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Featural affixation[1]

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Underlyingly free (floating) features occur crosslinguistically. These features sometime function as morphemes. Such features, like segmental morphemes, often refer to specific edges of the stem, hence they are ‘featural affixes.’ They get associated with the base to be prosodically licensed. We propose to account for the association of such features through a family of alignment constraints called ‘featural alignment’ which is a featural version of McCarthy & Prince’s Align (MCat, MCat). Under featural alignment, an edge is defined for a feature based on a possible licensor, which may be a root node or a mora. We argue that misalignment takes place under pressure from feature cooccurrence constraints. Thus a featural suffix may get realized elsewhere in the stem, surfacing as a featural infix or even as a featural prefix. This constraints based approach is preferred to rule based approaches since it does not require a variety of additional assumptions needed within rule based approaches to account for the same phenomenon. These include structure preservation, prespecification, extratonality and filters.

1. Introduction: The Problem

It is a well known crosslinguistic fact that phonological features may function as grammatical morphemes. This phenomenon is usually discussed under the general rubric of ‘nonconcatenative morphology’ in recent texts on morphological theory (see for example Spencer (1991). The most commonly found cases and thus by implication the most commonly cited, are tonal. An example is the associative marker in Bini (Amayo 1976), exemplified in (1). (The forms before the arrow indicate the isolation forms of the nouns and the forms after the arrow are associative constructions. For clarity the tones in the examples in (1) are indicated with both tone marks and the letters L, H for Low and High respectively.)

(1) *Bini* (Amayo 1976)

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ɔ̀wɛ̀        ɔ̀sà           →    ɔ̀wɛ́ ɔ̀sà     [ɔ̀wɔ́!sà]
|   |       |  |               |   | |  |
L   L       L  L               L  H L  L

‘leg’       ‘chimpanzee’       ‘a chimpanzee’s leg’

àmɛ̀        èhỹɛ̃́          →    àmɛ́ èhỹɛ̃́    [àmé!hỹɛ̃́]
|  |         |   |             |   | |   |
L  L        L   H              L  H L  H

‘water’     ‘pepper’           ‘solution of water and pepper’

ɔ̀wɛ̀        ɔ̀nà           →    ɔ̀wɛ́ ɔ̀nà     [ɔ̀wɔ́!nà]
|  |        |  |               |   | |  |
L  L        L  L               L  H L  L

‘leg’       ‘this one’         ‘this one’s leg’
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Each of the input nouns in the leftmost column is underlyingly low toned. We have specified each as having two low tones for reasons of exposition, but we assume formally that a single low tone is associated with both vowels in each noun, following the Obligatory Contour Principle (Leben 1973, McCarthy 1986). In the output associative constructions, on the other hand, the final syllable of the first noun is high toned. The obvious deduction here is that the associative morpheme is a high tone, which gets realized on the last syllable (or mora) of the head noun.

Several cases of nontonal features functioning as grammatical morphemes have also been described in the literature. A representative list is given in (2).[2]

(2) *Nontonal examples of featural morphemes*:

(a) In Chaha, the third masculine object is indicated by labialization. (Johnson 1975; McCarthy 1983; Hendricks 1989; Rose 1993; Archangeli & Pulleyblank 1994)

(b) Nuer indicates tense/aspect distinctions with the features [continuant] and [voice]. (Crazzolara 1933, Lieber 1987)

(c) In Zoque, the third person singular is marked by palatalization. (Wonderly 1951)

(d) [nasal] is the first person possessive marker in Terena. (Bendor-Samuel 1960)

(e) The feature of "uncontrolledness" is signaled by palatalization in Japanese. (Hamano 1986, Mester & Ito 1989, Archangeli & Pulleyblank 1994, etc.)

(f) The noun class 5 is marked by voicing the first consonant of the root in Aka (Bantu, Zone C). (Kosseke & Sitamon 1993; Roberts 1994)

(g) Noun class morphemes in Fula include the features [continuant] and [nasal]. (Arnott 1970, Lieber 1984, 1987)

(h) The Athapaskan d-classifier consists solely of the feature [-continuant]. (Rice 1987)

In this article, my primary focus will be featural affixes such as those in (1) and (2). I will provide detailed analyses of several of the featural affixes above; and leave the reader to apply the general approach to the rest of the cases listed in (2) as well as to cases occurring in other languages. My goal is twofold. I will show that featural morphemes fall into the normal typology of prefixes and suffixes, and therefore do not require any new type of morphology. Also just as segmental morphemes can be misaligned with respect to their normal position (McCarthy & Prince 1993b), featural affixes can too. I argue that Optimality theory (Prince & Smolensky 1993) provides an excellent framework to account for these intuition and that the patterning of such morphemes is not surprising given Optimality theory.

First, I will pursue a line of thought which builds on recent advances in Optimality theory to account for the association of featural affixes through a family of morphological alignment constraints called Featural Alignment. In doing this I will be proposing a featural spellout of McCarthy & Prince's (1993b) Align (MCat, MCat), developed in Generalized Alignment, to account for the alignment of these features. Secondly, I will develop the theme that featural misalignment results when a feature co-occurrence constraint dominates an alignment constraint. This is parallel to (and in line with) McCarthy & Prince's original idea that prosodic constraints dominate morphological constraints to yield the phenomena of prosodic morphology. This single proposal of a feature co-occurrence constraint dominating an alignment constraint handles the same data for which a variety of additional theoretical assumptions have been employed in rule based approaches. These theoretical assumptions include 'structure preservation' (Chaha, McCarthy 1983), 'prespecification' (Nuer, Lieber 1987), 'extratonality' (Pulleyblank, 1986), and 'filters' (Terena, Gerfen 1993). The proposal here is not to reject any of these ideas as invalid theoretical constructs but that the assumption of constraint domination and violation in Optimality theory captures the same intuition without recourse to these assumptions; and therefore they may not be required in the treatment featural affixes. This proposal is thus preferred for that reason.

2. Theoretical Assumptions

2.1 Generalized Alignment

The general approach employed in the analysis of featural affixes in this paper is that of Optimality theory (Prince & Smolensky 1993, McCarthy & Prince 1993a). The alignment constraints to be employed are based on the following general schema which McCarthy & Prince (1994: 338-339) propose for the well-formedness constraints on the alignment of morphological and/or prosodic categories.

(3) *Generalized Alignment* (GA)
Align (Cat1, Edge1, Cat2, Edge2) $=_{def}$
$\forall$ Cat1 $\exists$ Cat2 such that Edge1 of Cat1 and Edge2 of Cat2 coincide.
where
Cat1, Cat2 $\in$ PCat $\cup$ GCat (Prosodic and Grammatical categories)
Edge1, Edge2 $\in$ {Right, Left}

Informally, Align (Cat1, ..., Cat2, ...) says that "each instance of Cat(egory)1 shares a specific edge with an instance of Cat(egory)2." They give the following as typical examples of aligned structures, and of various values of Cat1 and Cat2.

(4) (a) $[_{PrWd}\ [_{Ft}$ Align(Ft, L, PrWd, L)
"Every Ft is initial in PrWd".
Align(PrWd, L, Ft, L)
"Every PrWd is Ft initial". (Ito & Mester 1992)
(b) $[_{Stem}\ [_{Af}$ Align(Af, L, Stem, L)
"Every Affix is a prefix in Stem".
(c) $]_{\sigma}\ ]_{Stem}$ Align(Stem, R, Syll, R)
"Every Stem ends on a syllable edge".
(Prince & Smolensky (1991, 1993)
(d) $]_{PrWd}\ [_{Af}$ Align(Af, L, PrWd, R)
"Every Affix subcategorizes for a preceding PrWd".

Generalized Alignment unites these various types of alignment; within the prosodic hierarchy (4a), the morphological hierarchy (4b), and between prosodic and morphological constituents (4c,d).

2.2 Featural alignment

Within the above general schema of GA, I propose that the alignment of all featural affixes may be subsumed under Featural Alignment (5). Featural Alignment simply expands this notion to the alignment of features (see Kirchner 1993).[3]

(5) *Featural Alignment*
Align (PFeat, GCat)
A prosodic feature is aligned with some grammatical category.

PFeat consists of a set of prosodic features in the Firthian sense of the word, features which span grammatical categories. As is well known, such features may include pitch, nasality, roundness, palatalization, and the like (see Firth 1948). PFeat is the featural spellout (or content) of the morphological category in question.[4] (5) is a version of (4b); thus what is in essence being aligned in (5) is the featural affix. Featural Alignment (5) aligns a featural element with specific edges of grammatical categories (such as a noun stem, a verb stem, etc.); this is therefore morphological alignment. Featural Alignment (5) does not however exclude alignment to prosodic categories. In sections 6 and 7 we discuss two cases in which we argue that, with featural affixes, alignment to prosodic categories usually involves a combination of morphological alignment and phonological alignment.

Under Featural Alignment an edge does not necessarily mean a morphological edge; an edge is defined for a PFeat based on possible licensor in a language. Universally, feature licensors can (only) be either a MORA or a ROOT NODE (Ito 1989; Ito & Mester 1993; Ito, Mester & Padgett 1993, etc.). Therefore while edges in tones refer to the initial or final mora, edges in nasal harmony and the like may refer to the first or last Root node; i.e. a real morphological edge, since the last licensor also coincides with the last segment of the morpheme (see Archangeli & Pulleyblank 1994).[5]

Such features as in (2), like segmental morphemes, often refer to specific edges of stems and thus are featural affixes (e.g. Chaha labialization and palatalization, Aka voicing, Zoque palatalization, etc.) While the fact that phonological features may function as grammatical morphemes is uncontroversial, the status of such features as prefixes or suffixes often remained muted in spite of traditional intuition, with some scholars contented with referring to the morphemes simply as ‘floating autosegments’.[6] The present study provides a formal account of traditional intuition. The reason why the status of featural affixes as prefixes or suffixes is often problematic is that while segmental affixes may be phonetically realized independently, featural affixes are always phonetically realized as part of some other segment or segments of the stem. The question therefore is why featural affixes get realized as part of the stem. The answer to this can be found in licensing. Features have to be licensed in order to get phonetically realized, therefore featural affixes must associate with a licensor in the stem or elsewhere.[7]

In their study of alignment in regular affixation, McCarthy & Prince (1993b: 103) observe that an alignment constraint, such as one that aligns the left edge of one morpheme with the right edge of another (as in Tagalog {*um-*} prefixation) may be violated when dominated by a prosodic constraint, such as one that disallows a coda. This may force a prefix to be realized as an infix. A major theme of Featural Alignment (5) is that a feature alignment constraint may be violated under pressure from a feature co-occurrence constraint, leading to misalignment (see Pulleyblank 1993). A featural suffix may for example be realized elsewhere in the stem, resulting in featural infixation.

In the following sections I illustrate how the ideas proposed above account for several of the phenomena in (2). In the discussion of Chaha (section 3), I show that a featural suffix [round] is realized as a featural infix or even as a featural prefix when a feature co-occurrence constraint and a parse constraint both dominate an alignment constraint, forcing the featural affix away from the edge. The opposite effect is derived when no such domination exists, as in Nuer (section 4). A comparison of Chaha and Nuer reveals that long distance versus local realization of a featural morpheme derives from alternative ranking of alignment constraints and parse constraints, as predicted by Optimality theory.[8] The state of affairs predicted by the possible rankings of the small set of constraints considered is presented in the appendix.

The tonal data from two closely related Edoid languages, Etsako and Bini (section 6), and the nasalization data from Terena (section 7) show situations in which featural morphemes span the entire base of affixation. Aside from confirming the proposals made with nontonal data from Chaha, Nuer, and Zoque regarding featural misalignment, the data also show that feature opacity versus transparency is derivable from higher versus lower ranking of the faithfulness constraint referring to the feature in question (Smolensky 1993). In the analyses of the Terena nasalization data and the Edoid tonal data, I suggest that these are still cases of prefixation and suffixation respectively, but in conjunction with harmony. Therefore they require no special treatment in this framework.

3. Chaha labialization

In Chaha, a Gurage language of Ethiopia, the third masculine singular object is indicated by labialization (with the suffix +n). (Johnson 1975; McCarthy 1983; Hendricks 1989; Rose 1993; Archangeli & Pulleyblank 1994). Labialization surfaces on the ‘rightmost labializable consonant’ of the stem. Labializable consonants in Chaha include labial and dorsal consonants, but not coronal consonants. The data in (7) - (10) (from McCarthy 1983: 179) show the surface realization of this morpheme.

(7) *Rightmost consonant of the stem is labializable*

without object	with 3rd m. sg. object	
dänäg	dänäg^{w}	‘hit’
nädäf	nädäf^{w}	‘sting’
näkäb	näkäb^{w}	‘find’

(8) *Medial consonant of the stem is labializable, final is not*

näkäs	näkʷäs	‘bite’
käfät	käfʷät	‘open’
bäkär	bäkʷär	‘lack’

(9) *Only the leftmost consonant of the stem is labializable*

qätär	qʷätär	‘kill’
mäsär	mʷäsär	‘seem’
mäkʸär	mʷäkʸär	‘burn’

(10) *No labializable consonant*

sädäd	sädäd	ɨchaseı

A number of observations are important here. Labialization must be realized only on the RIGHTMOST LABIALIZABLE CONSONANT, and on no other. This is obvious from the third example, näkäb --> näkäbʷ, in (7). Both of the last two consonants of the verb root in this example are labializable, but only the root final consonant is labialized. The medial consonant is not labialized because of this requirement of RIGHTMOSTNESS. In the forms in (8) all of the final consonants of the verb roots are coronal, e.g. näkäs, therefore only the root medial consonants, which are either labial or dorsal, are the RIGHTMOST; and so only these receive the labialization feature. Note further that the initial consonants in the last two examples, käfät and bäkär, are labializable but again are not labialized because of the requirement of rightmostness. In (9) the only labializable consonants of the verb root are the leftmost consonants, qätär --> qʷätär, and so by rightmostness receive labialization. Finally, in (10) none of the consonants is labializable and so the feature is not realized.

