STUDIES
in
AFRICAN LINGUISTICS

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VIIIth Conference on African Linguistics
Department of Linguistics
UCLA
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STUDIES IN AFRICAN LINGUISTICS

Volume 7, Number 2

July 1976

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STATISTICAL DEMONSTRATION OF A MEANING: THE SWAHILI
LOCATIVES IN EXISTENTIAL ASSERTIONS[1]

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Data involving the locative morphemes pa-, ku- and mu-
in Swahili, a Bantu language of East Africa, are discussed.
The existential use of these forms (as in the English
'there is/there are') is focused on. Locatives in Swahili
are semantically distinct whereas speakers of Swahili
claim no distinctiveness for the same forms when used
existentially. A statisticaly analysis of contextual
variables of existentials is presented and it is shown
that in fact the choice of pa-, ku- and mu- in ex-
istential contexts is not arbitrary as native speakers
suggest.

1. Introduction

This paper will address the methodological problem of determining

whether a contrast in meaning between two forms is preserved even in

contexts where none is reported by native speakers on direct question-

ing. We will demonstrate the use of a statistical technique to estab-

lish that the forms are in fact being used contrastively even in these

contexts. The results of this method will also provide support for a

particular semantic analysis. We will conclude that where there are

differences in surface form it is profitable to look for differences

in meaning even if these are not immediately obvious.

2. The Analytical Problem

In Swahili, forms that are regularly used to refer to place--that

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is, locatives--are also used where there is no apparent reference to place. For example:

(1)　　a.　Aliweka kitabu <u>hu-KU.</u>
　　　　　　　　　　　　this-LOC.

　　　　　'He kept the book <u>somewhere around here.</u>'[2]

　　　b.　Na kama mchumba angali kigoli, basi <u>ha　- KU　- na</u>
　　　　　　　　　　　　　　　　　　　　　　neg. LOC. 'associated
　　　　　　　　　　　　　　　　　　　　　　　　　　　with'

　　　　　kizuizi cha kumwona kila mara.　[Uz 103]
　　　　　obstacle

　　　　　'And if the fiancée is still a girl, then <u>there is not</u>
　　　　　[any] obstacle to seeing her every time [the young
　　　　　man goes to her home].'

(2)　　a.　Aliweka kitabu　<u>ha-PA.</u>
　　　　　　　　　　　　　this-LOC

　　　　　'He kept the book <u>right here.</u>'

　　　b.　<u>Ha　- PA　- na</u>　　　haja hata kidogo ya kuona haya.
　　　　　neg.　LOC. 'assoc.d with'　need　　　　　　[Kf 47]

(3)　　a.　Aliweka kitabu　<u>hu-MU</u>
　　　　　　　　　　　　　this-LOC

　　　　　'He kept the book <u>inside here.</u>'

　　　b.　Ndani yake [chungu]　<u>MU - na</u>　　　　yai viza.　[KG 58]
　　　　　　　　　　　　　　LOC. 'assoc.d with'　egg

　　　　　'Inside it [the pot] <u>there is</u> a rotten egg.'

The third pair of examples differs from the other two in that the locative notion of "insideness", associated with the spatial meaning of mu, appears in both examples. This pair thus bridges the semantic gap

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[2]Examples (1a), (2a) and (3a) and their translations are taken from Zawawi [1971:106] (underlining mine [ECM]). All other examples in the paper are from Swahili writings, identified by initials followed by page number. For fuller references, see bibliography.

between locative expressions and so-called "existential" expressions.[3]
Since there is no doubt that we have the same mu in (3a) and (3b),
the question naturally arises: do we not also have the same pa and ku
in the other pairs?[4]

On this point, native speaker intuition does not provide a clear
guide. Although pa and ku produce a difference in message when sub-
stituted for each other in locative expressions:

(4)   a. Aliweka kitabu hu-KU.

        'He kept the book somewhere around here.'

     b. Aliweka kitabu ha-PA.

        'He kept the book right here.'

