierarchy* (Prince and Smolensky 1993, Lombardi 1997)

*PL/LAB, *PL/DORS >> *PL/COR >> *PL/PHAR

Because this hierarchy is fixed universally, a laryngeal like ‐ will always incur lower-ranking marks from it than a coronal, labial, or dorsal will. Alternatively, one might retain Prince and Smolensky’s original formulation and regard the laryngeals as truly placeless. In that case, ‐ would incur no violations of the place-markedness hierarchy.

Although (13) favors laryngeal place as least marked, other markedness constraints can conflict with (13). Through appropriate ranking, these other constraints ensure that ‐ does not have default status in every context in every language. For instance, a constraint barring ‐ from codas will conflict with (13) in any situation of coda-filling epenthesis. More generally, the markedness constraints of UG will presumably reflect the difficulty of perceiving ‐ as well as the ease of producing it.⁸

Following Clements and Hume 1995 and the literature reviewed there, we assume that vowels bear the same place features as consonants: [labial] for round vowels, [coronal] for front vowels, [dorsal] for back vowels, and [pharyngeal] for low vowels. According to (13), then, the vowels that incur the lowest-ranking marks are [coronal] *i* and [pharyngeal] *a*. If we adopt the assumption that mid vowels combine the features of high and low vowels (Schane 1984), then any mid vowel will incur worse marks than its peripheral counterparts.⁹ And if U is assumed to be featurally empty (see van Oostendorp 1995 for recent discussion), then it incurs no marks from (13) at all.

⁸ Though (13) favors [pharyngeal] consonants over others, it is up to other constraints to pick out ‐ as the default among them. One constraint, often undominated, militates against rare [pharyngeal] consonants like ‐ and (Lombardi 1997). Another selects ‐ over *h*, perhaps on the grounds that ‐ is of lower sonority than *h* and so is favored in syllable onsets (cf. Clements 1990, Prince and Smolensky 1993).

⁹ Dispersion effects also militate against mid vowels (Flemming 1995, Gnanadesikan 1997).

In sum, (13) predicts that the favored default vowels crosslinguistically will be *i*, *a*, and U. This is a good match to the facts, since all three are typical context-free defaults (e.g., *i* and *a* in various Arabic dialects (Farwaneh 1995), U in Dutch (van Oostendorp 1995) or Lushootseed (section 2.3)).

Because it incurs no violation marks from (13), U is the least marked vowel according to this hierarchy. As in the case of consonants, though, other constraints can be brought into conflict with (13) through ranking, to select *a* or *i* as the default vowel in particular languages or contexts. One such constraint bars U from prominent syllables, as in Lushootseed (section 2.3). A more general constraint militates against U's featurelessness, on the assumption that syllables are headed by their nuclei and segments are headed by their place features.

- (14) *SEG-HEAD* (Junko Itô, personal communication, Itô and Mester 1993)
Every head of a syllable must itself be headed.

Though we use *SEG-HEAD* in the analyses below, there are other, equally plausible ways of achieving the same result, such as constraints expressing preferences for high-sonority nuclei (Dell and Elmedlaoui 1985, Prince and Smolensky 1993) or dispersed vowel systems (Flemming 1995).

For *i* to be a default vowel, as in Yoruba (section 2.2) and stressed syllables of Lushootseed (section 2.3), two interactions with (13) are necessary: *SEG-HEAD* or some equivalent constraint must dominate *Pl/Cor, and some constraint disfavoring *a* must dominate *Pl/PHAR. Concerning the constraint disfavoring *a*, Steriade (1995:139–140) speculates “that the frequent choice of a high vowel [in epenthesis]—typically *i* or é—indicates a preference for the vowels that are phonetically shortest . . .” Kirchner (1996), discussing a vowel-raising process, finds evidence for a similar preference. We therefore adopt the following constraint, after Kirchner:

- (15) *REDUCE*
Minimize the duration of short vowels.

This constraint is plausibly involved in raising or reduction processes and epenthesis of high vowels or U.

A final remark. In Tübatulabal, reduplicative TETU effects are observed with consonants only, whereas in Yoruba and in Lushootseed they are observed with vowels only, and in Nancowry with both consonants and vowels. We will distinguish among these cases by permuting the ranking of MAX-C_{BR}, MAX-V_{BR}, and their DEP counterparts (cf. McCarthy and Prince 1994b, Prince and Smolensky 1993), thereby allowing separate BR faithfulness interactions for consonants and vowels.

The necessary theoretical background is now in place. We turn to applications of the theory.

2.2 Case Study: Yoruba

In Yoruba the reduplicant copies the initial consonant of the base and combines it with the fixed vowel *i* and a high tone.

Tableau 1

Default epenthesis in Yoruba

/grama/	*COMPLEX-ONSET	SEG-HEAD	REDUCE	*PL/DORS, PL/LAB	PL/COR	PL/PHAR
a. g girama			<i>a, a</i>		<i>i</i>	<i>a, a</i>
b. gurama			<i>a, a</i>	<i>u!</i>		<i>a, a</i>
c. g rama		!	<i>a, a</i>			<i>a, a</i>
d. garama		∅	<i>a!, a, a</i>			<i>a, a, a</i>
e. grama	*!		<i>a, a</i>			<i>a, a</i>
H(<i>i</i>)						

- (16)
- Deverbal reduplication in Yoruba*
- (Akinlabi 1984, Pulleyblank 1988, Ola 1995:86ff.)

gbóná	<u>gbí</u> -gbóná	‘be warm, hot’/‘warmth, heat’
jé	<u>jí</u> -jé	‘eat’/‘act of eating’
rí	<u>rí</u> -rí	‘see’/‘act of seeing’

We will argue that the fixed vowel *i* is a consequence of reduplicative TETU and that it accords with the default structure of the language.¹⁰

Marantz (1982) analyzes Yoruba with prespecification of *i* on a CV template. Pulleyblank (1988) argues instead that *i* is a default, a result of late fill-in of an empty V slot in the reduplicative affix. Independent evidence for *i*’s default status comes from, among other things, the phonology of loanwords, which usually resolve unsyllabifiable sequences by epenthizing *i*: *gíráma* ‘grammar’.¹¹

Pulleyblank’s insight carries over into OT, though without the assumptions about underspecification. To say that *i* is the default vowel in Yoruba is to say that the grammar of Yoruba includes a ranking in which certain of the constraints of the place-markedness hierarchy (13) are crucially dominated (cf. (10)). Specifically, SEG-HEAD (14), which disfavors U, must dominate *PL/COR, and REDUCE (15), which favors *i* over *a*, must dominate *PL/PHAR. For convenience, we will call the hierarchy (13) modified in this way H(*i*), as shown in tableau 1. To highlight the locus of constraint violation, we have sometimes used the offending segment(s), rather than asterisks, to indicate constraint violations. We have simplified the tableau by showing only the markedness violations incurred by vowels, since those are the only relevant differences between candidates, and by leaving out the IO faithfulness constraints.

¹⁰ Bode (1996) reports variation when the base contains *u*: *mí-mu* ~ *mí-u-mu* ‘drinkable’. Some speakers find both variants equally good, some accept both but prefer *i*, and some find *u* “mildly unacceptable.” We discuss a similar situation in Igbo in section 2.3.

¹¹ Some loans epenthize *u* under conditions of back harmony or labial attraction, though many loans epenthize only *i*. See Pulleyblank 1988:247ff. for discussion.

Tableau 2

TETU in Yoruba

/RED- $j^a\varepsilon^b/$	MAX-V _{IO}	SEG-HEAD	REDUCE	*P _{L/DORS} , *P _{L/LAB}	*P _{L/COR}	*P _{L/PHAR}	MAX-V _{BR}	DEP-V _{BR}
a. $\varepsilon^a j_1 \acute{f} j_1^a \varepsilon_2^b$			ε		i, ε	ε	ε	i
b. $j_1 \acute{\varepsilon}_2 j_1^a \varepsilon_2^b$			$\varepsilon, \varepsilon!$		ε, ε	ε, ε		
c. $j_1 \acute{i}_2 j_1^a i_2$	$\varepsilon!$				i, i			

Form (e) in tableau 1, though fully faithful to the input, violates top-ranked *COMPLEX-ONSET; because *COMPLEX-ONSET and MAX-C_{IO} dominate DEP-V_{IO}, epenthesis is unavoidable. Tableau 1 shows that the choice of which vowel to epenthize falls to markedness considerations. All candidates in tableau 1 equally share the markedness violations incurred by the two *a* vowels, so decisive differences will appear in the epenthetic vowel itself. The optimal candidate is form (a), with epenthetic *i*, since it best satisfies H(*i*) without violating *COMPLEX-ONSET. The default status of *i* is a matter of obedience to this hierarchy of markedness constraints.

The hierarchy H(*i*) is *default-defining* but not *inventory-defining* in Yoruba; the language as a whole has other vowels. This shows that H(*i*) is crucially dominated by IO faithfulness constraints, such as MAX-V_{IO} and IDENT_{IO}, so its force emerges only in situations where IO faithfulness is not directly relevant. For this reason, the input /a/’s of tableau 1 must be reproduced faithfully in the output and not simply replaced to improve markedness.

