Tigrinya vowel features and vowel coalescence

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In this paper I examine various facts regarding the vowel system of Tigrinya, an Ethiopian Semitic language, with an emphasis on vowel coalescence. I propose a set of underspecified feature representations and a rule of fusion which together account straightforwardly for exactly the attested coalescences. This same underspecification also leads to simple treatments of such things as the nature of epenthetic vowels, an apparent ordering paradox, and peculiar facts about certain verb classes.[1]

§1 summarizes approaches to underspecification and gives a representation of the Tigrinya vowels in Combinatorial Specification. §2 discusses a treatment of epenthesis in Tigrinya and how this treatment can be used to resolve an ordering paradox and facts about the vocalization of glides. §3 turns to vowel coalescence, giving examples of its occurrence in various contexts along with morphological complications. Finally, §4 shows how the analysis developed in the preceding sections can be used to provide a more unified treatment of certain verbs which have the vowel /a/ in their stem.

1.   Underspecification

Since I focus on vowels in this paper, I will not propose an underspecification of the consonants. Shown below is the vowel inventory of Tigrinya; there are no long vowels.[2]

(1)   *Vowel   inventory*

i	ɨ	u
e	ʌ	o
	a	

Using four features to distinguish the seven vowels, I assume the following full specification of values:

(2)   *Fully   specified   features*

	i	e	ɨ	ʌ	a	o	u
high	+	−	+	−	−	−	+
low	−	−	−	−	+	−	−

back	–	–	+	+	+	+	+
round	–	–	–	–	–	+	+

A considerable literature has arisen in recent years treating various aspects of phonological underspecification (for surveys see Archangeli 1988, Mester and Itô 1989, Mohanan 1991). One major point of debate is whether one or both values of a given feature should be specified underlyingly: advocates of Contrastive Specification (e.g. Clements 1988, Steriade 1987) generally argue that both [+] and [–] values of a feature must be present for segments where that feature is contrastive, while proponents of Radical Underspecification (e.g. Archangeli 1984, Pulleyblank 1986) claim that, since the lexicon is properly the depository of unpredictable, idiosyncratic information, all redundant phonological features should be excluded from the lexical representations of words; predictable features are inserted by rule, generally at the end of the lexicon.[3] Only one value for each feature, [+] or [–], is allowed underlyingly. In the simplest case, one segment is chosen as fully under-specified, and the others are assigned features based on how they differ from that segment. The more recent approach of Combinatorial Specification (Archangeli and Pulleyblank 1993) similarly rejects the systematic inclusion of both contrastive feature values, but does permit the unmarked feature to be specified in particular instances (which will not be relevant to the present analysis).

Following the algorithm described in Archangeli (1988) for deriving a Contrastive Specification, we must first determine those pairs of segments which differ by the value of exactly one feature.

(3)   *Minimally contrasting pairs of vowels*

high   i, e; u, o; ɨ, ʌ
low   a, ʌ
back   i, ɨ; e, ʌ
round   u, ɨ; o, ʌ

Specifying each of these vowels only for these contrastive features, we arrive at the following matrix.

(4)   *Features under Contrastive Specification*

	i	e	ɨ	ʌ	a	o	u
high	+	–	+	–		–	+
low				–	+		
back	–	–	+	+			
round			–	–		+	+

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[3] There is good evidence from phonetic interpolation that in some cases features remain underspecified beyond the phonology (Keating 1988, Beckman and Pierrehumbert 1988). Since I know of no evidence suggesting such phonetic underspecification in Tigrinya (one place to look would be the phonetic realizations of the central vowels /ʌ/ and /ɨ/ adjacent to rounded and palatal segments), I assume in this paper that the vowel features are assigned by the phonology.

For example, /i/ and /e/ differ only in their values for [high], and so they must both be underlyingly specified for that feature. A feature such as [low] is distinctive only for /ʌ/ and /a/, so other segments need not be specified for it.

Under Combinatorial Specification, as well as its predecessor Radical Underspecification, most of the values in (4) are predicted on the basis of other features. I take /ɨ/ to be the fully underspecified vowel since (as we see below) it is the vowel that is inserted by epenthesis, and the representations which result from this assumption turn out to have many benefits. Thus [+high], [−low], [+back], and [-round] are the default values; only the opposite values are present underlyingly.

(5)   *Features under Combinatorial Specification*

	i	e	ɨ	ʌ	a	o	u
high		−		−		−	
low					+		
back	−	−					
round						+	+

The values given here are precisely those by which the segment in question differs from /ɨ/, except that /a/ does not include [−high] since this value is trivially predictable from [+low].[4] The rules which insert the predictable feature values are as follows:[5]

(6)   *Redundancy rules*

Ø → [+high]
Ø → [−low]
Ø → [+back]
Ø → [−round]

These rules are unordered relative to each other and apply at the end of the lexicon.

A basic idea of Combinatorial Specification is that there are not underlying phonemes, but rather underlying features which can be combined with each other and then completed by the application of redundancy rules (Archangeli and Pulleyblank 1993; cf. also Archangeli 1988). Recall from (4) that in Tigrinya the underlying features are [-high], [+low], [-back], and [+round]. If allowed to combine freely, these features will overgenerate: for example, they would create front rounded vowels and more than one low vowel. To prevent this overgeneration, constraints are necessary which

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[4] I mean only that a segment with the feature [+low] cannot also be [+high] (but see Schane 1984, Kaye et al. 1985), and do not intentionally refer to 'trivial underspecification' in the sense of Steriade (1987), where it is used to mean underspecification of a feature value which is never assigned in the phonology. I do, however, assume below that /a/ never needs a value for [high], so that its underspecification could be considered trivial in this technical sense as well.

[5] As Abaglo and Archangeli (1989) argue, underlying features and the rules that complement them can vary on a language-specific basis, so that these redundancy rules should not be taken to be universal.

restrict the possible combinations to those which are attested in the language. The following such constraints hold for Tigrinya:

(7)   *Feature cooccurrence constraints*

      *[+low, –back]   rules out   [æ]
      *[+low, +round]   [ɒ]
      *[+round, –back]   [ü, ö]

In addition to limiting the possible underlying combinations of features (the 'phonemes'), these constraints also serve to restrict the application of phonological rules: when a rule would create an output which contains one of these combinations, its application is blocked (for an example of this process, see Archangeli and Pulleyblank 1989). We will see below that the formulation of rules in Tigrinya is simplified by the existence of these constraints.

    Mester and Itô (1989) present a version of Contrastive Specification theory which they term Restricted Underspecification. The crucial innovation is that the theory incorporates privative features, which are either present or absent (rather than having both positive and negative values). A privative feature mimics the effect of Combinatorial Specification: since the opposite value does not exist, it is inherently underspecified (Archangeli 1988). If all four vowel features under discussion here are privative, we will have a featural representation identical to that in (5), regardless of the actual theory of underspecification one otherwise adopts. Two of the features must be renamed to correspond to the negative values used above: [mid] for [-high] and [front] for [-back].

(8)   *Privative features*

	i	e	ɨ	ʌ	a	o	u
mid		•		•		•	
low					•		
front	•	•					
round						•	•

Some relatively early examples of privative vowel features are Schane (1984) and Kaye at al. (1985). There are various more recent approaches which use privative articulator nodes or features for vowels, and which could give a representation similar to that in (8). For example, one can use Labial for [+round], Pharyngeal for [+low], and Coronal for [-back], with no features corresponding to [-round], [-low], or [+back]. I am not aware of an approach, however, which has a feature corresponding exactly to [mid]. Clements (1991) and Clements and Hume (1993) advocate privative vowel place features but have a special representation of vowel openness using multiple tokens of the equipollent feature [±open]. Selkirk (1991, 1993) gives mid vowels both Dorsal and Pharyngeal (which alone mark high and low vowels respectively), which does not produce the results desired for Tigrinya (see below). Since there is no apparent need in Tigrinya to make reference to the unmarked values of any vowel features, it should be borne in mind that a privative approach with

the right set of features will work as well as the Combinatorial Specification assumed here.