Language consultants[5] report that they can be interchanged in ex-
istential expressions without appreciable effect:

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[3]Although there seems to be no empirical basis for claiming that
"existential" is a grammatical category of Swahili, I will continue to
use this term below to refer to the class of contexts in which a loca-
tive is prefixed to the associative particle na (in non-present tenses,
with the auxiliary verb kuwa 'be'), followed by a noun, where the English
translation is generally 'there is an X'.

[4]It will be recognized that a similar analytical problem arises in
English, as well as in other languages: English there appears in both
locative and existential expressions. The question whether English
existential there is (a replacement for) a locative expression (as
argued in e.g. Fillmore [1968], Juno [1971], Kimball [1973] and others)
or something else (Jespersen [1949], Perlmutter [1967], Allan [1971],
Bach [1974] and others) continues to generate controversy. It has
also been argued that there is a "universal" relationship between
locatives and existential expressions (e.g. Lyons [1967]). The purpose
of this paper is not to take a stand on these issues, but rather to
deal directly with the analytical problem which occurs in Swahili, i.e.
the semantic relationship between the forms used in the a. examples
and those used in the b. examples above, and that between the locatives
pa and ku in existential contexts.

[5]Three first speakers of Swahili from Zanzibar, one second speaker
from Moshi.

(5) a. Ha-$\begin{cases}\text{PA-na}\\\text{KU}\end{cases}$ haja hata kidogo ya kuona haya.

'<u>There is not</u> any need at all to feel embarrassed.'

b. Na kama mchumba angali kigoli, basi ha-$\begin{cases}\text{KU-na}\\\text{PA}\end{cases}$ kizuizi

cha kumwona kila mara.

'And if the fiancee is still a girl, then <u>there is not</u>

[any] obstacle to seeing her every time.'

If "intuitive" judgments were the only data on which to base
semantic analysis, we would have to conclude that pa and ku do not
contrast in meaning in existential expressions. Since they clearly do
contrast in locative expressions, the formal similarity between the
locatives in the a. examples and those in the b. examples would have
to be a coincidence, i.e. we would have to set up the homonyms pa_1
(locative) and pa_2 (existential); ku_1 (locative) and ku_2 (exis-
tential). This is essentially the position taken by Perrott [1972:147]
and Ruzicka [1960:211], who feel that the use of locatives in existen-
tial expressions is "idiomatic", having no semantic relation to the
original spatial meanings of the locatives.[6]

Authors who affirm that the forms used in the a. examples are "the
same as" those used in the b. examples (Meinhof [1948], Ashton [1944],
Gregersen [1967], Christie [1970]) do not confront the problem of the
apparent lack of semantic contrast between pa and ku in example
(5).

In summary, although there is a formal (morphological) similarity
between the forms used in locative and those used in existential ex-
pressions in Swahili, the question of their semantic relationship needs
closer examination because (a) reference to a literal place may not be
apparent in the message; (b) language consultants do not report a con-
trast between pa and ku in existential expressions, although they do
in locative expressions.

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[6]Neither of these authors comments on the difference, if any, be-
tween "idiomatic" (existential) pa and "idiomatic" ku.

3. Methodology

The kind of distribution we will examine is the tendency for a form to occur in semantically compatible contexts.

Language is a device of communication. For effective communication it is desirable that utterances have semantic coherence. We therefore expect that when a particular form is used, there will often be something else in the linguistic context whose presence can be explained by its semantic compatibility with that form.[7]

In what follows we will isolate variables in the linguistic context which are semantically compatible with one or the other of the forms under study, and will show that the distribution of ku and pa with respect to these variables can be explained by their respective locative meanings. The general procedure is as follows:

(6)   a. Make a hypothesis about the meaning of a form.

        b. Choose one or more contextual variables suggested by their semantic association with the meaning being tested.

        c. On the basis of the hypothesized meaning, predict the direction of statistical skewing of the form with respect to the chosen variable(s).

        d. Count the frequency of co-occurrence of that form with the variable(s).

If we find that the distribution of the form is consistently skewed in the expected fashion, we have found support for the hypothesized meaning.

