ON THE TREATMENT OF SYNTACTICALLY-DISTRIBUTED DOWNSTEP

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It is argued in this paper that the downsteps which mark the
associative construction in Igbo and the set of "Class I"
words in Kikuyu are best analyzed as morphemes of the form
[↓], where the symbol " ↓ " represents a drop in pitch. If
lexical tone contours are represented dynamically, as sequences
of pitch rises (↑ 's) and pitch drops (↓ 's), then the inter-
action of the downstep with the surrounding tone contour can
be accounted for in a coherent way by means of rules which
move or delete pitch changes which would otherwise lie too
close to another pitch change. In the final section of the
paper, this approach is extended to alienable possessive
phrases in Asante Twi, whose special tonal properties are
shown to result from the presence of an associative morpheme
of the form [↑].

0. Introduction

Many African languages exhibit a tonal phenomenon called "downstep",
which is a drop in pitch between two tone-bearing units with the same phon-
ological tone.[1] A downstep may appear in the lexical tone contour of a word,
as in the Igbo personal name:

(1) [2]

    Igwe
    H⎤ H

(where the downstep site is marked with a " ꟾ ") or it may serve as the
marker of a syntactic construction or lexical class. Igbo, for example,

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[1]This definition does not include the phenomenon of a lowered high tone
after low which Hyman [1979] includes in the category "downstep". The
treatment which I will propose here is probably extendable to these sorts
of cases, but I will not be discussing them here.

[2]Unless otherwise specified, the Igbo data in this paper is taken from
Green and Igwe [1963].

uses a downstep to mark the second constituent of the associative construc-
tion, as in the example:

(2)

    isi eɣu   'the head of a goat'   (isi 'head' + eɣu 'goat')
    H H H'H   H H   H H

Another language which uses a downstep as a grammatical marker is Kiku-
yu; here the downstep appears after any member of a certain lexical class
(called Class I words). For example, in the following sentences taken from
Clements and Ford [1977a], there is a (circled) downstep after the Class I
words mòaɣáhìɲá (a) and mòanèkì (b):

(3) a.

    aheirε moaɣahiɲa njata   'he gave the weakling a star'
    H L H   L H L H ' H H

    he-gave weakling   star

   b.

    moaneki ɔ:nirε   'Mwaniki saw'
    L L L 'L H H

Notice that the size of the downstep pitch drop is different in these two
languages; in Kikuyu it is equal to a drop from high tone to low tone, while
in Igbo it is much smaller. The size of the pitch drop is irrelevant to its
status as a downstep—what is important is the fact that it appears be-
tween two identical tones; in other words, it is a lowering of the overall
pitch register rather than a movement from one tone level to another.[3]

In this paper, I will be concerned primarily with the downstep which is
used as a grammatical marker, though an analysis of the lexical downstep of
Igbo (illustrated in (1)) will be given incidentally in the course of the
discussion. The question I will be addressing is how such a downstep should
be represented in the synchronic grammar of a language; the answer I propose
will have profound consequences for the representation of tone contours in
general. The first two sections of the paper will be concerned with the
grammatically-induced downsteps of Igbo and Kikuyu, illustrated in (2) and

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[3]I will be revising this definition during the course of the paper.

(3) above. In the third section of the paper, I will discuss a syntactically-distributed *upstep* in Twi which lends itself to the same theoretical treatment which is proposed here for downstep.

1. Downstep in the Igbo Associative Construction

1.1 <u>Previous analyses of this construction</u>. Several syntactic constructions of Igbo, including the associative construction, are characterized by the appearance of a downstep. The downstep is accompanied by two other tonal alternations, so that in fact what we find in these constructions is a "package" of tonal alternations, described below:[4]

(4) a. If the first CV-syllable of the second constituent is high-toned, then a downstep is introduced before it, as in the following examples:

    isi eɣu 'the head of a goat' (isi 'head' + eɣu 'goat')
    H H H'H   H H   H H

    isi ji 'the top of the yam' (ji 'yam')
    H H ' H   H

b. If the second constituent carries a low prefix tone, that tone is deleted,[5] and the stem tone spreads back onto the prefix. For example:

                6
    isi oke 'the head of a rat' (oke 'rat')
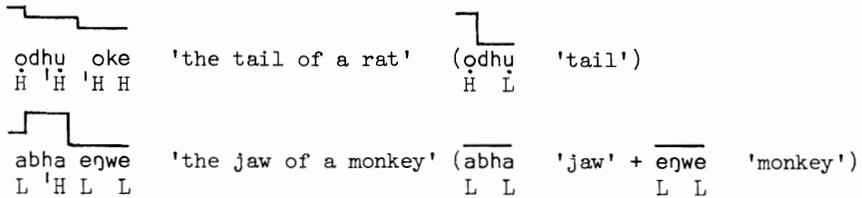   H H 'H H   L H

c. If the second constituent now begins with L or 'H tone, a low tone

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[4]This set of tonal alternations is also found (with slight variations) at the boundary between the subject and predicate of a relative clause and at the boundary between a verb in one of certain grammatical forms and a following NP. The fact that these alternations co-occur in several different constructions is important to our argument, since it shows that their convergence in the associative construction cannot be simply an historical accident.

[5]This alternation is also often described as follows: if the second constituent has a low prefix tone followed by a high stem tone, the prefix tone is raised to 'H.

[6]The downstep in this phrase is introduced by rule (4a).

at the end of the first constituent is raised to 'H. For example:

ǫdhụ oke   'the tail of a rat'   (ǫdhụ   'tail')
H̤ 'H̤ 'H H   H̤   L

abha eŋwe   'the jaw of a monkey' (abha   'jaw' + eŋwe   'monkey')
L 'H L L   L   L   L L

   Why should the three apparently unrelated tonal alternations of (4) re-
cur as a "package" in several distinct syntactic constructions in Igbo?
What ties these three alternations together? Linguists working on Igbo
have uniformly tried to answer this question by positing some tonally-act-
ive element in these constructions which acts as a sort of "trigger" for
each of these changes individually. Ideas as to the nature of the trigger-
ing element vary from one analysis to another. Carrell [1970] analyzed it
as a special boundary symbol (≠), Welmers [1970], Voorhoeve, Meeussen,
and deBlois [1969], Hyman [1974], Williams [1976], and Goldsmith [1976] ana-
lyze it as a floating *high* tone, and Williamson [1970] argues that it is
floating *low* tone.

   Before considering these analyses in detail, we should first be clear as
to what it would mean to say that an analysis along these lines had *explained*
the co-occurrence of these three tonal alternations. I suggest that this
will be the case if and only if the analysis satisfies the following crit-
eria:

(5) a.   The "triggering element" is taken from some specifiable set of ele-
         ments which may serve this function in human languages.

    b.   The alternations which the triggering element is said to induce in
         the surrounding string are (allowing for some variation) predict-
         able in advance by general phonological principles. For example,
         if the triggering element is a floating high tone, then the set of
         tonal alternations which is associated with it should be predict-
         able from what we know about the general behavior of high tones and
         of floating tones.

Unless these criteria are met, our theory will not distinguish sets of to-
nal alternations like (4), which *may* function as "packages", from other im-
aginable sets of tonal alternations which apparently never function in this

way.

With these criteria in mind, let us now consider some of the analyses
which have been proposed for the facts of (4). Consider first the analysis
proposed by Carrell [1970]. Carrell attributes this package of alterna-
tions to the presence of a special boundary symbol (≠). For example, in
Carrell's analysis, the first phrase of (4c) is given the underlying repre-
sentation:

(6) ọdhụ ≠ oke   'the tail of a rat'
     H L   L H

The boundary symbol ≠ then serves as a context for the tone rules which
give this phrase its surface contour (shown in (4c)).

While Carrell's analysis was important as a first attempt to give an
explicit formal statement of the tonal alternations of (4), it is easy to
see that an analysis along these lines will not meet the criteria we estab-
lished above in (5). Because the boundary symbol ≠ is chosen arbitrarily,
it is impossible to list in advance the set of such symbols which might be
available to human languages and impossible to predict what package of tonal
alternations might be associated with each such symbol. Consequently, the
analysis does not explain why the tonal alternations of (4) should be able
to function as a recurring "package" while other arbitrarily chosen sets of
alternations may not.