Our analysis of the above facts is as follows. Following earlier analyses we assume that the third person masculine singular object marker in Chaha is the feature [round]. It is a featural SUFFIX, as indicated by the insistence on rightmostness. In Chaha, [round] may be licensed by any consonantal Root node.

The data in (7) - (10) can be accounted for with a morphemic alignment constraint which aligns the 3m. sg. object [round] with the right edge of the stem. We give the specific alignment constraint as in (11).

(11) ALIGN-3M-SG
Align (3m. sg., R, Stem, R)
The right edge of the 3m. sg. must be aligned with the right edge of the stem. ‘3m. sg. is a suffix in stem.’

The alignment constraint explicitly treats the morpheme as a suffix, but the morpheme content is a feature [round], hence what the constraint aligns is the feature [round]. The right edge of the stem has to coincide with the feature [round], the featural content of the affix. Thus the [round] affix seeks out the rightmost consonantal Root node in the verb root for licensing, given the proposals about licensing and edges above. As noted in our description of the facts, coronal consonants cannot receive the labialization feature. This means that the feature [round] cannot be parsed with a coronal consonant. We can bar this with a feature co-occurrence constraint which forbids [round] from linking to a Root node associated to [coronal]. The constraint is given in (12). Constraints such as *COR/LAB (12) belong to the universal family of constraints on feature co-occurrence (Stanley 1967, Archangeli & Pulleyblank 1994).

(12) *COR/LAB
If [coronal] then not [round].

Finally it is necessary to ensure that an underlying affixal [round] is realized on the surface; hence we need a faithfulness constraint which enforces the parsing of [round]. Since [round] is a morpheme, this must be an instantiation of the universal (but violable) constraint which enforces the realization of morphemes. I will refer to it as PARSE-MORPH.[9] (See also Samek-Lodovici 1993.) The constraint is stated in (13).

(13) PARSE-MORPH
A morph must be realized in the output.

The particular instantiation of this universal constraint is PARSE-3M-SG (13’) which enforces the surface realization of the [round] affix in Chaha.

(13’) PARSE-3M-SG
3m. sg. must be realized in the output.

I will adopt the particular instantiation in (13’) for the case at hand.

The construction of a grammar in Optimality theory is a matter of determining the proper ranking of CON, the set of constraints out of which grammars are constructed. A constraint tableau such as the one in (14) is employed as a calculation device. Constraints are arranged on a tableau from left to right in order of domination. On a typical constraint tableau a (thick) line between two constraints indicates domination, but a dashed (or thin) line is used to show that there is no evidence of ranking between two constraints. Constraint violations are indicated by ☞, and fatal constraint violations are indicated by !. Below the fatal violations, cells are shaded to indicate their irrelevance to determining the comparison at hand. Finally, the optimal candidate is indicated by ☞. In this study I adopt a version of Optimality theory in which unparsed elements (which are stray erased) are not indicated in the output (see McCarthy & Prince 1995). This has the advantage of visibly differentiating unparsed elements from ‘floating’ elements (such as tones) in the output.

To begin with the most straightforward case, an output like näkäb --> näkäb^{w} ɨf̄ndı indicates that all else being equal, the optimal surface candidate is one in which the affix is realized on the surface in obedience of PARSE-3M-SG.

It is also one in which the affix is realized on the rightmost root (= stem) final consonant in obedience of ALIGN-3M-SG, and finally it is one in which the affix [round] is not realized on a coronal consonant as dictated by *COR/LAB. The first candidate in the tableau in (14) satisfies all these requirements.

(14) Input; näkäb, [rnd]; Output, näkäb^{w}

Candidates	*COR/LAB	PARSE-3M-SG	ALIGN-3M-SG
(a) ☞ n ä k ä b | [rnd]			
(b) n ä k ä b		*!	
(c) n ä k ä b \ [rnd]			*!
(d) n ä k ä b \ [rnd]	*!		**

GEN supplies the four candidates above (among others which are less viable), three of which violate one or more of the constraints. In the second candidate the feature is not realized on the surface, in violation of PARSE-3M-SG In the third candidate the feature is realized but not on the final consonant, in violation of ALIGN-3M-SG; and finally in the last candidate the feature is realized on a coronal consonant, in violation of *COR/LAB (and ALIGN-3M-SG). Since a candidate which satisfies the three constraints is possible, no other one can be optimal.

The tableau in (14) however does not show a conflict between the constraints; therefore it does not establish a ranking among them (i.e. it does not show that one constraint is more important than the other). Since all else is not always equal, we must examine cases in which the optimal form violates constraints. The interaction of the three constraints above accounts for the surface realization of the Chaha third person object labialization in those cases, and it is these cases that establish a ranking among the constraints.

First, outputs like [näk^{w}äs] show that *COR/LAB must dominate ALIGN-3M-SG The tableau in (15) illustrates this fact.

(15) *COR/LAB >> ALIGN-3M-SG, from (näkäs, [rnd]), output [näk^{w}äs]

Candidates	*COR/LAB	ALIGN-3M-SG
☞ n ä k ä s \\ [rnd]		*
n ä k ä s | [rnd]	*!	

In the above tableau, both candidates satisfy PARSE-3M-SG since the affixal [round] is realized at the surface in both forms. PARSE-3M-SG is thus irrelevant in this case. Note however that while [round] is realized on the medial consonant in the first candidate in violation of right alignment, [round] is parsed with the rightmost consonant in the second candidate, in violation of *COR/LAB. Since the first candidate which obeys *COR/LAB is optimal, *COR/LAB must dominate ALIGN-3M-SG That is, it is more important not to realize the [round] morpheme on an 'rightmost' consonant if that will create a labialized coronal than to do so. Perfect alignment is thus sacrificed in favour of a cooccurrence constraint.

Furthermore, an output such as [sädäd] shows that *COR/LAB must dominate PARSE-3M-SG, as illustrated in tableau (16).

(16) *COR/LAB >> PARSE-3M-SG from (sädäd, [rnd]), output [sädäd]

Candidates	*COR/LAB	PARSE-3M-SG
s ä d ä d | [rnd]	*!	
☞ s ä d ä d		*

A violation of *COR/LAB deriving the putative form *[sädäd^{w}] is illformed because it derives a labialized coronal, whereas not parsing [round] in violation PARSE-3M-SG, gives the correct output. PARSE-3M-SG may therefore be violated in favor of (satisfying) *COR/LAB, and is therefore dominated by *COR/LAB. Therefore, *COR/LAB dominates both ALIGN-3M-SG (11) and PARSE-3M-SG (13').

If we consider a third candidate in which the featural affix is not realized on the surface in addition to the two in the tableau in (15), we see immediately that PARSE-3M-SG (13') must dominate ALIGN-3M-SG (11). This implies that it is preferable to realize the morphemic feature [round] even if it is not perfectly aligned with the right edge of the stem.[10] The overall ranking of the three constraints is given in tableau (17).

(17) Overall ranking: *COR/LAB >> PARSE-3M-SG >> ALIGN-3M-SG; from (näkäs, [rnd]), output [näk^{w}äs].

Candidates	*COR/LAB	PARSE-3M-SG	ALIGN-3M-SG
n ä k ä s | [rnd]	*!		
n ä k ä s		*!	
☞ n ä k ä s \ [rnd]			*

Before concluding this discussion, we would like to highlight some of the results and consequences of the account proposed here and compare them with alternative rule-based accounts.

Chaha labialization is important because it reveals interesting properties of featural affixation, properties which make it parallel to segmental affixation. We find parallels here with McCarthy & Prince's (1993a,b) accounts of segmental affixation within OT. These studies show that prefixes appear on the surface as infixes when alignment constraints are dominated by prosodic constraints such as NO-CODA and ONSET in Tagalog and in Timugon Murut respectively. The Tagalog affix *-um-* "falls as near as possible to the left edge of the stem, so long as it obeys the phonological requirement that its final consonant *m* not be syllabified as a coda." (McCarthy & Prince 1993b: 79) Therefore, it appears as a prefix before a vowel initial word: *um* + *aral* --> *um-aral 'teach'*, but it appears as an infix when the word is consonant initial: *um* + *sulat* --> *s-um-ulat 'write'*, *um* + *gradwet* --> *gr-um-adwet 'graduate'*. The Timugon Murut reduplicative affix is infixed after an initial onsetless syllable: *abalan* --> *a-ba-balan 'bathes/often bathes'*; otherwise it is prefixed: *limo* --> *li-limo 'five/about five'*.

In parallel to the above, in the unmarked case, the third person masculine singular object [round] in Chaha appears as a FEATURAL SUFFIX in (7), associated with the final consonant of the stem, dänäg --> dänäg^{w} ɨh̄tɪ. When the final consonant is a coronal, the featural suffix is pushed in under pressure from higher ranking co-occurrence constraint *COR/LAB, emerging as the equivalent of a FEATURAL INFIX in (8), näkäs --> näk^{w}äs ɨb̄teɪ. This is indeed not the end. If the medial consonant is again a coronal then the featural suffix [round] recedes even further under the force of *COR/LAB, emerging as a FEATURAL PREFIX in (9), qätär --> q^{w}ätär ɨk̄llɪ.

In all autosegmental accounts of the above Chaha data that I am aware of (see for example McCarthy 1983, Leiber 1987, Archangeli & Pulleyblank 1994, and others), the feature [round] is formally characterized as a ‘floating morpheme’, but not as a ‘featural suffix’. It is understandable why previous studies shied away from seeing [round] as a ‘featural suffix’ in spite of the statement ‘rightmost’; there is no formal explanation for why a ‘suffix’ should end up on the first syllable! An Optimality theoretic constraint-based approach offers an explanation: [round] is forced from the featural suffix position by a higher ranking constraint. This is completely possible within a framework such as OT where constraints are violable when they are dominated by higher ranking constraints.

In rule based approaches, the class of ‘labializable consonants’ consist of labials and velars. Labialized coronals are ruled out by structure preservation (McCarthy 1983). But structure preservation is nothing more than a constraint! The use of structure preservation to rule out the class of coronal consonants from being labialized here is a tacit admission of the fact that RULES MAY BE VIOLATED, which is what forms the cornerstone of Optimality theory. The claim being made here is not that structure preservation does not work, but that the class of very class of ‘labializable consonants’ is unnecessary, at least for the purposes of the [round] morpheme. The Optimality theory explanation is assumes that any consonantal Root node can license [round]; that is, any consonant can potentially be labialized. A separate constraint takes care of feature co-occurrence. Optimality theory derives the effect of structure preservation in this case from a constraint rankable with respect to other constraints. The feature co-occurrence constraint is more important than the constraints requiring the surface realization of the 3m. sg. [round] and realizing it at the right edge, and these may be violated in favour of the co-occurrence constraint. This is what we see happening in Chaha.[11]

3.1 Conclusion

The two crucial issues of this article, the surface realization of featural affixes and the misalignment of featural affixes under domination by feature co-occurrence constraints, are exemplified with data from Chaha labialization above. The surface realization of a featural affix is crucially dependent on possible licensors, and the direction of association. Rightmostness of association in Chaha labialization implies featural suffixation.

The domination of an alignment constraint by a co-occurrence constraint forces a violation of right alignment, thus making a featural suffix appear elsewhere other than at the right edge of the stem. The domination *COR/LAB >> ALIGN-3M-SG forces the featural suffix away from the edge, and the relative importance of PARSE-3M-SG forces it to be realized elsewhere, as an infix or a prefix in this case.

The prediction of the analysis proposed here is that a reverse of the alignment situation in Chaha should possible; that is, it should be possible for a language to ‘insist’ on having a featural suffix at the edge and the edge alone. This is what we see in Nuer, to which we now turn.

4. Nuer Mutation

The consonant mutation process of Nuer, a Nilo-Saharan language of Sudan, presents an interesting contrast to Chaha, in that the featural suffix must be realized at the very right edge of the verb stem rather than anywhere else in the stem. If the featural suffix cannot be realized on the last consonant of the root due to a co-occurrence constraint it is simply not realized at all (see Chaha palatal prosody). Nuer thus presents a system in which alignment ranks higher than parse. This presents an interesting confirmation of a theoretical prediction; that re-ranking of the same set of universal constraints produces a different grammar.

In the Nuer verb roots, final consonant mutation is associated with various tenses and aspects in the verbal paradigms, as the following examples illustrate. The alternation is only productive in verbs and not in nouns. (All data are from Crazzolara 1933). The table in (18) summarizes the observed consonant alternations and the data in (19) provide examples. In the following examples each place of articulation is represented by two verb paradigms.