Note that the variables are chosen only on the basis of their semantic relevance to the hypothesized meaning. The meaning leads both to the choice of pertinent variables and to predictions about now the form will skew with respect to these variables. For example, suppose that the contrast in meaning between $\emptyset$ and suffixed -s on English nouns (e.g. bird/birds) were not intuitively obvious, and that we had adopted the hypothesis that they mean 'one' and 'more than one' respectively. Quantitative expressions such as five, many would would be a semantically relevant variable to correlate with -s and $\emptyset$,

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[7]See also Garcia [1975:44] for discussion of this point.

because there is an apparent semantic association between this variable and the hypothesized meanings. On the other hand verb tenses would not be a semantically relevant variable: there is no apparent semantic association between e.g. the meaning 'one' and past tense.[8] Therefore the statistical method outlined above cannot be used as a discovery procedure for a meaning, but only as a test of a hypothesis.

It will be apparent from the results of this statistical method that ku and pa are used in existential expressions in conformity with their locative meanings.

4. Meanings of the Locatives

We have assigned the following meanings to the Swahili locatives:[9]

(7)   mu: a space differentiated with respect to insideness
      pa: a space viewed as simple and homogeneous, i.e. an
          undifferentiated spot
      ku: any kind of space, i.e. one whose structure is
          left unspecified

It is suggested in (7) that the Swahili locative system classifies spaces according to degree of spatial differentiation--that is, the meanings refer to spaces which are defined with increasing precision. On a scale of increasing differentiation, the locatives fall in the order ku, pa, mu. This relationship has an effect on their distribution. In general, the more precise a meaning is, the more restricted are the contexts to which it is appropriate. Given that in existential contexts considerations of a specific, literal place may not be of primary importance, we would expect the relative frequency of the loca-

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[8] I am not claiming that there could not possibly be such a relationship. Conceivably, entities which are individuated might correlate with tenses denoting relative importance, or present relevance, of an action. However this connection would be extremely indirect and thus not especially appropriate for testing the meaning 'one.'

[9] For a detailed justification of this analysis, the reader is referred to Contini [1974].

tives in this context to be in inverse proportion to their relative degree of spatial precision. And in fact the distribution of locatives in the existential sample used for this study is 59% ku, 36% pa, and 5% mu.

The meaning of ku both includes and exceeds those of pa and mu: on the one hand spaces which can be referred to by pa or mu can also be referred to by ku:[10]

(8) a. Uani   KU-a   bwana Ali KU-likuwa   kama ua wowote
         yard-   LOC-of   LOC(subject) like   etc.
         place   -past-/be/

         tu wa shamba.   [MWK 10]

         'The yard of Mr. Ali KU(subject)-was like any [ordinary] yard
         of a farm.'

Cf: b. PA-le   chini ya mti PA-likuwa   PA-kitumika
         LOC-that   under of tree LOC(subject)   LOC(subject)-
                                  -past-'be'   'being used'

         kama marikiti ya watu wa Giningi.   [KG 69]

         'That place under the tree PA(subject)-was being used
         as a market by the people of Giningi.'

     c. Tulipokuwa tukicheza KU-le   ndani   nikastuka na
                               LOC-that inside

         kusema 'Jamani tumekwisha fungiwa!' [RS 4]

         'While we were playing there [that-KU] inside, I
         started and said, "Friends we've been closed in!"'

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[10] This is something of an oversimplification: the substitution of ku for pa or mu leads to a loss of information, which in some cases produces a difference in message (as in example (4) above). However with sufficient redundancy in the context ku can refer to spaces which are indistinguishable from those referred to by pa or mu, as in example (8).

Cf: d.   Wakati sisi tulipokuwa tukicheza MU-le   ndani,
                                          LOC-that inside

           yule bwana mwenye shamba alikuja akamkuta kaka yangu

           amesimama karibu ya pango.   [RS 2]

           'At the time when we were playing <u>there</u> [that-MU]

           <u>inside</u>, the man who owned the farm came and found

           my brother standing near the cave.'

on the other hand, ku may refer to spaces for which neither pa   nor
mu   would be appropriate:

(9)   Kunako vifundo vya mikono yake kafunga singa za mikia

       ya ng'ombe zilizokuwa zikining'inia mpaka viganjani
                                          palms-place
    ⎧ KU-ake.   [KG 45]
    ⎨ ?PA his
    ⎩ ?MU

       'Around his wrists he had tied cow tail hairs which waved

       [down] <u>to/around his palms</u>.'[11]

    The question we will address below is in what ways the more
precise spatial meaning of pa and the less precise meaning of ku
affect their distribution in existential sentences.