Analyses in which the triggering element is a floating tone fare better
by our criteria, in two ways: first, if the "triggering element" is always
a floating tone, then we have satisfied criterion (5a), for this is, at
least in principle, a specifiable set of entities; furthermore, since float-
ing tones have phonological content, it should be possible to predict in ad-
vance what tonal alternations they might trigger in the surrounding string.

To see how this works out in reality, consider the analysis of Igbo
which is proposed by Goldsmith [1976]. In Goldsmith's analysis, the trig-
gering element is a floating high tone; for example, the phrase of (6) is
assumed to have the underlying representation shown in (7):

(7) ọdhụ   oke
     | | | |
     H L Ⓗ L H

where the circled H is the floating high tone. In this analysis the
raising of the low tone at the end of the head noun is accounted for by
means of a rule which "docks" the floating tone onto the syllable which
precedes it,[7] creating the intermediate form:

(8) ọdhụ   oke

H   L Ⓗ L H
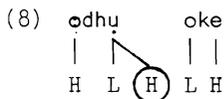
A subsequent countour simplification rule then gives ọdhụ its output form:

(9) ọdhụ

H ¹H
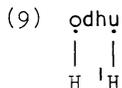
By analyzing the triggering element as a floating high tone, we obtain
an entirely principled account of this alternation, for the "docking" which
is illustrated in (8) is expected behavior for a floating tone, and it is
also not surprising that a high tone should merge with a low tone to create
a lower-than-normal high, as in (9). Unfortunately, the alternations in
the righthand constituent, that is, the downstepping of a high stem tone
(alternation (4a)) and the deletion of a low prefix tone (alternation (4b)),
do not follow so naturally from the assumption that the triggering element
is a floating high tone. Goldsmith's rules for these alternations are as
follows:[8]

(10) <u>Introducing the downstep</u>

   $H \implies {}^1H \: / \: [H]_{affix}^{9} \#\# \: (tone)\underline{}$

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[7]I believe the idea of attributing this alternation to the docking of a
floating high tone was first proposed by Welmers.

[8]I have made small adjustments in the statement of these rules so as to
avoid going into Goldsmith's feature system for Igbo tones. Both in their
original version and in the adjusted version given here, these rules prod-
uce incorrect outputs in some cases. (See Clark [1978], Chapter II, for a
discussion of these cases with a suggested reformulation of the rules so as
to accommodate them.) The argument which will be made here holds for the
reformulated versions of the rules as well as for the versions given here.

[9]Goldsmith follows Welmers in analyzing the floating high tone as an in-
dependent morpheme—an affix. By referring to the affixal status of the H

(11) Deleting a low prefix tone

$$L \Longrightarrow \emptyset \ / \ [H]_{affix}\#\#\_\_\_$$

The application of these rules to the phrase of (7) is shown below:

(12) ọdhụ   oke   'the tail of a rat' (underlying form)
    | |
   H L H L H
          'H   rule (10)

          ∅   rule (11)

   'H   docking of the floating high tone

   ọdhụ   oke   output
   | | ＼
   H 'H   'H

While Goldsmith's rules derive the correct surface contour for this phrase, the analysis lacks the principled basis which we had hoped for. Rule (11), which deletes the low prefix tone of the righthand constituent, might be said to be a natural consequence of the presence of a floating tone, though to my knowledge no one has explicitly argued that this is the case. However, rule (10), which introduces the downstep, is completely ad hoc, for there is no reason to expect a floating high tone to have this effect. Thus the analysis fails to satisfy our criterion that the effects of the triggering element should be predictable by general phonological principles.

Other analyses which have used a floating high tone as a trigger for the tonal alternations of (4) fail at this same point. I know of only one

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tone in these rules rather than to the fact that it is a "floating" tone, Goldsmith is able to accommodate Williams' [1976] observation that the verb forms which induce these changes in a following NP (see fn. 1) are exactly those verb forms in which toneless suffixes at the end of the verb have uniformly high tone. If the high suffix tone in these verb forms is analyzed as a suffix and if the rules of (11) depend on the *affixal* nature of the high tone rather than on the fact that it is a floating tone at the time the rules apply, then these rules will apply to the appropriate verb forms as well as to the associative construction.

exception to this statement, and that is the analysis proposed by Hyman
[1974]. Hyman's analysis is based on the assumption (for which he gives
historical motivation) that every Igbo noun has a floating low-tone prefix.
For example, in Hyman's analysis, the phrase ísí éɣú 'the head of a goat'
(4a) has the underlying representation shown in (13). (For the sake of
consistency, I continue to use Goldsmith's autosegmental notation, without,
I hope, doing violence to the spirit of the analysis.)

(13) isi   eɣu[10]
      │ │   │ │
      H H (H)(L) H H
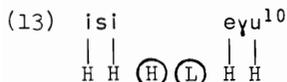
    In Hyman's analysis, the (H) associative tone docks to the left only
when the segmental prefix tone of the righthand constituent is non-high.
When the segmental prefix is high-toned, as in (13), the (H) docks to the
right, displacing the original prefix tone, as illustrated in (14):

(14) isi   eɣu   isi   eɣu
      │ │   │ │   │ │   ╱│╲
      H H (H)(L) H H   H H H(L)H
                    ⇓
                    Ø
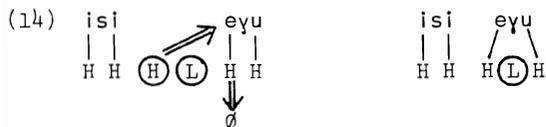
It is the floating low tone which ultimately creates the downstep between
the two high tones of eɣu , either by means of the downdrift rule, which
regularly lowers a high tone after low in Igbo, or, alternatively, by means
of a special rule of the form:

(15) L ⟹ 'H / H ___ H

which Hyman proposes and suggests independent motivation for. On either
account, this analysis gives us a plausible source for the downstep, since
HLH sequences are known to simplify to H'H in a variety of languages and
contexts.

    In spite of this very satisfactory result, Hyman's analysis fails in
the end, for the following reason: there is no independent synchronic evi-
dence for (and a great deal against) the floating low prefix tone upon which

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[10]The head noun isi will also, presumably, have a low prefix tone. I
omit this tone here, for the sake of simplicity, but will return to it later
in the discussion.

his analysis depends. For example, consider the following phrases:

(16) a. ... zụγị anụ   'and didn't buy meat'
         | | | | [Green and Igwe 1963:141]
         H H H H

    b. ma ọcịγị jị   'if he doesn't carry away yams'
        | | |/ !   [Green and Igwe 1963:128]
        L H'H   H

    c. o nyeře Adha jị   'he gave Adha yams'
        | |/ | | | [from my own informant]
        H L L H H

If there is really a floating low-tone prefix at the beginning of nouns like
eγu , anụ , and jị , then why doesn't this prefix have the same downstep-
ing effect in the examples of (16) as it is said to have in (14)? Unless
this question can be answered, the analysis has simply substituted one
question for another, and the presence of the downstep (alternation (4a))
in the tonal package of (4) is still unexplained.

    Williamson [1970] takes a different approach from those we have consid-
ered so far in that she identifies the triggering element in the Igbo asso-
ciative phrase as a floating *low* tone. This allows her to account for the
appearance of the downstep in the following way: let an associative phrase
like ísí éγú 'the head of a goat' have the underlying representation shown
in (17):

(17) ísi   eγu
      | | | |
      H H (L) H H

where the (L) is the floating low tone (again, for the sake of consistency,
I have translated Williamson's notation into that of Goldsmith's autoseg-
mental framework). Now the appearance of the downstep between the two H's
of eγu can be accounted for in a fairly simple way, by means of a rule
which transposes a floating low tone with the high tone to its right, creat-
ing the intermediate structure:

(18) ísi   eγu   (ultimately, ísi eγu)
      | | / \ | | | |
      H H H(L)H   H H H'H

The downstep itself is introduced by the downdrift rule, which regularly lowers H after L in Igbo.