Now we come to reduplication in tableau 2. By virtue of a TETU ranking, H(*i*) is inventory-defining in the reduplicant, so improved performance on H(*i*) is obtained at the cost of inexact copying. Formally, H(*i*) must dominate the BR faithfulness constraints MAX-V_{BR} and DEP-V_{BR}, even though it is dominated by the parallel IO faithfulness constraint MAX-V_{IO}. (In the tableau IO correspondence is shown by alphabetic superscripts and BR correspondence by numeric subscripts.) In the actual output form (a), a vowel of the base is not copied, violating MAX-V_{BR}, and a noncopied vowel appears in the reduplicant, violating DEP-V_{BR}. Nonetheless, its expected syllabic role, as nucleus in the reduplicant, is indispensable. A vocalic nucleus is supplied, and the chosen vowel minimizes markedness violation, just like ordinary epenthesis.

The noncopying of the vowel in Yoruba reduplication—that is, the MAX-V_{BR} violation—is motivated by exactly the same markedness constraints, H(*i*), that determine the choice of the epenthetic vowel. Noncopying arises because MAX-V_{BR} is ranked below H(*i*), so the candidate with exact copying, (b) in tableau 2, fares worse on H(*i*) than an alternative with inexact copying (a). This alternative is optimal because H(*i*) dominates MAX-V_{BR} and DEP-V_{BR}. The same reasoning applies with equal force to roots with all the other vowels of Yoruba (except for *i* itself; see below).

Candidate (c) in tableau 2 exhibits a different kind of behavior, a kind of *back-copying*, in which a derived property of the reduplicant is copied back into the base, thereby maintaining perfect BR identity while achieving markedness improvements. Back-copying is in general possible in reduplication (McCarthy and Prince 1995), but it can never be obtained in TETU situations

like this one, because the logic of constraint ranking forbids it (McCarthy and Prince, to appear). Form (c) improves on even the actual output in H(*i*) performance, and it achieves perfection on MAX-V_{BR}, but it does so at too high a price: violation of top-ranked MAX-V_{IO}. This fault in (c) is the same as in any example, reduplicated or not, where an input vowel is replaced by *i*. (The same reasoning applies to (c)'s near-twin, $j_1\acute{l}_2-j_1^a\acute{l}_2^b$, which violates IDENT_{IO}.) This is what it means to say that the *i* of the reduplicant is an *emergent* property of Yoruba phonology. The vowel *i* is not a target to which all input vowels are mappable, because IO faithfulness crucially dominates the constraints in H(*i*).

A question that arises in this context is whether the *i* of the reduplicant is truly epenthetic or just an inaccurate copy. In correspondence terms, is the actual output form $j_1\acute{l}_2-j_1\varepsilon_2$, with MAX-V_{BR} and DEP-V_{BR} violations as in (a) of tableau 2, or is it a different candidate, $j_1\acute{l}_2-j_1\varepsilon_2$, with violations of various IDENT_{BR} constraints, which require corresponding segments to match featurally? Tableau 2 is constructed under the assumption that IDENT_{BR} is undominated, but the opposite approach is equally consistent with all known data in Yoruba. Indeed, either tack would work and would support our overall claims. As we note at various points below, other examples appear to require one approach or the other, indicating that both are attested. This is what we would expect, since both approaches reflect different possibilities afforded by ranking permutation.

Another question concerns the status of the output when the root has the vowel *i*, such as *rí*. Under correspondence theory, the full description of a candidate includes any correspondence relations it enters into. Thus, $r_1\acute{l}_2-r_1\acute{i}_2$, with copied *i*, and $r_1\acute{i}-r_1\acute{i}_2$, with epenthetic *i*, are formally distinct (though phonetically identical) candidates. Since both candidates obey H(*i*), the latter's violations of MAX-V_{BR} and DEP-V_{BR} are gratuitous, so $r_1\acute{l}_2-r_1\acute{i}_2$, with copying, must be the actual output form. The general result is that accidental resemblance between the default segment and the base leads to copying rather than epenthesis, and Igbo (section 2.3) supports this result.

This completes the picture of Yoruba fixed segmentism under the TETU ranking schema (4). The vowel *i* is the default because it performs best with respect to the markedness hierarchy H(*i*). This default vowel emerges in epenthesis because there is nothing better to epenthize with respect to H(*i*); it emerges in reduplication because H(*i*) is favored over accuracy of copying. In that way, H(*i*) defines the vocalic inventory of the reduplicant. It therefore exemplifies the predicted correlation between fixed and default segmentism (11). It also exemplifies the point that the reduplicant's inventory can be a proper subset of the whole language's (7).

2.3 Case Study: Lushootseed

In the Salish language Lushootseed, there is an alternation between CV and Ci reduplication. According to Bates (1986), the choice between CV and Ci is predictable on the basis of the phonology of the root: “[f]orms take Ci if CV-prefixation is prevented by independent principles” (Bates 1986:11). Following Urbanczyk (1996b), we will show how these independent principles—analyzed as ranked constraints—interact to produce this pattern.

The reduplicant is always a CV syllable, with a simplex onset and a short vowel. These requirements are enforced by the constraints *COMPLEX-ONSET and NO-LONG-VOWEL deployed in TETU rankings under GTT (for details see Urbanczyk 1996b). The reduplicant is always

stressed (with a handful of exceptions) because it is a member of the class of stress-attracting affixes in Lushootseed. Descriptively, the determinants of CV versus *Ci* reduplication are as follows:

- (17) *Lushootseed diminutive reduplication* (Bates, Hess, and Hilbert 1994, Urbanczyk 1996b)¹²
- | | | | |
|--|----------------------------------|---|--|
| a. CV reduplication | čáluS
s-duk ^w | čá-čáluS
s- <u>dú</u> - ^w -duk ^w | 'hand'/'little hand'
'bad'/'riffraff' |
| b. <i>Ci</i> reduplication | | | |
| i. With CU . . . roots | tUláw-il
g ^w Udil | tí-tUlaw'-il
<u>g</u> ^w <u>i</u> -g ^w Udil | 'run'/'jog'
'sit down'/'sit down briefly' |
| ii. With CV _i . . . roots ¹³ | s-du:k ^w
lu:x-d | s-dí-du:k ^w
<u>l</u> í- ^w -lu:x-d | 'knife'/'small knife'
'hear s.t.'/'hear s.t. a little' |
| iii. With CC . . . roots | č'Y'a-
c'k ^w 'usUd | č'í-č'Y'a-
<u>c</u> 'í-c'k ^w 'usUd | 'rock'/'little rock'
'walking stick'/'little walking stick' |

The restrictions on the reduplicant—stress, *COMPLEX-ONSET, No-LONG-VOWEL—help make sense of the difference between the CV-reduplicating roots in (17a) and the *Ci*-reduplicating roots in (17b). In (17a) it is possible to copy the initial CV sequence of the root exactly and still satisfy these and other restrictions, but not in (17b).

The CU roots (17bi) pit exactness of copying (*tí-tUlaw'-il) against the avoidance of stressed schwa (tí-tUlaw'-il). The latter wins, reflecting a general (though not invariant) pattern of the language. Aside from inherently stressed morphemes, Northern Lushootseed locates stress on the leftmost nonschwa syllable, otherwise initially.

- (18) *Stress in Lushootseed* (Hess 1977, Bates, Hess, and Hilbert 1994, Urbanczyk 1996b: 135ff.)
- | | |
|-------|------------------|
| ítut | 'sleep' |
| tUyíl | 'to go upstream' |
| jÚsUd | 'foot' |

This stress pattern reflects the domination of a constraint demanding initial stress (ALIGN-L(PrWd, σ)) by the constraint *Ú (Cohn and McCarthy 1994, Kenstowicz 1994, van Oostendorp 1995, Urbanczyk 1996b). When a nonschwa vowel is preceded by an initial string of schwas (e.g., *tUyíl*), top-ranked *Ú is decisive. Otherwise, the main candidates tie on *Ú, either because all obey it (ítut) or all violate it (jÚsUd). Then ALIGN-L favors initial stress.

¹² According to Bates (1986), the ^w sometimes appearing between reduplicant and base is inserted postlexically. We disregard it here.

¹³ A number of examples of this type arguably have long vowels only underlingly. See Bates 1986 and Urbanczyk 1996b:209.

Tableau 3

*/>>MAX-V _{BR} , DEP-V _{BR}		MAX-V _{BR}	DEP-V _{BR}
⊖	/RED-tdaw'-il/		
a.	t _i í-t _i law'-il	*	, a
b.	t' _i á-t _i law'-il	*!	a

Though *Ú is only contingently obeyed in the language as a whole, it is categorically obeyed in the reduplicant. Rather than copy and stress U, the reduplicant supplies a more readily stressable vowel. The main TETU ranking is given in tableau 3; it ensures that less exact copying is preferred to Ú. To complete the TETU picture, observe that MAX-V_{IO} (or DEP-V_{IO}) and IDENT_{IO} must dominate *Ú; otherwise, jÚsUd would come out as *jísUd. In this way, stressed schwa is banned from the inventory of the reduplicant though tolerated generally.