2.   Epenthesis

As mentioned above, the epenthetic vowel is /ɨ/. Tigrinya has a very strict syllable structure: the only syllables allowed are CV and CVC. The template for the maximal syllable, which subsumes both CV and CVC, is the following:[6]

(9)

$$\sigma$$

μ μ

CV C

The coda consonant is assumed to carry weight since this distinction is necessary for generating forms such as *dɨmmu* 'cat' where the /m/ is forced to spread to fill the heavy initial syllable in the template. In addition, we can express the minimal word constraint as two moras, since there are words of the form CVC and CVCV but none of the type CV (cf. Buckley 1994). It remains to be seen whether there is independent evidence for treating these two moras as a foot, in which case we can simply say that the minimal word equals a foot, as discussed in McCarthy and Prince (1986).
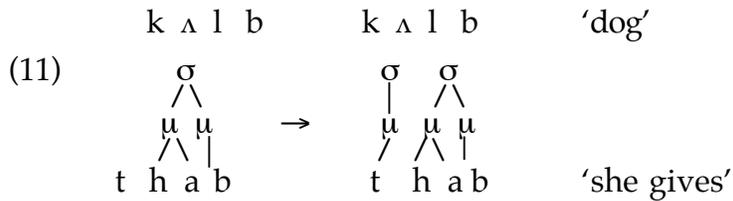
I assume, following Itô (1989), that epenthesis is prosodically determined and follows from the principles of syllabification. Vowels with the feature [−high] must link to a nuclear (V) mora; true consonants must link to a non-nuclear slot, either the onset or coda. A nonconsonantal segment which is unspecified for [high] can link to a non-nuclear slot, surfacing as a glide, or to a nuclear slot, surfacing as a high vowel. Note that 'high vowels' means those which eventually become [+high], and would seem to include /ɨ/, but since this fully underspecified vowel does not actually exist as a feature matrix underlyingly there is no way to associate it to a consonantal position. Therefore only /i/ and /u/ can function as glides.

Whenever a consonant cannot be syllabified a mora is inserted, and the consonant becomes the onset to the new syllable. Examples of Epenthesis are given below:[7]

(10)

$$\sigma \qquad \sigma \quad \sigma$$

μ μ   →   μ μ   μ

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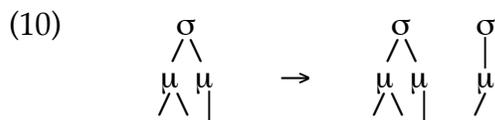
[6] My use of moras in this paper is not crucial to the rest of the analysis; the same underspecification could be applied in an X or CV theory as well. I show onsets linked to the strong mora, rather than to the syllable node, primarily for graphic convenience; but this assumption also has the advantage of rendering automatic the process of vocalization discussed below. As noted in the text, in a prosodic treatment of the morphological templates (McCarthy and Prince 1986), coda consonants must necessarily bear weight to distinguish, for example, CvCvC ($\sigma_\mu\sigma_{\mu\mu}$) from CvCCvC ($\sigma_{\mu\mu}\sigma_{\mu\mu}$).

[7] A diagonal line is used to link the onset consonant to the strong mora in order to express graphically the fact that the features of that segment are unable to head the syllable. The angle of the line has no formal status here.

k ʌ l b   k ʌ l b   'dog'

(11)   σ   σ   σ
               /\ | /\
              μ μ   →   μ   μ μ
             /\ | /   /\ |
            t h a b   t h a b   'she gives'

As the fully underspecified vowel, [ɨ] will be the realization of a mora which
has no head vowel features, resulting in *kʌlbɨ* and *tɨhab*.[8]
    It should be noted that word-final /ɨ/ is subject to a rule which fronts
non-low central vowels; that is, /ɨ/ becomes [i] and /ʌ/ becomes [e]:[9]

(12)   a. kʌlbɨ   →   kʌlbi   'dog'
           kʌlbɨ-na   →   kʌlbina   'our dog'

       b. nɨgɨs-tɨ   →   nɨgɨsti   'queen'
           nɨgɨs-tɨ-kum   →   nɨgɨstɨkum   'your (m.pl.) queen'

       c. sɨʔlɨ   →   sɨʔli   'picture'
           sɨʔlɨ-tat   →   sɨʔlɨtat   'pictures'

       d. rʌkʌb-kɨ   →   rʌkʌbki   'you (f.sg.) found'
           rʌkʌb-kɨ-nna   →   rʌkʌbkɨnna   'you (f.sg.) found us'

(13)   a. dʌmbʌ   →   dʌmbe   'pen'
           dʌmbʌ-na   →   dʌmbʌna   'our pen'

       b. ħaz-ʌ   →   ħaze   'he caught'
           ħaz-ʌ-kka   →   ħazʌkka   'he caught you (m.sg.)'

       c. barʌk-ʌ   →   barʌke   'he blessed'
           barʌk-ʌ-nni   →   barʌkʌnni   'he blessed me'

The suffixed forms do not undergo the rule since the central vowel is not
final. Vowel Fronting must be postlexical because it does not apply to vowels
before the phrase-level clitic =*n* 'and' (notice that the clitic is added to a noun
phrase here):

(14)   ʔɨtu kalɨʔ kʌlbɨ=n   'and the other dog'
      *ʔɨtu kalɨʔ kʌlbi=n

Because of the constraints given in (7), this rule will be prevented from
applying to [+low] and [+round] vowels, so no more need be specified in the
structural description (assuming these constraints are active in at least part of
the postlexical component).

_____

    [8] This account assumes that a nuclear mora will take on vowel features such as [-cons, +son]
by default, and then default place features as in (6).
    [9] Leslau (1941) describes the fronted allophone of /ʌ/ as 'very close' to underlying /e/, but I
have observed no difference between the underlying and derived [e]'s. There is, however, a
difference in the palatalization of a preceding coronal consonant: this occurs only with
underlying /e/, i.e. before the fronting of /ʌ/ takes place. For example, /gze/ → [gɨzÁe] 'time'
while /ħizʌ/ → [ħize] 'I caught'.

(15)   *Vowel Fronting*

   V → [–back] / __]$_W$

The rule applies vacuously to front vowels. Following Inkelas (1989), I assume that a clitic combines with a word to form a larger constituent also labeled as a word, and so the rule as formulated in (15) will in effect apply to the 'clitic group' in (14).

   By treating the epenthetic /ɨ/ as completely featureless underlyingly, its distribution in surface forms follows automatically (cf. Denais 1990). Being without features, its presence cannot be specified in a string of underlying segments. Therefore /ɨ/ is usually found only in places where Epenthesis would predict it, such as at a morpheme boundary in *kʌlbɨ-na,* or in a stem where either Epenthesis or a template can be invoked to explain the presence of a mora, e.g. *rɨʔy-e* 'I saw'. The exceptions to this generalization are when /ɨ/ is found in a doubly open syllable, that is *VCɨCV*. Here Epenthesis cannot explain the presence of /ɨ/ since the sequence *VCCV* is perfectly acceptable. However, in all such cases a mora between the two consonants is motivated by some other part of the grammar: either by a morphological template (*kʌnafɨr-u* 'his lips', §3.2), or by an underlying vowel /a/ which has been dissimilated to [ɨ] (*mɨ-bɨrak* 'to bless', §4). The underspecification proposed thus offers a straightforward account of why /ɨ/ has this limited distribution.

2.1. <u>An ordering paradox</u>

The formulation of Epenthesis as the insertion of a mora rather than a set of vowel features is defensible on the grounds that it avoids redundant information. Since the vowel that surfaces is that predicted by the redundancy rules and the rule of Vowel Fronting, no particular features need be inserted; a simple mora will produce the correct output. A more practical benefit is that it allows an account of an apparent ordering paradox involving noun suffixes.

   Consider the noun *sɨʔli* 'picture'. When unsuffixed, it undergoes Epenthesis parallel to *kʌlbi* in (10):

(16)   sʔl   *Underlying Form*
       sɨʔlɨ   *Epenthesis*
       sɨʔli   *Vowel Fronting*

The most common plural suffix in Tigrinya is *-(t)at*. The initial /t/ of the suffix appears when the stem to which it attaches ends in a vowel; otherwise just *-at* is added:

(17)   sʌb   'person'
       sʌb-at   'people'

(18)   ʔabbo   'father'
       ʔabbo-tat   'fathers'

When the plural is added to a noun such as *sɨʔli,* the form *-tat* is used:

(19)   siʔlɨ-tat   'pictures'
         *siʔl-at

It appears from this fact that Epenthesis PRECEDES plural suffixation.
    Next consider the third-person possessive suffixes, for example *-(ʔ)u* 'his'. These suffixes are also sensitive to whether the noun stem to which they are added ends in a vowel or consonant: if a vowel then the glottal stop is included, if a consonant then /ʔ/ is omitted:

(20)   ʕarat-u   'his bed'
        ʔabbo-ʔu   'his father'

When the possessive suffix is added to a noun such as *siʔli*, the form *-u* is used:

(21)   siʔl-u   'his picture'
         *siʔlɨ-ʔu

This fact suggests that Epenthesis FOLLOWS possessive suffixation.
    The paradox arises when we consider the relative ordering of the plural and possessive suffixes:

(22)   siʔlɨ-tat-u   'his pictures'
         *siʔl-u-tat

Clearly, the suffixation of the plural precedes that of the possessive. By the evidence of Epenthesis, however, the opposite order is suggested: if possessive suffixation precedes Epenthesis (cf. (21)) and Epenthesis precedes plural suffixation (cf. (19)), then the possessive ought to precede the plural.
    This contradiction can be resolved by making the two suffixation rules sensitive to different things. Suppose, as I did above, that Epenthesis consists of inserting a mora without any features. Application to [siʔl] will yield the following representation:

(23)

I propose that the form of the plural suffix is determined by whether there is a strong mora at the right edge of the noun stem (i.e. a vocalic mora which heads the syllable: Zec 1988), while the form of the possessive suffix is determined by whether there is an actual vowel at the right edge of the stem (i.e. a set of features including [-cons]).