While an analysis along these lines allows a principled account of the downstep in the second constituent of the associative construction, it does not do so well with the alternation in the lefthand constituent, namely the raising of a low tone at the end of the head noun (tone change (4c)), illustrated below:

(19) ọdhụ   eŋwe ==>   ọdhụ eŋwe
      | | | | | | | |
      H L Ⓛ L L   H 'H L L

Williamson proposes to account for this change by means of a rule which raises the floating low tone to H when it is followed by a low tone, as in (19). The application of this rule converts the underlying form in (19) to (20):

(20) ọdhụ   eŋwe
      | | | |
      H L Ⓗ L L

and the raising of the final L of ọdhụ is then accomplished in the usual way, by the docking of the Ⓗ , with simplification of the resulting LH contour to 'H.

I have three criticisms to make of this analysis. The first is that it does not produce the correct output for phrases like the following:

(21) ọdhụ ji   or   ọdhụ ji
      | | | | /\ |
      H 'H 'H   H L H 'H

      (from underlying ọdhụ   ji)
                        | | |
                        H L Ⓛ H

Since ji begins on a high tone level, Williamson's rule which raises Ⓛ to Ⓗ should not apply in this case; thus there is no way to account for the raising of the final L of ọdhụ . If, on the other hand, the rule were restated in such a way that it *did* apply in this case, producing the intermediate form:

(22)   ọdhụ   ji

H   L Ⓗ   H

then the output would still be incorrect, since there would now be no way
to account for the downstep before ji . We could salvage the analysis by
postulating a floating low prefix before ji (as is done by Hyman [1974]);
however, as was pointed out above, this assumption is untenable because it
incorrectly predicts 'H tone on ji in other contexts as well, e.g. in
(16b).

My second criticism of Williamson's analysis is that the rule which
raises the Ⓛ to Ⓗ in phrases like (19) is ad hoc, since there is no
general principle which would lead one to expect a floating low tone to
undergo this alternation. Williamson is aware of this weakness in her ana-
lysis, and tries to mend it by arguing that the raising of a low tone be-
fore low is a widespread phenomenon in Igbo—that, in fact, there is a gen-
eral rule of the form:

(23)   L → H / +__+ L (where + = "morpheme boundary")

As evidence for this rule, Williamson cites the fact that a compound verb
which is made up of two low-toned verb radicals receives a HL tone con-
tour, as in the example:

(24)   we   'pick up'   +   fu   'go out' ==> wefu   'take away'
       L   L   H L

However, although rule (23) would account for the facts of (24), as Carrell
claims, there is a great deal of evidence to show that this is not a *general*
rule of Igbo. To give just a few examples, such a rule would incorrectly
predict high tone on fe in the verb stem:

(25)   gafemi (ga 'go' + fe 'pass by' + mi 'be deep')
       H L L   H   L   L

       'go out of one's depth' [Igwe and Green 1970:141]

on c_i in the example:

(26) acị h̃a anụ (acị   'were carrying' + h̃a 'they' + anụ 'meat')
      H L   L H H   H L   L   H H

'they were carrying (bits of) meat' [Green and Igwe 1963:75]

and on the low-toned agentive prefix ọ- in:[11]

(27) ọza 'sweeper' (ọ + za 'sweep') [Green and Igwe 1963:75]
      L L   L   L

Examples like these suggest that the rule which gives wè its high tone in
(24) is a lexical rule which applies specifically to the first verb radical
of a compound verb. In Clark [1978], Chapter VII, I argue that the envir-
onment of this rule is correctly stated as follows:

(28) L → H / verb[or —— L
                  verb stem

If this argument is correct, then clearly this rule will not account for the
raising of ⓛ to Ⓗ in (19), (20) as Williamson's analysis requires. Thus
there is no independent motivation for the rule which *does* create this
change, and the analysis fails to satisfy our criterion (5b) which requires
that the behavior of the triggering element should be predictable on the
basis of more general rules or principles.

    A third, somewhat more theoretical argument which might be made against
Williamson's analysis has to do with the rule which transposes ⓛ with F
in (17), (18). Such rules, while statable in an autosegmental framework,
have not generally been employed, and I believe it is hoped that they will
not be needed. The multiplication of rule types is, in general, to be
avoided, because it tends to create indeterminacy in the analysis of parti-

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[11]The forms below show that the postposed subject pronoun h̃a and the
agentive prefix ọ- are indeed low-toned:

(i)   acị h̃a akhụ   'they were not carrying palm nuts'

       H'H L H H

(ii)   ọcị   'carrier'

       L H

Thus it is not possible to account for the non-application of rule (23) in
(26) and (27) by claiming that ọ- and h̃a are underlyingly toneless, and
simply share the adjacent low tone segment. Similar evidence can be given
for the underlying low tone of the verb radical mi in (25).

cular phenomena by providing multiple alternative ways of deriving the same output (see Clark [1979] for a more careful development of this argument).

2.2. <u>A new proposal</u>. We began the previous section by listing three tone changes which occur as a "package" in several distinct syntactic construc- tions in Igbo. We than considered several possible analyses of these facts, all based on the notion of a "triggering element", variously analyzed as a special boundary symbol, a floating high tone, and a floating low tone. While most of these analyses provided a principled account of some of these tonal alternations, each analysis had to resort to an ad hoc statement of at least one of them. Thus in each of these analyses, the composition of this package of tonal alternations appears to be at least partly accidental, a conclusion that is hard to accept in view of its repeated occurrence in the grammar of Igbo.

I would now like to propose a radically different, and I believe more principled, account of these facts. This account is based on the notion that the central tonal alternation in this package is the insertion of the downstep; in other words, the downstep itself is the "triggering element" for the other two alternations. To make this idea work, we must begin by making a fundamental revision in our thinking about the nature of tone contours.

Consider a tone contour as in the Igbo noun ọ̀ kụ kọ́ 'chicken'. This contour is usually defined as an ordered sequence of tone levels, LHL, mapped onto the phonological string as shown in (29):

(29) ọ̀   kụ   kọ́
      | | |
      L   H   L

However, there is another logically possible way of defining this contour, viz. by means of the pitch *changes* rather than the pitch *levels* within it.[12]

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[12]This way of looking at tone contours is not original with me. Dynam- ic-tone analyses have been given of Japanese (by the Japanese linguist Hat- tori) and of English (by British linguists such as Crystal), though not, to my knowledge, of tone languages like Igbo. Winston [1960] and Stewart

In this view, which I will call the "dynamic-tone" view, we could represent
the tone contour of (29) as shown in (30):

(30) o̥ ↑ ku̥ ↓ ko̥[13]

What this representation means is that there is a rise in pitch (↑) be-
tween the first two syllables of o̥ │ ku̥ │ ko̥ and a drop in pitch (↓)
between the second and third syllables. Both representations (29) and (30)
define the same physical contour; the difference between them lies simply
in whether the pitch levels or the pitch changes within the contour are
taken to be significant. Which view is correct is an empirical question
which may be investigated in a variety of ways, for example, by studies of
the perception of tone contours, as in the work of Hombert [1976] and Gan-
dour and Harshman [1978], or, as in the present paper, by studying the ton-
ological systems of human languages to see which view leads to a better ov-
erall theory of tonal processes.

    Let us now give a more formal interpretation of the tonal representation
of (30). To begin with, let us assume that the pitch-change markers ↑ and
↓ (henceforth "pcm's") are independent phonological units, on a par with
the phonological segments, though, of course, very different from them in
phonetic content, since they represent articulatory gestures rather than
articulatory configurations. In addition to the two "basic" pcm's ↑ and
↓ , some languages also make use of an "abbreviated" rise and fall which I

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[1971] make use of a "mixed" system in which the *downstep* is represented by
a dynamic-tone unit "!", which designates a drop in pitch, but in which the
lexical tone contours of words are represented as sequences of tone levels
such as "low" and "high".

    [13]In the remainder of this paper, I will, for the sake of clarity, use
a more graphic representation, shown below, in which the pitch levels are
filled in with dotted lines:

(iii)   o̥ ↑ ku̥ ↓ ko̥

The dotted lines have no theoretical status, but are there simply to make
the contour more readable. They can be filled in by means of the following
algorithm: draw a line from the head of each pcm to the tail of the pcm
which follows it. Draw a line extending backwards from the tail of the
first pcm to the beginning of the phrase. Draw a line extending forwards
from the head of the last pcm to the end of the phrase.

will represent as ˄ and ˅   We can, if we wish, establish a feature
system for the set of pitch-change markers; the feature [± pcm] may be used
to distinguish pcm's from other phonological units, the feature [± fall] to
distinguish ↓ and ˅ from ↑ and ˄ , and the feature [± full size] to
distinguish ↓ and ↑ from ˅ and ˄ .