The usual default vowel in Lushootseed is U, indicating that the place-markedness hierarchy (13) dominates SEG-HEAD (14). But despite U's general default status, the vowel *i* is the default under stress. This observation shows that *Ú dominates *PL/COR, so Lushootseed has two defaults, U for unstressed syllables and *i* for stressed syllables. (As (10) emphasizes, contextual determination of the default is possible because markedness constraints may be context-sensitive.) Further, it shows that REDUCE (15) dominates *PL/PHAR, favoring default *i* over *a*.

The other two cases of fixed segmentism in Lushootseed (17bii,iii) also involve emergence of a fixed vowel where copying the base's vowel would create BR identity problems. In tableau 4 the choice is between copying a vowel while shortening it (b), or not copying it at all (a). This candidate comparison is equivalent to a question raised earlier: Are fixed segments noncopies or imperfect copies? Formally, do fixed segments violate MAX_{BR}/DEP_{BR} or do they violate IDENT_{BR}? The ranking in tableau 4 shows that Lushootseed fixed segments are truly epenthetic rather than imperfect copies of the base.¹⁴ Copying *u*: without its length, as in (b), violates IDENT_{BR}(μ), which demands faithfulness to quantity. Not copying *u*: at all and substituting *i*, as in (a), violates MAX-V_{BR} and DEP-V_{BR}. With the ranking in tableau 4, noncopying is the actual outcome.

A similar constraint conflict can be seen in tableau 5. Since initial clusters are banned from the reduplicant, C₁C₂V . . . roots offer Hobson's choice: (a) don't copy the vowel at all, (b) skip C₂, violating CONTIG_{BR}, or (c) skip C₁, violating L-ANCHOR_{BR}. The ranking given in tableau 5

Tableau 4

IDENT _{BR} (μ) >> MAX-V _{BR} , DEP-V _{BR}		MAX-V _{BR}	DEP-V _{BR}
/s-RED-du.kʷ/	IDENT _{BR} (μ)		
a.	s-d _i í-d _i u ₂ kʷ	<i>u</i>	<i>i</i>
b.	s-d _i ú ₂ -d _i u ₂ kʷ	*!	

¹⁴ This argument applies with equal force to a candidate like *s-d_ií-d_iu₂kʷ*, which incurs the same IDENT_{BR}(μ) violation as (b) in tableau 4 as well as featural IDENT_{BR} violations.

Tableau 5

L-ANCHOR _{BR} , C _{ONTIG_{BR}} >> MAX-V _{BR} , DEP-V _{BR}	L-ANCHOR _{BR}	C _{ONTIG_{BR}}	MAX-V _{BR}	DEP-V _{BR}
/RED-c'la?			a	i
c ₁ í-c ₁ l ₂ a ₃ ?			*!	
c. l ₂₃ -c ₁ l ₂ a ₃ ?	*!			

ensures that noncopying is preferred to violating C_{ONTIG_{BR}} or L-ANCHOR_{BR}. Taken together, tableaux 4 and 5 provide a formal account of the most remarkable aspect of Lushootseed reduplication: bad copying on one dimension (violating MAX-V_{BR} and DEP-V_{BR}) is tolerated in order to avoid bad copying on other dimensions (violating IDENT_{BR}(μ), C_{ONTIG_{BR}}, or L-ANCHOR_{BR}).

Lushootseed shows that fixed segmentism can emerge as a kind of compensation, when better copying is ruled out by high-ranking constraints. Two other cases known to us, Makassarese and Igbo, have this property as well. Makassarese is analyzed in these terms by McCarthy and Prince (1994a); here we will focus on Igbo (Clark 1990, Clements 1989, Ní Chiosáin and Padgett 1995, Beckman 1998). Several familiar phonological processes—labial and palatal attraction, rounding harmony—are emergent in the reduplicant, but only if it is not identical to the base.

(19) *Reduplication in Igbo*¹⁵

- a. A high vowel is copied exactly:

ti-ti	'cracking'	nu-nu	'pushing'
ji-ji	'snapping'	ju-ju	'being full'
mi-mi	'drying'	mu-mu	'learning'

- b. Otherwise, labial/palatal attraction:

ci-c:	'seeking'	bu-be	'cutting'
n ^y i-n ^y o	'shadow'	gbu-gbe	'crawling'

- c. Otherwise, rounding harmony:

ki-ke	'sharing'	ku-k:	'telling'
ni-na	'going home'	nu-no	'swallowing'

The vowel of the reduplicant is always high, a TETU effect like the one in Yoruba (see tableau 2). If the vowel of the base is also high, it can be copied exactly, and so it is. But if the vowel of the base is not high, then it cannot be copied exactly, and so it is not copied at all. Instead, the backness and rounding of the noncopied vowel are determined by a hierarchy of emergent phonological processes: attraction to a labial or palatal consonant, and otherwise rounding harmony. The “fixed” segmentism of Igbo is variable in a way that depends on its phonological context and the possibility of exact copying. The ranking for “Copy exactly if possible, otherwise . . . ” is abstractly the same as in Lushootseed (cf. tableau 4). The various “otherwise”

¹⁵ For clarity, tones and affixes have been suppressed. Inexplicably, the reduplicant has *u* just in case the base is γa.

conditions are characterized by TETU rankings of the same constraints responsible for processes of labial/palatal attraction and rounding harmony globally in other languages. See Beckman 1998 and Ní Chiosáin and Padgett 1995 for the full story.

In summary, Lushootseed provides support for all of the claims about fixed segmentism by TETU that were developed in section 2.1. In Lushootseed as a whole, stressed schwa is avoided, though it is possible under duress. The phonology of the reduplicant accords exactly with this independently motivated default (see (11)). Another claim is that an inventory restriction on the reduplicant in one case will be paralleled by an inventory restriction on a whole language in another case (8)–(9). This is also true of *Ú, which is unviolated in Indonesian (Cohn and McCarthy 1994). Fixed segmentism may also be variable (12), and in Lushootseed it is, appearing only in situations where *Ú, IDENT_{BR}(μ), CONTIG_{BR}, or L-ANCHOR_{BR} is at issue.

Lushootseed shows that other models of fixed segmentism are inadequate. Marantz's (1982) approach cannot express the contingent character of Lushootseed fixed segmentism. Prespecification is all-or-nothing, but the appearance of fixed segmentism in Lushootseed depends on a delicate interplay of phonological and BR correspondence constraints. Steriade's (1988) full-copy model (FCM) posits a series of derivational steps to effect reduplication (see (24) below for the details): (a) a full copy of the base is made; (b) fixed segments are specified by substitution rules applied to the full copy; and (c) the copy is reduced to match the template. We have shown, however, that the appearance of fixed segmentism in forms like *s-dí-du:kʷ* is a side effect of template matching (see tableau 4). Since the FCM handles fixed segmentism with rules applied before template matching, there is no way to make fixed segmentism depend on template matching.

In contrast, Urbanczyk's (1996b) analysis, which we have summarized here, shows that constraint ranking in OT can characterize the conditions and nature of Lushootseed fixed segmentism, thereby giving full formal expression to Bates's (1986) insight that fixed segmentism emerges where exact copying is excluded by independent constraints.

2.4 Case Study: Tübatulabal

In the Uto-Aztec language Tübatulabal, aspectual reduplication has two significant segmental properties: fixed initial ~ and the contextually determined possibility of a nasal coda (Voegelin 1935, Swadesh and Voegelin 1939).

(20) Reduplication in Tübatulabal (examples from Voegelin 1958)¹⁶

- a. Reduplicant-initial ~, regardless of base-initial consonant

pététa	~é-pététa	'to turn over'
to̯yan	~o̯-doyan	'he is copulating'
ʃé~éwé	~é-ʃé~éwé	'it looks different'
~a̯iba~iw	~a̯i-~aba~iw	'it is showing'

¹⁶ All initial stops are voiceless, but when prefixation (usually reduplicative) puts them into medial position, some alternate in voicing (*to̯yan*/*~o̯-doyan*) and others do not (*pététa*/*~é-pététa*), depending on the lexical item involved. When the root-initial stop is voiced, the reduplicant is heavy (CV: or CVN); otherwise, it is light (CV). Some analysts (McCawley 1969, Heath 1981) argue that this is evidence for an underlying distinction between simplex and geminate consonants. The geminates resist intervocalic voicing and require the preceding vowel to be short (cf. Crowhurst 1991).

- b. Reduplicant-final nasal, copying base, if base begins with oral stop or affricate

pa`ham	<u>~</u> am-ba`ham	'to hide in the blind'
tumu:ga	<u>~</u> un-dumu:ga	'to dream'
tsama	<u>~</u> an-dzama	'it's burning'
cf.-o:m	<u>~</u> or-`om, * <u>~</u> oN-`om	'to string beads'

We will argue that the reduplicant-initial ~ accords with the default status of that segment in Tübatulabal, paralleling the analysis of *i* in Yoruba. We will show that the reduplicant-final nasal is governed by the same universal markedness constraints that define inventories in languages like Japanese or Diola-Fogny. And we will show how variation in the shape of the reduplicant (absence or presence of the coda nasal) follows from these constraints as well. Thus, reduplication in Tübatulabal supports all our main claims about fixed segmentism as TETU.

