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 [\[ \downarrow \] \], where the symbol "\[ \downarrow \] " represents a drop in pitch. If lexical tone contours are represented dynamically, as sequences of pitch rises (\[ \uparrow \]'s) and pitch drops (\[ \downarrow \]'s), then the interaction 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 [\[ \uparrow \] \].

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 phonological tone.\(^1\) A downstep may appear in the lexical tone contour of a word, as in the Igbo personal name:

(1) \[ \text{Igwe} \]

H\[ h \]

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

\(^1\)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 construction, as in the example:

(2) ☐

\[
\begin{array}{c}
\text{isi eyu} \\
\text{H H H H}
\end{array}
\]

'\text{the head of a goat}'

\[
\begin{array}{c}
\text{isi} \\
\text{H H}
\end{array}
\]

'\text{head}'

\[
\begin{array}{c}
\text{eyu} \\
\text{H H}
\end{array}
\]

'\text{goat}''

Another language which uses a downstep as a grammatical marker is Kikuyu; 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 \text{moayahina} (a) and \text{moanek} (b):

(3) a. ☐

\[
\begin{array}{c}
\text{he-he} \\
\text{H L H L H H}
\end{array}
\]

\text{moayahina njata} 'he gave the weakling a star'

\[
\begin{array}{c}
\text{he} \\
\text{H H}
\end{array}
\]

'gave'

\[
\begin{array}{c}
\text{weakling} \\
\text{H H}
\end{array}
\]

'star'

b. ☐

\[
\begin{array}{c}
\text{moanek} \\
\text{L L L L H H}
\end{array}
\]

'Mwaniki saw'

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 between 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

\(^3\)I will be revising this definition during the course of the paper.
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 **Previous analyses of this construction.** 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) 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:

\[
\begin{align*}
\text{isi eyu} & \quad \text{the head of a goat} \quad (\text{isi} \quad \text{head} + \text{eyu} \quad \text{goat}) \\
H \ H \ H \ H & \quad H \ H \ H \ H
\end{align*}
\]

\[
\begin{align*}
\text{isi ji} & \quad \text{the top of the yam} \quad (\text{ji} \quad \text{yam}) \\
H \ H \ I \ H & \quad H \ H
\end{align*}
\]

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

\[
\begin{align*}
\text{isi oke} & \quad \text{the head of a rat} \quad (\text{oke} \quad \text{rat}) \\
H \ H \ I \ H \ H & \quad L \ H
\end{align*}
\]

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

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4This 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.

5This 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.

6The downstep in this phrase is introduced by rule (4a).
at the end of the first constituent is raised to 'H. For example:

\[
\begin{align*}
\text{Odhù oke} & \quad \text{'the tail of a rat'} \\
H & \quad H \quad H \quad H
\end{align*}
\]

\[
\begin{align*}
\text{Abha enwe} & \quad \text{'the jaw of a monkey'} \\
L & \quad H \quad L \quad L \quad L \quad L
\end{align*}
\]

Why should the three apparently unrelated tonal alternations of (4) recur 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-active element in these constructions which acts as a sort of "trigger" for each of these changes individually. Ideas as to the nature of the triggering 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] analyze 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 criteria:

\[(5) \]

\[(5) \]

a. The "triggering element" is taken from some specifiable set of elements 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) predictable 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 predictable 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 tonal alternations like (4), which may function as "packages", from other imaginable 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 alternations to the presence of a special boundary symbol (≠). For example, in Carrell's analysis, the first phrase of (4c) is given the underlying representation:

\[
(6) \quad \text{ọdụ ≠ ọke} \quad \text{'the tail of a rat'}
\]

\[
\begin{array}{ccc}
\text{H} & \text{L} & \text{L} & \text{H}
\end{array}
\]

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 established 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 floating tones have phonological content, it should be possible to predict in advance 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 triggering element is a floating high tone; for example, the phrase of (6) is assumed to have the underlying representation shown in (7):

\[
(7) \quad \text{ọdụ} \quad \text{ọke}
\]

\[
\begin{array}{ccc}
| & | & | \\
\text{H} & \text{L} & \text{H} & \text{L} & \text{H}
\end{array}
\]
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, creating the intermediate form:

(8) $\text{odhù} \quad \text{oke}$

\[ \begin{array}{l}
\text{H} \quad \text{L} \\
\text{H} \quad \text{L} \quad \text{H}
\end{array} \]

A subsequent contour simplification rule then gives $\text{odhù}$ its output form:

(9) $\text{odhù}$

\[ \begin{array}{l}
\text{H} \\
\text{H}
\end{array} \]

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:

(10) Introducing the downstep

$H \rightarrow \, ^{\prime}H / [H]$\text{affix} \# (\text{tone})$

\[ \begin{array}{l}
\text{H} \\
\text{H}
\end{array} \]

\[ \begin{array}{l}
\text{H} \\
\text{H}
\end{array} \]

$^7$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 produce 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 independent morpheme—an affix. By referring to the affixal status of the $H$
(11) Deleting a low prefix tone
L \rightarrow \emptyset / [H]\text{affix}##

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

(12) 9 dh
\begin{array}{c}
| \hline
H & L & H & L & H \\
| \hline
\end{array}

\begin{array}{c}
\vdots \\
\vdots \\
\vdots \\
\vdots \\
\vdots \\
\vdots \\
\vdots \\
| \hline
\end{array}

\begin{array}{c}
H \text{ rule (10)} \\
L \text{ rule (11)} \\
H \text{ docking of the floating high tone} \\
\end{array}

\begin{array}{c}
d\text{odu} \\
\rightarrow \text{oke} \\
\end{array}

\begin{array}{c}
\text{the tail of a rat'} \text{ (underlying form)} \\
\end{array}

\begin{array}{c}
| \hline
H & 'H & 'H \\
| \hline
\end{array}

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 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 'isi é'yu' 'the head of a goat' (1a) 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 e'yu10
| H H | H H |

In Hyman's analysis, the 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 e'yu
| H H | H H |

It is the floating low tone which ultimately creates the downstep between the two high tones of e'yu, 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 \[\Rightarrow \ H / H \quad H\]

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 evidence 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. ... zụ́ụ́ any 'and didn't buy meat'  
[Green and Igwe 1963:141]

b. ma oćíụ́ ji 'if he doesn't carry away yams'  
[Green and Igwe 1963:128]

c. o nye 'ji Adha ji 'he gave Adha yams'  
[from my own informant]

If there is really a floating low-tone prefix at the beginning of nouns like eyu, any, and ji, then why doesn't this prefix have the same downsteping 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 (14a)) in the tonal package of (4) is still unexplained.

Williamson [1970] takes a different approach from those we have considered so far in that she identifies the triggering element in the Igbo associative 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 isi eyu 'the head of a goat' have the underlying representation shown in (17):

(17) isi eyu

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 autosegmental framework). Now the appearance of the downstep between the two \( H \)'s of eyu 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, creating the intermediate structure:

(18) isi eyu  
(ultimately, isi eyu )
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:

\[
\begin{array}{c|c|c|c}
| & | & | & |
\hline
H & L & L & H
\end{array}
\]

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):

\[
\begin{array}{c|c|c|c}
| & | & | & |
\hline
H & L & H & L
\end{array}
\]

and the raising of the final L of \(\text{odhu}\) is then accomplished in the usual way, by the docking of the "\(\circ\)" 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:

\[
\begin{array}{c|c|c|c|c|c|c}
| & | & | & & & & |
\hline
H & H & 'H & L & H & 'H
\end{array}
\]

Since \(\text{j}i\) begins on a high tone level, Williamson's rule which raises \(\circ\) to 'H should not apply in this case; thus there is no way to account for the raising of the final L of \(\text{odhu}\). If, on the other hand, the rule were restated in such a way that it \emph{did} apply in this case, producing the intermediate form:
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 L to H 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 analysis, and tries to mend it by arguing that the raising of a low tone before low is a widespread phenomenon in Igbo—that, in fact, there is a general rule of the form:

\[(23) \text{L} \rightarrow \text{H} / \_+ \text{L} \quad (\text{where } \_ = "\text{morpheme boundary}" )\]