   A pcm represents a change in the tension, length, and thickness of the
vocal cords which produces a change of pitch. Although it is possible to
execute such a gesture quite independently of any phonological segment,
e.g. it is possible to "hum" the tone contour of a word or phrase, pcm's
normally occur in conjunction with a phonological string. In the theory
which I propose here and in Clark [1978], pcm's are associated with a phono-
logical string through the prosodic structure; in particular, pcm's occupy
the boundaries of prosodic units such as the syllable or mora. The pitch
levels of the prosodic units themselves are predictable from the configura-
tion of pcm's; thus these pitch levels need not be marked in any way in the
phonological representation, nor should they be expected to play any role in
tonological processes. One important property of the system is that there
can be no more than one pcm at a given boundary in the surface form; repre-
sentations such as σ ↑ ↓ σ (where σ = "syllable") are ill-formed, since
it is impossible to go up and down in pitch at the same time.

   Now consider how the lexical tone contours of Igbo are to be represented
in this system. In the dynamic-tone representation given above for
o̩ | ku̩ | ko̩ 'chicken', only those pitch changes which are internal to the
word are marked. In the end, however, it will also be necessary to indicate
the tonal relationship of one word to another, as well as the difference in
the isolation tone levels of such words as éɣú 'goat' and èŋwè 'monkey'.
For this purpose, I propose to use the device of a "word-level" pcm which,
in Igbo, will be placed at the end of each word, as in the two syllable
words below:

(31) a. e̅ɣ̅u̅ ↓   b. o̲ ↑ k̅e̅ ↓   c. m̅ ↓ b̲e̲ ↑   d. e̲ŋ̲w̲e̲ ↑

   When a word is pronounced in isolation, its word level pcm indicates
whether its final syllable is to be pronounced on a higher-than-neutral or
lower-than-neutral pitch level, and the pitch levels of preceding syllables

are adjusted accordingly. When words are combined into phrases, the word
level pcm's serve to indicate the relative pitch levels of adjacent words.
For example, in the phrase:

(32) ō ↓ nyer̃e ↑ Ekwe ↓ eŋwe ↑   'he gave Ekwe the monkey'

it is the word level ↑ of ō ↓ nyer̃e ↑ 'he gave' which gives us the rise
in pitch between ō ↓ nyer̃e ↑ and Ekwe ↓ . Similarly, it is the word lev-
el ↓ of Ekwe ↓ which gives us the drop in pitch between Ekwe ↓ and
eŋwe ↑ .

     In some cases, the word level pcm does not appear as a change of pitch
in the surface form. For example, in the following sentence there is no ↑
at the end of Ō ↓ gu ↑ :

(33) ō ↓ nyer̃e ↑ Ō ↓ gu eŋwe ↑   (ō ↓ nyer̃e ↑ + Ō ↓ gu ↑ + eŋwe ↑)

        'he gave Ogu the monkey'

Similarly, in the following sentence, there is no drop in pitch at the end
of Ekwe ↓ :

(34) ō ↓ nyer̃e ↑ Ekwe eɣu ↓   (ō ↓ nyer̃e ↑ + Ekwe ↓ + eɣu ↓)

        'he gave Ekwe the goat'

The general rule is this: the word final pcm fails to show up as a change
of pitch in the surface form just in case the next succeeding pcm in the
underlying string points in the same direction. Thus we can account for
these cases by means of a rule of the following form:

(35) Identical PCM Deletion

              pcm ... pcm

        S.D.   1   2   3   where 1 = 3 and where "..." contains no pcm
        S.C.   Delete 1.

This rule accounts for all cases in which the word level pcm fails to show
up as a change of pitch at the end of the word in the surface form. Rules
of this sort are the typical means by which lexical tone contours are
blended together to form phrasal contours.

     A rule like (35) also appears to be involved in the formation of lexical

contours in compound words such as the verb ga ⌐femi 'go out of one's
depth' (25). This verb consists of a toneless verb radical ga 'go' plus
two "low-toned" verb radicals fe↑ 'go across' and mi↑ 'be deep'. If
we assume that low-toned verb radicals (like low-toned words) are marked
with a final ↑ , then this verb has the "underlying" representation ga +
fe ↑ + mi ↑ . If we allow rule (35) to apply within a single word, then
this rule will, correctly, delete the ↑ of fe ↑ in ḡā⁻↓ femi ↑ .[14]
So that the rule will apply in cases like this, let us add the following
condition on its application:

(36) Identical PCM Deletion

               pcm ... pcm

    S.D.   1 2 3   where 1 = 3 and where "..." contains no pcm

    S.C.   Delete 1.

          Condition: This rule applies at the phrasal level and, if the
                     target pcm is a ↑ . also within words.

    As the condition suggests, rule (36) does not apply within words if the
target pcm is a ↓ . Thus it is possible to find verbs like the following,
which have two pitch drops in a row:

(37) a ⁻⁻ tu̧ ↓ ↓ bha ↑   (atubha)   'not to throw in'
                      H¹H L

In such cases, all but the last ↓ will be a "small-sized" ↓ , i.e. a
fall from "high" to "downstepped high" rather than a fall from "high" to
"low". The small size of the pitch drop in these cases can be accounted
for by means of a rule of the form:

---

    [14]The ↓ after the first verb radical in ḡā⁻↓ femi ↑ is inserted by
a rule of the form:

(iv) ∅ → ↓ / [σ __ ...↑   where "..." contains no pcm
           verb
           stem

This is the dynamic-tone version of rule (28) above.

(38)   ↓   Before   ↓   Reduction

    ↓ → [-full size] / __ ... ↓   where "..." contains no pcm

As will be shown below, this rule applies at the phrasal level as well as within words.

    With these preliminaries behind us, let us now return to the downstep which marks the constituent boundary of the associative construction. What I wish to propose is that this downstep is simply an instance of ↓ ; that is, it is a pitch-drop marker exactly like the pitch-drop markers which appear in the lexical representations of words. What distinguishes this ↓ from other ↓ 's is the fact that it is the sole phonological realization of a grammatical formative whose non-tonal segments have dropped out.

    The grammatical formative [↓] is inserted at the constituent boundary of an associative phrase by means of a rule of the form shown in (39):

(39)   [[X]   [Y]   ]
                            $\begin{bmatrix} +N \\ -V \end{bmatrix}$

    S.D.   1   2

    S.C.   Insert the morpheme [↓] between 1 and 2, cliticizing it
               to 2.[15]

The feature complex [+N,-V] in this rule indicates that the constituent to which the rule applies must be a member of the set of nominal categories NP, N̄, N, etc. There are other conditions which must be placed on this rule if it is to apply correctly in every case. I will not discuss these here but refer the reader to Clark [1978], Chapter VI, for a carefully motivated, detailed statement of the rule. Rules of a similar form will be used to insert the downstep ↓ in the other syntactic constructions in which it appears.

    When a "bare" pitch-change marker is inserted into a string by a rule such as (39), a tension is created, for there will now be two pcm's at the

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    [15]This cliticization does not always take place. For example, in Clark [1978], Chapter VI, I argue that the special tonal properties of the construction which Green and Igwe call the "Genitive of Personification" arise from the fact that the associative [↓] does not undergo cliticization in this construction.

same syllable boundary, as is shown below for some typical cases (where the
circled ↓ is the associative marker):

(40) a. a̲b̲h̲a̲ ↑ ⊕e̲ŋ̲w̲e̲ ↑   'the jaw of a monkey'

   b. o̅⁻ ↓ ̲d̲h̲u̲ ↑ ⊕ j̅i̅⁻ ↓   'the bottom of the yam'

   c. i̅s̅i̅ ↓⊕e̲ŋ̲w̲e̲ ↑   'the head of a monkey'

There are just three logically possible ways to resolve the ill-formedness
which is created by the insertion of the associative ↓ in these examples.
(1) Two pcm's at the same syllable boundary might be added together, so
that a ↑ ↓ sequence counts as ∅ , a ↓ ↓ sequence as an extra large
pitch drop, and so forth. (2) One of the competing pcm's might be deleted,
e.g. a ↑ ↓ sequence might be simplified to ↓ . (3) One of the two com-
peting pcm's might be moved to another boundary, e.g. the ↑ of a ↑ ↓
sequence might be retracted to the preceding syllable boundary. If we con-
sider a variety of languages, we can find examples of all these strategies
in use. Which strategy is chosen to resolve a particular conflict depends
partly on the language and partly on the configuration of pcm's which is be-
ing resolved, e.g. a ↑ ↓ sequence is particularly likely to be resolved by
strategy (3). Igbo uses only strategies (2) and (3), and in the following
way:

   A ↑ ↓ sequence is resolved by retracting the ↑ to the preceding syl-
lable boundary. The rule for this retraction is stated in (41), and its ap-
plication is illustrated in (42):

(41) ↑   Retraction[16]

            σ   ↑   ↓   where "σ" = "syllable"
   S.D.   1   2   3
   S.C.   Move 2 to the left of 1.