(24)   *Environment for* -tat   *Environment for* -ʔu

$$\mu_s\,]\,\underline{\quad} \qquad\qquad \left[\begin{array}{c}\mu \\ | \\ [-\text{cons}]\end{array}\right]\;\underline{\quad}$$

In the case of an underlying vowel, both suffixes will take their consonant-initial forms, but when there is just an epenthetic mora the results will differ in the desired fashion. This way Epenthesis can apply before both suffixation rules, for example after the rule of template association which links the underlying consonants and vowels to a syllabic template. Then we are free to order the two suffixes in the morphology as necessary.

I further propose that vowels are not underlyingly associated to moras, but rather the rules of syllabification supply the moras when necessary. This facilitates an elegant account of the possessive suffix and its interaction with Epenthesis. Often moras will be supplied by the syllabic templates required by Tigrinya's nonconcatenative morphology (McCarthy and Prince 1986), but for concatenative affixes, which do not require templates, the moras will be supplied by syllabification. For example, in *kʌlbi* 'dog' the consonant melody {klb} is associated to a monosyllabic template along with the vowel /ʌ/, but since a further syllable is necessary to license the final /b/ a mora is inserted.[10] This process was illustrated in (10). In the case of *siʔli* no underlying vowel is assumed; the [i] internal to the stem is predicted by redundancy rules and it will automatically follow from the mora of the syllabic template, just as the final [i] does when there is no suffix. Examples of the application of these rules to the form in (21) are given below; the root here is {sʔl}.

(25)   *Template   Association   Epenthesis*

After the creation of the new syllable and the linking of /l/ to the onset, every segment is prosodically licensed. If no suffix is added then both moras will surface as the default vowel [i] by the redundancy rules in (6) at the end of the lexicon. Note what happens, however, if the possessive suffix is added:

(26)   *Possessive   Suffixation   Syllabification   Redundancy Rules*

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   [10] If, as I argue elsewhere (Buckley 1990), association in Tigrinya is edge-in, the template cannot actually be monosyllabic. Rather, following McCarthy and Prince (1990b), I assume a defective syllable in the template which represents the onset position that /b/ associates to. In this case it may be that Epenthesis is related to the insertion of a mora to provide a place for the onset to link in the (previously) defective syllable. From either perspective, mora insertion is the direct result of the general syllabification process and requires no special rule.

σ   σ   σ   σ   σ   σ

μ μ   μ   →   μ μ   μ   →   μ μ   μ

s ʔ l + u   s ʔ l u   s ɨ ʔ l u
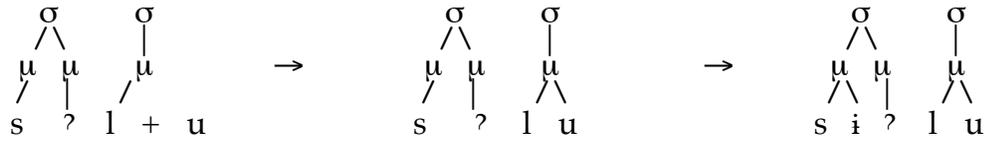
Because the suffix vowel /u/ is not underlyingly associated to a mora, it can simply link to the epenthetic mora and the syllabification of the word is complete. If a mora were already linked to the /u/, an additional rule or principle would be needed to remove the extra mora.

2.2. Glide-vowel interactions

Another advantage of the syllabification principles given above is that they deal naturally with the frequent interaction of glides and vowels in Tigrinya. I assume here that /i, y/ and /u, w/ are not underlyingly distinguished; the difference between them is based on whether the segment is syllabified as the head of a syllable. For example, in the word ʕ*ayni* 'eye' the glide /y/ is the same as /i/ in terms of its features, but since it is located after a vowel the principle of Maximality, which creates the largest syllables possible (Itô 1989), ensures that it is associated to a coda position and not as a new nucleus.

(27)

σ   σ

μ μ   μ

ʕ a i   n i
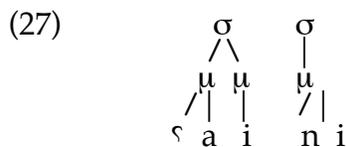
Conversely, when an epenthetic mora is inserted adjacent to /i/ or /u/, the high vowel simply associates to the inserted mora and does not surface as a glide.

This treatment accounts for the fact that of the many nouns with the underlying pattern *CVCC*, which require a final epenthetic vowel when unsuffixed (*kʌlbi, sɨʔli*), none has a glide as the final consonant.

(28)   šahy   →   šahi (*šahyi)   'tea'
        ħamw   →   ħamu   (*ħamwi) 'father-in-law'
        čflɨrw   →   čflɨru (*čflɨrwi)   'bird'[11]

This is because when a mora is inserted, the high vowel links to it and no default vowel ever appears. For example, the derivation might be something like the following.

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[11] This last example is particularly striking since comparison with the broken plural form — čflʌraru, from /čflʌrarɨw/, where the template is *CʌCaCɨC* — indicates that the root for 'bird' is in fact {čflrw}.

(29)   *Template   Association   Epenthesis   Resyllabification*
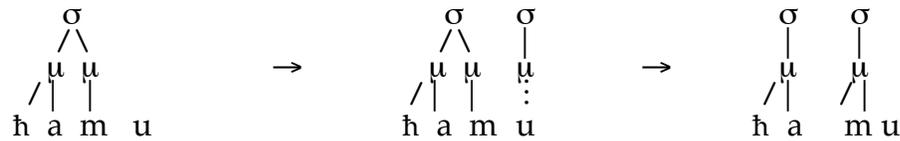
This gap in the data then follows directly from the principles of syllabification.

2.3. <u>A complication</u>

Inflectional prefixes on the verb often trigger Epenthesis, as illustrated by the following words:

(30)   t-sʌbbɨr   →   tɨ-sʌbbɨr   'she breaks'
        k-t-sʌbbɨr   →   kɨ-t-sʌbbɨr   'that she break'
        k-ʌy-t-sʌbbɨr   →   k-ʌy-tɨ-sʌbbɨr   'that she not break'

The epenthetic vowel appears after the first unlinked consonant, after which the second consonantal prefix (if present) can link to the coda of the new syllable. Note that this is evidence that syllabification proceeds left to right and noncyclically in Tigrinya; otherwise we would expect Epenthesis after each prefix: for example, first after /t/ and then after /k/, yielding *kɨ-tɨ-sʌbbɨr*. Alternations between forms such as [t] and [tɨ] provide evidence that the underlying representation of such prefixes is a consonant without a vowel, i.e. /t/.[12]
       Consider now the other third-person agreement prefix:

(31)   yɨ-sʌbbɨr   'he breaks'
        *ʔi-sʌbbɨr

By analogy with the other prefixes, we would like to treat the prefix vowel as epenthetic. But since the underlying features of the prefix /y/ are identical to /i/, we might expect to find the starred form above, since the /i/ should link to the epenthetic mora (with insertion of a default onset). There is a principled reason why this does not happen, however.
       It is a pervasive fact of Tigrinya that every syllable must have an onset. There are no words with underlying vowel-vowel sequences. Borrowed words also conform to the requirement for an onset, for example *jeʔograf* 'geography' and *dɨyablos* 'devil' (Greek *diablos*), though as these examples show either a glide or glottal stop can be added when the word is borrowed (which then becomes part of the underlying form). In addition, there are rules to provide onsets when one is lacking. When, for example, the

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[12] A general rule syncopating [ɨ] in a doubly-open syllable would make false predictions, since the vowel is found in this environment, e.g. *mɨ-bɨrak* 'to bless' (about which more later); for this reason an underlying /tɨ/ would be problematic, in addition to missing the generalization that all surface CV verb prefixes have [ɨ].

negative prefix /ʌy/ occurs word-initially, a glottal stop is inserted (with subsequent lowering of the vowel):

(32)   ʌy-kʌd-ku-n   →   ʔay-kʌd-ku-n   'I didn't go'

Compare this with the form *k-ʌy-kʌd-ku* 'that I not go', where the negative prefix is not initial.
     The rule of Glottal Stop Insertion is only postlexical, however, as illustrated by the following realizations of the underlying /ʌbbo/ 'father':