(18) *Nuer final consonant alternation* (Crazzolara 1933, Lieber 1987)[12]

	Labial	Interdental	Alveolar	Palatal	Velar
Voiced	b	dh	d	y	ɣ
Voiceless cont.	f	th	ʈ	ç	h
Voiceless stop	p	t̪	t	c	k

(19) *Verbal paradigms*[13]

(a) Labial final verbs	‘to overtake a person’	‘to scoop (food) hastily’
3rd sg. ind. pres. act.	cóbɛ́ jɛ̀	kɛ́bɛ́ jɛ̀
1st pl. ind. pres. act.	còɔfkɔ̀ jɛ	kɛ̀afkɔ̀ jɛ
Pres pple. neg.	còp	kɛp
Past pple.	cof	kɛ̀f

(b) Interdental final verbs	‘to suck’	‘to wade’
3rd sg. ind. pres. act.	lódhɛ́ jɛ̀	jä́dhɛ́ jɛ̀
1st pl. ind. pres. act.	loɔ̀thkɔ̀ jɛ	jä́thkɔ̀ jɛ
Pres pple. neg.	lot̪	jät̪
Past pple.	loth	jäth

(c) Alveolar final verbs	‘to sharpen’	‘to cut a point’
3rd sg. ind. pres. act.	paádɛ̀ jɛ́	wḯdɛ́ jɛ̀
1st pl. ind. pres. act.	páaʈkɔ́ jɛ̀	wëʈkɔ̀ jɛ
Pres pple. neg.	paat	wït
Past pple.	pàaʈ	wïʈ

(d) Palatal final verbs	‘to hit’	‘to dismiss a person’
3rd sg. ind. pres. act.	jáayɛ̀ jɛ	jyéeyɛ̀ jɛ
1st pl. ind. pres. act.	ja̋aɔkɛ̋ jɛ̀	jyáaçkɔ́ jɛ̀
Pres pple. neg.	jaac	jyèec
Past pple.	jaaç	jyeeç

(e) Velar final verbs	‘to throw away’	‘to find’
3rd sg. ind. pres. act.	yä́ɣɛ́ jɛ̀	jë́ɣɛ́ jɛ̀
1st pl. ind. pres. act.	yä̀kɔ̀ jɛ	jëkɔ̀ jɛ
Pres pple. neg.	yäk	jëk
Past pple.	yäh	jëh

First, Crazzolarra (1933: 102) notes that the verb root is monosyllabic in Nuer. Secondly, all verbs begin and end in consonants. I assume, following Lieber (1987), that the features implicated here are [continuant] and [voice]. I will also assume that the morphemes involved in the mutation consist of the following inputs.[14]

3rd sg. ind. pres. act. = [cont] ɛ
[voice]

1st pl. ind. pres. act. = [cont] k ɔ

Pres. pple. neg. = ∅

Past pple. = [cont]

The most important illustration of the themes of this paper is the past participial morpheme which under any analysis must include the feature [continuant]. I will illustrate with this example; leaving the reader to extend this analysis to the rest of the morphemes.

It is clear from the mutation cases in Nuer that the features involved are suffixes; since in two cases the free features actually form part of traditional segmental suffixes. In the case of the past participle morpheme however the entire content of the morpheme is the free feature [continuant]. [continuant] is licensed by a Root node in Nuer. This feature links to the rightmost consonant of the verb. I propose that this be formally accounted for with the alignment constraint in (20), and the PARSE-MORPH constraint in (21).

(20) ALIGN-PT-PPLE
Align(Pt. pple., R, Stem, R)
The right edge of the past participle is aligned with the right edge of the verb stem. ‘The past participle is a suffix in stem’.

(21) PARSE-PT-PPLE
The past participle must be realized in the output.

The alignment constraint in (20) formally defines the past participle morpheme in Nuer as a suffix. This morpheme happens to have just a single featural content [continuant]. The following tableau shows that all else being equal the morpheme must be realized on the last consonant of the verb stem.

(22) Input: pàat, [cont]

Candidates	ALIGN-PT-PPLE	PARSE-PT-PPLE
(a) ☞ pàaʈ | [cont]		
(b) pàat		*!
(c) fàat | [cont]	*!	

Crazzolara however notes that a number of segments do not undergo the mutation processes in Nuer. These segments consist the nasals m, n, nh (interdental nasal), ŋ, ɲ; and the liquids and glide l, r, and w. I will split these segments into two groups, the nasals on the one hand and the liquids and glide on the other.

I propose that the nasals do not undergo mutation because of a co-occurrence constraint forbidding the association of [continuant] to a consonant specified for [nasal]. The examples in (23) illustrate this fact.

(23) *Nonalternating final consonant*

	‘to see’[15]	‘to hear’
3rd sg. ind. pres. act.	nɛ́ɛnɛ̀ jɛ	ľḯiŋɛ́ jɛ̀
1st pl. ind. pres. act.	nɛ́ɛankɔ́ jɛ̀	ľieŋkɔ̀ jɛ
Pres pple. neg.	nɛ̀ɛn	ľiŋ
Past pple.	nɛ̀ɛn	ľîŋ

I state the co-occurrence constraint responsible as in (24) (see Cohn 1990, Steriade 1993, Padgett 1994).

(24) *NAS-CONT
If [nasal] then not [continuant].

Since morphemes with final nasals never alternate, and since [cont] does not show up anywhere else, both *NAS/CON and ALIGN-PT-PPLE must dominate PARSE-PT-PPLE Therefore in these cases [cont] must remain unrealized (i.e. unparsed). The following tableau illustrates the derivation and the constraint ranking.

(25) Input: nɛ̀ɛn, [cont]

Candidates	*NAS-CONT	ALIGN-PT-PPLE	PARSE-PT-PPLE
(a) nɛ̀ɛn | [cont]	*!		
(b) nɛ̀ɛn | [cont]		*!	
(c) ☞ nɛ̀ɛn			*

I assume that the remaining sonorants, liquids and glide undergo the process, though the surface forms appear invariant; i.e. [continuant] links vacuously to stems whose final consonants belong to this class, but without any apparent surface effect since they are already continuants.[16]

In conclusion, [cont] in Nuer provides a significant contrast to labialization in Chaha. In both Chaha and Nuer, the featural affix is a suffix, given the insistence on linkage to the final consonant. This is formally captured by the alignment constraints specifying that the right edge of the affix coincides with the right edge of the stem. In both languages, the featural content of the affix cannot co-occur with a class of segments. This results in the nonrealization of the featural suffix on the final segment. This fact is captured by the co-occurrence constraints between the feature content of the affix and the feature content of the class of segments. Thus it is co-occurrence constraints that force featural affixes from edges. The substantive difference between the two languages is seen in Chaha's insistence on realizing the featural suffix on other segments even if it cannot be realized on the EDGEMOST segment, while Nuer will not realize the featural suffix at all. This is formally captured by different raking of constraints: Parse dominates Alignment in Chaha, while Alignment dominates Parse in Nuer.[17]

Before ending this section it is necessary to compare the analysis given above with the previous rule based analysis of Lieber (1987). The essential ingredients of Lieber's analysis are as follows. Final consonants of verb stems are 'underspecified' for the features [continuant] and [voice]. The relevant values of these features are supplied by the tense and aspect suffixes which are specified for these features, in a feature filling manner. Nasals and liquids/ glides that do not participate in the alternation are assumed to be 'prespecified' for [+voice, -cont] and [+voice, +cont] respectively, and these features override the suffixal features. As in the case of structure preservation in Chaha, the assumption of 'prespecification' in Lieber's analysis is an admission of rule violation, a natural expectation in an Optimality theoretic approach. 'Prespecification' in nasal consonants is a co-occurrence constraint disallowing nasals from being continuants. All consonants are potential licensors of [continuant] subject to this co-occurrence constraint. Thus an OT analysis captures Leiber's insight without prespecification, making it less ad-hoc. Once again, constraint domination and violation take care of the conflict: it is more important to respect the co-occurrence constraint than to realize the suffixal [continuant].

The prediction of the above analysis of featural affixes is that just as there are featural suffixes which refer to final segments there will be featural prefixes which refer to initial segments. This prediction is borne out by fact. Several languages, including Zoque (Wonderly 1951) and Fula (Arnott 1970), have featural affixes which link only to initial segments, making them featural prefixes by definition. The facts of these languages can be accounted for in ways similar to those proposed for Chaha and Nuer above. For the sake of completeness I will illustrate with one language, Zoque.

5. Zoque Palatalization

In this section, I consider the process of morphological palatalization in Zoque (Zoque-Mixe of southern Mexico). Zoque palatalization contrasts with Chaha labialization (section 3) in some crucial senses. First, while Chaha labialization illustrates a case of long distance realization of an affix, Zoque palatalization illustrates local realization; i.e. the affix must be realized at the edge, just as Nuer mutation (section 4). However, unlike Nuer mutation, palatalization is always realized in Zoque. I derive both of these effects from constraint ranking (or re-ranking), as predicted by Optimality theory. However Zoque differs substantively from both Chaha and Nuer in the sense that the featural affix is a prefix as opposed to a suffix. This difference is formally captured by the difference in edge alignment.

Wonderly (1951: 117-118) describes a process of palatalization in Zoque which marks the third person singular. He represents this morpheme as a prefix [y], and he treats this process of palatalization as 'metathesis' of [y] and the following consonant. A rule based treatment assuming metathesis is proposed in Dell (1980). The relevant examples are listed in (26), with the morpheme transcribed as [y], as done by Wonderly.[18]

(26) *Zoque third person singular*

(a) With labial consonants

y	-	pata	pyata	'his mat'
y	-	pyesa	pyesa	'his room'
y	-	buro	byuro	'his burro'
y	-	faha	fyaha	'his belt'

y	-	mula	myula	‘his mule’
y	-	wakas	wyakas	‘his cow’

(b) With alveolar consonants

y	-	tɪh	tyatah	[catah]	‘his father’
y	-	tɪh	nʌ tyɪhu	[nʌ cɪhu]	‘he is arriving’
y	-	duráʌhk	nʌ dyuráʌhku	[nʌ juratsʌhku]	‘it is lasting’
y	-	tsʌhk	tsyahku	[čahku]	‘he did it’
y	-	sʌk	syʌk	[šʌk]	‘his beans’
y	-	swerte	šwerte		‘his fortune’
y	-	nanah	nyanah	[ñanah]	‘his mother’

(c) With palatal consonants (no change)

y	-	čoʔngoya	čoʔngoya	‘his rabbit’
y	-	šapun	šapun	‘his soap’

(d) With velar consonants

y	-	kama	kyama	‘his cornfield’
y	-	gayu	gyayu	‘his rooster’

(e) With laryngeal consonants

y	-	ʔatsɪ	ʡyatsɪ	‘his older brother”
y	-	hayah	hyayah	‘her husband”
y	-	huy	hyuyu	‘he bought it”

All words in Zoque are consonant initial. The data in (26) shows that the morpheme produces secondary palatalization of the first consonant of stem if is labial (26a), velar (26d), or laryngeal (26e); it turns alveolars into alveopalatals in (26b), and has no phonetic effect on underlying palatals (26c). As Wonderly (1951: 118) puts it, ‘when y precedes an alveopalatal consonant č, š, the y is lost.’ In this analysis I propose that the morpheme is not ‘lost’ but that it has no phonetic effect if the initial consonant of the stem is palatal.

I assume that the third person singular in the above data is the feature [-back] (see Sagey 1986). [-back] is licensed by any Root node in Zoque. It is apparently a featural PREFIX, given its restriction to the first (or leftmost) consonant. The surface realization of the third person singular [-back] in Zoque is governed by two constraints: ALIGN-3-SG and PARSE-3-SG, which I state as follows:

(27) ALIGN-3-SG
Align(3 sg., L, stem, L)
The left edge of the third person singular must be aligned with the left edge of the stem. ‘The 3 sg. is a prefix in stem’.

(28) PARSE-3-SG
3 sg. must be realized in the output.

PARSE-3-SG (28) is an instantiation of PARSE-MORPH (13), just as are PARSE-3M-SG in Chaha labialization and PARSE-PT-PPLE in Nuer. PARSE-3-SG (28) calls for the surface realization of the morpheme, and ALIGN-3-SG (27) indicates where it is to be realized, as a prefix.[19]

The palatalization case in Zoque is completely straightforward. All consonants participate in the palatalization, regardless of place of articulation. For example, labials are not barred from being palatalized, as they are in Chaha (see footnote 10). Therefore universal co-occurrence constraints (such as one barring [-back] from labials) must be LOW RANKED in Zoque, dominated by both Parse and Alignment constraints that the effect is not seen. I shall therefore not include such co-occurrence constraints in the tableau of Zoque palatalization. What determines the realization of the 3 sg. morpheme in Zoque therefore are the Alignment and Parse constraints in (27) and (28); both of which must be obeyed here. A violation of either constraint leads to illformedness, as the following tableau illustrates.

(29) Input: 3.sg; pata; Output, [pʸata]

Candidates	ALIGN-3-SG	PARSE-3-SG
(a) ☞ pata | [-back]		
(b) pata		*!
(c) pata | [-back]	*!	

In this tableau, only the first candidate which satisfies both ALIGN-3-SG and PARSE-3-SG is wellformed. The other two contenders, each of which violates one of the two constraints is thus not optimal.