5.   <u>Statistical Evidence</u>

    A count was made of all the ku and pa existentials in six
short novels by different Swahili authors[12] and in two issues of the

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[11]This meaning relationship is similar to that described in Harries
[1965]: "The locative affix of Class 17, -ku- or ku-, can be said
to include within its wider range of meaning the particular location
expressed by either class 16 [pa] or class 18 [mu] affix". However
Harries does not specify what the range of meaning is nor what kinds
of locations are expressed by pa and mu. Certainly the traditional
definitions as given in e.g. Ashton [1944] do not point to an includ-
ing relationship.
    [12]For references, see bibliography.

weekly magazine <u>Nchi Yetu</u> (in all, 550 pages of running text), a total
of 281 examples of which the total number of ku-existentials was 173,
and of pa-existentials 108.

Semantically relevant variables were chosen based on the hypothe-
sized meanings for pa and ku given in (7) above. The first is as
follows:

(10)   Contextual variable I: concrete vs. abstract entities
        Prediction I:
        Pa should favor contexts where a <u>concrete</u>, or readily
        localizeable, entity is said to exist, while ku should
        favor entities which are <u>abstract</u>, or not readily localizeable.

Pa designates a "spot". The kind of entity most likely to occupy a
spot is a concrete entity. On the other hand, ku refers to a struc-
turally undefined space. An abstract entity is more likely to be
associated with this type of space than with a particular spot.

Note that pa and ku do not themselves mean "concrete" and
"abstract" respectively.[13] These are attributes of the entity whose
existence is being predicated. The classification of entities as con-
crete or abstract is being used as a convenient measure of relative
localizeability and thus of relative compatibility with the spatial
meanings of pa and ku.

To illustrate, here are examples of each type of noun:

(11)   a. Zaidi ya vitu hivyo palikuwa na <u>msahafu mkuukuu.</u> [KG 25]
            'Besides these things there was <u>a worn Koran.</u>'

        b. Katika Kufikirika kuna <u>maradhi</u> na <u>mauti</u>, lakini
            katika Pepo uko uzima na maisha ya milele.   [Kf. Intro.]
            'In [the country of] Kufikirika there is <u>disease</u> and
            <u>death</u>, but in [the country of] Pepo there is health and
            eternal life.'

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[13]In particular, the use of these terms should not be confused with
their use by Christie [1970], who makes a distinction between "abstract"
and "concrete" locations (attributed to Lyons [1968]) as an argument
for a relationship between locatives and possessives.

In example a., the word msahafu 'Koran' would be counted as refer-
ring to a concrete entity. In the second example the words maradhi
'disease' and mauti 'death' would be counted as abstract. I also
included under the general category of "abstract" such nouns as wind,
darkness, which are not localizeable although it could be disputed
whether they were abstract. The results of the count are as follows:

(12) | Clearly Abstract | Clearly Concrete | Indeterminate[14] Cases | Total |
|---|---|---|---|
| PA 36% (39)[15] | 53% (57) | 11% (12) | 100% (108) |
| KU 52% (89) | 35% (61) | 13% (23) | 100% (173) |

(total abstr. 128) (total concr. 118) (total indet. 35) (total 281)

$p < .005$

The table in (12) can be read in two ways: first of all, if we look
at the overall distribution of pa-existentials, we find that the
majority (or 53%) are used to predicate the existence of concrete
entities, while only 36% predicate the existence of abstract entities.
We also find the distribution of ku to be almost the mirror image
of that of pa: while 52% co-occur with abstract nouns, only 35% co-
occur with concrete. This skewing conforms with the prediction.