(33)   ʔabboy   'my father'   *(with Glottal Stop Insertion and Vowel Lowering)*
        b=ʌbboy   'by my father' *(with neither rule)*
        n=ʌbboy   'to my father' *(with neither rule)*

When the clitic *b=* 'by' or *n=* 'to, for' is available as the onset of the initial syllable of *ʌbboy*, then no glottal stop is inserted. We know that the clitic must be added after the lexicon since it occurs at the beginning of a syntactic constituent, the noun phrase (e.g. *b=ʌtu kʌlbi* 'by the dog') Contrast this with a word which begins with a phonemic glottal stop, such as *ʔɨgri* 'foot':[13]

(34)   ʔɨgrɨ   'foot' *(with Epenthesis)*
        bɨ=ʔɨgri   'on foot' *(with Epenthesis also after the clitic, and Vowel Fronting)*

If Glottal Stop Insertion always took place in the lexicon we would expect *bɨʔabboy* to be the only possible outcome in (33). This form is acceptable as an alternate, suggesting that either the insertion rule is optional in the lexicon, or that it can occur in the postlexical component before the clitic is added. Note that **b=ɨgri* is ill-formed, so that we cannot simply say that a glottal stop is optionally deleted after the clitic.
     The lack of onsetless syllables can be expressed as a constraint on well-formed syllables (adapted from Itô 1989):

(35)   *Strict Onset Principle:*   * [_σ V

This constraint will prevent the creation of any form which violates it, though by itself cannot 'fix' forms which violate it underlyingly (such as /ʌbbo/); these must wait for a rule (e.g. postlexical Glottal Stop Insertion) which will eliminate the violation.
     We can now see why the prefix /y/ does not link to the epenthetic mora: the result of such an association is ill-formed, since the syllable will have no onset, violating (35). If /y/ links to the onset, the resulting structure is already perfectly acceptable since the unlinked mora will receive values by default, just as it does when the onset is not a glide.[14]

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[13] We know that the glottal stop is present underlyingly since it is part of the root {ʔgr}, as seen in the broken plural *ʔa-ʔgar*, where the template is *ʔa-CCaC*.
[14] There is an irregularity in some dialects: Leslau (1941) reports, in accordance with my own elicitations, that the prefix /y/ is lost when a prefix such as /k/ is added before it (*kɨ-*

3.   Vowel coalescence

The underspecified feature values given in (5) lend themselves to a simple analysis of vowel coalescence phenomena in Tigrinya.   There are morphological irregularities described below which complicate the situation, but when coalescence occurs regularly the resulting vowel is predictable by simply combining the features of the two segments undergoing merger.
        The following examples of coalescence are attested:[15]

(36)   ɨ + u   →   u
        ɨ + i   →   i
        ʌ + u   →   o
        ʌ + o   →   o
        ʌ + i   →   e
        ʌ + e   →   e
        ʌ + a   →   a

Cases where the input refers to /i/ or /u/ should be taken to include /y/ and /w/, since their feature specifications are the same (the glide symbols are used here when the segment is part of a consonantal root).   The vowel /ɨ/ has no place features, so it cannot really participate in coalescence: in the first two examples above /i/ and /u/ simply associate to an empty mora and /ɨ/ never appears; this process is referred to here as Vocalization, but is in fact an automatic effect of syllabification.   As illustrated below in (48), the vowels in the corners of the vowel space (/i,u,a/) cannot combine with each other because each pairing would violate one of the constraints in (7); the same is true of the pair /e,o/, which would create */ö/.
        Consequently, the only meaningful examples of coalescence involve /ʌ/ and some other vowel.   All possibilities are attested.   Since /ʌ/ is simply [–high], it serves to lower the high vowels /i,u/ and has no effect on /e,o,a/, which are already nonhigh:

(37)   *Coalescence with high vowels*

	√ + i → e		√ + u → o	
high	-	-	-	-
low				
back	-	-		
round			+	+

---

sʌbbɨr 'when he breaks'), even though we would expect it to associate to the epenthetic mora in this case, producing /ki/, since the additional prefix will serve as the onset. The related language Amharic has a similar prefix which behaves regularly: compare yɨ-sʌbr 'he breaks' and s-i-sʌbr 'when he breaks' (Leslau 1967). Ullendorff (1985) hints at a similar situation for an unidentified dialect of Tigrinya, as does Palmer (1962).

    [15] Similar facts hold in Amharic (Leslau 1967, Hartmann 1980), which has an identical vowel inventory, suggesting that the same underspecification and coalescence rule may be motivated for that language.

(38)   *Coalescence with nonhigh vowels*

	√ + e → e	√ + o → o	√ + a → a
high	- - -	- - -	- -
low			+ +
back	- -		
round		+ +	

In all cases the output features are identical to the underlying radical under-specification of the output vowel given in (5), except that in (38) the redundant value [–high] is present for /a/. There are times when two instances of /ʌ/ coalesce, where naturally the output is the same vowel; see below for more discussion.

   The examples above suggest that the mechanism of vowel coalescence in Tigrinya is a rule which simply merges (or 'unifies') the feature matrixes of two adjacent vowel segments. It is a mirror image process, i.e. it applies whether the first or second of the two feature matrices is linked to a mora.

(39)   *Vowel Coalescence*
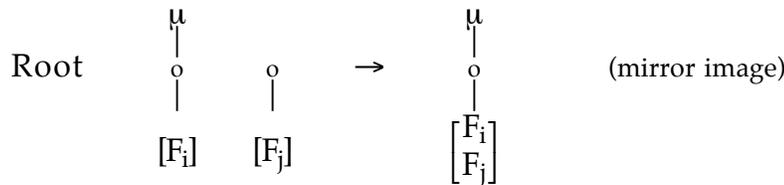
In other words, a segment will merge with an adjacent vowel and their features will be combined in a new vowel. The rule applies whether the second segment (the one which is not associated to a nuclear mora position) is free, in the coda, or in the onset; this is why no skeletal structure is given for the segment. This rule is intended to operate by the principle of unification, where 'the unification of two feature structures D´ and D´´ is defined as the most general feature structure D, such that D´ subsumes D and D´´ subsumes D' (Shieber 1986, 17-18).

   If, in a parametric theory of rules, we permit an operation such as Fuse which has precisely this function, then the formulation of the rule is not problematic; it simply fuses a nuclear mora with an adjacent segment, subject to blocking by cooccurrence restrictions and constraints such as the Strict Onset Principle.

   The rule is expressed in extremely general terms: it says that any segment adjacent to a mora will give up its features to that mora. In cases where the adjacent segment is not a vowel, the rule will be blocked by cooccurrence restrictions: a [+cons] segment cannot link to a nucleus. Since application of the rule would produce an ill-formed segment, it is blocked. This leaves open the possibility that any vowel will merge with an adjacent mora. This is in fact the case, subject to blocking by the Strict Onset Principle and cooccurrence restrictions.

   This rule will create redundant features in some cases. For example, both /ʌ/ and /o/ carry the feature [–high], so when they are merged the

resulting structure will include two instances of [–high] linked to the same mora (this problem is ignored in (38)). When two values of a feature are linked to the same segment in traditional representations, it is interpreted as a contour sequence: in a common case, [-cont] and [+cont] linked to the same consonant represent the change in stricture found in affricates. But if both features were, say, [+cont], then the stricture would not change and the segment would be a simple fricative. This is idea behind the Twin Sister Convention of Clements and Keyser (1983, 95), which states that 'Twin sisters degeminate', as illustrated below:

(40)
$$
\begin{array}{ccc}
\overset{\circ}{\diagup\diagdown} & \rightarrow & \overset{\circ}{\mid} \\
[\alpha F]\ [\alpha F] & & [\alpha F]
\end{array}
$$

Alternatively, one could assume that the Obligatory Contour Principle will collapse such redundant pairs into a single instance. In either case the two representations will yield the same results. (If the fusion operation is true unification, the identical features combine automatically and the process of readjustment in (40) does not arise.) Note that if the vowel features are contrastively specified (as in (4)), this type of approach to coalescence is impossible, since every pair of segments by definition has conflicting features.

The present account correctly predicts that contradictory features cannot be merged via coalescence: for example, /a/ cannot merge with /i/ or /u/ because the feature combinations [+low, -back] and [+low, +round] are ruled out by the constraints in (7). This prediction may be redundant, however, since it appears that this type of blocking has been morphologized to such an extent that these offending vowel sequences are never allowed to be adjacent in the first place. In fact, there is a great deal of interference by the morphology which either prevents certain vowels from coalescing by placing a consonant between them, or causes unexpected coalescence in particular morphological contexts. The rest of §3 considers these cases in some detail and attempts to motivate the claim that these irregularities are due to the morphology, and not to an inadequate formulation of the phonological rule. There are basically three circumstances where vowels coalesce: at a noun or verb suffix boundary, internal to nouns, and internal to verbs. Each of these will be treated separately.