The only set of consonants that require additional comments is the set of palatal consonants, as seen in (26c) ([-back]; šapun --> šapun ɨh̄s sɔapı). There are two approaches to this set of consonants. One is to assume that the [-back] 3sg. morpheme is unparsed when the first segment is underlyingly palatal. The second approach is to assume that [-back] links vacuously to a palatal segment. I adopt the second position here since linking [-back] to a palatal consonant will not change the consonant's realization (see Nuer continuancy and glides). If palatal consonants are assumed to have underlying tokens of [-back], then linking the morpheme in this case simply implies that the [-back] specification in the surface representation corresponds to two tokens of the same feature in the input. Phonetically, it is will be impossible to distinguish one or two tokens of the same feature.[20]

In conclusion, Zoque provides a third choice in the ranking of the Parse and Alignment constraints that we have seen in the discussion of Chaha and Nuer; a situation in which there is no domination of one constraint by the other (i.e. no domination between ALIGN-3-SG and PARSE-3-SG). In both Chaha and Nuer, a co-occurrence constraint is undominated (it dominates both Parse and Align), and forces a featural affix away from the edge. In Zoque, such co-occurrence constraints (which must be universal) are low ranked and have no surface effect. In Chaha, Parse dominates Alignment, resulting in the realization of the featural affix elsewhere in the stem under the force of the co-occurrence constraint. In Nuer, Alignment dominates Parse, resulting in the nonrealization of the featural affix under the force of the co-occurrence constraint. In this case both Parse and Alignment are equally ranked, therefore both constraints must be satisfied.

The domain of a featural affix is often the entire stem. In these cases I take the phenomenon to be the combination of a featural prefix or suffix, plus harmony involving the feature in question. The rest of the paper is devoted to such cases. I will discuss one case involving a featural suffix (Edoid tone), and one involving a featural prefix (Terena nasalization).

6. Edoid Associative Construction

Tonal data from Edoid languages (Niger Congo, Nigeria) provide the first example a different kind of featural alignment, one in which a featural morpheme must be aligned with both edges of the stem. I propose that this phenomenon involves featural suffixation plus harmony. Suffixation is detectable from the fact that priority is given to right alignment, and harmony is seen in the transmission of the feature throughout the entire domain. In addition the data provides additional evidence in support of one of the issues of the preceding sections: in parallel to Chaha labialization (and Japanese palatalization in the appendix), a tonal co-occurrence constraint forces misalignment of the tonal affix in Bini. In this case however it is phonological alignment as opposed to morphological alignment that is affected.

In several Edoid languages the associative morpheme is a free (floating) High tone. The list includes languages like Etsako (Elimelech 1976) or Yekhee (Elugbe 1989), Bini (Amayo 1976), Isoko (Donwa 1982), Emai (Egbokhare 1990), etc. In this section I will only examine the facts of Etsako and Bini. Other Edoid languages have systems which are similar to one of these two.

6.1 Etsako (Ekpheli dialect)

Etsako is a two tone language, with High and Low tones (Elimelech 1976: 41). In this language, the associative High tone links to the head noun, replacing all Low tones in a right to left manner, until it reaches a lexical High tone. The examples below consist of disyllabic nouns, but they are representative of what happens in longer forms. The forms cited here (from Elimelech 1976: 55) exhaust all possible tonal combinations of disyllabic nouns. The tone(s) at the top of the first row in each of (30)-(33) indicates the underlying tone pattern of the head noun in isolation, and the corresponding tone(s) after the arrow indicates its tone pattern in an associative construction. For clarity, I have indicated the tonal pattern of the first example in each set with tone letters H & L, in addition to the tone marks. The crucial tones to focus on are those of the first noun since the tones of the second noun remain constant.

(30)	L			H	
(a)	àmɛ̀	èθà	→	ámɛ́èθà	[ámɛ̂θà]
	\ /	\ /		\ / \ /	
	L (**H**)	L		H L	
	‘water’	‘father’		‘father’s water’	
(b)	àmɛ̀	òké	→	ámɛ́òké	[ámôkê][21]
	‘water’	‘ram’		‘a ram’s water’	
(c)	àmɛ̀	ɔ́mɔ̀	→	ámɛ́ɔ́mɔ̀	[ámɔ́mɔ̀]
	‘water’	‘child’		‘a child’s water’	
(d)	àmɛ̀	ódzí	→	ámɛ́ódzí	[ámódzî]
	‘water’	‘crab’		‘a crab’s water’	

(31)	H L			H(H)	
(a)	únò	èθà	→	únóèθà	[únêθà]
	| |	\ /		\ / \ /	
	H L (**H**)	L		H L	
	‘mouth’	‘father’		‘father’s mouth’	
(b)	únò	òké	→	únóòké	[únôkê]
	‘mouth’	‘ram’		‘a ram’s mouth’	
(c)	únò	ɔ́mɔ̀	→	únóɔ́mɔ̀	[únɔ́mɔ̀]
	‘mouth’	‘child’		‘a child’s mouth’	

(d)	únò	ódzí	→	únóódzí	[únódzî]
	‘mouth’	‘crab’		‘a crab’s mouth’	
(32)	H			H	
(a)	ódzí	èθà	→	ódzíèθà	[ó̌jêθà]
	\ /	\ /		\ / \ /	
	H (**H**)	L		H L	
	crab	father		father”s crab	
(b)	ódzí	òké	→	ódzíòké	[ó̌jôkê]
	‘crab’	‘ram’		‘a ram’s crab’	
(c)	ódzí	ɔ́mɔ̀	→	ódzíɔ́mɔ̀	[ó̌jɔ́mɔ̀]
	‘crab’	‘child’		‘a child’s crab’	
(d)	ódzí	ódzí	→	ódzíódzí	[ó̌jódzî]
	‘crab’	‘crab’		‘a crab’s crab’	
(33)	L H			L H	
(a)	ɔ̀tɛ́	eθà	→	ɔ̀tɛ́èθà	[ɔ̀têθà]
	| |	\ /		| | \ /	
	L H (**H**)	L		L H L	
	‘cricket’	‘father’		‘father’s cricket’	
(b)	ɔ̀tɛ́	òké	→	ɔ̀tɛ́òké	[ƈ̀tôkê]
	‘cricket’	‘ram’		‘a ram’s cricket’	
(c)	ɔ̀tɛ́	ɔ́mɔ̀	→	ɔ̀tɛ́ɔ́mɔ̀	[ɔ̀tɔ́mɔ̀]
	‘cricket’	‘child’		‘a child’s cricket’	
(d)	ɔ̀tɛ́	ódzí	→	ɔ̀tɛ́ódzí	[ɔ̀tódzî]
	‘cricket’	‘crab’		‘a crab’s cricket’	

The tone changes on the head noun in associative constructions may be summarized descriptively as follows:

(30’) L → H

(31’) H L → H H

(32’) H → H

(33’) L H → L H

In (30) we assume there is a single Low tone associated with both syllables (moras) of the noun, following the Obligatory Contour Principle (Leben 1973, McCarthy 1986). The associative High tone replaces this underlying Low tone, and this Low tone itself is not realized on the surface. That the assumption made here with disyllabic forms is true of longer forms is confirmed by the trisyllabic examples in (34) where the three syllables of the head noun are now realized on a High tone in the associative constructions. Therefore all adjacent Low tone syllables become High regardless of the number of syllables.

```
(34)  L                               H
      àɣòɣò       òké        →        áɣóɣóòké     [áɣóɣôkê]
       \ | /      | |                  \ | / | |
         L   (H)  L H                    H  L H
      ‘skull’     ‘ram’               ‘a ram’s skull’

      àjɛ̀jɛ̀        èθà        →        ájɛ́jɛ́èθà      [ájɛ́jêθà]
      ‘butterfly’ ‘father’            ‘father’s butterfly’
```

In (31) (with HL pattern), the final Low tone of the head noun becomes High. Given the forms in (34), we assume that any number of adjacent syllables with Low tones will become High. Therefore we predict that HLL head nouns will be realized as HHH. This prediction cannot be confirmed because our sources do not have any examples with such patterns. The forms in (32) are unremarkable, since the head noun is underlyingly High toned. Finally in (33) underlying LH remains the same. Our assumption here is that the associative High tone links vacuously to the final syllable of the head noun just as [-back] links to palatal consonants in Zoque (section 5).

I propose the following analysis of the facts described above. Following Elimelech I assume that ‘the associative marker (AM) ... is underlyingly a High floating tone’ (Elimelech 1976: 42). Tone is licensed by any mora in Etsako. Based on the facts in (30)-(34) above (especially 33), as well as facts presented in the Edoid studies cited at the beginning of this section, I propose that the associative High tone is a featural SUFFIX. It is suffixed to the head noun. However a (separate) process of tonal harmony transmits the associative High tone throughout the entire head noun. Therefore the domain of the associative High tone is the entire head noun, a prosodic word (Selkirk 1986, Nespor & Vogel 1986, McCarthy & Prince 1990).

This type of phenomenon must be handled with two types of alignment; one is the morphological alignment, the type of which we have seen so far. This alignment places the featural affix at a particular edge of the stem, characterizing it as a prefix or as a suffix. The second is phonological alignment. This alignment handles feature propagation by establishing the fact that the domain of the feature is a phonological category, such as the prosodic word. (see Kirchner 1993; Pulleyblank 1993, 1994; Akinlabi 1994, in press; Cole & Kisseberth 1994)

The following constraints together account for the alignment of the Etsako associative High tone. The first alignment constraint reveals its status as an affix while the second reveals its behavior as a phonological feature.

(35) ALIGN-AM-R
Align(AM, R, Stem, R)
The right edge of the AM must be aligned with the right edge of the stem. 'The associative marker is a suffix in stem'.

(36) ALIGN-AM-L
Align(AM, L, PrWd, L)
The AM must be left aligned with a prosodic word.

Left-align and right-align must be interpreted as leftmost and rightmost moras respectively following our theory of edges and licensing in featural alignment.

In the approach advocated here, morphemic features that span an entire category will require two alignment constraints as proposed above for Etsako tone. (See also Kirchner 1993; Pulleyblank 1993, 1994; Akinlabi 1994, to appear). The dominance of one of the edges reveals whether the featural affix is a prefix or a suffix. The dominance of the right edge implies that it is a suffix, while the dominance of the left edge implies that it is a prefix. This dominance is clearly observable when prevailing conditions prevent harmony, such as the presence of an opaque segment.

In the case of Etsako tone, there is a possible alternative analysis. Since the associative High tone replaces only Low tones that are adjacent to each other in a right to left manner, if we assume that all the adjacent syllables are linked to a single tone it is possible to assume that only one alignment constraint, ALIGN-AM-R, is necessary. The associative maker simply replaces the single Low tone linked to all these syllables. However this assumption will neither account for cases in closely related languages like Bini (see below), nor for other similar cases; therefore I will adopt the two alignment constraints approach.

It is crucial to note that the associative High tone is different from an underlyingly specified High tone of a head noun (the lexical High tone). First, while the associative High tone is a morpheme the lexical High tone is not. And secondly, the lexical High tone is underlyingly linked, while the associative High tone is underlyingly free, i.e. it belongs to a morpheme with no other content. Any analysis of Etsako must recognize these differences. We recognize these differences here by assuming independent faithfulness constraints for the lexical tones (High and Low) and for the associative High tone.

(37) PARSE-H
A lexical High tone must be realized in the output.

(38) PARSE-L
A lexical Low tone must be realized in the output.

(39) PARSE-AM
The AM must be realized in the output.

PARSE-H (37) and PARSE-L (38) are PARSE-SEG constraints whereas PARSE-AM is a particular instantiation of the PARSE-MORPH constraint (13). Some of these parse constraints conflict in Etsako, hence the need to formally separate them.

We now turn to show how the constraints proposed so far account for the Etsako data, through constraint ranking and domination. The crucial forms for our purposes are those in (30) (i.e. L → H) and (33) (i.e. L H → L H).

The forms in (30) (as in àmɛ̀ **H** ɛ̀θà → ámɛ́ɛ̀θà) show that PARSE-L must be ranked below PARSE-AM. These candidates reveal a conflict between PARSE-AM and PARSE-L. The winning candidate is one that satisfies PARSE-AM by realizing the associative High tone, while violating PARSE-L by not realizing the Low tone. This confirms that PARSE-AM dominates PARSE-L. In other words, it is preferable to realize the associative marker than to realize a lexical L tone, as (40) shows.[22]

(40) PARSE-AM>> PARSE-L, from (àmɛ̀, **H**)

Candidates	PARSE-AM	PARSE-L
a m ɛ \ / L	*!	
☞ a m ɛ \ / H		*

However with an all Low head noun such as in àmɛ̀, preference is for parsing the associative High tone and aligning it with both edges of the head noun, thereby satisfying both ALIGN-AM-R and ALIGN-AM-L. A violation of any of these constraints renders a candidate nonoptimal as the tableau in (41) shows. Therefore, these forms do not provide evidence for domination between the three constraints.

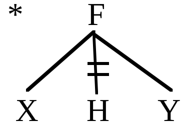
(41) PARSE-AM, ALIGN-AM-R, ALIGN-AM-L >> PARSE-L, from (àmɛ̀, **H**)

Candidates	PARSE-AM	ALIGN-AM-R	ALIGN-AM-L	PARSE-L
(a) a m ɛ \ / L	*!			
(b) a m ɛ \ / H L		*!		
(c) a m ɛ \ / L H			*!	
(d) ☞ a m ɛ \ / H				*

Trimoraic forms with Low tones in (34) (àʊɔ̀ʊɔ̀ **H** ɔ̀ké → áʊɔ́ʊɔ́ɔ̀ké̂) receive a similar treatment to the one proposed above for bimoraic forms. There is however one major difference; trimoraic and longer forms have intervening moras to which the associative High tone also gets associated.

To account for this we have to make a crucial assumption on phonological representation: that association lines may not be gapped; that is, they may not skip possible anchors. The constraint on gapping was originally proposed by Kiparsky (1981), stated as in (42), and more recently by Archangeli and Pulleyblank (1994), and was first applied to feature spreading by Kirchner (1993). I state it as in (43) below and I assume that it is universally unviolated.