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 contour, as in the example:

\[(24) \text{we 'pick up'} + \text{fu 'go out'} \rightarrow \text{wefu 'take away'}\]

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:

\[(25) \text{gafemi ('go') + fe 'pass by' + mi 'be deep')}\]

'go out of one's depth' [Igwe and Green 1970:141]
Syntactically-Distributed Downstep

(26) aci ūa any (aci 'were carrying' + ūa 'they' + any 'meat')
H 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 0- in:11

(27) 0za 'sweeper' (0 + za 'sweep') [Green and Igwe 1963:75]
L L L L

Examples like these suggest that the rule which gives we 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 environ­
ment 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 L to H 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 L with H
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-

11 The forms below show that the postposed subject pronoun ūa and the
agentive prefix 0- are indeed low-toned:
(i) aci ūa akhū 'they were not carrying palm nuts'
H'H L H H
(ii) 0cî 'carrier'
L H

Thus it is not possible to account for the non-application of rule (23) in
(26) and (27) by claiming that 0- and ūa 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. A new proposal. We began the previous section by listing three tone changes which occur as a "package" in several distinct syntactic constructions in Igbo. We then 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 겁 ky 깝 'chicken'. This contour is usually defined as an ordered sequence of tone levels, LHL, mapped onto the phonological string as shown in (29):

\[
\text{(29) } \text{k} \text{ k} \text{ k} \\
\text{L H L}
\]

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.\(^{12}\)

\(^{12}\)This way of looking at tone contours is not original with me. Dynamic-tone analyses have been given of Japanese (by the Japanese linguist Hattori) 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) \( \varphi \uparrow k_u \downarrow k_o \)

What this representation means is that there is a rise in pitch (\( \uparrow \)) between the first two syllables of \( \varphi \) and a drop in pitch (\( \downarrow \)) 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 Gandour and Harshman [1978], or, as in the present paper, by studying the tonological systems of human languages to see which view leads to a better overall 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 \( \uparrow \) and \( \downarrow \) (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 \( \uparrow \) and \( \downarrow \), some languages also make use of an "abbreviated" rise and fall which I

[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) \( \varphi \uparrow k_u \downarrow k_o \)

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 \([\pm \text{pcm}]\) may be used to distinguish pcm's from other phonological units, the feature \([\pm \text{fall}]\) to distinguish \(\downarrow\) and \(\uparrow\) from \(\downarrow\) and \(\uparrow\), and the feature \([\pm \text{full size}]\) to distinguish \(\downarrow\) and \(\uparrow\) from \(\downarrow\) and \(\uparrow\).

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 phonological 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 configuration 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; representations such as \(\sigma \uparrow \sigma\) (where \(\sigma = \"\text{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 \(_{0}\underline{\text{kù}}_{_{kọ}} \"\text{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 \(_{0}\underline{\text{ẹgùú}} \"\text{goat}\"\) and \(_{0}\underline{\text{ẹgùẹ}} \"\text{monkey}\"\). 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. \(_{0}\underline{\text{ẹgùú}} \uparrow\) b. \(_{0}\underline{\text{ọke}} \uparrow\) c. \(_{0}\underline{\text{ẹbe}} \uparrow\) d. \(_{0}\underline{\text{ẹẹwẹ}} \uparrow\)

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) \[ o \downarrow \underline{nye\breve{r}e} \downarrow \underline{Ekwe} \downarrow \underline{enwe} \downarrow \]  'he gave Ekwe the monkey'

it is the word level \( \downarrow \) of \[ o \downarrow \underline{nye\breve{r}e} \downarrow \] 'he gave' which gives us the rise in pitch between \[ o \downarrow \underline{nye\breve{r}e} \downarrow \] and \[ \underline{Ekwe} \downarrow \]. Similarly, it is the word level \( \downarrow \) of \[ \underline{Ekwe} \downarrow \] which gives us the drop in pitch between \[ \underline{Ekwe} \downarrow \] and \[ \underline{enwe} \downarrow \].