3.1. Suffixes

The two major places where coalescence involves suffixes are with the possessive noun suffixes and the subject and object suffixes on the verb. The vowel-initial possessives are:

(41)   THIRD-PERSON   masculine singular   *-u*
                         feminine singular   *-a*
                         masculine plural   *-(at)om*
                         feminine plural   *-(at)ʌn*
          FIRST-PERSON   singular   *-ʌy*

As described in §2.1, the morphology inserts a glottal stop before a third-person possessive and a vowel-final noun, so coalescence never occurs. The first-person -ʌy generally does coalesce with a preceding vowel, as shown in the following examples:[16]

(42) gʌza-ʌy   →   gʌzay   'my house'
      ħinʌ-ʌy   →   ħinʌy   'my vengeance'
      mɨħe-ʌy   →   mɨħey   'my rug'[17]
      ʔabbo-ʌy   →   ʔabboy   'my father'
      dɨmmu-ʌy   →   dɨmmoy   'my cat'

Given that /ʌ/ consists only of the feature [–high], the suffix vowel simply disappears unless the other vowel is high, in which case it lowers it as in dɨmmoy. Words ending in /i/ exhibit special behavior:[18]

(43) šahi-ʌy   →   šahɨyʌy   'my tea'

There are two ways of analyzing this pair. First, we could say that a special rule causes the vowel /i/ to link to the onset of the syllable dominating the suffix, leaving its original mora to surface as [ɨ] and preventing Coalescence by the Strict Onset Principle. Second, there could be an allomorph of the suffix, –yʌy, which is selected by words ending in /i/, and a rule of Front Dissimilation (attested in the verbal system[19]) deletes the feature [–back] from a nucleus when an adjacent slot carries the same feature (so that /iy/ → [ɨy]). The latter alternative seems preferable since the character of the glide is not necessarily a function of the preceding vowel: the same -yʌy is found after certain nouns ending in /u/:

(44) bʌrayu-ʌy   →   bʌrayuyʌy   'my slaves'

The final /u/ in bʌrayu is a plural suffix, which always triggers insertion of the glide. In some other nouns ending in /u/, where it is not a suffix, both forms are found (Leslau 1941):

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[16] The suffix -ʌy does not itself coalesce to become -e because the relevant environment is not derived, so the Strict Cycle Condition prevents application of the rule. In addition, since the rule is noniterative it does not apply to its own output and ħinʌy does not become ħine.

[17] Phonemic /ʌy/ and /ey/ are both pronounced [ɛy] due to the influence of the glide; recall also that finally /ʌ/ is fronted and pronounced like /e/. The distinction between the two is apparent only with a suffix such as -na 'our', before which the vowels retain their underlying character.

[18] Subject nominals that take the form CʌCaCi add a further complication: they behave like other words ending in /i/ for the purposes of selecting the suffixal allomorph, but when the suffix is added the /i/ becomes [ɨ] as though it were epenthetic: sfiʌħafi 'scribe', sfiʌħafɨ-ʔu 'his scribe' (compare šahi-ʔu 'his tea', but kʌlb-u 'his dog' where the final vowel of unsuffixed kʌlbi is epenthetic), sfiʌħafi-yʌy 'my scribe' (šahɨ-yʌy 'my tea', kʌlb-ʌy 'my dog'), sfiʌħafi-na 'our scribe' (šahi-na 'our tea', kʌlbi-na 'our dog'). I assume this is a morphological fact about the template.

[19] For example, in a verb with medial /y/ associated to the gerund template CʌCCiC, the /i/ comes out as [ɨ]: kfiʌyyɨd-u 'he bound'.

(45) ħamu-ʌy → ħamu-yʌy, ħamoy 'my father-in-law'

The fact that the glide insertion is sensitive to the morphology of the noun stem and seems to apply optionally only to certain lexically determined nouns strongly suggests that it is caused by a morphological, rather than a purely phonological rule. Therefore the formulation of the rule in (39) is not undermined. Vowel Coalescence applies regularly when it can (ħamoy), but is prevented from applying when the morphology inserts a consonant and eliminates vowel sequences (ħamu-yʌy).[20]

On the verb there are even more morphological complications, which generally seem to be leftover effects from historical changes which eliminated material from the ends of verbs without object suffixes (Leslau 1938). As a result, the rule of Vowel Coalescence rarely has a chance to apply. For example, the third-person feminine singular gerund *riʔya* 'she saw' takes a /t/ between the stem and an object suffix, regardless of whether the suffix starts with a vowel or a consonant: *riʔya-tt-o* 'she saw it', *riʔya-tɨ-nna* 'she saw us'.[21] At an earlier stage of the language the unsuffixed form was something like *riʔyat*. Similarly, insertion of glottal stop (and a vowel in some inflections) occurs in the second- and third-person feminine plural even when the verb ends in a consonant: *sʌbʌrkin* 'you (f.pl.) broke' plus the object *-o* 'it' yields *sʌbʌrkin-aʔo*. In other cases glides are inserted. Due to the clear morphological conditioning of these inserted segments — they depend on the person and gender features of the stem — I will not consider it a responsibility of the phonological description to account for the lack of coalescence here; rather, the morphology inserts segments which eliminate the environment required by the phonological rule.

Because so much consonant insertion is going on, only one stem-object juncture meets the structural description for coalescence: the perfect tense with a third-person masculine singular subject. Only third-person object suffixes begin with vowels, giving four configurations:

(46) sʌbʌrʌ-o → sʌbʌro   'he broke it (m.)'
      sʌbʌrʌ-a → sʌbʌra   'he broke it (f.)'
      sʌbʌrʌ-om → sʌbʌrom 'he broke them (m.)'
      sʌbʌrʌ-ʌn → sʌbʌrʌn 'he broke them (f.)'

Unfortunately, since the stem-final vowel is /ʌ/ and the suffix vowels are already [-high], the effect of the coalescence is uninteresting. Nevertheless it is consistent with the predictions made by (39).

3.2. <u>Within nouns</u>

Tigrinya has typical Semitic morphology, with independent consonant and vowel melodies which combine to form different inflectional and

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[20] The glide /y/ is of course the same as a vowel in its features, but it cannot undergo coalescence here due to the Strict Onset Principle.

[21] The geminate consonants [tt] and [nn] are due to a rule which geminates the consonant preceding the vowel of an object suffix, regardless of whether that consonant is part of the stem, suffix, or inserted like /t/ (see Kenstowicz 1982); *riʔya-tɨ-nna* derives from *riʔya-t-nna* by Epenthesis.

derivational categories. One of the interesting alternations in the noun is the broken plural, where the singular and plural forms have different vocalic patterns but the same consonants. One common pattern has the plural $C_ʌC_aC_ɨC$ with various singular forms including $C_ʌCC_ʌC$, $C_ʌCC_ɨC$ or $C_ɨCC_ɨC$. For motivation of the patterns, along with examples without glides, see Palmer (1955). When one of the root consonants is a glide, the following sorts of forms occur:

(47)

	SINGULAR	PLURAL	GLOSS	ROOT
$C_ʌCC_ʌC$	dʌrho	dʌrahu	'chicken'	drhw
	kokʌb	kʌwakɨb-ti	'star'	kwkb
$C_ʌCC_ɨC$	mʌdid	mʌdayɨd	'grindstone'	mdyd
	sʌldi	sʌladí	'money'	sldy
	ʕellu	ʕilalu	'young donkey'	ʕylw
$C_ɨCC_ɨC$	diʕul	dʌʕawɨl	'ram'	dʕwl
	dɨmmu	dʌmamu	'cat'	dmw
	wɨhiΔ	wʌħayɨΔ	'stream'	wħyΔ

It is clear from comparison with the templatic patterns that the following changes are taking place: /ɨw/ → [u], /ɨy/ → [i], /ʌw/ → [o], /ʌy/ → [e]. The first two are simply association of the glide to the empty mora, while the last two are coalescences as predicted by (39). Notice that the initial /w/ in *wʌħayɨΔ* does not coalesce with the following vowel to produce [o]. Rather, Coalescence takes place when the vowels are adjacent and application of the rule will not leave a syllable without an onset. This is due to the Strict Onset Principle as discussed in §2.3.

Given this independently motivated constraint, we do not need to modify the statement of the Vowel Coalescence rule in (39) to account for its nonapplication in forms like *wʌħayɨΔ*.[22] Note that the /y/ in *wʌħayɨj* and the initial /w/ in *wɨhiΔ* are not interpreted as syllable heads because of the same constraint: such an interpretation would produce the onsetless syllables [u] and [i]. Therefore they are treated as onsets and the syllable is headed by default [ɨ]. Recall that this is the same explanation given in §2.3 for the lack of coalescence in the prefix [yɨ].