(42) No Skipping (Kiparsky 1981)



(43) *Gapped
Autosegmental association may not be gapped. (Archangeli & Pulleyblank 1994)

The association of the associative High tone to intervening moras is thus forced by *Gapped, a violation of which renders a form nonoptimal.

The above account reveals that the domain of the associative High tone in Etsako is the entire head noun. In order to give a complete account of the associative construction however, two things must be shown: (a) the ranking relation among the rest of the constraints; and deriving from this is (b) the apparent blocking effect of a lexical High tone. The blocking effect of the lexical

High tone is manifested in the associative High tone being prevented from spreading leftwards. I will now show how the constraint ranking accounts for this blocking effect.

The first crucial set of data are the ones in (33) (as in ɔ̀tɛ́ **H** èθà → ɔ̀tɛ́èθà). In these forms the High tone of the associative marker does not spread leftwards. There are two approaches to the data. We may either assume that the associative High tone is not linked at all, or that it links vacuously to the syllable with the underlying lexical High tone. It is prevented from spreading because the surface High tone corresponds to two input High tones, the lexical High tone and the associative High tone. I adopt the latter approach here since such forms satisfy both PARSE-H and PARSE-AM, as the following tableau shows. (We take exception for indicating unparsed H tone in < > in the following tableau, for reasons of exposition.)

(44) PARSE-H, PARSE-AM; (ɔ̀tɛ́, **H**)

Candidates	PARSE-H	PARSE-AM
(a) ☞ ɔ t ɛ | | L H		
(b) ɔ t ɛ | | L H <**H**>		*!
(c) ɔ t ɛ | \ L <H> **H**	*!	

Phonetically, there is no way of telling whether High tone parsed in the optimal candidate (a) in (44) is the associative High tone (bolded) or the lexically linked High tone, or indeed both. Phonologically however we know that parsing the associative High tone alone (as in candidate (c)) implies a link to the initial syllable as well (i.e. if it had docked it would have spread), otherwise the form cannot be optimal, as proven in tableau (41). Had the lexical High been unparsed as in candidate (c), the unparsed High tone would have been transparent and ALIGN-AM-L would not have been violated, as is the case here. Since the associative High tone does not spread to the first syllable, we must assume that this candidate makes the wrong prediction. Therefore a candidate that satisfies both PARSE-H and PARSE-AM is better. This implies that the associative High links vacuously to the final lexical High in such cases.

There is however one more candidate to consider. Recall that PARSE-L ranks low in Etsako, and the associative marker is underlyingly free. Therefore we must consider the possibility that the associative marker links to the first syllable in violation of PARSE-L, skipping the lexical H, as in the second candidate in the following tableau in (45). However, the first candidate still fares better since it satisfies the low ranking PARSE-L which the second candidate violates.

(45) PARSE-H, PARSE-AM, (ɔ̀tɛ́, **H**)

Candidates	PARSE-H	PARSE-AM	PARSE-L
☞ ɔ t ɛ | | L H			
ɔ t ɛ | | **H** H			*!

The analysis presented so far does not establish a dominance relationship between the constraints PARSE-H, PARSE-AM, ALIGN-AM-R, and Align-AM-L. However ALIGN-AM-R must dominate ALIGN-AM-L, if the associative marker is a suffix as claimed here. That is, if conditions do not permit spreading the associative marker will be contented with being realized as a featural sufix. This is in fact true, as confirmed by the examples with LHL in (46). In such trimoraic nouns as in (46), it is only the final Low tone of the head noun that becomes High.

(46)	LHL			LH(H)	
	àtásà	èθà	→	àtásáèθà	[àtásêθà]
	| | |	\ /		| \ / \ /	
	L H L (**H**)	L		L H L	
	‘plate’	‘father’		‘father’s plate’	
	àtásà	òké	→	àtásáòké	[àtásôkê]
	‘plate’	‘ram’		‘a ram’s plate’	
	àtásà	ɔ́mɔ̀	→	àtásáɔ́mɔ̀	[àtásɔ́mɔ̀]
	‘plate’	‘child’		‘a child’s plate’	
	àtásà	ódzí	→	àtásáódzí	[àtásódẑ]
	‘plate’	‘crab’		‘a crab’s plate’	

Therefore, ALIGN-AM-R dominates ALIGN-AM-L. ALIGN-AM-L may thus be violated in favor of ALIGN-AM-R. This confirms that the featural affix is a suffix. The ranking also derives the apparent right to left spread of the associative tone (seen in (30) and (34) above). Leftward spread (i.e. alignment) is apparently blocked in the examples in (46) by the underlying High tone of the second mora. Spreading across the High tone is prohibited by the No-Crossing (N-C) constraint (Goldsmith 1976),[23] which is universally undominated (and which therefore dominates every other constraint here). Therefore ALIGN-AM-L is violated in such cases, but ALIGN-AM-R is obeyed as the following tableau illustrates.

(47) ALIGN-AM-R >> ALIGN-AM-L (àtásà; **H**)

<table>
<tr><th>Candidates</th><th>ALIGN-AM-R</th><th>ALIGN-AM-L</th></tr>
<tr><td>☞ a t a s a
| | |
L H H</td><td></td><td>**</td></tr>
<tr><td>a t a s a
| | |
H H L</td><td>**!</td><td></td></tr>
</table>

In this tableau, the candidates considered are the two that satisfy the high ranking constraints PARSE-H and PARSE-AM, and both have one violation each of the low ranking constraint PARSE-L. So these constraints are irrelevant here. The only difference between the forms here is that the optimal candidate realizes the associative High tone on the right, while the nonoptimal candidate realizes it on the left. That the winning candidate is the one which obeys ALIGN-AM-R in violation of ALIGN-AM-L implies that domain may be violated in favour of basic realization as a suffix. The constraint hierarchy established for Etsako is given in (48).

(48) *Etsako constraint hierarchy*

N-C, *Gapped, PARSE-H, PARSE-AM, ALIGN-AM-R >> ALIGN-AM-L >> PARSE-L

From this hierarchy, a number of things are clear; the Etsako (and Edoid) associative marker is a featural SUFFIX, given the insistence on linking to the rightmost mora. The A.M. undergoes spreading (i.e. harmony) in the traditional autosegmental sense. The undominated PARSE-AM implies that the associative marker must be realized, but it may not spread. The opacity of the lexical High tone derives from the high ranking of PARSE-H, and the ban on crossing association lines (by high ranking N-C).

The main goal in this subsection has been to show first that the domain of a featural affix may be the whole lexical category, but that it can still be identified as a prefix or suffix. We now turn to show that even in these cases, barring opacity, misalignment results when a feature co-occurrence constraint dominates an alignment constraint. For this we turn to another closely related Edoid language, Bini.

6.2 Bini

The facts of the Bini associative construction are similar to those encountered in Etsako. The key issues for our purposes in Amayo (1976)’s description of Bini may be summarized as follows.

In disyllabic (bimoraic) nouns of the LL pattern, the last mora of the head noun is realized with a High tone.

(49)	**L**				**LH**	
	òwɛ̀		ɔ̀sà	→	òwɛ́ ɔ̀sà	[òwɔ́ꜝsà]
	\ /		\ /		| | \ /	
	L	(**H**)	L		L **H** L	
	‘leg’		‘chimpanzee’		‘a chimpanzee’s leg’	
	àmɛ̀		èhỹɛ̃́	→	àmɛ́ èhỹɛ̃́	[àméꜝhỹɛ̃́]
	‘water’		‘pepper’		‘solution of water and pepper’	
	òwɛ̀		ɔ̀nà	→	òwɛ́ ɔ̀nà	[òwɔ́ꜝnà]
	‘leg’		‘this one’		‘this one’s leg’	
	òwɛ̀		òzó	→	òwɛ́ òzó	[òwóꜝzó]
	‘leg’		‘ozo’		‘ozo’s leg’	
	ɛ̀vbò		òzó	→	ɛ̀vbó òzó	[ɛ̀vbwóꜝzó]
	‘town’		‘ozo’		‘ozo’s town’	

In polysyllabic forms, all the Low tones of the head noun become High, EXCEPT THE FIRST.

(50)	àkòbɛ̀		úỳ̄	→	àkɔ́búỳ̄
	\ | /		| |		| \ / |
	L	(**H**)	H L		L H L
	‘iron trap’		‘Uyi’		‘Uyi’s iron trap’
	ùgbàlètò		àmɛ̀	→	ùgbálétàmɛ̀
	‘head tie’		‘Ame’		‘Ame’s head tie’
	ùgbàlètò		áyì	→	ùgbálétáyì
	‘head-tie’		‘Ayi’		‘Ayi’s head-tie’

ɔ̀ghɛ̀dɛ̀	úgbó	→	ɔ̀ghɛ́dúgbó
‘plantain’	‘Ugbo’		‘Ugbo’s plantain’
ɔ̀zùkpògyèvà	áyì	→	ɔ̀zúkpógyéváyì
‘second-in-command’	‘Ayi’		‘Ayi’s second in command’

The analysis of the Bini data follows a pattern similar to that presented in the discussion of Etsako above. The associative marker is a free High tone. The domain of the associative H-tone is the entire head noun, and tone is licensed by any mora. The constraints needed are also those already encountered in Etsako. These constraints however have a different ranking relation to each other in Bini, a situation predicted by Optimality theory’s ranking principle: “constraints are ranked on a language particular basis... A grammar is a ranking of the constraint set”. (Prince & Smolensky 1993)

As in Etsako, ALIGN-AM-R must dominate ALIGN-AM-L in Bini, given forms like òwɛ̀ --> òwɛ́.

(51) ALIGN-AM-R >> ALIGN-AM-L: òwɛ̀ → òwɛ́

From the same form also, and from the other forms in (50), it is clear that ALIGN-AM-R (and PARSE-AM) must dominate PARSE-L, since underlying Low is replaced by the associative H on every mora except the leftmost. This suggests the partial ranking in (52).

(52) ALIGN-AM-R, PARSE-AM>> PARSE-L: òwɛ̀ → òwɛ́

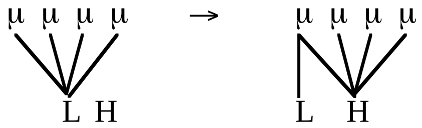
However, unlike in Etsako, the underlying (lexical) Low tone is always realized on the leftmost mora in Bini, in violation of ALIGN-AM-L. Therefore, PARSE-L must dominate ALIGN-AM-L, the phonological alignment.

(53) PARSE-L >> ALIGN-AM-L: ùgbàlètò → ùgbálétó

Note however that Align A.M. Left must be operative for the associative marker to spread all the way to the left except to the very leftmost mora. This is why LLLL becomes LHHH, and not *LLLH.

The crucial question that arises here is: why is it the case that the associative High tone never spreads to the first mora? In other words, why does it seem as if ALIGN-AM-L is nonexistent in Bini? Even if ALIGN-AM-L is at the bottom of the constraint hierarchy, as argued here, and PARSE-L is ranked above it, there is still a way of satisfying both constraints. A form like *ǔgbálétɔ́ satisfies the ranking PARSE-L >> ALIGN-AM-L, realizing the Low tone and aligning the associative High tone with the leftmost mora. The representation of the output form may be depicted as follows.

(54)



The reason this is not possible is that Bini bars a LOW-HIGH contour on a mora, which will be created on the first mora if this were to take place. As Amayo (1976: 167) shows, a falling tone may occur within a single syllable (or mora in our sense) as a variant of a Low tone,[24] but he analyses all LO-HI sequences as disyllabic (or bimoraic). The constraint responsible for this is obvious, it is one that bars the association of a High tone to a mora linked to a Low tone: a feature co-occurrence constraint. We state it as in (55).

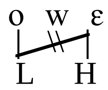
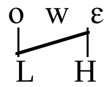
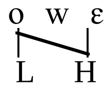
(55) *RISE
A rising tone may not occur in a single mora (If L then not H).

The reason that the associative High tone never links to the leftmost mora (and why ALIGN-AM-L is always violated) is now clear; *RISE (and of course PARSE-L) must dominate ALIGN-AM-L.[25]

(56) *RISE >> ALIGN-AM-L

In fact *RISE is unviolated in Bini and is thus undominated. It must be at the top of the hierarchy. The tableau in (57) illustrates how the overall constraint ranking established for Bini derives the realization of the associative constructions.

(57) *RISE, PARSE-AM, ALIGN-AM-R >> Parse Low >> ALIGN-AM-L

Candidates	*RISE	PARSE-AM	ALIGN-AM-R	Parse Low	ALIGN-AM-L
☞ 					*
o w ɛ \ / L		*!			
	*!				*
	*!				
o w ɛ \ / H				*!	

Finally, we return the fact that a Low tone is realized on just one mora, the initial mora, in satisfaction of PARSE-L, regardless of the number of L-toned moras in a sequence. The answer to this can be found in the principle of minimal violation of constraints in Optimality theory. Parsing the Low tone on only one mora violates ALIGN-AM-L minimally, while at the same time satisfying PARSE-L. Realizing the Low tone on any additional moras will lead to a gratuitous violation of ALIGN-AM-L and that will be nonoptimal.

6.3 Conclusion

The surface realization of the affixal High tone in Edoid is crucially dependent on possible licensors, moras, and the domain of its realization, the entire head noun. The realization of the morpheme on the rightmost mora when there is a choice between two edges implies that the affix is a SUFFIX. The domination of a (phonological) tonal alignment constraint, ALIGN-AM-L, by a tonal co-occurrence constraint, *RISE, forces a violation of left alignment, thus making left alignment look nonexistent. But only the assumption of ALIGN-AM-L, and domination by *RISE can explain why spreading goes to all moras short of the first!