The initial ~ of the reduplicant converges with the independently motivated default onset, which appears in hiatus resolution (Voegelin 1935:74, 114). Glottal stop is the default onset because it satisfies some hierarchy of markedness constraints better than any other possible onset (cf. (10)). The core of this hierarchy is the fixed universal ranking (13), which favors laryngeal place over the alternatives. Thus, in situations of hiatus in Tübatulabal, where epenthesis of *some* consonant is compelled by high-ranking ONSET (i.e., ONSET, MAX-V_{IO} >> DEP-C_{IO}), the default consonant that emerges is ~, simply because it is better, according to (13), than alternatives like *p*, *k*, or *t*. The details parallel those of *i*-epenthesis in Yoruba (see tableau 1).

Moreover, in a parallel to tableau 2, the place-markedness hierarchy (13) will compel imperfect copying, with ~ emerging in place of a copy of the base-initial consonant. Fixed segmentism emerges when BR identity requirements are subordinated to markedness constraints under the TETU rubric. In a reduplicated form like ~oi-doyan, three aspects of BR identity are violated in pursuit of segmental unmarkedness:

- MAX-C_{BR} is violated because the base's initial *d* lacks a reduplicative correspondent.
- DEP_{BR} is violated by the fixed, noncorrespondent ~.
- L-ANCHOR_{BR} requires that the leftmost segment of the base have a correspondent in the reduplicant. This is an edge-specific version of MAX_{BR}, keyed to the well-known preference for copying edge material (Marantz 1982, McCarthy and Prince 1986:sec. 4, Yip 1988).

The full ranking is therefore as in tableau 6, a typical case of TETU. Form (a) has a fixed reduplicant-initial ~, which is not in correspondence with anything in the base; that is, it is epenthetic. Form (b) has a more exact copy, but incurs worse violation of the place-markedness hierarchy (13). Since (13) dominates the BR faithfulness requirements, (b) is nonoptimal. Form (c) involves noncopying of the base-initial consonant, but does not replace it with ~—a fatal error, given ONSET's undominated status in this language. And form (d), which replaces all consonants with ~, achieves significant markedness improvement across the board and perfect copying, but it does so at the expense of fatally violating MAX-C_{IO}. (Similarly, reducing all of the base's consonants to ~ while maintaining IO correspondence would satisfy MAX-C_{IO} but incur equally fatal violations of various featural IDENT_{IO} constraints.)

Tableau 6

The Tübatulabal onset

/RED-toyan/	MAX-C _{IO}	ONSET	*P _L /DORS, *P _L /LAB	*P _L /COR	*P _L /PHAR	MAX/C _{BR}	DEP-C _{BR}	L-ANCHOR _{BR}
a. t₂ t ₂ -d ₁ o ₂ yan				d, y, n	?	d, y, n	?	*
b. t ₁ o ₂ -d ₁ o ₂ yan				t!, d, y, n		y, n		
c. o ₂ -d ₁ o ₂ yan		*!		d, y, n		d, y, n		*
d. ? ₁ o ₂ -? ₁ o ₂ ?a?	d, y, n!				?, ?, ?, ?	?, ?		

We turn now to the reduplicant's coda. The first thing that must be explained is why the coda is usually absent. There is no constraint like ONSET to demand that syllables have codas, so any coda posited, even \emptyset , would involve gratuitous violation of the place-markedness hierarchy, even though it would better satisfy MAX-C_{BR}.¹⁷ Tableau 7 makes this clear. The full place-markedness hierarchy militates against all consonants, whatever their source or nature. By dominating MAX-C_{BR}, it bars the copying of consonants in Tübatulabal, in onset or coda position. (The vowel length alternation is discussed in footnote 16.)

There is, however, one circumstance where the reduplicant actually requires a coda. If having a coda does not introduce additional place-markedness violations, then all place-markedness constraints will tie. Exactly this situation is evidenced in (20b): a nasal is copied if it can share place with a following base-initial stop (e.g., un-dumu:ga). Under the usual assumption that the cluster shares a single place node (represented here by the ligature *nd*), it incurs just one violation of the relevant place-markedness constraint. (That is, the *P_L/X constraints look at autosegmental tiers rather than individual segments (McCarthy and Prince 1994a, Itô and Mester 1994, Beckman 1995).) Thus, place markedness does not decide between copying a place-linked coda nasal and not copying it; this tie then goes to MAX-C_{BR}, which favors copying the nasal. It should be noted, though, that there is an alternative analysis of evidently equal merit: that the emergent constraint is actually a version of Itô's (1986) Coda Condition, which does not allow coda position to license a freestanding place feature. Either approach is fully consistent with the premises of section 2.1.1.

Tableau 7

The codaless reduplicant in Tübatulabal

/RED-ʃiʔwi/	*P _L /DORS, *P _L /LAB	*P _L /COR	*P _L /PHAR	MAX-C _{BR}
a. ʃ₂ ʃ ₂ -ʃ ₂ ʔwɪ	w	ʃ	?, ?	ʃ, ?, w
b. ʃ ₂ ʃ ₃ -ʃ ₂ ʃ ₃ ʔwɪ	w	ʃ	?, ?, ?!	ʃ, w

¹⁷ In addition, any constraint specifically prohibiting *laryngeal* codas, as suggested in section 2.1.2, would account for their absence in the Tübatulabal reduplicant.

Tableau 8

The assimilated nasal coda in the Tübatulabal reduplicant

/RED-dumu,ga/	*PL/DORS, *PL/LAB	*PL/COR	*PL/PHAR	MAX-C _{BR}	IDENT _{BR} (Place)
a. $\text{w}^* \text{lu}_2 \text{n}_3 \text{-d}_1 \text{u}_2 \text{m}_3 \text{u ga}$	g, m	\overline{nd}	?	g	*
b. $\text{lu}_2 \text{-d}_1 \text{u}_2 \text{m}_3 \text{u ga}$	g, m	d	?	$m!, g$	

Tableau 8 completes the analysis of the nasal coda at the level of formal detail. The only relevant difference between the two candidates in this tableau is in the extent of copying: in (a) the *m* is copied, nonidentically, as *n* in the reduplicant, whereas in (b) the *m* is not copied at all. As long as IDENT_{BR}(Place) is low-ranking, form (a) is a better copy than form (b). And they tie on place markedness, because the doubly linked [coronal] feature of \overline{nd} gets the same violation mark as the singly linked [coronal] feature of *d*.¹⁸

Some final points about the analysis. First, the reduplicant permits a nasal coda only before a root-initial oral stop or affricate. This follows from independently motivated restrictions on NC clusters, for which see Padgett 1991, 1994, and references there. Second, the restriction on reduplicant codas is a further instance of TETU, since the language as a whole permits a much wider range of codas, as Carden (1984) emphasizes (also see Heath 1981). Third, because it evaluates copying and assimilation in parallel, this analysis solves a problem with serial treatments of Tübatulabal. Serial analyses encounter an ordering paradox: the nasal can be copied because it assimilates to the following stop, but it cannot assimilate until it has copied. In a strictly serial derivation, either copying or assimilation must take place first, but neither order yields the correct result. Parallelism in OT (Prince and Smolensky 1993) therefore receives support from Tübatulabal.

To sum up, we have shown that the occurrence and distribution of a nasal coda in the Tübatulabal reduplicant follows from the same constraint interaction that yields the initial $\text{-}:$ domination of MAX-C_{BR} by the place-markedness hierarchy. This result exemplifies the observation in (7) that the reduplicant's inventory can be a proper subset of the whole language's. It also exemplifies one of the predicted types of variance in fixed segmentism in (12). The reduplicant has a coda only when copying and place linking are possible; otherwise, the reduplicant is codaless. Finally, it supports the claim that every fixed-segmentism TETU effect—that is, every inventory restriction on a reduplicant—has a counterpart in the inventory structure of whole languages, and vice versa (8)–(9). Many languages restrict their coda inventories to place-linked clusters (Itô 1986, Goldsmith 1990, Yip 1991), just as Tübatulabal restricts its reduplicant.

Compare this analysis to a prespecification account. Kiparsky (1986:61) proposes that there are two distinct types of templatic prespecification, absolute and conditional. Absolute

¹⁸ Tübatulabal does not permit geminates across reduplicant-base juncture (e.g., *patbé* → ${}^*\underline{ap}atbé$, where the *p* is simultaneously an IO correspondent of the underlying root-initial /p/ and a BR correspondent of the root-medial *b*). This transmorphemic fusion is ruled out by the constraint MORPH-DIS (McCarthy and Prince 1995:310).

prespecification is the same as in Marantz 1982; conditional prespecification determines the class of potential fillers for a template slot, but does not require that the slot be filled in fact. In these terms, Tübatulabal is described as having a C_1VC_2 template, where C_1 is absolutely prespecified as \emptyset and C_2 is contingently prespecified as [+nasal]. Descriptively, this is satisfactory, but it misses a generalization: what is absolute or conditional in Tübatulabal prespecification is exactly what is absolute or conditional in the language as a whole, since onsets are obligatory but codas are not.

The FCM of Steriade 1988 has similar difficulties in generalizing over the Tübatulabal onset and coda. In the FCM, markedness parameters specify the shape of reduplicative templates, so the coda restriction would be seen in these terms. But fixed segments are attributed to special rules applied prior to template matching (see (24)). This means that the FCM uses different devices, applied at different stages of the derivation, to express the restrictions on the reduplicant's onset and coda.