Note that, as mentioned above, there is no coalescence of /a/ with the glides /y, w/. Thus we find *gawna* rather than **gona* or **gɒna*.

(48) gawn-a   'male baboon'
      bary-a   'slave'
      rawy-a   'sp. of vulture'
      ʔa-ʔdaw   'hands'
      ʔa-ʕsflaw   'wood (pl.)'

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[22] Morphological rules (such as one which brings two vowels together) are allowed to violate phonological constraints since there are phonological rules (such as Onset Insertion and Vowel Coalescence) which will repair the violation. Phonological rules are not allowed this luxury.

ʔa-ʕwaf	'birds'
ʔa-sflwar	'burdens'
ʔa-btay	'nursing calves'
ʔa-byat	'houses'
ʔa-kyas	'cloth sacks'

These facts follow from the feature specification assumed here, the cooccurrence restrictions in (7), and the fusional analysis of coalescence.

(49) *Impossible coalescences*

	i a → *æ		i u → *ü		e o → *ö	
high			− −	−	− −	−
low	+	+				
back	−	−			−	−
round			+	+	+	+

    Template Association must precede Vowel Coalescence for two reasons. Most obviously, the root consonants and template vowels need to be adjacent for the structural description of coalescence to be met. For example, *dʌrho* 'chicken' (root {drhw}) has a template with two heavy syllables where both moras are linked to /ʌ/:[23]

(50)   *Template Association*   *Vowel Coalescence*

The templatic /ʌ/ and root /w/ must be adjacent before they can merge to [o], and Template Association accomplishes this. For graphic simplicity I also assume that Plane Conflation precedes Vowel Coalescence, though one could imagine an analysis where that is not necessary (cf. McCarthy 1989).
    A second reason for association/syllabification to precede coalescence is that a glide must be associated to an onset position before coalescence has a chance to apply if we expect the Onset Principle to block the application. The derivation of *wʌħayiʌ* 'streams', root {wħyʌ}, illustrates this ordering; it associates to a trisyllabic template which has /ʌ/ and /a/ on the first two moras, and no features on the last mora:

(51) *Template Association*   *Vowel Coalescence/Vocalization (blocked)*

---

[23] The two moras are represented here with separate vowels /ʌ/, a violation of the Obligatory Contour Principle, for graphic clarity. In reality there is a single segment linked to both moras.

$$\sigma \quad \sigma \quad \sigma \qquad\qquad * \; \sigma \quad \sigma \quad \sigma$$

(diagram: w ʌ ħ a y Δ → o ħ a i Δ)

Vowel Coalescence is blocked from applying to /wʌ/ since it would create the onsetless syllable [o], prohibited by (35). Similarly, /y/ is not interpreted as the head of the syllable due to the Strict Onset Principle: the syllable [iΔ] would be ill-formed. As we see in the singular *wɨħiΔ*, /y/ can vocalize when some other consonant is present to serve as the onset (here the template has two featureless moras):

(52)　　*Template Association　　Vocalization*
　　　　Resyllabification

(diagram: w ħ y Δ → w ħ i Δ → w ħ i Δ)
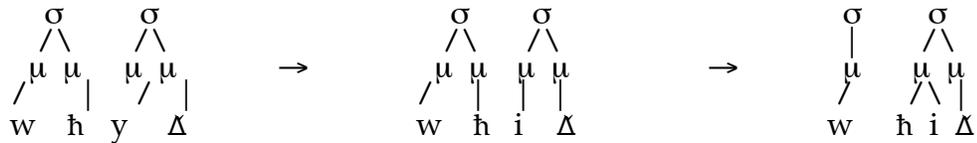
In this case the preceding radical /ħ/ is available as onset of the second syllable, so coalescence of [y] with the following empty mora is permitted. Note at the same time, however, that the initial /w/ cannot do so since there is no other consonant to link to the onset; this is the same situation found with the verbal prefix /y/ described in §2.3. This account assumes that spreading takes place only by the rule of Leftward Spreading which is part of Template Association (Buckley 1990), and cannot apply here after Vocalization; instead, the /ħ/ is resyllabified as the onset of the following syllable, and the coda mora to which is was previously linked is deleted by Stray Erasure.[24] I also assume that the temporary violation of the Strict Onset Principle created by Vocalization (*[wʌħ][yɨΔ]* → *[wʌħ][iΔ]*) is corrected by Syllabification (*[wʌ][ħiΔ]*) before the form is checked against the constraint (for example, at the end of the cycle or stratum).

Vowel Coalescence must precede Epenthesis (which is part of Syllabification) because of forms like the following:

(53)　bet　　*bʌyti, *beti　　'house'
　　　ʕof　　*ʕawfi, *ʕofi　　'bird'

There is clear evidence from the broken plural forms *ʔa-byat, ʔa-ʕwaf* that the roots for these words are {byt} and {ʕwf}. In the singular they both associate to monosyllabic templates with the vowel /ʌ/. As shown in (53), the sequences /ʌy/ and /ʌw/ merge to form [e] and [o]. But if Epenthesis applied before Coalescence, then a mora should be inserted to syllabify the final consonant, as in *kʌlbi* (in (10)); the starred forms in (53) indicate that this does not

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[24] Actually, the /ħ/ cannot spread anyway since geminate gutturals are ill-formed in Tigrinya. The same facts are found with other consonants, however: /tʌfyin/ 'wild ox' becomes *tʌfin*, not **tʌffin*.

happen.[25] Instead, the glide is merged with the preceding vowel, freeing the coda position, so that the final consonant surfaces as a coda without need of Epenthesis.

3.3. Within verbs

Since verbs in Tigrinya have a morphology similar to that of nouns, the patterns of vowel coalescence seen are also similar, but there are important differences. I will consider primarily the most common type, the triradical, which has three root consonants ('radicals'). Longer roots (with four or five radicals) behave in parallel fashion.[26] In this section I go into fairly excruciating detail on some matters, only because it is necessary to anticipate potential counterexamples. My contention is that the apparent exceptions to Vowel Coalescence found in the verbs are morphologically determined and cannot therefore be expected to obey a phonological rule.

First, it is relevant to note that just as the initial glide of *wʌħayɨj* does not undergo coalescence because it is necessarily the onset of a syllable, verb roots with glides as initial radicals, such as {wld}, exhibit no special behavior:[27]

(54)   *CʌCiC-suff*
        wʌlid-a   'she gave birth'

This follows from the Strict Onset Principle.

Roots with final glides show several examples of coalescence, which are shown below with {sty} 'drink' and {ftw} 'like':

(55)   *CʌCʌC-suff*
        sʌtʌy-na → sʌtena   'we drank'
        fʌtʌw-na → fʌtona   'we liked'

(56)   sʌtʌy-u   'they drank'
        fʌtʌw-u   'they liked'

In (56) coalescence is prevented by the Strict Onset Principle.

(57)   *CʌCiC-suff*
        sʌtiy-na → sʌtina   'we drank'
        fʌtiw-na (→ fʌtina)   'we liked'

(58)   sʌtiy-u → sʌtyu   'he drank'
        fʌtiw-u (→ fʌtyu)   'we liked'

In *sʌtyu* the two (identical) segments /iy/ merge and link to the onset of the following syllable, so the Strict Onset Principle is satisfied. This was not possible in (56) since the output of merger would be a mid vowel, which

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[25] Lowenstamm and Prunet (1985) give the form *bʌyti*. This may be due to a different rule ordering in the dialect attested. Alternatively, Coalescence may be optional or missing.

[26] Some of the processes in this section are discussed in Schein and Steriade (1986).

[27] There are no verbs in the language with initial /y/.

cannot serve as an onset. The changes in parentheses reflect an optional rule which changes /w/ to [y] adjacent to /i/; if this rule does not apply then coalescence is blocked, since /i/ and /w/ would yield [-back, +round], which is barred by (7).

(59)   *yi-CʌCCiC*
        yi-sʌttiy → yisʌtti   'he drinks'
        yi-fʌttiw → yifʌttu   'he likes'

This same merger is exemplified for nouns in (47).