---

[16]In the Ọ̀h̄ụ̄h̄ụ̄ dialect described by Green and Igwe [1963], rule (41)
retracts the ↑ ̇just one *mora* to the left, as can be seen from cases like
the following, where this rule acts to create a rising glide, rather than
a level high tone, on the final syllable of the head noun:

(v) m̀kpǎ ˈj̲í̲ 'a stick of yams' (m̀kpà 'stick' + j̲í̲ 'yams')

Since the rule has this effect only when the second constituent begins with

(42)   abha ↑ ⊕eŋwe ↑ ⟹ _a_↑ b̄h̄ā ↓_eŋwe_↑

When the preceding syllable boundary is already occupied, as in (40b),
the application of rule (41) creates a new pcm-conflict at that boundary,
as shown in (43):

(43) ọ ↓ dhụ ↑ ⊕ji ↓ $\xrightarrow{\text{rule (41)}}$ ọ ↓ ↑ dhụ⊕ji ↓

This new conflict is resolved by the deletion of the ↑ . The rule for this
deletion is stated in (44), and its application to (43) is illustrated in
(45):

(44) ↑   Deletion

      ↑ → ∅ / ↓ __

(45) ọ ↓ dhụ ↑⊕ji ↓ $\xrightarrow{\text{rule (41)}}$ ọ ↓ ↑ dhụ⊕ji ↓ $\xrightarrow{\text{rule (44)}}$ ọ   dhụ ↓j̄ī̄ ↓

The reduction of the first two ↓ 's in this form is accomplished by the
rule of ↓ Reduction (38).

Now consider the change which takes place on the other side of the down-
step, namely, the raising of the low prefix tone of a noun with the lexical
tone contour of ọ_↑ k̄ē ↓ 'rat' (4b). This change is easily accounted for
by means of an extension of rule (44), so that this rule deletes a ↑
after a ↓ even when there is an intervening vowel. The revised statement
of the rule is given below in (46), followed by an illustration of its ap-
plication in the derivation of the phrase ísí 'óké 'the head of a rat'.

(46) ↑   Deletion (revised from (44))

      ↑ → ∅ / ↓ (V)__

---

a consonant, we can account for such cases in the following way: first,
assume that Igbo syllables normally contain one mora (μ), but that they
lengthen to two moras in word-final position before a consonant; then as-
sume that rule (44) shifts a ↑ back just one mora, rather than a whole
syllable. Rule (44) will then apply correctly to (v), as shown below:

(vi) σ   σ   σ   σ   σ   σ
      | /\ | | /\ |
      μ   μ μ   μ   μ   μ μ   μ
      | /\ | /\ | /\ | /\
      m kpa a ↑ ↓ ji ↓ ⟹ m kpa ↑ a ↓ ji ↓

(47)   isi ↓ Ⓓo↑ke ↓   underlying form, after insertion and
         :   :   :   cliticization of the downstep [↓]
        Ø   :   :   Identical PCM Deletion (36)
              :   Ø   ↑ Deletion (46)
              :   :   ↓ Before ↓ Reduction (38)
              ↓
        ----   ------
        isi   oke ↓   output

The extension of the rule of ↑ Deletion to cover cases like (47) is
plausible, I believe, since the ↑ which is deleted in these cases, while
not at the same syllable boundary as the controlling ↓ , is at least very
close to it—in fact, only one mora away, since there is a general rule of
vowel coalescence which merges vowel sequences like io in (47) into a sin-
gle syllable. If this argument is correct, then we have succeeded in giving
a principled account of the whole package of tonal alternations which was
described in (4). In particular, we have shown that if the insertion of the
downstep (4a) is taken to be the central tone change in this construction,
then the other alternations ((4b) and (4c)) can be derived from it in a
principled way by means of rules which resolve pcm "conflicts" by deleting
or moving away one of the conflicting pcm's.

There is one fact about this construction which still remains to be ac-
counted for, and that is the fact that when the prefix vowel of the second
constituent is high-toned (as in ísí é'γú 'the head of a goat'), the as-
sociative ↓ does not appear at the constituent boundary in the surface
form, but comes after the prefix vowel. We can account for the surface pos-
ition of the downstep in phrases like this by means of a rule of the follow-
ing form:

(48)   ↓ Shift[17],[18]

               [↓   V   ... ↓
        S.D.   1   2   3 4   where 3 contains no pcm
        S.C.   Move 1 to the right of 2

--- ---------

[17]Notice that rule (48) is not subject to the criticism which we made
above of Williamson's rule of low tone transposition ((17), (18)). The
difference is that this rule does not transpose one tone unit with another,

Notice that the condition that the prefix vowel must be high-toned has
been replaced here by the (equivalent) condition that the pcm which most
immediately follows it in the string must be a ꜜ . I do not regard this
as a particularly natural condition, and it is perhaps significant that it
has been dropped in some dialects (including the Aboh dialect described by
Hyman [1974]). In these dialects, the downstep ꜜ *always* shifts to the
right of the prefix vowel.

2. Downstep in Kikuyu

According to Clements and Ford [1977a], Kikuyu has two lexical classes
of words, which they call "Class I words" and "Class II words". As is shown
in the following examples, Class I words are marked by a downstep (') which
normally takes the form of a drop in pitch at the end of the word:

(49) a.
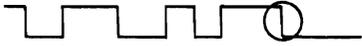
	aheire	moaɣahiɲa		ɲjata	'he gave the weakling a star'
	H L H	L H L H	'	H H	
	he-gave	weakling (Cl I)		star	

b.

	Moaneki		ɔ:nirɛ	'Mwaniki (Cl I) saw'
	L L L	'	L H H	

---

but rather changes the position of a tonal unit with respect to the phono-
logical string. Such rules are common in a dynamic-tone framework, where
they take the place of what Hyman and Schuh [1974] call "tone-spreading"
rules. I do not believe it is ever necessary to postulate a rule which
moves one pcm over another; the sphere of operation of tone rules is always
limited to the string which includes the target pcm and the pcm's which most
immediately precede and follow it (hence the conditions on rules (36), (38),
and (48) that the variable "..." may not subsume a pcm.)

[18]It should perhaps be noted here that when the nominal constituent to
which rule (48) applies contains three syllables or more, the downstep is
deleted by a subsequent rule. Thus, for example, the phrase ísí ákwúkwɔ́
'chapter of a book' lacks the expected downstep after the prefix vowel of
ákwúkwɔ́ 'book' (see Clark [1978], Chapter VI, for a discussion and analysis
of this fact).

The examples of (49) show the downstep as it appears when it comes be-
tween two high or two low tones. When the downstep lies between a high tone
and a following low tone,[19] as in the example below, it undergoes a process
called "Downstep Displacement", which shifts it over the string of low tones
to its right to create the output tone contour shown on the right below:

(50)

ndinarɔra	keŋaŋi	==>	ndinarɔra	keŋaŋi
L H H H	L H H		L H H H	H H'H

I-didn't-watch(Cl.I) crocodile   'I didn't watch the crocodile'
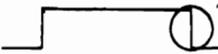
Clements and Ford [1979] propose the following analysis of these facts:
first of all, the downstep is created by a floating extra low tone, $\bar{L}$,
which acts as the triggering element for a register lowering rule which
lowers both the high and low tone registers.[20] Since this floating low
tone never "docks", it is not actually pronounced but receives its sole
phonetic realization through the register lowering which it triggers. The
process of Downstep Displacement is then accounted for by means of a rule
of the following form:

(51) **Downstep Displacement**

$$H \quad \bar{L} \quad L_Q \quad \Longrightarrow \quad H \quad H_Q \quad \bar{L}$$

The $\bar{L}$ in this rule is the floating extra low tone, and L_Q is the maxim-
al sequence of low tones to its right. The application of this rule to (50)
is shown below:

(52) underlying form: ndinarɔra   keŋaŋi
                            L H H H L̄   L L H

      Rule (51):   ndinarɔra   keŋaŋi
                            L H H H   H H L̄ H

---

[19]There is a fourth possibility, L'H. This sequence is realized as a
level low tone; that is, the downstep wipes out the expected rise between
L and H .