Summarizing, we have argued that two fixed properties of the Tübatulabal reduplicant—the initial \emptyset and the homorganic nasal coda—are forced by the place-markedness hierarchy through domination of BR faithfulness. These unmarked properties are emergent, in the sense that they are not observed in the language as a whole, because of high-ranking IO faithfulness. As predicted by the TETU model of fixed segmentism, these properties show significant correlations with the default status of \emptyset in Tübatulabal and the typology of coda restrictions.

2.5 Case Study: Nancowry

Nancowry (also called Nicobarese) is an Austroasiatic language spoken in the Andaman Islands. Radhakrishnan (1981) provides a detailed discussion of Nancowry phonology and morphology, and this has served as the basis of our analysis below. In addition, we have checked the generalizations against a comprehensive list of roots and their derivatives that he provides. Our attention was first directed to Nancowry by the discussion in Carden 1984 and Steriade 1988.

We will begin with a few words about the general phonology of Nancowry. Roots are usually monosyllabic but occasionally disyllabic. Stress falls on the last (or only) syllable of the root. The range of permissible phonological contrasts in stressed syllables is much greater than in unstressed syllables: stressed syllables have 10 oral and 10 nasal vowels and 5 diphthongs, but unstressed syllables have only *i*, *u*, and *a*. This reduction of the inventory in unstressed syllables is a familiar phenomenon; space limitations preclude giving an analysis here, but it is relatively easy to construct an account in terms of the interaction of markedness and positional faithfulness constraints (Beckman 1997).

The reduplicant is prefixed, and reduplication is permitted only with monosyllabic roots (Radhakrishnan 1981:51).¹⁹ As the data in table 1 show, the reduplicant has a complex pattern of dependence on and independence from the base.

¹⁹ See Takeda 1997 on the restriction to monosyllabic roots in the related language Kammu.

Table 1

Reduplication in Nancowry

Final C	Red.-root	Gloss (simple/reduplicated)	Frequency
a. With root-final coronal or palatal stop—reduplicant is <i>-it</i> or <i>-in</i>			
t	<u>it</u> -sut	'to rub'/'to kick with the foot'	15
n	<u>in</u> -uan	'groaning noise'/'to groan'	12
c	<u>it</u> -cac	'word'/'to pray'	14
.	<u>in</u> -se'	'to cut things to pieces'/'to cut things to pieces'	9
b. With root-final coronal or palatal continuant—reduplicant is <i>-i</i>			
s	<u>i</u> -tus	'to fall off [bird's feather]’/‘to pluck out'	4
y	<u>i</u> -ruay	'moving back and forth'/'to beckon'	7
c. With root-final dorsal stop—reduplicant is <i>-up/um</i> or <i>-uk/u^</i>			
p	<u>up</u> -kUp	'to hold'/'to sting'	10
m	<u>um</u> -rom	'flesh of fruit'/'to eat pandanus fruit'	9
k	<u>uk</u> -iak	'binding'/'to bind'	13
^	<u>u^</u> -mia^	'corner'/'corner'	13
d. With root-final dorsal continuant—reduplicant is <i>-u</i>			
w	<u>u</u> -h:w-a	'empty'/'cave'	10
fi	<u>u</u> -tuafi	'round'/'a knot'	18
e. With root-final <i>-</i> —reduplicant is <i>-u</i>			
-	<u>u</u> -ya-	'to leave s.t.'/'to lay an egg'	7
f. With root-final <i>h</i> —reduplicant is <i>-u</i> or <i>-i</i>			
h	<u>u</u> -köh	'downward curve'/'round, spherical'	18
h	<u>i</u> -fah	'to sweep'/'to sweep'	12
h	<u>u</u> ~ <u>i</u> -tUh	unattested/'to refuse'	2
g. With root-final vowel—reduplicant is <i>-i</i>			
V	<u>i</u> -múa	'twisted'/'to wring'	8

All The reduplicant begins with an epenthetic *-*. The evidence of *-*'s epenthetic status comes from alternations like the following: /ma-RED-kec/→*m-it-kec*, **ma-it-kec*.

- (a,c) A root-final oral or nasal stop is copied, with palatals *c* and *·* becoming plain coronals. The vowel of the reduplicant is determined by this consonant, *i* with coronals and *u* with labials or dorsals.
- (b,d) With a root-final continuant, the reduplicant has no coda. But the vowel of the reduplicant is still determined by the final consonant of the root, just as if it were copied (*i* with *s* or *y*, and *u* with *w* or *fi*).²⁰
- (e,f) If the root ends in a laryngeal, the reduplicant has no coda. The choice of vowel in the reduplicant is inconsistent (see below).
- (g) Vowel-final roots reduplicate regularly with *-i*. A few roots listed as vowel-final reduplicate with *u*, but may actually be *w*-final.

²⁰ Syllable-final *l* is dark (Radhakrishnan 1981:32).

Our primary focus will be on the solidly attested and systematic behavior of roots ending in a high glide, *fi*, *s*, or a stop ((a–d) in table 1). We will have less to say about the other roots (e–g).

The reduplicant-initial $\bar{}$ is familiar from Tübatulabal. Unmarked place emerges in the reduplicant's onset, showing that the place-markedness hierarchy is ranked above MAX-C_{BR} and DEP-C_{BR}. An interesting complication is that the Nancowry reduplicant maintains place distinctions in the coda, though only if the corresponding base ends in an oral or nasal stop. Below we will argue that the root-final consonant is *always* copied (an anchoring effect), though structural factors may cause it to be copied as a vowel.

In some languages, such as Nisgha (Shaw 1987:295–296), the quality of epenthetic vowels is determined by agreement with an adjacent consonant. The situation is the same for the vowel in the Nancowry reduplicant: it shares place features with the adjacent coda, if any. For example, [coronal] place is shared in the form $\bar{\underline{it}}_3-s_1u_2t_3$, [labial] place is shared in $\bar{\underline{up}}_3-k_1U_2p_3$, and [dorsal] place is shared in $\bar{\underline{uk}}_4-i_2a_3k_4$. The emergent constraint, then, is one that compels assimilation; for concreteness, we adopt AGREE(Place) (Lombardi 1997, Gnanadesikan 1997, Baković 1999), which is violated by any pair of adjacent segments that do not share a place feature. Since unassimilated alternatives like $*\bar{\underline{ip}}_3-k_1U_2p_3$ or $*\bar{\underline{ap}}_3-k_1U_2p_3$ in fact do better on *PL/DORS than the actual output form $\bar{\underline{up}}_3-k_1U_2p_3$, AGREE(Place) must crucially dominate *PL/DORS (and *PL/LAB). And since AGREE(Place) forces noncopying and emergence of a (contextually determined) default vowel, it must also dominate MAX-V_{BR} and DEP-V_{BR}. This too is emergent unmarkedness, though of the context-sensitive variety (cf. (10), (12)). Assimilation of nucleus to coda is not a general phenomenon of Nancowry, but it appears in the reduplicant, paralleling the behavior of epenthetic default segments in languages like Nisgha.

Though the reduplicant's onset and nucleus show emergent unmarkedness, copying still goes on in Nancowry root-finally. Place markedness is crucially dominated, then, by a constraint requiring faithful copying of the root-final consonant. That constraint is R-ANCHOR_{BR}(Root, Reduplicant), which demands that the segment at the right edge of the root stand in correspondence with a segment at the right edge of the reduplicant. Usually, prefixing reduplication favors left-anchoring over right-anchoring (L-ANCHOR_{BR} \gg R-ANCHOR_{BR}), with the opposite situation obtaining in suffixing reduplication. But free permutation of ranking predicts the possibility of reversal, as in Nancowry. Observe also that the copied root-final consonant is not at liberty to change its place of articulation to achieve improvement on place markedness or AGREE(Place), so *kUp* cannot reduplicate as $*\bar{\underline{it}}_3-k_1U_2p_3$ or $*\bar{\underline{uk}}_3-k_1U_2p_3$. This shows that IDENT_{BR}(Place) is ranked above both place markedness and AGREE(Place).

Summing up, we have argued that Nancowry ranks the place-markedness hierarchy and AGREE(Place) above various BR correspondence constraints: MAX-C_{BR}, MAX-V_{BR}, their DEP counterparts, and L-ANCHOR_{BR}. Hence, unmarked structure emerges in both the onset and the nucleus of the reduplicant: the onset is $\bar{}$ and, by virtue of AGREE(Place), the nucleus shares place features with the following coda. But despite this pattern of noncopying and emergent unmarkedness, the root-final consonant must be copied faithfully, because R-ANCHOR_{BR} and IDENT_{BR}(Place) are top-ranked.