Again here as in the preceding sections, the two main topics of this paper: the phonetic placement of a featural affix and the domination of a feature alignment constraint by a feature co-occurrence constraint, have been brought to the fore. In addition we have shown that the traditional observation that an underlying High tone stops the propagation of an associative High tone is derivable from ranking PARSE-H highly in these languages, in conjunction with the ban on the crossing association lines.

In concluding this section, it is crucial to note that a rule-based approach has never linked the fact that the associative High tone does not spread to the first syllable to the absence of a rise in Bini, or in any other language. The standard rule based treatment of similar phenomena is to regard the peripheral segment as ‘extratonal’ (see Pulleyblank’s 1986 treatment of Margi tone spread for example).[26] The constraint-based approach to this data is preferred in part because the same insight is captured without the use of such a mechanism. This treatment links the fact that the High tone does spread to the first mora to an independently necessary observation in the language: the lack of rising tones on single moras. The rule based approach iterates spreading and stops short of the first syllable, the constraint-based approach explains why this has to be so. The use of ‘extratonality’ in rule based approaches is again an admission of the fact that the spreading rule is VIOLATED; this again is what forms the core of Optimality theory, and it is expected given the domination of the alignment constraint by the co-occurrence constraint.

7.0 Terena Nasalization

The last example of a featural morpheme that I will address here is nasality, and a classic case is Terêna. In this section I argue that the feature [nasal] in Terena is a featural prefix given the insistence on association to the initial consonant of the stem (in a direct contrast to the Edoid associative high tone), and that the featural prefixation is accompanied by harmony. Terena not only confirms the proposals already made in the preceding sections about both featural alignment and misalignment, it also provides a direct comparison with Edoid in terms of opacity and transparency of a lexical feature which also functions as an affix in the language. In direct contrast to the Edoid associative marker, the lexical feature [nasal] is transparent to the propagation of the featural affix [nasal]. I derive this from the domination of the PARSE-SEG constraint by an alignment constraint.

In Terena, an Arawakan language of Brazil (Bendor-Samuel 1960), the category of the first person is marked through a process of progressive nasalization. Thus the difference between the Terena examples in the first and the third columns is that the latter are marked for the first person.

(58) *First person in Terena*

(a)	ayo	‘his brother’	ãỹõ	‘my brother’
(b)	arıne	‘sickness’	ãr̃ĩnẽ	‘my sickness’
(c)	unae	‘boss’	ũnãẽ	‘my boss’
(d)	emoʔu	‘his word’	ẽmõʔũ	‘my word’
(e)	owoku	‘his house’	õw̃õᵑgu	‘my house’
(f)	ıwuʔıšo	‘he rides’	ĩw̃ũʔĩⁿžo	‘I ride’
(g)	ıtuke	‘poss. pro’	ĩⁿduke	‘1p. poss. pro’
(h)	nokone	‘need’	nõᵑgone	‘I need’
(i)	takı	‘arm’	ⁿdakı	‘my arm’
(j)	tutı	‘head’	ⁿdutı	‘my head’
(k)	paho	‘mouth’	ᵐbaho	ɨmy mouthı
(l)	pıho	‘he went’	ᵐbıho	‘I went’
(m)	ahyaʔašo	‘he desires’	ãⁿžaʔašo	‘I desire’
(n)	haʔa	‘father’	ⁿzaʔa	‘my father’
(o)	hyıšoe	‘dress’	ⁿžıšoe	‘my dress’

The descriptive generalizations from the above data are as follows. The first person pronoun is expressed by nasalizing the noun or verb. Nasalization affects vowels, liquids, glides and underlying nasal consonants. Therefore, nasalization spreads through underlying nasal consonants. Laryngeal stops, but not laryngeal fricatives, are affected by nasalization.

The examples in 58 (e - h) show that nasalization proceeds in an apparent left to right fashion until it reaches an obstruent. The interesting thing here is that the obstruent becomes prenasalized (and voiced), as in 58 (e), but nothing after it is nasalized (except of course it is an underlying nasal consonant as in 58h). Therefore obstruents block [nasal] spreading, but not before they become prenasalized. If a form begins with an obstruent, the effect of the first person progressive nasalization is to turn that obstruent into a prenasalized consonant, as in 58 (i - l), and there is no nasalization of subsequent segments. I shall not be concerned with further changes in obstruents, other than prenasalization. For example, I shall not discuss the fact that laryngeal continuants change to coronals when nasalized in 58 (m - o)

Continuing the approach developed in the preceding sections, we propose the following analysis of the above Terena facts. The first person marker is a free feature [nasal]. [nasal] is licensed by any Root node in Terena. Given the insistence on associating to the first segment of the noun or verb regardless of the nature of the segment, it is a featural PREFIX. However a process of harmony transmits nasality from the prefix through the stem; and thus the apparent domain of the [nasal] morpheme is the entire stem, which is a prosodic word. The surface realization of this morpheme may be accounted for with the following alignment constraints, the first of which reveals its status as an affix (a prefix) while the second reveals its behavior as a phonological feature.

(59) ALIGN-1P-LEFT
Align(1p., L, Stem, L)
The left edge of the 1p. must be aligned with the left edge the stem.
‘The first person pronoun is a prefix in stem.’

(60) ALIGN-1P-RIGHT
Align(1p., R, PrWd, R)
The first person pronoun must be right aligned with the prosodic word.

Just as the High tone in Bini and Etsako, [nasal] is both the featural content of a morpheme as well as a lexically specified feature in Terena. Again these two functions must be recognized by any analysis, and we do so here by proposing different faithfulness constraints for the morphemic and the nonmorphemic [nasal]. The parse constraint in (61) is a PARSE-SEG/FEAT constraint while the one in (62) is again an instantiation of the PARSE-MORPH constraint in (13).

(61) PARSE-[nas]
Lexical [nas] must be realized in the output.

(62) PARSE-1P
The first person pronoun must be realized in the output.

The optimal outputs in the first three forms in (58) (as in ayo --> ãỹõ) are those which satisfy both alignment constraints and PARSE-1P. This is illustrated with the tableau in (63). (For clarity, I will represent the [nas] morpheme with N throughout this section.)

(63) ALIGN-1P-LEFT, ALIGN-1P-RIGHT, PARSE-1P; Input: ayo, N;
Output: ãỹõ

Candidates	ALIGN-1P-LEFT	ALIGN-1P-RIGHT	PARSE-1P
☞ ayo \ / N			
ayo			*!
ayo / N	*!		
ayo \ N		*!	

Since these examples reveal no conflict between these three constraints they shed no light on ranking relations among them.

7.1 Nasal Transparency

Forms like arıne --> ãr̃ĩnẽ ‘my sickness’ (58b) reveal that nasal stops do not block the propagation of the [nasal] morpheme in Terena, i.e. underlying nasal stops are transparent to the morphemic [nasal] spread. Our account of this transparency is that the underlying lexical [nas] is simply unrealized (unparsed) when in conflict with the [nas] morpheme. Were it to be linked, it would have blocked the propagation of the [nas] morpheme. The implication of this assumption is that PARSE-[nas] is violated to satisfy ALIGN-1P-RIGHT, and by implication PARSE-1P. Proper right alignment would have meant a violation of the No-Crossing constraint (Goldsmith 1976). Therefore, ALIGN-1P-RIGHT and PARSE-1P dominate PARSE-[nas]. The tableau in (64) illustrates the point. (In this and in subsequent tableaus [+n] stands for the underlying nasal specification of a nasal stop as distinct from N which stands for the first person [nas] morpheme.)

(64) ALIGN-1P-RIGHT, PARSE-1P >> PARSE-[nas]; (arıne, N)

<table>
<tr><th>Candidates</th><th>ALIGN-1P-RIGHT</th><th>PARSE-1P</th><th>PARSE-[nas]</th></tr>
<tr><td>(a) ☞ a r ı n e
\ \ | / /
N</td><td></td><td></td><td>*</td></tr>
<tr><td>(b) a r ı n e
\ \ | |
N [+n]</td><td>*!</td><td></td><td></td></tr>
<tr><td>(c) a r ı n e
|
[+n]</td><td>*!</td><td>*</td><td></td></tr>
</table>

In this tableau, I have omitted ALIGN-1P-LEFT because it is irrelevant here. The crucial relevance of this tableau lies in the fact that the optimal candidate is the one that violates PARSE-[nas] while satisfying both ALIGN-1P-RIGHT and PARSE-1P.

There is an important difference between the underlying lexical High tone in Edoid (as exemplified by Etsako and Bini) and [nasal] in Terena. While the underlying High tone in Edoid blocks the propagation of the morphemic High tone, the propagation of the [nasal] morpheme in Terena is not blocked by the underlying lexical [nasal].

In the case of the Etsako High tone, our proposal was that both PARSE-H (enforcing the realization of the lexical High tone) and PARSE-AM (enforcing the realization of the featural suffix) are undominated, and that they both dominate ALIGN-AM-L, resulting in lexical High tone opacity and an ALIGN-AM-L violation. The opposite assumption accounts for the transparent behavior of lexical [nasal] in Terena. In Terena, ALIGN-1P-RIGHT and PARSE-1P dominate PARSE-[nas]; i.e. parsing the morphological [nasal] and its right alignment both dominate parsing the lexical [nasal], resulting lexical [nasal] transparency. Opacity of lexical High tone in Edoid versus transparency of lexical [nasal] in Terena is thus accounted for through constraint ranking. HIGHER ranking implies opacity while LOWER ranking implies transparency (Smolensky 1993). No other mechanisms are required.

7.2 Obstruents and co-occurrence

We now turn to account for the behavior of obstruents in Terena. As noted above obstruents block the rightward propagation of the [nasal] morpheme, while becoming prenasalized: owoku 'his house' --> õw̃õᵑgu 'my house'. To account for this, we assume a co-occurrence constraint between obstruents and [nasal] in Terena. The feature co-occurrence constraint may be stated as in (65) (see Pulleyblank 1989: 109).

(65) *NAS/SON
If [nas] then not [-son].

Note however that while *NAS/SON (65) appears to bar the association of [nas] to obstruents in general (as in Orejɔ́n, Pulleyblank 1989), Terena obstruents are partly nasalized. This apparent contradiction disappears once we examine prenasalized stops in the light of Steriade's (1993) aperture theory.[27]

Steriade argues that prenasalized stops are best represented by a theory of feature geometry which encodes both the closure phase and the release phase of segments through the use of aperture nodes. In Steriade's theory, segments may have a closure phase and a release phase. Stops consist of a closure phase (A_o) followed by a release phase (A_{max}). Vowels and approximants have only the release phase (A_{max}). Fricatives also contain a single phase of fricated closure (A_f). Therefore affricates are (A_oA_f). If this is the case, then a partial representation of Terena stops may be given as follows.

(66) *Partial representation of Terena stops*
A_o A_{max}
|
[-son]

In this representation, [-son] is associated with the release phase of obstruents in Terena. Given this representation, we will interpret *NAS/SON as barring the association of [nas] to a node associated with [-son] in Terena, forbidding a structure such as that in (67).

(67) **NAS/SON in Terena*
* [nas]
|
A_{max}
|
[-son]

In the sense of Archangeli and Pulleyblank (1994), *NAS/SON bars the occurrence of [nas] on a path with [-son].

The import of this for our analysis is that prenasalization in Terena can be seen as the association of the [nas] morpheme to the closure phase of the stops, and not to the release phase. Therefore, the partial structure created by Terena prenasalization can be given as in (68).

(68) [nas]
|
A_o A_{max}
|
[-son]

For any segment to be prenasalized it has to be complex, i.e. it has to have both a closure phase and a release phase. Therefore prenasalization in fricatives involves a concomitant projection of a closure phase (A_o).

The above explanation reveals that while [nas] links to the closure phase of obstruents, it does not link to the release phase.[28] Therefore the co-occurrence constraint *NAS/SON applies to the release phase of an obstruent in Terena.

Since [nas] cannot skip any phase of a segment to link to the next segment the propagation of [nas] is effectively terminated as soon as it hits a node with [-son] specification. This follows from the unviolated constraint against gapped representation, *Gapped (43) (Archangeli & Pulleyblank 1994).

We now turn to the rest of the examples in (58). The forms in 58 (e)-(h) reveal a number of dominance relationships among the constraints. Forms like owoku ‘his house’ --> õw̃õᵑgu ‘my house’ indicate that *NAS/SON is inviolable, and that it dominates ALIGN-1P-RIGHT. The following tableau reveals this.

(69) *NAS/SON >> ALIGN-1P-RIGHT. Input: owoku, N; Output: õw̃õᵑgu

Candidates	*NAS/SON	ALIGN-1P-RIGHT
☞ ɔ w ɔ k u \ |/ N		*
ɔ w ɔ k u \ \ | / / N	*!	

In this tableau, ALIGN-1P-LEFT is irrelevant since both candidates satisfy it. [nas] is also parsed, hence PARSE-1P is satisfied by both candidates. The relevant constraints therefore are *NAS/SON and ALIGN-1P-RIGHT. The second candidate *õw̃õŋũ satisfies ALIGN-1P-RIGHT violating *NAS/SON, while the first candidate does the reverse deriving õw̃õᵑgu ‘my house’, which is optimal. *NAS/SON must therefore dominate ALIGN-1P-RIGHT. In other words, perfect nasal harmony may be sacrificed if [nas] will in the process associate with an obstruent. The other possible candidate we have not considered is one in which the release of the obstruent is skipped and [nas] spreads to the last segment. Since such a candidate must violate a universally higher ranking constraint *Gapped, it is not viable.