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 \( \uparrow \) at the end of \[ o \downarrow \underline{gu} \downarrow \]:

(33) \[ o \downarrow \underline{nye\breve{r}e} \downarrow 0 \downarrow \underline{gu} \downarrow \underline{enwe} \downarrow \] ( \[ o \downarrow \underline{nye\breve{r}e} \downarrow + 0 \downarrow \underline{gu} \downarrow + \underline{enwe} \downarrow \] )

'he gave Ogu the monkey'

Similarly, in the following sentence, there is no drop in pitch at the end of \[ \underline{Ekwe} \downarrow \]:

(34) \[ o \downarrow \underline{nye\breve{r}e} \downarrow \underline{Ekwe} \downarrow \underline{eyu} \downarrow \] ( \[ o \downarrow \underline{nye\breve{r}e} \downarrow + \underline{Ekwe} \downarrow + \underline{eyu} \downarrow \] )

'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**

\[ \text{pcm ... pcm} \]

\[ \text{S.D. 1 2 3} \quad \text{where 1 = 3 and where "..." contains no pcm} \]

\[ \text{S.C. Delete 1.} \]

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\textsubscript{femi} 'go out of one's depth' (25). This verb consists of a toneless verb radical ga 'go' plus two "low-toned" verb radicals fet '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 + fet + mi +. If we allow rule (35) to apply within a single word, then this rule will, correctly, delete the + of fet in ga\textsubscript{femi} +. So that the rule will apply in cases like this, let us add the following condition on its application:

(36) \textbf{Identical PCM Deletion}

\begin{align*}
\text{pcm} & \ldots \text{pcm} \\
\text{S.D.} & 1 \ 2 \ 3 \quad \text{where 1 = 3 and where "\ldots" contains no pcm} \\
\text{S.C.} & \text{Delete 1.}
\end{align*}

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\textsubscript{t}u\textsubscript{bha}\textsubscript{bha} + ( atubha ) 'not to throw in'

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:

14The + after the first verb radical in ga\textsubscript{femi} + is inserted by a rule of the form:

(iv) $\varnothing \rightarrow \downarrow / \text{verb stem}$

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

(38) \[ + \text{ Before } + \text{ Reduction} \]
\[ + \rightarrow [\text{-full size}] /... + \] 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):

\[ (39) \quad [\quad [X] \quad [Y] \quad ] \quad \left[ \begin{array}{c} +N \\ -V \end{array} \right] \]

S.D. \quad 1 \quad 2
S.C. \quad 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, \(\overline{N}\), 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

\(^{15}\)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 \( \uparrow \) is the associative marker):

\[(40) \]  
\( \text{a. } \text{abha} \text{\( \uparrow \)}_{1} \text{enwe} \text{\( \uparrow \)}_{2} \text{t} \leftarrow \text{the jaw of a monkey} \) 
\( \text{b. } \text{Q} \text{\( \uparrow \)}_{1} \text{dbu} \text{\( \uparrow \)}_{1} \text{\( \uparrow \)}_{1} \text{j} \leftarrow \text{the bottom of the yam} \) 
\( \text{c. } \text{isi} \text{\( \uparrow \)}_{1} \text{enwe} \text{\( \uparrow \)}_{2} \text{t} \leftarrow \text{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 \( \uparrow \) in these examples.

1. Two pcm's at the same syllable boundary might be added together, so that a \( \uparrow \uparrow \) sequence counts as \( \emptyset \), a \( \uparrow \uparrow \) sequence as an extra large pitch drop, and so forth.
2. One of the competing pcm's might be deleted, e.g. a \( \uparrow \uparrow \) sequence might be simplified to \( \uparrow \).
3. One of the two competing pcm's might be moved to another boundary, e.g. the \( \uparrow \) of a \( \uparrow \uparrow \) sequence might be retracted to the preceding syllable boundary. If we consider 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 being resolved, e.g. a \( \uparrow \uparrow \) sequence is particularly likely to be resolved by strategy (3). Igbo uses only strategies (2) and (3), and in the following way:

A \( \uparrow \uparrow \) sequence is resolved by retracting the \( \uparrow \) to the preceding syllable boundary. The rule for this retraction is stated in (41), and its application is illustrated in (42):

\[(41) \text{\( \uparrow \) Retraction}}_{16} \]  
\[\sigma \text{\( \uparrow \)} \text{\( \uparrow \)} \text{\( \uparrow \)}_{2} \text{\( \uparrow \)}_{3} \]  
\[\text{where } \sigma = \text{"syllable"} \]  
\[\text{S.D. 1 2 3} \]  
\[\text{S.C. Move 2 to the left of 1.} \]

\(16\text{In the } \text{O}	ext{h}	ext{u}	ext{h}	ext{u} \text{ dialect described by Green and Igwe [1963], rule (41) retracts the \( \uparrow \) 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) \text{mkp\( \uparrow \)j} \text{\( \uparrow \)} \text{\( \uparrow \)} \text{\( \uparrow \)} \text{\( \uparrow \)} \text{a stick of yams} \text{ ( \text{mkp\( \uparrow \) stick} \text{\( \uparrow \)} \text{\( \uparrow \)}} \text{\( \uparrow \)} \text{\( \uparrow \)} \text{\( \uparrow \)} \text{\( \uparrow \)} \text{yams}) \]

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

$$\text{(43)} \quad \varphi + \text{dhu} + \text{i} \xrightarrow{\text{rule (41)}} \varphi + \text{dhu} \text{i}$$

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):

$$\text{(44) Deletion}$$

$$\rightarrow \varnothing$$

$$\text{(45)} \quad \varphi + \text{dhu} + \text{i} \xrightarrow{\text{rule (41)}} \varphi + \text{dhu} \text{i} \xrightarrow{\text{rule (44)}} \varnothing \xrightarrow{\text{rule (44)}} \varnothing$$

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 downstep, namely, the raising of the low prefix tone of a noun with the lexical tone contour of $\varphi_{-} \text{ke} + \text{rat}' (4b)$. 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 application in the derivation of the phrase $\text{fs} \text{'óké} + \text{'the head of a rat'}$.

$$\text{(46) Deletion (revised from (44))}$$

$$\rightarrow \varnothing$$

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 assume 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:

$$\text{(vi)} \quad \text{m kpa a + + j i }$$
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 single 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 accounted for, and that is the fact that when the prefix vowel of the second constituent is high-toned (as in isi élýú 'the head of a goat'), the associative does not appear at the constituent boundary in the surface form, but comes after the prefix vowel. We can account for the surface position of the downstep in phrases like this by means of a rule of the following form:

\[(48) \uparrow \text{Shift}^{17,18} \]

\[
\begin{array}{cccc}
\text{S.D.} & 1 & 2 & 3 4 \\
\text{S.C.} & \text{Move 1 to the right of 2} \\
\end{array}
\]

where 3 contains no pcm

\[17\text{Notice that rule (48) is not subject to the criticism which we made above of Williamson's rule of low tone transposition ((17), (18)). The difference is that this rule does not transpose one tone unit with another,} \]
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 + . 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 + 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. ahrtɛ moayahiŋa ɲata 'he gave the weakling a star'

\[\begin{array}{l}
\text{he-gave weakling star (Cl I)}
\end{array}\]

b. Moaneki ɲiŋirɛ 'Mwaniki (Cl I) saw'

\[\begin{array}{l}
\text{star}
\end{array}\]

But rather changes the position of a tonal unit with respect to the phonological 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.)

\[\text{It should perhaps be noted here that when the nominal constituent to which rule (48) applies contains three syllables or more, the downstep is deleted by a subsequent rule. Thus, for example, the phrase } \text{fs} \text{f akwukwɔ} \text{ 'chapter of a book' lacks the expected downstep after the prefix vowel of akwukwɔ 'book' (see Clark [1978], Chapter VI, for a discussion and analysis of this fact).}\]
The examples of (49) show the downstep as it appears when it comes between two high or two low tones. When the downstep lies between a high tone and a following low tone, 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:

\[(50)\]
\[
\text{ndinar\textsuperscript{ora}} \text{ ke\textsuperscript{aji}} \Rightarrow \text{ndinar\textsuperscript{ora}} \text{ ke\textsuperscript{aji}}
\]
\[
\begin{array}{ccccccc}
L & H & H & H & L & H & H \\
I-didn't-watch(Cl.I) crocodile & 'I didn't watch the crocodile'
\end{array}
\]