The interplay among these factors can be seen in tableau 9. Candidate (a) is optimal. It

Tableau 9

/RED-na λ → ?u λ -na λ ‘dust, mushroom’

/RED-na λ	R-ANCHOR _{BR} , IDENT _{BR} (Place)	AGREE(Place)	*PL/DORS	*PL/LAB	*PL/COR	*PL/PHAR	MAX-C _{BR} , MAX-V _{BR}
a. $\overline{u\lambda} - n_1 a_2 \lambda$?u, λn , na, a λ	$\widehat{u\lambda} \lambda$	u	n	? $, a$	n, a
b. $n_1 a_2 \lambda - n_1 a_2 \lambda$		na, a λ !, λn , na, a λ	$\lambda \lambda \lambda$		n, n	a, a	
c. $n_1 \overline{u\lambda} - n_1 a_2 \lambda$		nu, λn , na, a λ	$\widehat{u\lambda \lambda}$	u	n!, n	a	a
d. $\overline{\lambda n}_3 - n_1 a_2 \lambda$	*!	?i, na, a λ	λ		$\widehat{i n n}$? $, a$	n, a
e. $\overline{\lambda} - n_1 a_2 \lambda$	*!	?i, na, a λ	λ		i, n	? $, a$	n, a, λ

copies the root-final $\widehat{}$, as demanded by R-ANCHOR_{BR}, but otherwise it allows unmarked structure to emerge in the reduplicant (default onset, linked nucleus). Unlike (a), form (b) has perfect copying, but at the expense of a fatal violation of AGREE(Place). (Violations of AGREE(Place) are indicated by showing the offending pair of nonagreeing adjacent segments.) Form (c) fares worse on the place-markedness hierarchy, because it does not have a default onset in the reduplicant. Finally, forms (d) and (e) have produced markedness improvement by altering or failing to copy the root-final consonant, contrary to the dictates of IDENT_{BR}(Place) and R-ANCHOR_{BR}. These candidates help make the point that R-ANCHOR_{BR} defines a specific condition where BR faithfulness is strongly enforced, though other important constraints on BR faithfulness (MAX_{BR}, L-ANCHOR_{BR}) are low-ranking.

Other candidates, not considered in tableau 9, involve other ways of satisfying AGREE(Place), by linking place between onset and nucleus in addition to (or instead of) nucleus and coda, as in $^*-\underline{a}_2 \widehat{\lambda} - n_1 a_2 \widehat{\lambda}$, $^*r_1 \underline{i n}_3 - r_1 u_2 n_3$, or $^*p \underline{u m}_3 - c_1 i_2 m_3$. Place linkage of CV sequences is not observed in the Nancowry reduplicant, though linkage of tautosyllabic VC sequences is pervasive. It is known that the possibility of autosegmental linkage may depend on the prosodic roles of the segments involved (Fu 1990, Itô and Mester 1995:838, Itô, Mester, and Padgett 1995:600ff., Lamontagne 1993:135, Selkirk 1990a,b). In Nancowry, then, a constraint against CV linkage must dominate AGREE(Place).

The analysis thus far accounts for the stop-final roots ((a,c) in table 1). We turn now to roots ending in the continuants *s*, *fi*, *w*, or *y* ((b,d) in table 1). The reduplicant ends in a vowel that is homorganic to the root-final consonant: *i* when the root ends in *s* or *y* (*i-tus*, *i-ruay*) and *u* when the root ends in *fi* or *w* (*u-tuaf*, *u-h:w*). The core of our proposal is that these roots satisfy R-ANCHOR_{BR} just as the roots ending in stops do, but they do so by altering the copied segment from a continuant to a vowel. Formally, the root-final consonant stands in correspondence with the reduplicant-final vowel: $\underline{i}_3 - t_1 u_2 s_3$, $\underline{u}_3 - h_1 : w_3$, and so on. R-ANCHOR_{BR}, which demands correspondence between the rightmost segments of base and reduplicant, is satisfied here just as it is with the stop-final roots, but there is a mismatch of featural makeup (*i/s*, *u/fi*) and prosodic role (*i/y*, *u/w*) between the corresponding segments.

We will focus on the featural disparity. When *s* is placed in correspondence with *i* or *fi* with *u*, there is disparity of stricture, and since BR correspondence is at issue, the constraint being

violated is of the IDENT_{BR} family. This violation of IDENT_{BR} must be compelled by an emergent markedness constraint. There are two likely candidates for what it is. One is a constraint banning continuants from coda position (Steriade 1988, Zec 1995:111–112). The other is general No-Coda. Either way, the responsible constraint is one that has an established basis in the inventory structure of whole languages, in conformity with (7)–(8).

The first alternative is easy to work out, so here we will address the second, which is a little more subtle. The idea is that No-Coda forces reduplicative vocalization in $\underline{_i}_3\text{-}t_1u_2s_3$ and $\underline{_u}_4\text{-}t_1u_2a_3\text{fi}_4$. But reduplicative vocalization of a stop ($*\underline{_u}_j\text{-}kUp_j$, $*\underline{_u}_j\text{-}rom_j$) is not possible, and then the reduplicant has a coda ($\underline{_u}p_j\text{-}kUp_j$, $\underline{_u}m_j\text{-}rom_j$). It falls to the IDENT_{BR} constraints to distinguish the permissible B → R mappings ($s \rightarrow i$, fi → u) from the impermissible ones ($t \rightarrow i$, n → i, p → u, m → u).

A phonological scale is one way to make sense of these IDENT_{BR} constraints. Drawing evidence from lenition, coalescence, and inventories, Gnanadesikan (1997) proposes that stricture is expressed by values on a ternary scale (supplanting [continuant] and [consonantal]).²¹

(21) *Consonantal stricture (CS) scale*

CS1 stop > CS2 fricative/liquid > CS3 vocoid/laryngeal

Faithfulness on a scale has a natural interpretation: a change of only one step is more faithful than a change of two steps.

(22) *Faithfulness on the CS scale* (Gnanadesikan 1997)

a. IDENT(CS)

Corresponding segments must have identical values on the CS scale.

b. IDENT^{Adj}(CS)

Corresponding segments must have identical or adjacent values on the CS scale.

IDENT(CS) is violated whenever IDENT^{Adj}(CS) is, but not vice versa, so two-step movements always incur worse faithfulness violations than one-step movements, other things being equal.

In Nancowry, No-Coda is able to compel violation of IDENT_{BR}(CS) but not of IDENT_{BR}^{Adj}(CS). The ranking argument in tableau 10 shows why a deviation of one step on the CS scale is permissible to achieve a codaless reduplicant, and the argument in tableau 11 shows why a deviation of two steps is not. These tableaux also confirm the decisive role of top-ranking R-ANCHOR_{BR}, which demands that the root-final consonant have a correspondent in the reduplicant.

This concludes the main points of our analysis of Nancowry, which is summarized in (23).

(23) *Ranking summary—Nancowry*

a. Place-markedness hierarchy >> MAX-C_{BR}, DEP-C_{BR}

Improvement in place markedness is achieved by noncopying of the onset, substituting a default.

²¹ Relevant earlier work on phonological scales or *n*-ary features includes Clements 1990, Ladefoged 1971, Selkirk 1984, and Williamson 1977.

Tableau 10No-CODA >> IDENT_{BR}(CS)

/RED-tus/	R-ANCHOR _{BR}	IDENT _{BR} ^{Adj} (CS)	No-CODA	IDENT _{BR} (CS)
a. $\text{t}_3\text{-t}_1\text{u}_2\text{s}_3$			*	*
b. $\widehat{\text{t}}\text{s}_3\text{-t}_1\text{u}_2\text{s}_3$			**!	
c. $\text{t}\text{u}_2\text{-t}_1\text{u}_2\text{s}_3$	*!		*	

Tableau 11IDENT_{BR}^{Adj}(CS) >> No-CODA

/RED-cat/	R-ANCHOR _{BR}	IDENT _{BR} ^{Adj} (CS)	No-CODA	IDENT _{BR} (CS)
a. $\text{t}_3\text{-c}_1\text{a}_2\text{t}_3$			**	
b. $\widehat{\text{t}}_3\text{-c}_1\text{a}_2\text{t}_3$		*!	*	*
c. $\text{t}\text{a}_2\text{-c}_1\text{a}_2\text{t}_3$	*!		*	

- b. AGREE(Place) >> MAX-V_{BR}, DEP-V_{BR}, place-markedness hierarchy
The nucleus of the reduplicant is an assimilated default vowel rather than a copy.
- c. MAX-C_{IO}, MAX-V_{IO} >> AGREE(Place) >> place-markedness hierarchy
Segments outside the reduplicant are not generally deleted or assimilated.
- d. R-ANCHOR_{BR}, IDENT_{BR}(Place) >> place-markedness hierarchy
The root-final consonant is copied faithfully despite the attendant cost in markedness.
- e. IDENT_{BR}^{Adj}(CS) >> No-CODA >> IDENT_{BR}(CS)
To avoid a coda in the reduplicant, the final consonant of the base is copied as a vowel, but only if it is similar to a vowel structurally.
- f. MAX-C_{IO}, IDENT_{IO}(CS) >> No-CODA
The language as a whole has codas, including both stops and continuants.²²

Overall, this is a typical case of TETU: IO faithfulness stands at the top of the hierarchy, BR faithfulness stands at the bottom, and markedness constraints on codas and place are in the middle. Two BR correspondence constraints are located at the top, however, and they give the system much of its interest. R-ANCHOR_{BR} ensures that the root-final consonant is reduplicated, though place markedness would be better served by not copying it. And IDENT_{BR}^{Adj}(CS), combined with R-ANCHOR_{BR}, forces CVC reduplicants with stop-final roots, in spite of No-CODA.