[20]See Clements and Ford [1977a] for very strong arguments that the down-
step is triggered by a *phonological* unit and not by a diacritic feature on
Class I words.

Although this analysis produces the correct phonetic output, it is nev-
ertheless unsatisfactory for two reasons: first, since Kikuyu does not ex-
hibit downdrift, the rule which creates the downstep by lowering the high
and low tone registers after $\bar{L}$ has no independent motivation in the lang-
uage. This makes the analysis extremely abstract. I find it difficult to
believe that a child learning Kikuyu, hearing an unexpected drop in pitch
at a certain point, somehow attributes this drop to the presence of a float-
ing low tone, even though no such tone is audible, and even though there is
no evidence in his language that a floating low tone would have such an ef-
fect. To make the analysis plausible, one would have to argue that the link
between downstep and floating low tone is built into the Language Acquisi-
tion Device. But this would imply a universality which has not been and
cannot be demonstrated; for example, as we have seen, there is no satisfact-
ory way to attribute the downstep of Igbo to a floating low tone.

A second serious objection to the analysis is the complexity and apparent
arbitrariness of the rule of Downstep Displacement (51). Unless some way
can be found to predict that a floating low tone should interact with the
surrounding tone contour in just this way in the synchronic grammar of a
language, this analysis serves only to describe the facts and not to explain
them.

In a paper given at the Winter 1978 LSA Meeting, Will Leben proposed the
following more principled account of Downstep Displacement, based on his Ob-
ligatory Contour Principle, which requires that a string of low-toned or
high-toned syllables be analyzed as sharing a single tone segment. In Leb-
en's analysis, the phrase of (52) is assigned the following underlying rep-
resentation:

(53) ndinarɔra   keŋaŋi
      | \|/   \/ |
      L H   L̥   L H
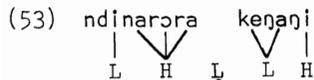
where $L̥$ represents the floating low (or extra low) tone. But this repre-
sentation includes a sequence of low tones ($L̥$ L) which, by the Obligatory
Contour Principle, should simplify to a single tone segment. That is ex-
actly what happens, through rule (54) below, whose application to (53) is
shown in (55):

(54) L → ∅ / L̥ __

(55) ndinarɔra   keŋaŋi ==> ndinarɔra   keŋaŋi

       L H L̥ L H   L H L̥   H

Now, by a general tone spreading convention for Kikuyu, the final H of
ndinarɔra spreads onto the toneless initial syllables of keŋaŋi to pro-
duce the (correct) output contour shown in (56):

(56) ndinarɔra   keŋaŋi

      L   H   L̥ H

   This revised version of the analysis does not answer our first object-
ion above, viz. that the child learning Kikuyu has no evidence on which to
base his postulation of a floating low tone as the source of the downstep.
However, it does seem to answer the second, since rule (54), which corres-
ponds to Clements and Ford's rule of Downstep Displacement, has a principled
basis in the Obligatory Contour Principle. This result is illusory, how-
ever, for there is another dialect of Kikuyu which cannot be accounted for
in this way. The dialect I have in mind is that spoken by one of Ford's
informants, Mr. Thairu from the Nyeri district.[21] Mr. Thairu differed from
Ford's other informants in that he consistently placed *two* downsteps in
"Downstep Displacement" environments when the righthand word was a member of
Class I. An example showing this characteristic of Mr. Thairu's speech is
given below (where I continue to assume that the downstep is triggered by a
floating low tone):

(57)

ti karioki   ==>   ti karioki   'it isn't Kariuki'

 H L̥   L   H L̥   H L̥   H L̥ H L̥

Notice that Leben's proposal cannot be extended to this dialect; in

_____

particular, since there is a downstep between ti and karioki in the
surface form, the high tone of the first two syllables of karioki cannot
be obtained by spreading the high tone segment of ti . We can, of course,
account for these facts by means of a rule like that below, which changes
L to H Ḷ in the environment following H Ḷ :

(58) L → H Ḷ / H Ḷ __

But this rule shares the complexity and arbitrariness which we objected to
above in Clements and Ford's original statement of Downstep Displacement
(51). Once rules like this have been admitted, it becomes difficult or im-
possible to place limits on the "package" of tonal alternations which may
be associated with a floating low tone in the synchronic grammar of a lan-
guage.

     I believe it is possible to give a more principled account of the Kikuyu
downstep within the dynamic-tone framework which we have developed in the
preceding section for Igbo. Let us begin by assuming that lexical tone is
represented in the same way in Kikuyu as in Igbo, except that the word level
pcm appears at the beginning of the word instead of at the end.[22] For exam-
ple, the words kèŋàŋí 'crocodile' and áhɛ̀irɛ́ 'he gave' will be repre-
sented as shown in (59):

(59) ↓ keŋa ↑ ŋi   ↑ a ↓ hɛi ↑ rɛ

The blending of lexical tone contours into phrasal contours will be accom-
plished by means of a rule of the form:

(60) Identical PCM Deletion

          pcm ... pcm
     S.D.   1   2   3   where 2 contains no pcm
     S.C.   Delete 3.

          Conditions: (i)   1 = 3
                       (ii) If 1 and 3 are ↓ 's, the rule does not ap-
                             ply within a single word.

_____

[22]The position of the word level pcm—whether it comes at the beginning
or the end of the word (or in both places)—has widespread consequences for
the tonal system of a language. See Clark [1978] Chapter II, for a discus-

Notice that this rule has the same form as the rule of Identical PCM Dele-
tion (36) which was proposed for Igbo in the previous section.[23] The appli-
cation of the rule is illustrated below (where the circled pcm is the pcm
which is deleted by the rule):

(61) a. ↓_ndɔ:ni_↑⁻r̄ε̄ +ⓣk̄ȳā:⁻ ↓_na:_↑⁻n̄ā ==> ↓_ndɔ:ni_↑⁻r̄ε̄⁻ k̄ȳā:⁻ ↓_na:_↑⁻n̄ā[24]
        I-saw   childish-person   'I saw a childish person'

     b. ↓_ndera:_↑⁻r̄ɔ̄⁻+rirε̄+ ⓣkena_↑⁻ŋ̄ī ==> ↓_ndera:_↑⁻r̄ɔ̄⁻↓_rirε__kena_↑⁻ŋ̄ī
        I-watched   crocodile   'I watched the crocodile'

Now consider how we are to account for the downstep which follows a
Class I word in phrases like (49a) and (29b). I suggest that this downstep
is a morpheme consisting of a ↓ only,[25] like the associative ↓ of Igbo,
and that it is introduced into the string by means of a rule which inserts
the morpheme [↓] in the environment immediately following a Class I word.

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sion of criteria for determining the position of the word-level pcm for a
given language.

[23]The fact that this rule applies in the opposite direction from the
Igbo rule, i.e. it deletes all but the first of a sequence of identical
pcm's rather than all but the last as in Igbo, is a consequence of the fact
that the word-level pcm of Kikuyu comes at the beginning of the word rather
than at the end.

[24]Since prefixes are all underlyingly low-toned, nouns which begin on a
high tone level, as ↑⁻k̄ȳā⁻↓_na:↑⁻n̄ā: does, are somewhat exceptional. I
have not been able to find any examples in Clements and Ford's work in
which a word which ends on a high tone level is followed by a word which be-
gins (at the underlying level) on a high tone level. Thus I constructed
this example myself from parts found in Clements and Ford [1977a]. Since
I have not been able to check the example with a native speaker, it should
be taken as an example of how, in principle, rule (60) is meant to work,
and not as an example of a grammatical sentence of Kikuyu. In both these
examples I have ignored the occurrence of underlying downsteps which do not,
for one reason or another, affect the surface contour.