A surface form like ĩⁿduke ‘1 p. poss. pro’ reveals that ALIGN-1P-LEFT must dominate ALIGN-1P-RIGHT. That is, the 1st person pronoun is primarily a featural prefix. If for reasons of opacity the 1p. affix [nas] is unable to spread then it is contended with being realized as a prefix. This domination also derives the left to right directionality of nasal harmony in Terena. The derivation of ĩⁿduke is shown in the next tableau, which also reveals the constraint ranking.

(70) ALIGN-1P-LEFT >> ALIGN-1P-RIGHT. Input: ıtuke, N; Output: ĩ^{n}duke

Candidates	ALIGN-1P-LEFT	ALIGN-1P-RIGHT
☞ ı t u k e \ \ N		****
ı t u k e / N	****!	

Both candidates satisfy *NAS/SON, a higher ranking constraint, and so are equivalent on that score. The interesting thing about this example is that an obstruent occurs as the penultimate segment to each edge. While [nas] is able to link to the closure phase of /t/ in the first candidate, such a possibility is not open to the second candidate since linking would have implied the association of [nas] to the release phase of the segment /k/ (deriving *[g$^{\text{ŋ}}$]), and a violation of *NAS/SON. The crucial difference here however is the fact that the optimal candidate satisfies ALIGN-1P-LEFT while violating ALIGN-1P-RIGHT, and the nonoptimal candidate does the precise opposite.

The first person [nas] prefix is always realized in Terena, even if the leftmost segment is an obstruent (takı --> ^{n}dakı). Therefore, PARSE-1P must be undominated. This is confirmed by all of the examples in 58(i - l). The constraint hierarchy so far developed for Terena nasalization is given in (71).

(71) *Terena constraint hierarchy*:
*NAS/SON, PARSE-1P, ALIGN-1P-LEFT >> ALIGN-1P-RIGHT >> PARSE-[nas].

Finally, a form like nokone 'need' --> nõ$^{\text{ŋ}}$gone 'I need' illustrates the fact that though PARSE-[nas] is low ranked in Terena, this does not imply that it is always violated. It must in fact be satisfied when the appropriate conditions permit. One of such situations is when the propagation of the first person [nas] morpheme is blocked by an obstruent, preventing it from spreading to a following underlying nasal consonant as in nõ$^{\text{ŋ}}$gone 'I need'. This form shows that both PARSE-1P and PARSE-[nas] may be satisfied in the same form. The optimal form is one in which both constraints are satisfied. Tableau (72) illustrates the point. This tableau also shows the five constraints as ranked in (71).

(72) *NAS/SON, PARSE-1P, ALIGN-1P-LEFT >> Align-Right >> PARSE-[nas]; from Input: nokone, N; Output: nõᵑgone

Candidates	*NAS/SON	PARSE-1P	ALIGN-1P-LEFT	ALIGN-1P-RIGHT	PARSE-[nas]
(a) ☞ n o k o n e \ \ / | N [+n]				****	*
(b) n o k o n e \ \ / N				****	*!*
(c) n o k o n e \ \ | / / / N	*!				**
(d) n o k o n e | | [+n] [+n]		*!			
(e) n o k o n e | \ | / [+n] N			***!		*

There are several other candidates that GEN supplies given these constraints, but I will limit myself to the five above. The most crucial candidates are (a) and (b). Both pass on the three high ranking constraints, and both fail on ALIGN-1P-RIGHT. The only difference between them is that while the optimal candidate violates PARSE-[nas] once, the second candidate has an additional violation of the same constraint. Hence the deciding factor here is the gratuitous violation of the lower ranking PARSE-[nas] in the second candidate. Notice however that the optimal candidate parses both first person [nas] as well as the lexically contrastive [nas] when conditions permit. The remaining three candidates violate one each of the three higher ranking constraints as well as some other constraint, and so are immediately rejected.

7.3 Conclusion

In concluding this section it is necessary to highlight a few points. First is the issue of transparency and opacity in Optimality theory. The essential idea is that these correspond directly to higher versus lower ranking of relevant constraints. In contrast with higher ranked PARSE-H in Edoid, PARSE-[nas] is lower ranked in Terena, and transparency is derived simply by unparsing the lexical [nas], in favor of PARSE-1P In our framework unparsing a feature implies unparsing its link, hence no violation of the crossing constraint.

Secondly *NAS/SON demonstrates how the application of a constraint can vary from one language to the other. In Terena *NAS/SON holds of the release of obstruents, as opposed holding of both the closure and release (or the entire obstruent) as in Orejon and other languages (Pulleyblank 1989). The implication of this is that not only can't the whole obstruent become a nasal, a postnasal stop is also prohibited (Gerfen 1993). Therefore a co-occurrence constraint may hold either of the whole segment or of a part of it.

Thirdly and most importantly, in continuation of the themes of this article we showed that though the domain of the [nas] morpheme is the entire stem (a prosodic word), it is formally a featural PREFIX, given alignment. We also showed that *NAS/SON crucially dominates ALIGN-1P-RIGHT (which derives harmony), leading to misalignment at the right edge. Both of these provide support for the two crucial themes of this paper: that the realization of a featural affix is dependent on licensing, and that featural misalignment takes place when a feature co-occurrence constraint dominates an alignment constraint, forcing its violation.

And finally, note that alternative analyses of the Terena facts exist within rule based approaches (see for example Poser 1980, Leiber 1987, Spencer 1991, and Gerfen 1993 among others). I will only be concerned with Gerfen's analysis which is the closest to the one proposed here. In Gerfen's analysis the nasal harmony facts are accounted for with rules spreading [nas], and obstruent opacity is accounted for via a 'filter' whose role is similar to the role of *NAS/SON (65) above. Note however that the adoption of a filter such as (65) within a rule based approach is once again a tacit admission of the fact that rules CAN BE VIOLATED. The optimality theory account captures the same intuition while eradicating the distinction between rules and filters.

8. Summary

Each of the phenomena discussed here highlights the major themes of this paper: the surface realization of featural affixes and the misalignment of featural affixes under domination from feature co-occurrence constraints.

Unlike segmental affixes, the surface realization of featural affixes is crucially dependent on possible licensors. [round] in Chaha refers to consonantal Root nodes; tone in Edoid refers to moras; and [cont] in Nuer, [-back] in Zoque and [nas] in Terena refers to any Root node. As we have shown these determine edges in featural alignment. Overt references to a specific edge points to the feature as a featural suffix (Chaha [round], Nuer [cont], Edoid High tone), or as a featural prefix (Zoque [-back], Terena [nas]). Domains may also vary between just one segment as in Chaha, Nuer and Zoque to the entire stem in Etsako, Bini and Terena; the latter representing both affixation and harmony. We showed that all of these require no more than alignment constraints, the same family of constraints required in regular segmental affixation.

Featural misalignment results from a featural co-occurrence constraint dominating an alignment constraint, whether morphological or phonological. Examples include *COR/LAB >> ALIGN-3M-SG which forces the featural suffix to be realized as an infix or a prefix in Chaha; *RISE >> ALIGN-AM-L which bars the associative High tone from spreading to the left edge in Bini, and

*NAS/SON >> ALIGN-1P-RIGHT which prevents the Terena [nasal] affix from spreading to the right edge.

In sections 3-5 we discussed featural affixation which is not accompanied by harmony; these were handled by morphological featural alignment. In the last two sections we have discussed featural affixation which is accompanied by harmony. These cases were accounted for with a combination of morphological and phonological featural alignment. A natural question is how this analysis relates to, or extends to spreading of a linked or free feature which is not a morpheme (such as in regular featural harmony). The answer to this is straightforward. In such cases, all that is necessary is phonological feature alignment without morphological alignment. In such cases featural alignment is predicted to take as its domain a category such as the prosodic word (or minor phrase), etc. Cases of this type have received extensive treatment in the OT literature. (see Kirchner 1993; Pulleyblank 1993, 1994; Akinlabi 1994, in press; Cole & Kisseberth 1994; etc.)

APPENDIX
Factorial Typology

A1. Introduction

In the foregoing discussion of various featural affixes we have seen the interaction of three families of constraints: co-occurrence constraints, alignment constraints and parse constraints. The argument has been that alignment determines where the feature is realized, as a suffix or as a prefix. Parse determines that the feature is realized as part of surface structure. Co-occurrence constraints determine whether or not the featural composition of an affix can be licensed by a segment licensing some other feature. A specific ranking of these constraints, we have argued, results in a (distinct) grammar of featural affixation. Since the two crucial purposes are to show how featural affixes are realized and how co-occurence constraints force misalignment, our attention has been focused on how reranking Parse and Alignment constraints determine whether the featural affix is realized on the surface at all. The interactions of these few constraints however make more predictions than we have illustrated thus far. It is the validity of these predictions that we now turn to.

In Optimality theory each permutation (or hierarchy) of a set of constraints excludes a (possible) language type and admits another language type. The overall FACTORIAL TYPOLOGY over the three constraint families above predicts the following possible grammars featural affixes. ‘ α, β’ in the table below denote possible constraints which may intervene between the three constraint families, but we ignore these here. The last column after each possible ranking contains some language’s featural affix which characterizes this ranking, from the list in (2) (section 1). This confirms that all predicted patterns are actually attested.

(i) *Factorial typology*

(a)	Co-occurrence	>> α >>	Alignment	>> β >>	Parse	Nuer continuancy
(b)	Co-occurrence	>> α >>	Parse	>> β >>	Alignment	Chaha labialization
(c)	Parse	>> α >>	Co-occurrence	>> β >>	Alignment	Japanese mimetics.
(d)	Parse	>> α >>	Alignment	>> β >>	Co-occurrence	Aka voicing
(e)	Alignment	>> α >>	Co-occurrence	>> β >>	Parse	Athapaskan [-continuant]
(f)	Alignment	>> α >>	Parse	>> β >>	Co-occurrence	Aka voicing Zoque palatalization

Having illustrated the details of how the analysis works in the preceding sections the languages discussed in this appendix are supplied only for reasons of empirical coverage, and for the sake of completion of analysis. Therefore the facts of these languages will only be summarized with varying degrees of detail.

A2. Japanese mimetics

The facts of Japanese mimetics (Hamano 1986, Mester & Ito 1989, Archangeli & Pulleyblank 1994) support the ranking in (i) (c): Parse >> Co-occurrence >> Alignment. Japanese has a palatal prosody which adds an element of "uncontrolledness" to the base (Mester & Ito 1989: 268),[29] and the stem is usually reduplicated. Generally, the palatal prosody attaches to the RIGHTMOST coronal consonant.[30] If there is more than one coronal consonant in the root, the palatal prosody is realized on the rightmost coronal, as in (ii) (b). The relevant data are from Mester and Ito (1989), and this analysis only formalizes their basic insight within this approach.

(ii)	(a)	kata-kata	'homogeneous hitting sound'
		kat^{y}a-kat^{y}a	'nonhomogeneous clattering sound'
		kasa-kasa	'rustling sound, dryness'
		kas^{y}a-kas^{y}a	'noisy rustling sound of dry objects'
		pota-pota	'dripping, trickling, drop by drop'
		pot^{y}a-pot^{y}a	'dripping in large quantities'
		met^{y}a-met^{y}a	'destroyed'
		hun^{y}a-hun^{y}a	'limp'
	(b)	dos^{y}a-dos^{y}a	'in large amounts'
		nos^{y}o-nos^{y}o	'slowly'
		net^{y}a-net^{y}a	'sticky'

First, this indicates that the morpheme is a featural suffix. Secondly, the relevant co-occurrence constraint in this case is one between coronals and the palatal prosody; that is, the palatal prosody seeks out coronals. The co-occurrence constraint may be stated as in (iii).

(iii) If [-back] then [coronal].

If the rightmost coronal is the first consonant of the base, then the prosody goes on the first consonant, making a suffix become a prefix. As in previous cases, it is again a feature co-occurrence constraint (between coronals and [-back]) responsible for misalignment.

(iv)	(a)	zabu-zabu	'splashing'
		z^{y}abu-z^{y}abu	'splashing indiscriminately'
		noro-noro	'slow movement'

		n^{y}oro-n^{y}oro	‘[snake’s] slow wriggly movement’
	(b)	t^{y}oko-t^{y}oko	‘childish small steps’
		n^{y}oki-n^{y}oki	‘sticking out, one after another’

Two constraint rankings are established by the above data. The first established ranking is Parse >> Alignment. That is, it is preferred for the morpheme to get realized (if at all possible) than to get realized on the last consonant. Secondly, the ranking Co-occurrence >> Alignment is established since the palatal prosody is forced away from the edge to get realized on a coronal consonant which is not the last consonant, as long as there is one in the root. Thus, both Parse and Co-occurrence dominate alignment.

There is one final bit of this data that makes it extremely interesting and significant; if there is no coronal consonant in the root, then the palatal prosody gets realized on the initial consonant, as the data in (v) shows. First, this shows the overall dominance of Parse. That is, the prosody must be realized. Secondly it shows that the co-occurrence constraint can be violated in favor of Parse. Thus the ranking Parse >> Co-ccurrence is established, producing the overall ranking Parse >> Co-occurrence >> Alignment.