Several other markedness constraints are also emergent in the reduplicant. A constraint against palatal codas is evidenced by the pattern in (a) of table 1. That same constraint is inventory-

²² Because the reduplicant is unstressed, its TETU characteristics must be measured against those of other unstressed syllables. The evidence for unstressed syllables in the language as a whole is somewhat limited: infixation into disyllabic stems (/paló-/ → *pumló-*), the “particles” (Radhakrishnan 1981:82), and the loan *kulmore* ‘gold’ (Radhakrishnan 1981: 19).

defining in Korean and Sanskrit, which lack palatal codas categorically. The constraints granting default status to *i* emerge with vowel-final roots ((g) of table 1), which usually reduplicate with $\underline{\text{-}i}\text{-}$. The behavior of laryngeal-final roots ((e,f) of table 1) suggests two more TETU effects. First, neither - nor *h* appears as a coda in the reduplicant. Plausibly, this is another emergent constraint that is independently attested as a restriction on inventories (English *h*, Semitic gutturals (McCarthy 1994)). Second, Nancowry generally permits *i*, *u*, and *a* in unstressed syllables, but only *i* and *u* in the reduplicant, even with a laryngeal-final root. This too is an emergent constraint: see REDUCE (15) and alternatives discussed in section 2.1.2. Our system therefore predicts consistent $\underline{\text{-}i}$ -reduplication with laryngeal-final roots. In fact, the more common *h*-final roots divide between a majority with $\underline{\text{-}u}\text{-}$ and a large minority with $\underline{\text{-i}}\text{-}$, whereas the few - -final roots all reduplicate with $\underline{\text{-}u}\text{-}$. We do not have a satisfactory explanation for this, though Radhakrishnan (1981) proposes a kind of laryngeal-dorsal connection (see Merlingen 1977:44ff.).

A system with Nancowry's richness bears on many of the claims developed in section 2.1.1. The reduplicant's segmental inventory is certainly a proper subset of the whole language's (7). The fixed - onset of the reduplicant converges with the independently necessary default onset in epenthesis situations (11). The vowel of the reduplicant is high, but otherwise varies depending on the final consonant of the base (12). And the coda restrictions involve constraints that have inventory-defining force in other languages (8)–(9). Constraint ranking and violation—essential to OT—allow a complex pattern of interdependencies in the reduplicant to be derived from these simple markedness constraints.

In contrast, the prespecification model cannot deal with the facts of Nancowry even descriptively. The argument recapitulates one made previously, and we will not belabor it here. It is more interesting to examine an earlier account of Nancowry set within another framework, Steriade's (1988) FCM. As we noted previously, Steriade's insight that markedness plays a role in defining templates is an important one (shared in part with Shaw 1987)—and this insight finds fullest expression in OT through the TETU rubric (McCarthy and Prince 1994a,b). But the FCM treats only the prosodic structure of the reduplicant in markedness terms; fixed segmentism in the reduplicant is attributed to an apparatus of special postcopying phonological operations. According to Steriade (1988:133–134), Nancowry supplies an argument for this distinction.

The argument rests on examples with root-final continuants like $\underline{\text{-i}}\text{-as}$ 'sneeze'. The derivation proceeds something like this:

(24) *FCM derivation of $\underline{\text{-i}}\text{-as}$*

Input	-as
a. Full copy	$\text{-as-} \text{-as}$
b. Fixed-segmentism phonological operations	
Onset Substitution (-), Nucleus Substitution (<i>u</i>)	$\text{-us-} \text{-as}$
Assimilation ($u \rightarrow i / \underline{\text{_____}}$ [coronal])	$\text{-is-} \text{-as}$
c. Template matching	$\text{-i-} \text{-as}$

Stage (a) is full copying of the base. Ordered rules then apply (only to reduplicants) at stage (b). The last of these, Assimilation, shows why *s* must be copied at stage (a): it is needed to condition

assimilation, which replaces the fixed vowel *u* with *i* before a coronal. Then at stage (c) *s* deletes because it cannot be accommodated to the template, which permits only stops as codas. The information needed to apply Assimilation is available only at an intermediate stage of the derivation, after copying and before template matching. This intermediate stage is one reason why the FCM attributes fixed segmentism and templates to entirely different mechanisms.²³

The analysis that we have presented eliminates the need for this intermediate stage and hence allows both fixed segmentism and templates to be subsumed under a single rubric, TETU. Where the FCM posits a component of apparently unrestricted rewrite rules like those in (24b), we have argued that fixed segmentism comes from the same source as inventories, defaults, and phonological alternations generally: markedness constraints.

2.6 Summary

OT posits a few primitives to account for phonology and reduplicative morphology: universal markedness constraints, faithfulness constraints in the IO and BR dimensions, and adjudication of constraint conflict through ranking. We have argued that these primitives are enough to yield an articulated theory of reduplicative fixed segmentism, one that makes connections between fixed segmentism and the properties of inventories, defaults, and phonological processes, and that successfully characterizes the conditions under which “fixed” segmentism alternates.

Before going on to look at the morphological type of fixed segmentism, we will mention several other lines of research that connect with our results.

Yip (1993, 1998, to appear a) argues that a class of dissimilatory, identity-avoiding constraints, shared by morphology and phonology, is responsible for cases where the reduplicant and base are required to differ in some characteristics. Since identity avoidance also occurs in nonreduplicative phonology (Alderete, in preparation), this type of fixed segmentism is consistent with a TETU model.

We have not addressed tone in reduplication, but our results also have parallels in the tonal domain (see Myers and Carleton 1996, Akinlabi 1997). Myers and Carleton (1996:67) argue that, in some reduplicative patterns of Chichewa, “tone is subject to the same correspondence as any feature, and . . . non-correspondence can be attributed to general patterns of neutralisation.” This is precisely a description of the effects of markedness constraints on the reduplicant.

Shaw (1987) argues that markedness-like notions of structural simplification shape the reduplicant in Nisgha. For example, affricates become fricatives in the reduplicant’s coda, though affricate codas are permitted generally in the language. In our terms, a constraint prohibiting coda affricates is emergent in Nisgha—a constraint that also governs the whole inventory of Zuni (Newman 1965:13). Likewise, in Nuxalk (Carlson, to appear), restrictions on the reduplicant’s coda can be understood as emergence of constraints that are independently attested in inventory-

²³ Stuart Davis and a reviewer suggest that the rule-ordering effects of the FCM could be simulated in OT by invoking the sympathy relation (McCarthy 1998). This would not change the point of our argument: the FCM wrongly attributes fixed segmentism and templates to unrelated mechanisms.

defining rankings in other languages. For instance, postvelar and labialized codas are barred from the reduplicant by constraints that also function as general inventory restrictions in Bedouin Arabic (McCarthy 1994) and Zuni (Newman 1965), respectively. Such convergence between restrictions on reduplicants and restrictions on inventories strongly supports this approach.

3 Fixed Segmentism as Morphology: Overwriting

We now turn to the morphological type of fixed segmentism. In section 3.1 we will sketch an OT implementation of *overwriting* (McCarthy and Prince 1986, 1990). We will then return in section 3.2 to the phonological type of fixed segmentism, distinguishing the two types, identifying regions of overlap, and investigating what kinds of hypothetical patterns could not be subsumed under either one and are therefore predicted not to occur in any language.

3.1 Overwriting

The phonological, TETU type of fixed segmentism was the focus of discussion up until this point. In that type the choice of fixed segments is determined, often contextually, by phonological markedness constraints that are part of UG. We now turn to the other type of fixed segmentism, exemplified by Kamrupi (2) or English *schm*-words: *table-schmable*, *Oedipus-Schmoedipus* (*Time* magazine), *resolutions-schmesolutions* (3 Musketeers advertisement).

McCarthy and Prince (1986, 1990), Yip (1992), and Bruening (1997) argue that the identity of the fixed segmentism in overwriting is determined morphologically. In English the overwriting string *sm-* is a prefixal morpheme, and so its properties are those of prefixes and other bound morphemes generally. The same is true for Kamrupi *s-*. But unlike conventional prefixes, *sm-* and *s-* overlap with or “overwrite” the reduplicant, so their presence interferes with reduplicative copying.

Evidence for the affixal status of the overwriting string is abundant.²⁴ First, overwriting strings have faithfulness properties that are typical of affixes. Overwriting strings can contain marked structures (witness Kamrupi, English, and the other examples below), and contrasts among overwriting strings are possible, since a single language can have more than one overwriting string with no phonological conditioning of the choice. For instance, Hindi (Singh 1969) overwrites with *w-*, *s-*, and (rarely) *m-*. Markedness and the possibility of contrast are typical of affixes but strikingly different from phonological defaults like those discussed in section 2.

Second, overwriting strings have the alignment properties of affixes. An important contribution of research in OT is the idea that affixal position is determined by rankable, violable constraints. In most cases affixes are aligned with the left or right periphery, but infixation can be compelled by higher-ranking constraints, as in Tagalog *b-um-ilih* ‘buy’ (Prince and Smolensky 1993). Overwriting strings are strongly tropic to the periphery, as we would expect if they are affixes (Yip 1992). Kamrupi and English have overwriting prefixes; examples of overwriting suffixes include Tzeltal *-n* (Berlin 1963:215) and Telugu *-33a* (Bhaskararao 1977:9). There is also

²⁴ In making this argument, we have placed particular reliance on the insights of Yip 1992.