(60)   *ti-CCʌC*
        ti-stʌy → tiste   'you (m) drink'
        ti-ftʌw → tifto   'you like'

(61)   *ti-CCʌC-i*
        ti-stʌy-i   'you (f) drink'
        ti-ftʌw-i   'you like'

As in (56), merger is prevented in (61) by the Strict Onset Principle. It should be mentioned that there is special optional rule which collapses the sequence /ʌyʌ/ into [ʌ], so that both forms in the following pairs are possible (shown without the effects of Vowel Fronting):

(62)   sʌtʌy-ʌ, sʌtʌ   'he drank'
        sʌtʌy-ʌt, sʌtʌt   'she drank'

This is not an example of Vowel Coalescence since the output to that would be [e], not [ʌ]. In roots with /w/, a similar change is also optional:

(63)   fʌtʌw-ʌ, fʌto   'he liked'
        fʌtʌw-ʌt, fʌtot   'she liked'

In this case, however, the output is consistent with Coalescence, since the total of [-high], [+round], and [–high] produces [o]. Just why these results should obtain is considered below, but at any rate neither change is due to Vowel Coalescence (since it is both optional and a violation of the Strict Onset Principle). These examples suffice to give a picture of the behavior of glide-final roots.
    Roots with a medial glide are the most complicated; I will illustrate with {šytfl} 'sell' and {sflwr} 'carry'. In the jussive (and the imperative, which is based on it), the coalescence effects are irregular:

(64)   *yi-CCʌC*
        yi-šitfl, yi-šitfl   'that he sell'
        yi-sflur   'that he carry'

(65)   *CiCʌC*
        šitfl, šitfl   'sell!'

sɨur   'carry!'

Since the regular templatic patterns should be *šyʌtɨ* and *sɨwʌr*, by normal application of the rule we would expect the stems *šetɨ* and *sɨor*, but these are unattested in the jussive and imperative. Though they are not given by Leslau (as are the others here), I have elicited forms such as *zur, zɨr* 'walk!' from {zwr}, which extend the possibilities for *w*-medial glides to match those of *y*-medials.

In the 'gerund' (synchronically a finite verb), coalescence seems to depend partly on the syllable structure created by the agreement suffix:

(66)   *CʌCiC-suff*
        kʌyd-u   'he went'
        sɨlʌyr-u (Leslau: sɨloyr-u)   'he carried'

(67)   ked-na   'we went'
        sɨler-na (Leslau: ?)   'we carried'

With {kyd}, merger of /yi/ to [y] takes place regardless of the suffix; further merger of [ʌy] to [e] occurs when the suffix begins with a consonant, although we might expect Epenthesis to produce [kʌyɨdna]. Such a result would again trigger Coalescence and presumably cause an endless loop if phonological rules create derived environments. The coalescence of [ʌy] — unexpected since it represents iterative application to its own output — resolves this dilemma by eliminating one of the three consonants which form the unsyllabifiable cluster. It is not clear whether this result can be derived from phonological principles.

The facts for *w*-medial roots such as {sɨlwr} in the gerund are incomplete since Leslau gives forms only with a vowel-initial suffix. In (66) a regular merger of /ʌw/ to [o] occurs, but we do not know what happens to expected *sɨlʌwir-na*; perhaps nothing special happens. In my data these verbs undergo the rule seen in (57) and (58), so they behave like *y*-medial roots.

Further irregularities exist in the other inflectional types. For example, though partly regular in Leslau's data, my own elicitations show that, at least for one dialect, in the imperfect a medial glide is simply deleted when it is not geminated (i.e. when there is a suffix):

(68)   *yɨ-CʌCCiC*
        yɨ-kʌyyɨd   'he goes'
        yɨ-zʌwwɨr   'he walks'

(69)   *yɨ-CʌCC-u*
        yɨ-kʌd-u   'they go'
        yɨ-zʌr-u (Leslau: yɨ-zor-u)   'they walk'

In (69) we would expect *yɨkedu* and *yɨzoru*. The latter is attested by Leslau but is apparently not found in all dialects. Note that Leslau's data still shows irregular behavior in *y*-medial roots, as in the next set of examples.

Returning to where both dialects agree, in the perfect the sequence /ʌyʌ/ is optionally reduced to [ʌ], and /ʌwʌ/ to [o], as described above, even though

this seems to be a violation of the Strict Onset Principle which correctly blocked coalescence in the nouns (see §3.2):

(70) šʌyʌtfl-ʌ, šʌtfl-ʌ   'he sold'
      sflʌwʌr-ʌ, sflor-ʌ   'he carried'

Note that this coalescence is obligatory in the irregular verbs {kwn} 'be, become' and {mwt} 'die':

(71) kon-ʌ, *kʌwʌn-ʌ   'he was'

(72) mot-ʌ, *mʌwʌt-ʌ   'he died'

The fact that this unusual coalescence applies obligatorily with these irregular verbs (71)-(72) and only optionally with verbs that follow a productive pattern (70) suggests that this variety of coalescence is itself irregular. The fact that the nouns do not exhibit this type of coalescence supports the notion that it is morphological or idiosyncratic. This irregular merger is optional with many verbs, while the normal rule of Vowel Coalescence is obligatory and applies whenever its structural description is met (modulo blocking effects). Add to this the fact that there are many other processes affecting only verbs with glides in particular positions, as exemplified above, such as /ʌyʌ/ → [ʌ]. Taking all this into account, it seems justified to suppose that the rule of Vowel Coalescence as stated in (39) is correct as a rule of the phonology, and that the exceptions found in glide-medial verbs are due to special morphologically conditioned rules.
     There is one problem that remains. If Vowel Coalescence applies whenever it can, then why is the reduction in (63) optional rather than obligatory, and why doesn't /ʌyʌ/ become [e]? Application here is not blocked by the Strict Onset Principle if, as argued above, Coalescence occurs after Template Association (fʌtʌw → fʌto); it could then apply again after suffixation (fʌto-ʌ → fʌto). However, I believe that Template Association and affixation must both occur before the form is submitted to the phonological rules, for independent reasons. For example, the type A jussive consists of the pattern *pref-CCʌC*. If the stem *CCʌC* undergoes phonological rules before prefixation, we would expect Epenthesis to yield *CɨCʌC*. This is the correct result for the imperative, which is not prefixed, but incorrect for the jussive. Under this analysis we need a rule of Syncope which would then delete the epenthetic [ɨ]. Not only is this redundant, but also problematic, since the Syncope rule would have to be constrained not to apply to the type C infinitive *mɨ-CiCaC* and possessed plurals such as *kʌnafɨr-u* 'his lips'. The same problem arises with the prefixed plural *ʔa-CCaC*: if *CCaC* becomes *CɨCaC* before prefixation, then Syncope would have to apply to it as well once the prefix is added. Thus Syncope would need to be restricted to apply to some nouns (plurals in *ʔa-*) and verbs (jussives), but not to other nouns (plurals in *CʌCaCɨC*) and verbs (infinitives). Such a rule is burdensome to the learner and completely unnecessary if Template Association and affixation are allowed to apply together in the morphology before submission to the phonology. And once we assume this, forms such as those in (62) and (63) will not undergo normal Coalescence, and can be reduced only by special

morphological rules which are not subject to phonological blocking. Such paired application of the rules is further supported by the fact that each stem type is associated with one set of affixes, so that they form a coherent pair.[28]

4.   Verbs with /a/

There is an additional place in the Tigrinya verbal system where the underspecification proposed here offers a simple explanation: verbs which have /a/ in their vowel melody, for example roots belonging to what Leslau calls type C. These verbs are characterized by always having the vowel /a/ before the second radical consonant in the finite forms, while other triradicals never have an /a/ here.[29] Compare the common type A, type B where the medial radical is always geminated, and type C (slightly simplified):

(73)   *Triradical verb stems*

	TYPE A	TYPE B	TYPE C
perfect	C_1 ʌ C_2 ʌ C_3	C_1 ʌ C_2C_2 ʌ C_3	C_1 a C_2 ʌ C_3
gerund	C_1 ʌ C_2 i C_3	C_1 ʌ C_2C_2 i C_3	C_1 a C_2 i C_3
imperfect	C_1 ʌ C_2C_2 ɨ C_3	C_1 ɨ C_2C_2 ɨ C_3	C_1 a C_2 ɨ C_3
jussive	C_1 C_2 ʌ C_3	C_1 ʌ C_2C_2 ɨ C_3	C_1 a C_2 ɨ C_3
infinitive	C_1 C_2 a C_3	C_1 ɨ C_2C_2 a C_3	C_1 ɨ C_2 a C_3

Two generalizations are relevant here. First, the syllabic pattern of type C is generally the same as type A. They differ where A has no vowel after the first radical (jussive and infinitive), since C always has a vowel in this position; in the imperfect where C does not geminate; and most crucially in the infinitive where C has an extra /ɨ/. Second, the vocalism of the second syllable is the same for types B and C in all forms.