[25]Clements and Ford [1978] give evidence to show that the downstep was
historically part of the lexical tone contour of Class I words; it achieved
its "independent" status when lexical tone contours shifted to the right in
Kikuyu, leaving a final low tone (in our terms, a final ↓) unassociated.
However, the distribution of the downstep in modern Kikuyu is governed by
a set of rules which are entirely syntactic in form (see Clements and Ford
[1977a] for a complete statement of these rules). Thus I assume here that
the downstep has been re-analyzed as a grammatical formative in its own
right.

Suppose, furthermore, that like the morpheme [↓] of Igbo, the [↓] of
Kikuyu undergoes cliticization to the word which follows it. If these sug-
gestions are correct, then after the insertion and cliticization of the
[↓], the phrases of (49) will have the underlying representations shown
below (where the circled ↓ is the downstep):

(62) a.   ↑ā̄ ↓ hɛi ↑r̄ɛ̄ ↓ moa ↑ȳā ↓ hi ↑n̄ā ⊕↑ n̄jāt̄a

       'he gave the weakling (Cl I) a star'

    b. ↓ moaneki ⊕↓ ɔ: ↑n̄ir̄ɛ
       'Mwaniki (Cl I) saw'

The rule of Identical PCM Deletion (60) will apply to (62b), deleting the
⊕ , and producing the surface contour shown in (63), which is correct:

(63)   ↓ moanekī̄ ↓ ɔ: ↑n̄ir̄ɛ   (cf. (49b))

   For (62a), we will have to introduce a rule of ↑ Deletion, the same
rule which was proposed in the preceding section for Igbo:

(64) ↑ Deletion

    ↑ → ∅ / ↓ __

Rule (64) applies to the underlying form (62a) to produce the (correct) sur-
face contour:

(65) ↑ā̄ ↓ hɛi ↑r̄ɛ̄ ↓ moa ↑ȳā ↓ hi ↑n̄ā ↓ njata   (cf. (49a))

So far, then, we are able to account for the facts of Kikuyu using rules of
exactly the same form as those we proposed for Igbo in the preceding section.

   Now consider the phrase of (50), which undergoes the process which Clem-
ents and Ford call "Downstep Displacement". In the present framework, this
phrase will have the underlying representation shown below, where the cir-
cled ↓ is the downstep:

(66) ↓ ndi ↑ nārɔ̄rā ⊕↓ kena ↑n̄i

As usual, the insertion of the downstep has created an ill-formed string
containing two pcm's (in this case two ↓ 's) at the same syllable boundary;
thus a rule must be introduced to resolve the conflict. Of the three logic-

ally-possible strategies for the resolution of such conflicts, Kikuyu
chooses the third, i.e. it moves one of the conflicting ↓ 's away. The
rule which effects this movement may be stated as follows:

(67) Downstep Displacement

$$\qquad \overset{\downarrow}{} \quad \overset{\downarrow}{}$$

    S.D.   1   2
    S.C.   Move 2 maximally far to the right.

The term "maximally far" in the structural change of this rule means to the
end of the phrase or to the next pcm whichever comes first. If there is a
following pcm within the phrase, rule (67) cannot move the ↓ past that
point, because of a general condition on tone rules which prevents the move-
ment of one pcm over another (see footnote 17 above). Thus when it applies
to the phrase of (66), rule (67) moves the ↓ up to the following ↑ and
no further; the rule of ↑ Deletion (64) then deletes the ↑ , as shown
below:

(68) ↓ ndi ↑ narɔra ↓ ↓ keŋa ↑ ŋi   underlying form, after insertion
                                        and cliticization of the [↓]
                 ø ⟹ ↓   Downstep Displacement (67)
                   ø   ↑ Deletion (64)

                                          output so far
    ↓ ndi ↑ narɔra   ↓ keŋa ↓ ŋi

    The application of these two rules does not complete the derivation, for
there are *two* downsteps in our output tone contour where there should be
only one. The first downstep, which is the "extra" one can be eliminated
by means of a rule of ↓ Before ↓ Deletion, stated formally below:

(69) ↓ Before ↓ Deletion[26]

    ↓ → ø / __ ... ↓   where "..." contains no pcm
    Domain: This rule applies at either the word or phrase level.

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  [26]According to Clements and Ford [1977a], there is a downstep after the
first word in each of these phrases at the underlying level. However, since
the downstep is removed by subsequent rule (Clements and Ford's KU-4 and
KU-1, respectively), I have ignored it in these representations.

Rule (69) applies to the output form (68)[27] to produce the (correct) surface contour:

(70) ↓‾ndi‾↑ ‾n̄ar̄ɔ̄r̄ā‾ ‾‾k̄ēη̄ā‾ ↓‾ηi‾   'I watched the crocodile'

Notice that the need for an additional rule (rule (69)) is not a disadvantage of the analysis—quite the opposite, in fact, since the "double downstep" dialect of (57) is easily accounted for by means of a condition on this rule blocking its application to Class I words. Thus, in this dialect, rule (69) will not apply in (57), and the correct output contour is obtained.

The derivation of (68), (70) shows what happens when the rightward movement of a ↓ by Downstep Displacement is stopped by a ↑ later on in the phrase. Clements and Ford [1977a] also give an example in which the downstep has shifted all the way to the end of the phrase. A derivation of this example in the present framework is given below:

(71) 'he gave'   'weakling'   'banana' 'heavy'

↓‾ne‾↑ ‾ā‾ ↓‾hɛi‾↑ ‾r̄ɛ̄‾ ↓‾moa‾↑ ‾ȳā‾ ↓‾hi‾↑ ‾n̄ā‾	↓↓‾iriyo ↓‾irito		underlying form after insertion plus certain re-adjustment rules
		∅	Identical-PCM Deletion (60)
	∅————————→ ↓		Downstep Displacement (67)
	∅		↓ Before ↓ Deletion (69)

↓‾ne‾↑‾ā‾↓‾hɛi‾↑‾r̄ɛ̄‾↓‾moa‾↑‾ȳā‾↓‾hi‾↑‾n̄ā‾ ‾‾‾īrīyo‾ ‾īrīto‾↓   output form
'he gave the weakling a heavy banana'

---

[27]As it is stated here, rule (69) predicts the deletion of the initial ↓ of a phrase like (63); that is, in level-tone terms, it predicts that this phrase should begin on a high tone level when preceded by a high tone. I do not know whether or not this prediction is correct. If it is not, then this result could be avoided by including the deletion of the "extra" downstep in the structural change of the rule of Downstep Displacement (67). I would prefer not to have to resort to a solution of this sort, because there seems to be no principled connection between the two changes the rule would have to effect, namely, the movement of ↓₂ and the deletion of ↓₁ . Actually, so that the internal ↓ of keηaηi (68) will not *itself* be deleted before a following ↓ , rule (69) should be ordered before the rule of ↓ Deletion (64).

While the dynamic-tone analysis of Kikuyu which has been proposed here
is still tentative at certain points, I believe it is sufficiently well
worked out to illustrate the potential advantages of an analysis along these
lines. First, as we have seen here, the dynamic-tone framework allows a
very concrete representation of the downstep as a pitch drop (which is just
what it is phonetically). Thus we avoid the acquisition puzzle which is
posed by analyses which treat the downstep as the reflex of an otherwise
inaudible triggering element such as a floating low tone. In addition, as
has been shown here, the dynamic-tone framework permits a principled account
of the process of Downstep Displacement, for the rule which effects this
change is one of a small set of possible strategies for the resolution of
an ill-formedness created by the insertion of a "bare" pcm into the string.
Finally, the analysis proposed here includes a plausible account not only of
the standard dialect, but also of the "double-downstep" dialect which was
illustrated in (57).

3.   The Associative Marker of Twi: An Instance of Syntactically-Distributed Upstep

In the preceding sections of this paper, I argued that the syntactically-
governed downsteps of Igbo and Kikuyu should be analyzed as morphemes whose
only phonological realization is a pitch drop (↓). Since the theory of
tone which is proposed here also provides a second basic tone marker, ↑ ,
we naturally expect that there should also be morphemes consisting of a ↑
only, and that the introduction of one of these morphemes into a phonologic-
al string should give rise to tonal alternations of the same sort as those
we have found in connection with downstep. In this section, I will take up
some data from Twi which seem to fulfill this prediction. The analysis pro-
posed here is based on data presented in Nyaggah [1976].