(v)	(a)	poko-poko	‘up and down movement’
		p^{y}oko-p^{y}oko	‘jumping around imprudently’
	(b)	h^{y}oko-h^{y}oko	‘lightly, nimbly’
		g^{y}obo-g^{y}obo	‘gurgling’

The question now is, why is it that in the absence of a coronal consonant the palatal prosody is not linked to the final consonant as a featural suffix? The answer is that what attracts the palatal prosody to a coronal consonant is the positive cooccurrence constraint. When none is found, the pressure to parse leads to a violation of both co-occurrence and alignment, and hence the feature lands on the first consonant. If languages ever allow a SUFFIX to be realized only on the FIRST CONSONANT of the word, Japanese and Guɗe (footnote 29) provide the examples. In these languages the palatal prosody (a suffix) is realized only on the first consonant in words with no coronal consonant.

The above analysis provides a crucial insight into the apparent bidirectional nature of the association of this affix: right to left in roots with coronals and left to right in roots without coronals. This behaviour is completely captured by constraint domination and violation which reflect preference. The affix prefers to be realized as a suffix, hence reference to the right edge. It prefers to be realized with coronals, hence reference to the rightmost coronal. If that is not possible, the affix prefers to be realized with a coronal elsewhere in the root. If there is no coronal, the most important thing is for the affix to be realized on the surface, ending up on the first consonant.

A3. Aka voicing

In Aka, a Bantu language of Zone C, spoken in the Central African Republic (Kosseke & Sitamon 1993, Roberts 1994), the feature [voice] is the singular class 5 marker, serving as the counterpart of /ma-/, the plural class 6 prefix. What is crucial in the case of Aka voicing is that both parse and alignment dominate co-occurence, and so it is violated. This is why either (i) (d) or (f) gets the grammar of class 5 voicing in Aka.
This morpheme voices root initial obstruents of the singular class 5 nouns. A comparison of (via) and (vii), the singular classes 5 and 9 which take the same plural class 6 suffix, reveals this fact. It is clear that the singular class 5 marker is featural PREFIX [voice], given the insistence linking to the initial consonant. [voice] is licensed by a root node. If the initial consonant of the noun is underlyingly voiced, there is no surface effect of the singular class 5 [voice], as (vib) reveals. We assume that the class 5 [voice] is realized vacuously in these forms.

(vi)	(a)	Singular (class 5)	Plural (class 6)	Gloss
		dèŋgé	màtèŋgé	piercing tool
		dɔ̀tɔ̀	màtɔ̀tɔ̀	catridge
		gásá	màkásá	palm branch
		gìnì	màkìnì	fly
		bɔ̀kí	màpɔ̀kí	arch of the eyebrows
		bàpùlàkà	màpàpùlàkà	lung
		βɔ̀ndú	màɸɔ̀ndú	goiter
		βókó	màɸókó	hole
	(b)	gɔ̀àlà	màgɔ̀àlà	game of imitation
		bèlèlè	màbèlèlè	sound of a waterfall
		dʒámbà	màdʒámbà	mud

(vii)	Singular (class 9)	Plural (class 6)	Gloss
	tɔ̀ŋgú	màtɔ̀ŋgú	navel
	kùŋgà	màkùŋgà	body hair
	kómbó	màkómbó	name
	séɓá	màséɓá	horn
	sɔ́pɔ́	màsɔ́pɔ́	earth
	ɸúmà	màɸúmà	house

Thus the singular class 5 prefix is always realized on the surface, and it is always realized on the initial consonant. The implies that both Parse and Align are dominant in this language. What is of interest to us is the behavior of the initial voiceless alveolar fricative [s] in class 5 nouns. Given the fact that the featural prefix is simply [voice], the expected output is [z]. However, the output from these forms is [dʒ], as in (viii).

(viii)	Singular (class 5)	Plural (class 6)	Gloss
	dʒú	màsú	cheek
	dʒèlé	màsèlé	lizard [sp.]

The mystery disappears once we realize that Aka has neither [z] nor [tʃ]. We derive the [s]~[dʒ] alternation from the effect of a co-occurrence constraint barring [voice] from associating with coronal fricatives. Now if the prefix [voice] must be realized, and if it must be realized on the leftmost consonant of the base (i.e. as a featural prefix); the only compromise is for this co-occurrence constraint to be violated.[31],[32] This derives the overall ranking Parse, Align >> Co-occurrence.

A4. Athapaskan d-classifier

Rice (1987) provides the following description of the Athapaskan d-classifier.[33] The morpheme, traditionally termed a classifier, can be part of a basic lexical entry or indicate voice. This morpheme consists solely of the feature value [-continuant], creating noncontinuants from continuants. “This process takes a morpheme commonly called *d* and combines it with a following consonant, the initial consonant of the stem.” (p.503) It is thus a featural prefix in our characterization. Rice notes further that “it is either phonetically realized as part of the following consonant or is not phonetically realized.” (p.506) This description by Rice is consistent with a situation in which in which Parse is at the bottom of the hierarchy, suggesting the ranking in (i) (e).

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[2] See the references cited here for additional examples.

[3] The basic idea of employing alignment constraints for features was originally proposed by Kirchner (1993), with vowel harmony. The approach here extends featural alignment all autosegmental features which function as affixes.

[4] In its broadest expansion, Pfeat may be any autosegmental feature. A reviewer has pointed out that one implication of this is that given a feature hierarchy such as that of McCarthy (1988), this rules out the features [cons] and [son] from constituting featural morphemes independently of other features since they constitute the Root node. In support of this observation we have not found either of these reported as featural morphemes in the literature.

[5] One characteristics which feature alignment may show when featural affixation is characterized by Featural Alignment (5) is that the feature is underlyingly free, i.e. underlyingly unassociated. It should be noted that the proposals in this article allow for affixes which involve more than one autosegmental feature, though we do not discuss such cases here. For example, in Mokulu (Eastern Chadic, Chad republic) the completive aspect marker consists of the features [voice] and [high] (Jungraithmayr 1990, Roberts 1994). The first consonant of the stem becomes voiced while the first vowel becomes high, even if it was a low vowel in the input. In the approach proposed here both features constitute parts of a featural prefix. However such features may be realized on the same segment in the stem, or on different segments depending on licensing. In the case in question licensing forces [voice] and [high] on different segments. Details on how the idea of licensing works in this context will be discussed in the following sections.

[6] Most studies on tone are exceptions to this generalization (see Pulleyblank 1986, Clements & Goldsmith 1984, Anderson 1991, van der Hulst & Snider 1993).

[7] I am assuming here that floating tones, such as floating (L) tones which are assumed in tonal studies to cause downstep, are actually licensed by tonal structures into which tones are organized, following recent work by Akinlabi & Liberman (1995) and by Akinlabi, Bamba & Liberman (in progress).

[8] See Zoll (1994) for a broadly similar approach to the same phenomenon.

[9] The PARSE-MORPH family must be distinguished from the PARSE-SEG or PARSE-FEAT families, which enforce the realization of lexically specified segments and features respectively; though these constraints may sometime have identical featural referents. A crucial interaction of these different classes of Parse constraints is illustrated with both Edoid tone and Terena nasalization below.

[10] This assumes that an unparsed feature vacuously satisfies alignment. But see

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Akinlabi (to appear) for an alternative view.

[11] A similar analysis is available for morphological palatalization in this language, which we assume is a [-back] morpheme. For the [-back] morpheme, the class of ‘palatalizable consonants’ consists of velars and coronals, but not labials. A discussion of Chaha palatalization will not be given here since its details are close to those given for labialization above, but admittedly more complex. The reader is refered to Rose (1993) for a description, and to Zoll (1994) for an analysis.

[12] The transcription system in (18) may be interpreted as follows. dh and th are interdental continuants [ð] and [θ] respectively. t̪ is an interdental stop, and ʈ is a trilled alveolar continuant. Crazzolara suggests that what he writes as b is actually the continuant [β] in final position (Crazzolara 1933: 6). One can imagine that the same is true for what he writes as d, since he notes that Nuer stems can have up to three forms, one ending with a voiceless stop, one with a voiceless continuant, and the third with a voiced sound which in most cases is a continuant.

[13] I will not discuss the vocalic changes, since they are largely unpredictable from Crazzolara’s transcriptions. The umlaut symbol on front vowels apparently stands for centralization.

[14] But see Lieber (1987) for a different assumption on input.

[15] Crazzolara (1933: 124) points out that there is a separate negative particle /ċi/ which occurs before the subject clitic. Forms with nasals are the only complete paradigms that Crazzolara gives, and in these cases he provides no forms in which the first consonant is an oral stop and the second is a nasal. In all the other forms where the stem consonant does not alternate he provides the 3rd sg. ind. pres. act and the 1st pl. ind. pres. act. for the rest of the cases. Two examples with liquids are: (from pp. 131-132)

	‘to manifest’	‘to (be) smooth’
3rd sg. ind. pres. act.	pä́älɛ́ jɛ̀	ɡúúrɛ́ jɛ̀
1st pl. ind. pres. act.	pä́älkɔ̀ jɛ́	ɡwɔ̀rkɔ̀ jɛ́

[16] This implies that a single [cont] specification on the on the final consonant on the surface corresponds to two in the input. Such an output therefore violates the constraint UNIFORMITY (McCarthy & Prince 1995) which requires a one to one correspondence between the elements in the input and output. See also the discussions of Zoque palatalization (section 5) and Edoid tone (section 6) for similar violations.

[17] See also Pulleyblank (1994) for arguments for the same distinction, but with a different set of phenomena in different languages.

[18] The transcription here (from Wonderly 1951) is somewhat misleading because one can be led to believe that the morpheme here is indeed /y-/, and not a feature. However if this were a full segment as opposed to a feature then it will be completely unnecessary for the segment to seek licensing from another segment. It will also be compeletely an accident that metathesis is limited to Glide-Consonant sequences in this language. Note that this cannot be blamed on sonority rise in an onset because the so-called metathesis occurs in a sequence of two glides as well (which in many accounts are equal in sonority); y- wakas:

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wyakas 'his cow'.

[19] An objection may be raised that the alignment of the prefix is not 'crisp' in labials, velars and laryngeals, since they are realized with secondary palatal articulation. Note however that the same cannot be said of alveolars and alveopalatals which are realized as alveopalatals. Therefore what is crucial is that the feature be realized as part of the leftmost consonant.

[20] Again the output here (as in the preceding section) violates the constraint UNIFORMITY, which requires a one to one correspondence between the elements in the input and output (see footnote 16).

[21] At the phrasal level, a phrase final high tone is realized as a fall, hence the final falling tones in forms with underlying final highs such as (30b, d), e.t.c.

[22] A reviewer has observed, quite rightly, that underspecifing the L tone in Etsako will derive the same result. Note however that the effect of underspecification is derivable from low ranking in OT. More importantly, note that while underspecification can account for the complete replacement of the L tone by high tone in Etsako, it cannot account for the case of partial replacement L tone by H tone in Bini, which we discuss below. Since (low) ranking can account for both phenomena, we prefer the ranking approach to the underspecification approach.

[23] I assume here that the No-Crossing constraint has the same status as all other constraints in Optimality theory.

[24] A Low tone is realized as a falling tone after a High tone in Bini.

[25] The question here is whether or not *RISE exists in Etsako. Yes, it does, like every other universal constraint; it simply ranks low here. Note that Align-A.M. Right is never satisfied by creating a rise. This may be linked to the presence of *RISE in Etsako as well.

[26] My gratitude goes to Doug Pulleyblank for pointing my attention to this.

[27] For the full motivation for this theory, see Steriade (1993); and for an alternative treatment of similar phenomena in other languages, see Piggott (1992).

[28] In several languages, such as Orejon (Pulleyblank 1989) the cooccurrence constraint is simply between [nas] and the whole of the [-son] segment; i.e. no part of the obstruent may be associated with [nas]. In that case, the banned structure may be represented as follows:

$$\begin{array}{c} *\,[\text{nas}] \\ / \quad \backslash \\ A_o \; A_{max} \\ \backslash \quad / \\ [\text{-son}] \end{array}$$

As with every other universal constraint, this constraint is of course violable; so there are several languages where nasality spreads through obstruents. The above representation, which appears to be the universal, differs crucially from that in (67) in that [-son] and [nas] are linked to both the closure and release phases of the obstruent. In conjunction with the representation in (67) the above representation predicts that there is one additional possibilty: that in which [-son] is linked to the closure phase phase of an obstruent, as opposed to the release, and

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in which the closure phase is barred from associating to [nas]. This will appear to be the case in languages with only postnasal consonants, such as Zing Mumuye (Shimizu 1983).

[29] Schourup & Tamori (1992) contest the arguments that the palatal prosody is a morpheme in Japanese. However, Hoskison (1974) describes a palatal prosody in Guɗe, a Chadic language of Nigeria, with almost identical characteristics. In Guɗe, the palatal prosody marks verbs for ‘motion to speaker’ (Hoskison 1974: 23).

[30] Mester & Ito (1989) argue that /r/ is unspecified for [coronal] and so does not receive this feature. I will abstract away from this complication for the purposes of exposition. The reader is referred to their article for other details.

[31] However the fact that input [s] surfaces as [dʒ] in this language implies that there is a markedness constraint *z which is high ranked and unviolated. If this constraint must be obeyed the combination of [voice] with a coronal fricative must derive a third segment allowed in the inventory, hence [dʒ].

[32] The exact phonetic derivation is beyond the scope of this article, and is not directly relevant to the issue at stake. I will therefore leave it aside. The reader is referred to Roberts (1994) for additional ideosyncrasies of the singular class 5 prefix.

[33] This article contains no Athapaskan forms.