Tableau 12 $\text{MAX}_{\text{IO}} >> \text{MAX}_{\text{BR}}$ in *table-šmable*

/table-RED-šm/	MAX_{IO}	MAX_{BR}
a. table <u>table-šmable</u>		<i>t</i>
b. <u>table-table</u>	šm!	
c. šmable-table	<i>t!</i>	šm
d. šmable-šmable	<i>t!</i>	

an analogue to infixation in overwriting. In Marathi (Apte 1968) an affix consisting of just the vowel *-u-* overwrites the nucleus of a peripheral syllable: *saman/saman-suman* ‘luggage’/‘luggage, etc.’.

Third, overwriting morphemes can alternate by suppletion or allomorphy just like other affixes. Suppletive alternation of overwriting affixes is often caused by dissimilatory constraints (Yip 1993, 1998, to appear a). For instance, Telugu, with *gi-* usually, selects the alternant *pi-* when the word already starts with *gi* (*gilaka-pilaka* ‘rattle, etc.’). Yip argues that the constraint forcing suppletion is part of a general pattern of identity avoidance in phonology and morphology.²⁵

Finally, in some languages the overwriting string is an affix that also occurs independently of reduplication (Downing, to appear).

Once it has been established that overwriting strings are indeed affixes, it only remains to say how they are realized in reduplicated words. Precisely because they are affixes, overwriting strings are subject to alignment and IO faithfulness constraints that are typical of affixes. For example, English *šm-* is a prefix, and so it is subject to the usual prefical alignment requirement ALIGN-L(Prefix, PrWd). And like any affix, when *šm-* is present in the input, its corresponding presence in the output is demanded by the IO faithfulness constraint MAX_{IO} .

The only thing special about overwriting strings, then, is overwriting itself. We assume that overwriting affects the reduplicant, while the base remains intact (so the reduplicant is postposed in *table-šmable*).²⁶ Therefore, the presence of an overwriting morpheme indicates that IO faithfulness to the overwriting morpheme has taken precedence, through ranking, over BR faithfulness constraints. Tableau 12 establishes this result formally. Form (b) in this tableau has deleted the prefix *šm-*, a fatal mistake given the preeminence of IO faithfulness in the hierarchy. The other failed candidates (c,d) preserve *šm-*, but have overwritten the base with it, leading to equally fatal IO faithfulness consequences. In contrast, (a) preserves *šm-* and the base by tolerating defective

²⁵ Suppletion can involve complete blocking of a morphological process through domination of the constraint M-PARSE (Prince and Smolensky 1993).

²⁶ A reviewer asks whether the overwriting string is part of the formal reduplicant or not—*table-šmable* or *table-šmable*? We know of no evidence bearing on this technical matter; it is relevant to whether overwriting violates DEP_{BR} as well as MAX_{BR}.

copying. This ranking argument explains why overwriting is common in reduplication but not elsewhere: reduplication has distinct IO and BR correspondence relations, so it is possible to overwrite the reduplicant while maintaining faithfulness to the underlying form (cf. Struijke 1998).

Following McCarthy and Prince (1986, 1990) and Yip (1992), we have argued that the overwriting string is an affixal morpheme. We now turn to explicit comparison between this morphological source of fixed segmentism and the phonological source discussed in section 2.

3.2 Phonological and Morphological Fixed Segmentism Compared

In section 2 we showed how phonology can produce patterns of fixed segmentism through TETU. In section 3.1 we showed how morphology can also produce patterns of fixed segmentism, through alignment of an affixal morpheme in the reduplicant. In positing these distinct sources for fixed segmentism, we follow McCarthy and Prince (1986) and depart from approaches that seek to unite all such phenomena under a single rubric like prespecification or postcopying substitution operations. Our goal in this section is to show why both types are required, where they differ, where they overlap, and where neither is applicable.²⁷

The theory of phonological fixed segmentism is based on the TETU ranking. In this way, M has no inventory-defining power in the language as a whole, but it does have inventory-defining power in the reduplicant. This theory leads to a number of consequences (from section 2.1): a subset relation between the reduplicant's inventory and the whole language's (7); a crosslinguistic correlation between restrictions on reduplicant inventories and restrictions on whole language inventories (8)–(9); consistency between fixed segmentism and independent evidence of default status (11); and the potential for conditioned variability of ‘‘fixed’’ segmentism (12). In short, the theory of phonological fixed segmentism entails that it have exactly the properties of phonology generally.

The theory of morphological fixed segmentism is based on affixation. Again, there is an associated set of claims inferable from the fixed segments' affixal source (section 3.1).

(25) *Properties of morphological fixed segmentism based on affixation*

- a. Morphological fixed segmentism has the faithfulness properties of an affix. Its inventory structure is that of affixes generally, and contrasts are possible.
- b. Morphological fixed segmentism has the alignment properties of an affix. It is peripheral or minimally displaced from peripheral position under crucial domination.
- c. Morphological fixed segmentism has the context-sensitivity of an affix. It participates in any phonological process that affects other affixes, and it can alternate suppletively.

In short, the theory grants morphological fixed segmentism the properties of affixation generally.

²⁷ See Yip, to appear b, for discussion of these criteria and applications to Chinese.

We have shown that the theories of phonological and morphological fixed segmentism have different abstract properties. The empirical domains that they carve out are also mostly distinct.²⁸

Apart from suppletive allomorphy, alternating “fixed” segmentism can only be subsumed under the phonological theory (see (12)). Examples discussed here include the Lushootseed and Igbo nucleus (section 2.3), the Tübatulabal coda (section 2.4), the Nancowry nucleus and coda (section 2.5), and the coda restrictions of Nuxalk and Nisgha mentioned in section 2.6. For all of these cases, we have argued that the appearance or nature of the fixed segmentism is contingent on the interaction of phonological markedness constraints with BR identity constraints. There is no way to make sense of these contingencies in affixational terms.

Conversely, the phenomena discussed in section 3.1 cannot be understood phonologically, though they have a straightforward affixational analysis. A phonological account is impossible because there is no markedness constraint consistent with the phonological criteria in (7)–(12) that would also favor emergence of something like *šm-*.

Because of these differences, various imaginable systems of fixed segmentism should not exist if the proposals here are correct. Here are some hypothetical examples:

First, suppose a case of fixed segmentism shows a distinctly phonological pattern of emergent context-sensitivity, such as an assimilatory process that is not general in the language, like Nancowry. It must therefore be analyzed in TETU terms (compare the criteria (12) and (25c)). But this entails that the fixed segmentism also meet the TETU markedness criteria in (7)–(12). Concretely, a counterexample to our proposals would therefore be a fixed initial *s* (an unlikely default) that palatalizes to *š* before front vowels in a language where *s*-palatalization is otherwise never observed.

Second, suppose that the fixed segmentism shows a distinctly morphological pattern of context-sensitive alternation, like Telugu’s *pi-/gi-* suppletion (see (25c)). It must therefore be analyzed affixationally. We do not expect it at the same time to show the type of context-sensitivity that is diagnostic of TETU (12). Concretely, a counterexample to our proposals would therefore be a language that is like Nancowry in every respect except that accidental resemblance between reduplicant and base triggers identity-based suppletion in the form of the reduplicant.

Finally, suppose that the fixed-segmentism effect has templatic force, blocking copying but supplying no substitute, as in the Tübatulabal coda. This behavior is analyzable in TETU terms (see (12)), but it cannot be reconciled with the affixational model. Therefore, we predict, with GTT, that any such templatic effect will be interpretable in terms of markedness constraints of UG, with all that this entails (7)–(12). Concretely, a counterexample to our proposals would therefore be a language that banned only some arbitrary list of segments from the reduplicant’s coda.

In short, the general strategy to find potential counterexamples is this: look for systems that crosscut the correlated TETU criteria in (7)–(12) and affixation criteria in (25).

²⁸ There is some overlap at the phonology/morphology boundary. For example, Yoruba *i* or Tübatulabal *-* could in principle be analyzed either as phonological TETU or morphological affixation—though affixation would fail to account for the correlations with independently motivated defaults.

To sum up, we have argued that affixation, overwriting a portion of the reduplicant, provides a distinct source of fixed segmentism. We have presented an analysis of this phenomenon in alignment and faithfulness terms, and we have compared it in detail to the TETU type of fixed segmentism studied in section 2. The two types of fixed segmentism have different correlations of properties, and these correlations lead to predictions.

4 Conclusion

In this article we have examined the phenomenon of fixed reduplicative segmentism. We have argued that there are two types of fixed segmentism, phonological and morphological. The phonological type exhibits the properties of phonology generally, because it is based on the same universal markedness constraints as the rest of phonology, though their scope is limited by constraint ranking. The morphological type exhibits the properties of affixation generally, since it literally *is* affixation, but affixation simultaneous with the reduplicant rather than onto a base.

The general claims and the specific analyses are derived from a theory that posits literally no new constraints, devices, or other apparatus. Rather, the theory has only certain premises that it shares with OT as a whole: markedness constraints, faithfulness constraints set within correspondence theory, and constraint ranking and violation. This close match between what is needed to analyze fixed segmentism and what is needed independently strongly supports the approach taken here and offers a challenge to alternative models.

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