Clements and Ford [1979] propose the following analysis of these facts: first of all, the downstep is created by a floating extra low tone, \( \overline{L} \), which acts as the triggering element for a register lowering rule which lowers both the high and low tone registers. 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

\[
H \overline{L} L_Q \Rightarrow H H_Q \overline{L}
\]

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

\[(52)\] underlying form: ndinar\textsuperscript{ora} ke\textsuperscript{aji}

\[
\begin{array}{ccccccc}
L & H & H & H & L & L & H \\
\end{array}
\]

Rule (51):

\[
\begin{array}{ccccccc}
L & H & H & H & H & L & H \\
\end{array}
\]

\[19\]There is a fourth possibility, \( L^1H \). 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 downstep 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 nevertheless unsatisfactory for two reasons: first, since Kikuyu does not exhibit downdrift, the rule which creates the downstep by lowering the high and low tone registers after $L$ has no independent motivation in the language. 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 floating 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 effect. To make the analysis plausible, one would have to argue that the link between downstep and floating low tone is built into the Language Acquisition Device. But this would imply a universality which has not been and cannot be demonstrated; for example, as we have seen, there is no satisfactory 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 Obligatory Contour Principle, which requires that a string of low-toned or high-toned syllables be analyzed as sharing a single tone segment. In Leben's analysis, the phrase of (52) is assigned the following underlying representation:

\[
\text{ndinarora} \quad \text{kena}^g_i
\]

\[
\begin{array}{cccc}
L & H & L & H \\
\downarrow
\end{array}
\]

where $^g$ represents the floating low (or extra low) tone. But this representation includes a sequence of low tones ($L L$) which, by the Obligatory Contour Principle, should simplify to a single tone segment. That is exactly what happens, through rule (54) below, whose application to (53) is shown in (55):
Now, by a general tone spreading convention for Kikuyu, the final $H$ of ndinarora spreads onto the toneless initial syllables of keňani to produce the (correct) output contour shown in (56):

(56) ndinarora keňani

This revised version of the analysis does not answer our first objection 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 corresponds to Clements and Ford's rule of Downstep Displacement, has a principled basis in the Obligatory Contour Principle. This result is illusory, however, 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. 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 $\Rightarrow$ ti karioki 'it isn't Kariuki'

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

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21This information is taken from an earlier, unpublished paper by Clements and Ford, entitled "Tone in Kikuyu" [1977b]. I would like to thank Professor Clements for making this paper available to me.
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 $H_L$ in the environment following $H_L$:

(58) $L \rightarrow H_L \quad / \quad H_L$

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 impossible to place limits on the "package" of tonal alternations which may be associated with a floating low tone in the synchronic grammar of a language.

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 example, the words kēn̄aŋi 'crocodile' and āhēiře 'he gave' will be represented as shown in (59):

(59) $\begin{array}{ll}
+\text{kēn̄aŋi} & +\text{ŋi} \\
+\text{a} & +\text{hei} & +\text{ře}
\end{array}$

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

(60) Identical PCM Deletion

\[
\begin{array}{ccc}
\text{pcm} & \ldots & \text{pcm} \\
\text{S.D.} & 1 & 2 & 3 \\
\text{S.C.} & \text{Delete 3.}
\end{array}
\]

Conditions: (i) $1 = 3$

(ii) If $1$ and $3$ are 's, the rule does not apply 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 Deletion (36) which was proposed for Igbo in the previous section. The application of the rule is illustrated below (where the circled pcm is the pcm which is deleted by the rule):

\[(61)\]
\[
\begin{align*}
a. \quad +_{\text{ndoini}} +_{\text{t} \ -r} +_{\text{kya}} +_{\text{na}} & \Rightarrow +_{\text{ndoini}} +_{\text{t} \ -r} +_{\text{kya}} +_{\text{na}} \\
\text{I-saw} & \quad \text{childish-person} \\
\text{I saw a childish person'}
\end{align*}
\]

\[
b. \quad +_{\text{ngerai}} +_{\text{t} \ -r} +_{\text{ir}} +_{\text{kena}} +_{\text{na}} & \Rightarrow +_{\text{ngerai}} +_{\text{t} \ -r} +_{\text{ir}} +_{\text{kena}} +_{\text{na}} \\
\text{I-watched} & \quad \text{crocodile} \\
\text{I watched the crocodile'}
\]