Nyaggah begins her discussion by presenting six examples of possessive
constructions involving inalienable possession. Here, as she points out,
the tone of the possessive pronoun is determined by a sort of polarity rule
which gives the pronoun opposite tone from the first syllable of the head
noun:

(72) a.   nè yéré   'his wife'   (yéré   'wife')
     b.   né pàpá   'her father'   (pàpá   'father')
     c.   né wɔ̀fà   'her uncle'   (wɔ̀fà   'uncle')
     d.   né nàná   'his grandparent' (nàná   'grandparent')

Two further examples illustrate the application of a vowel elision rule
which deletes the second vowel of a sequence:

(73) a.   nè tʃ   'her head'   (nè 'her' + è-tʃ 'head')
     b.   nàsón   'his ear'   (nè 'his' + à-són 'ear')

(73b) shows that Vowel Elision must be preceded by a rule which changes [e]
to [a] before [a].

    Nyaggah then goes on to present a series of examples involving alienable
possession. In contrast to the examples of (72) and (73), these phrases
show characteristic tonal mutations in the head noun which Nyaggah attri-
butes to the presence of a floating high tone associative marker. The ex-
amples are divided into two groups: first those whose stems have initial
low tone underlyingly and then those with high-toned stems:

(74) a.   nàkónwá[28]   'her chair'   (à-kònwá 'chair')
     b.   nè póná   'her walking stick'   (pòmá   'walking stick')
     c.   nè dúá   'his tree'   (è-dùá   'tree')
     d.   nè sápɔ̀   'her sponge'   (sàpɔ́   'sponge')

(75) a.   né tá!   'his ladle'   (ɛ̀-tá   'ladle')
     b.   náfúó   'her farm'   (à-fúó   'farm')
     c.   né pónó   'his table'   (ɛ̀-pónó   'table')
     d.   né dáŋ   'his house'   (ɛ̀-dáŋ   'house')

The generalization to be drawn from this data is as follows: stems with
the lexical contour LH (74) acquire H¹H tone in this construction, with low
tone on the possessive pronoun, while stems with the lexical contour H or
HH (75) become ¹H(H), with high tone on the possessive pronoun.

    I will not present Nyaggah's own account of these facts but will pro-
ceed directly to a dynamic-tone analysis. Let us begin by assuming that

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    [28]The " ¹ " indicates a downstepped high tone. " ´ " and " ` ", as
usual, indicate high and low tone respectively.

lexical tone contours in Asante are represented as in Kikuyu, with the
"word level" pcm at the beginning of the word. Then the phrases of (72)
will be derived as follows:

(76) a.   ne + ꜛyɛ̄rɛ̄   ==>   ne͜ꜛˉyɛ̄rɛ̄   'his wife'

   b.   ne + ꜜpa ꜛp̄ā   ==>   n̄ē ꜜ͜pa ꜛp̄ā   'her father'

   c.   ne + ꜜwɔfa   ==>   n̄ē⁻ꜜ͜wɔfa   'her uncle'

   d.   ne + ꜜna ꜛˉn̄ā   ==>   n̄ē⁻ꜜ͜na ꜛˉn̄ā   'his grandparent'

Notice that if the possessive pronoun ne is assumed to be toneless, then
its "polarized" tone in these examples follows automatically from the as-
sumption that the word level pcm lies at the beginning of the word in
Asante.

   Now consider the examples of (73), which involve Vowel Elision. These
phrases have the underlying representations shown below:

(77) a.   ne ꜜe ꜛti

   b.   na ꜜa ꜛ son   (after assimilation of [e] to [a])

The deletion of the underlying vowels in these forms by Vowel Elision cre-
ates an unacceptable output, since the word initial ꜜ will end up at the
same syllable boundary as the following ꜛ . This ill-formedness is elim-
inated by means of the following rule:

(78)   Pcm-Shift (Leftward)

            σ pcm pcm
     S.D.   1   2   3
     S.C.   Move 2 to the left of 1.
            Condition: The boundary to the left of 1 is not already
                        occupied by a pcm.

Vowel Elision and pcm-Shift apply to the underlying strings (77) to derive
the (correct) surface forms shown in (79):

(79) a.   ꜜne͜ꜛˉtī   'her head'

   b.   ꜜna ꜛˉsōn̄   'his ear'

   Now consider the phrases of (74) and (75). Let us assume, with Nyaggah,
that phrases of this type contain a (purely tonal) associative morpheme; we
depart from Nyaggah in analyzing this morpheme as a pitch rise marker ꜛ

rather than as a floating high tone. These phrases will then have the un-
derlying representation shown below, where the circled ↑ is the associa-
tive morpheme:

(80) a. na Ⓐ ↓ akon ↑ wa   (after assimilation of [e] to [a])

     b. ne Ⓐ ↓ po ↑ ma

(81) a. na Ⓐ ↓ a ↑ fuo   (after assimilation of [e] to [a])

     b. ne Ⓐ ↓ ε ↑ pono

    Vowel Elision now applies to produce the intermediate forms below:

(82) a. na ↑ ↓ kon ↑ wa

     b. ne ↑ ↓ po ↑ ma

(83) a. ne ↑ ↓ ↑ fuo

     b. ne ↑ ↓ ↑ pono

The massive conflict of pcm's at the syllable boundary between the two con-
stituents is now resolved as follows: first, the ↑ ↓ sequences of (82)
are eliminated by means of a rule which shifts the ↓ to the following syl-
lable boundary. A statement of this rule is given below, along with the
output which is obtained by applying it to (82):

(84) ↓ Shift (Rightward)

           ↑ ↓ σ

    S.D.   1 2 3

    S.C.   Move 2 to the right of 3.

(82') a. na ↑ ↓ kon ↑ wa ==> na ↑ kon ↓ ↑ wa

     b. ne ↑ ↓ po ↑ ma ==> ne ↑ po ↓ ↑ ma

    Notice that rule (84) cannot apply to the forms of (83) because the
rightward movement of the ↓ is blocked by the following ↑ . Instead,
these forms undergo rule (78), which shifts the associative ↑ to the left,
creating the intermediate forms shown in (83'):

(83') a. ne ↑ ↓ ↑ fuo ==> ↑ ne ↓ ↑ fuo

     b. ne ↑ ↓ ↑ pono ==> ↑ ne ↓ ↑ pono

    Finally, the remaining ↓ ↑ sequences are eliminated by means of an

"addition" rule which merges a ↓ ↑ sequence into a small pitch drop (ˇ). The application of this rule produces the (correct) output tone contours shown below:

(82") a. n̲a̲ ↑ kon ˇ⁻w̲a̲   'her chair'

     b. n̲e̲ ↑ po ˇ⁻m̲a̲   'her walking stick'

(83") a. ↑ ne ˇ f̲u̲o̲   'her farm'

     b. ↑ ne ˇ⁻p̲o̲n̲o̲   'his table'

     In summary, the changes from lexical tone in Asante alienable possessive phrases arise, in this view, from the presence of an associative marker ↑ at the constituent boundary of the phrase. The presence of this "extra" pcm, along with the rule of Vowel Elision, creates a pcm conflict at the constituent boundary. This conflict is resolved by means of rules which (i) move one of the conflicting pcm's to an adjacent syllable boundary or (ii) merge a ↓ ↑ sequence into a single small sized pitch drop (ˇ).

     Because this analysis is based on such a small set of data, it must be regarded as very tentative. Nevertheless, the analysis is important, I believe, as an illustration of the sorts of tonal alternations which would, in principle, be expected to occur in the environment of a morpheme which consisted of a "bare" ↑ . I think it is significant that the rules which are found to apply in this case are of the same form as those which we observed in connection with the ↓ 's of Igbo and Kikuyu. This is a very satisfactory result, since it suggests that there are strong, specifiable constraints on the tonal alternations which may be expected to occur in the environment of grammatical formatives whose phonological realization is purely tonal.

[*Editor's note*: A reply to this article by George N. Clements and John Goldsmith, with a rebuttal by Mary M. Clark will appear in a future issue.]

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