    In order to generalize across all verbal forms, we would like to be able to say that only the vowel /a/ is provided by the infinitive template, and that instances of [ɨ] are inserted by Epenthesis (the prefix is /m/ which becomes [mɨ] itself). This description is true for A, B, and longer roots with four or five consonants (i.e. *mɨ-C₁iC₂C₃aC₄*, *mɨ-C₁C₂iC₃C₄aC₅*), but the [ɨ] in the type C stem is exceptional. In addition, there is a type of quadriradical stem with an /a/ 'augment' after the second radical (perfect $C_{1}ʌC_{2}aC_{3}ʌC_{4}$,),[30] as well as frequentative forms of every verb type which reduplicate the penultimate radical and insert the vowel /a/ (e.g. type A perfect $C_{1}ʌC_{2}aC_{2}ʌC_{3}$,), that all exhibit the same behavior: the /a/ is present in the finite forms and an [ɨ] occurs in the infinitive where Epenthesis would not insert it. I will attempt

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[28] The converse of this statement is not true, since the imperfect and jussive share the same affixes.

[29] Except as the result of lowering of /ʌ/ when tautosyllabic with a guttural.

[30] There is a possible exception to this in that Leslau (1941) gives an infinitive form without the expected [ɨ] for the active voice, but it is there in the passive. Since there is only a single place in the book where this form is given, I must elicit the word from a speaker before I will be convinced that it is truly an exception.

to correlate this exceptionality with the /a/ that occurs in the same place in all finite forms.

I suggest that this /a/ is always present in the same place in the verbal template, i.e. before the penultimate radical. It is placed there by a rule which makes use of Prosodic Circumscription (McCarthy and Prince 1990a): the segment /a/ is prefixed to the final syllable of the stem. In the formalism of McCarthy and Prince:

(74)   /a/ Infixation

      Prefix /a/ to B:Φ < σ, Right >

This rule states that /a/ is prefixed to the circumscribed constituent which is defined as the syllable at the right edge of the word. In finite forms the vowel surfaces unchanged, as in the derivation of the frequentative, where the second radical reduplicates to form the onset of the inserted vowel (this is also prefixation to the final syllable). For example, in the derivation of the type C perfect form *bʌrʌk → bʌrarʌk* 'keep blessing':

(75)   *Template Association*   *Reduplication of* σ_μ

         /a/ Infixation   *Coalescence*

This derivation of the frequentative assumes that type C has the same underlying vocalism as type B, and the correct result follows. In the simple (nonfrequentative) form the same assumption can be made. Here there is no reduplication, so the prefixed /a/ will be adjacent to the /ʌ/ of the initial syllable. By regular application of Vowel Coalescence, the two will combine to form /a/. Following is the nonfrequentative perfect stem of 'bless', *bʌrʌk → barʌk*:

(76)   *Template Association*   */a/ Infixation*   *Vowel Coalescence*

Thus the rule of Vowel Coalescence permits two generalizations: types B and C have the same vocalism, and the /a/ which appears in the various forms

marking the frequentative and type C (as well as the reciprocal) are the result of the same rule.

In the infinitive where we would expect an [a] there is instead an [ɨ], for example simple *mɨ-bɨrak* (cf. (76)) and frequentative *mɨ-bbɨrɨrak* (cf. (75)).[31] To account for this, I give a rule of Low Dissimilation which deletes the value [+low] of the first /a/:[32]

(77)   *Low   Dissimilation*

Dorsal $\quad\quad$ o $\quad\quad$ o
$\quad\quad\quad\quad\quad$ ǂ $\quad\quad$ |
$\quad\quad\quad$ [+low] [+low]
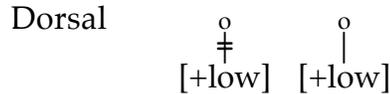
Because of the underspecification in (5), the removal of [+low] from the features of /a/ yields a completely underspecified vowel which will surface as [ɨ]. Note that if [-high] were redundantly included in the underlying specification, this rule would wrongly produce /ʌ/.[33] It applies only to verb stems, but need not be restricted to infinitives since there are no cases where /a/ is part of the underlying vowel melody of a finite form. Low Dissimilation must be ordered before Vowel Lowering, which changes /ʌ/ to /a/ when tautosyllabic with a guttural. This ordering permits surface forms such as *sflʌħaħafe* 'he kept writing', which is derived from /sflʌħaħʌfʌ/ by Lowering and Fronting. The latter is itself the frequentative form of underlying /sflʌħʌfʌ/ 'he wrote', derived by internal reduplication as in (75).

This rule may also be responsible for a dissimilatory effect found between /ʌ/ and a following guttural onset: the mid vowel becomes high (see Denais 1990, Berhane 1991 for discussion of related processes).[34]

(78)		*imperfect (3 m. sg.)*	*gerund (3 m. sg.)*
NORMAL PATTERN	yɨ-sʌbbɨr	sʌbir-u	'break'
WITH GUTTURAL	yɨ-siʔil	siʔil-u	'draw'
	yɨ-mɨhɨr	mɨhir-u	'teach'

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[31] By other processes the first radical geminates in certain infinitives, including the passive and the frequentative.

[32] The two /a/'s are separately linked since they come from different morphemes: the first is inserted by *a*-Prefixation, while the second belongs to the infinitive template. Note that this rule is similar to one proposed for Kera by Archangeli and Pulleyblank (Ling 660, LSA Linguistic Institute, Tucson, 1989) and for Rwaili Arabic by Parkinson (1993).

[33] A rule deleting the Dorsal node would not have this problem, but then the dissimilatory nature of the rule would be somewhat obscured.

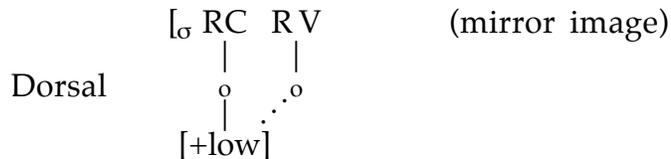[34] The data in (78) are from Berhane (1991). While Berhane does not indicate it in the data reproduced here, most sources show the deletion of the resulting [ɨ] in a doubly open syllable. Since this does not happen in the type C infinitive, the relationship between the two types of dissimilation requires a more subtle exploration of the morphological organization of Tigrinya than is presented here.

This is consistent with the rule in (77), which does not require that the trigger [low] be linked to a vowel. Every case of [a] following a guttural, or preceding one in coda position, can be treated as the result of Guttural Lowering, whereby /ʌ/ lowers to [a] due to a tautosyllabic guttural. In such cases, there is only token of [low], and no dissimilation occurs.

(79) *verb CʌCʌC*   *noun CʌCCʌC*
　　　　ʔas̲ʌr-ku 'I arrested'   mʌlʔa̲k 'angel'
　　　　sʌħa̲b-ku 'I pulled'   maʕtʌb 'decorative cord'
　　　　bʌla̲ʕ-ku 'I ate'   ħargʌš 'crocodile'

If gutturals are [+low], the assimilation can be expressed as follows.

(80) *Guttural Lowering*

$$
\begin{array}{l}
\quad\quad\quad [_\sigma \text{ RC}\quad\text{R V}\quad\quad\quad\text{(mirror image)} \\
\quad\quad\quad\quad\ \ |\quad\quad\ | \\
\text{Dorsal}\quad\quad\quad \circ\quad\quad.\circ \\
\quad\quad\quad\quad\ \ |\quad.. \\
\quad\quad\quad\ [+\text{low}]
\end{array}
$$

Both rules (Dissimilation in (79) and Lowering in (80)) could also be expressed using Pharyngeal as a privative articulator features, replacing [+low] (cf. McCarthy 1993, Parkinson 1993). In this case Pharyngeal would be a more principled equivalent of [low]. An approach such as Selkirk (1991), which also uses Pharyngeal for low vowels, will produce the correct output of dissimilation: the mid vowel /ʌ/ is **both** Pharyngeal and Dorsal, and upon loss of Pharyngeal is simply Dorsal, which is equivalent to [+high]. This same approach does not, however, generate the correct facts for coalescence: it predicts that Dorsal-Labial /u/ and Pharyngeal /a/ should combine to produce Pharyngeal-Dorsal-Labial /o/. As seen in (48), this is the wrong result. Difficulties such as these have led me to maintain the more traditional vowel features for this paper.

5. Conclusion

I have argued that an underspecified feature representation provides numerous advantages in the treatment of Tigrinya vowels. First, the redundancy rules which complete these underspecified feature matrixes make it possible to treat Epenthesis as mora insertion, which in turn explains the limited distribution of [ɨ] and resolves an ordering paradox. Second, a unification treatment of Vowel Coalescence based on these underspecified features makes correct predictions about what vowels will result from such merger, permitting a simple statement of the rule. Apparent exceptions to Coalescence are shown to result from syllable and feature cooccurrence constraints or from idiosyncratic rules conditioned by particular morphological contexts. Finally, the exceptional occurrence of vowels in infinitives is correlated with similar phenomena in finite forms by means of a straightforward dissimilation rule which would have to be more complicated under a more fully specified representation.

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