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, 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.

\[\text{23}\] 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.

\[\text{24}\] Since prefixes are all underlyingly low-toned, nouns which begin on a high tone level, as +_{\text{kya}} +_{\text{na}} +_{\text{na}} 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 begins (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.

\[\text{25}\] 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 suggestions 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. + a + he+i + rē + moa + ya + hi + na + njata
   'he gave the weakling (Cl 1) a star'
   b. + moaneki + c: + nīrē
   'Mwaniki (Cl 1) 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) + moaneki + c: + nīrē  (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) surface contour:

(65) + a + he+i + rē + moa + ya + hi + na + 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 Clements and Ford call "Downstep Displacement". In the present framework, this phrase will have the underlying representation shown below, where the circled + is the downstep:

(66) + ndi + nar−ra + + kega + ni

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**

\[
\begin{array}{cc}
\downarrow & \downarrow \\
S.D. & 1 \ 2 \\
S.C. & \text{Move 2 maximally far to the right.}
\end{array}
\]

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 \( \uparrow \) past that point, because of a general condition on tone rules which prevents the movement of one pcm over another (see footnote 17 above). Thus when it applies to the phrase of (66), rule (67) moves the \( \uparrow \) up to the following \( \uparrow \) and no further; the rule of \( \uparrow \) Deletion (64) then deletes the \( \uparrow \), as shown below:

(68) \( \uparrow \text{n} \downarrow \uparrow \text{nar} \downarrow \uparrow \text{ke} \downarrow \uparrow \text{ŋ} \downarrow \uparrow \text{i} \)

\( \uparrow \text{ke} \downarrow \uparrow \text{ŋ} \downarrow \uparrow \text{i} \)

underlying form, after insertion and cliticization of the \([ \uparrow \downarrow \])

\( \emptyset \Rightarrow \uparrow \)

Downstep Displacement (67)

\( \emptyset \)

\( \uparrow \) Deletion (64)

output so far

\( \uparrow \text{n} \downarrow \uparrow \text{nar} \downarrow \uparrow \text{ke} \downarrow \uparrow \text{ŋ} \downarrow \uparrow \text{i} \)

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 \( \uparrow \) Before \( \uparrow \) Deletion, stated formally below:

(69) **\( \uparrow \) Before \( \uparrow \) Deletion**\(^{26}\)

\( \uparrow \mapsto \emptyset / \_ \_ \_ \_ \_ \_ \_ \_ \_ \uparrow \)

where "..." contains no pcm

Domain: This rule applies at either the word or phrase level.

\(^{26}\)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)\textsuperscript{27} to produce the (correct) surface contour:

(70) \textasciitilde \textit{ndi} \textasciitilde \textit{narora} \textit{kena} \textit{qi} \quad '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 down-step 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'

\begin{align*}
&+_\textit{ne}+_\textit{a}+_\textit{hei}+_\textit{re}+_\textit{moa}+_\textit{ya}+_\textit{hi}+_\textit{na} & \uparrow \textit{iriyo} \uparrow \textit{irito} \\
\text{underlying form} & \text{after insertion} & \text{plus certain re-} \\
& \text{and certain rules} & \text{adjustment rules} \\
& \big\uparrow & \text{Identical-PCM} \\
& \text{Deletion (60)} & \text{Downstep Displacement (67)} \\
& \big\uparrow & \text{Before \uparrow De-} \\
& \text{letion (69)} & \text{letion (64)} \\
& _+\textit{ne}+_\textit{a}+_\textit{hei}+_\textit{re}+_\textit{moa}+_\textit{ya}+_\textit{hi}+_\textit{na} & \text{output form} \\
& \text{Tr\textit{yo}-----Tr\textit{to}} \\
\end{align*}

'he gave the weakling a heavy banana'

\textsuperscript{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 +\textsubscript{2} and the deletion of +\textsubscript{1}. Actually, so that the internal + of \textit{kena} (68) will not \textit{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 (\(\uparrow\)). Since the theory of tone which is proposed here also provides a second basic tone marker, \(\uparrow\), we naturally expect that there should also be morphemes consisting of \(\uparrow\) only, and that the introduction of one of these morphemes into a phonological 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 proposed 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. nè pàpà 'her father' ( pàpà 'father')
c. nè wòfà 'her uncle' ( wòfà 'uncle')
d. nè 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 tì 'her head' ( nè 'her' + è-tì 'head')
b. nàsòn 'his ear' ( nè 'his' + à-sòn '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 attributes to the presence of a floating high tone associative marker. The examples are divided into two groups: first those whose stems have initial low tone underlyingly and then those with high-toned stems:

(74) a. nàkónwá28 'her chair' ( à-kónwá 'chair')
b. nè pòmà 'her walking stick' ( pòmà 'walking stick')
c. nè dúà 'his tree' ( è-dúà 'tree')
d. nè sàpò 'her sponge' ( sàpò 'sponge')

(75) a. nè tà 'his ladle' ( è-tà 'ladle')
b. náfùó 'her farm' ( à-fùó 'farm')
c. nè pónó 'his table' ( è-pónó 'table')
d. nè dànj 'his house' ( è-dànj 'house')

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

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

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28The " ' " 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 + ñēñē ñēñē ➞ ne+ñēñē 'his wife'
b. ne + pa+pa ➞ ñē+pa+pa 'her father'
c. ne + wɔfa ➞ ñē+wɔfa 'her uncle'
d. ne + na+ñā ➞ ñē+na+ñā '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 assumption 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 ñē e t i
b. na ña a t son (after assimilation of [e] to [a])

The deletion of the underlying vowels in these forms by Vowel Elision creates an unacceptable output, since the word initial ñ will end up at the same syllable boundary as the following t. This ill-formedness is eliminated 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. tne+tētē 'her head'
b. tna+tēñā '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 t
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 + e + 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 elimi-
nated by means of a rule which shifts the + to the following syl-
latable 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 $\uparrow \uparrow$ sequence into a small pitch drop ('). The application of this rule produces the (correct) output tone contours shown below:

\begin{align}
  (82') \quad & \text{a. } \text{na} \uparrow \text{ kon} \uparrow \text{wa} \quad \text{\textquoteleft her chair\textquoteright} \\
  & \text{b. } \text{ne} \uparrow \text{ po} \uparrow \text{ma} \quad \text{\textquoteleft her walking stick\textquoteright} \\
  (83') \quad & \text{a. } \uparrow \text{ ne} \text{ fuo} \quad \text{\textquoteleft her farm\textquoteright} \\
  & \text{b. } \uparrow \text{ ne} \text{ pono} \quad \text{\textquoteleft his table\textquoteright}
\end{align}

In summary, the changes from lexical tone in Asante alienable possessive phrases arise, in this view, from the presence of an associative marker $\uparrow$ 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 $\uparrow \uparrow$ sequence into a single small sized pitch drop (').

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" $\uparrow$. 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 $\uparrow$'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.]
REFERENCES


Clark, Mary M. 1979. "On the relative determinacy of two theories of tone." In Elisabeth Engdahl and Mark Stein (eds.), *Papers Presented to Emmon Bach by His Students,* pp. 47-63. Linguistics Department, University of Massachusetts, Amherst, Mass.

Clark, Mary M. 1978. "A dynamic treatment of tone, with special attention to the tonal system of Igbo." Doctoral dissertation, University of Massachusetts at Amherst. [Distributed by the Graduate Linguistic Student Association, University of Massachusetts at Amherst and by the Indiana University Linguistics Club.]


Hattori, Shiro. 1973. "What is the prosodeme, i.e. 'word accent', and what are its distinctive features?" *Science of Languages* 4:1-61.