If we now look at the category "concrete" taken by itself, it
appears that the total number of examples (reading down, a total of
118 concretes) is split fairly evenly between pa and ku: there
are 57 examples with pa and 61 with ku. That is, while it is true
that pa admits mostly concretes, the reverse is not the case. Here
we must of course take into consideration the higher overall frequency

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[14] The indeterminate category represents existentials of a certain
type, fairly common in Swahili, which has no word for "no one". The
established way of expressing the message "no one came", for example,
is hakuna/hapana aliyekuja 'there-is-not one-who-came'. In these
cases I was uncertain whether to consider the noun involved as "con-
crete" or "abstract".

[15] Raw figures are given in parentheses.

of ku in the sample, but this statistic still deserves a comment.

As mentioned above, ku is the including member of the locative system. In other words, the meaning of ku makes no claim about what type of space is being referred to. While this makes ku the most compatible of the locatives with abstract entities, it does not make it incompatible with concrete entities. Pa, on the other hand, does have a meaning which is less compatible with entities which are not intrinsically localizeable. Therefore we find the skewing much more extreme in the Abstract column, where ku exceeds pa by more than two to one (89 to 39).

We conclude that the distribution of pa and ku with respect to abstract and concrete entities is skewed in a way which is consistent with their locative meanings.

Let us now move on to the next variable:

(13)   Contextual variable II: particular location mentioned vs.
                                 not mentioned

        Prediction II:
        Pa should be relatively favored and ku relatively dis-
        favored in existential contexts where a particular loca-
        tion is specified.

As mentioned above and as illustrated in examples (1b) and (2b), in existential assertions consideration of the literal place where something exists is not always of primary importance. However when a place is explicitly identified in the context as the location where something exists, given a choice between a more precise spatial meaning (pa) and a less precise one (ku), we expect the more precise meaning to be chosen. We therefore predict that pa and ku will skew with respect to explicit reference to a place in the context. Here is an example:

(14)   Katikati mbele ya mlango wa nyumba, baina ya sehemu mbili
        za bustani, PA-likuwa na muasmini mkubwa uliozaa sana. [KG 12]

'In the middle in front of the door of the house, between
the two sides of the garden, there was a jasmine tree
in full bloom.'

Here 'in the middle in front of the door of the house' and 'between
the two sides of the garden' are counted as specific places. The
results of this count are as follows:

(15)   Place mentioned   Place not mentioned   Total

  PA   44% (48)   56% (60)   100% (108)

  KU   18% (30)   82% (143)   100% (173)

  (total men. 78)   (total not men. 203)   (total 281)

  p <.005

Here again, the figures represent percentage of the total sample.
For example, of all pa-existentials, 44% co-occurred with a specific
place-referent, but only 18% of the ku examples did. That is, pa
is more than twice as likely as ku to co-occur with an explicit
place-referent.

    This table can also be read in another way: in the context of an
explicit place referent (reading down, a total of 78 examples), pa is
used 62% of the time, ku 38%, in spite of the higher overall fre-
quency of ku in the sample. Where no place is mentioned, pa is
used only 30% of the time, ku 70%.

    We conclude that the locative meanings hypothesized for pa and
ku correctly predict their relative skewing with respect to the
variable of explicit mention of place.

    Next variable:

(16)   Variable III: plural vs. singular nouns
      Prediction III:
      Pa-existentials should be used less often than ku to assert
      the existence of plural entities.

A homogeneous space by definition has no internal structure: no par-
ticular points falling within this space, nor any subdivision of the

space may be singled out without losing homogeneity. The kind of entity
which is most properly associated with such a space is an individual
entity, which itself defines the space. A plurality of entities is made
up of several individuals, each of which may be expected to define its
own spot: "no two things can occupy the same place at the same time".
A plurality of entities thus conflicts with a homogeneous spatial
interpretation, and we therefore expect that pa-existentials will be
less frequent than ku-existentials in contexts where reference is
made to a plurality of entities.

The results of this count are as follows:

(17)

Plural[16]	Singular	Total
PA	13% (14)	87% (94)	100% (108)
KU	32% (56)	68% (117)	100% (173)

(total pl. 70)   (total sg. 211)   (total 281)

p <.005

As can be seen from the plural column, the probability that ku will
co-occur with a plural noun is nearly three times as great as that
for pa. Further, in the context of plural nouns pa is used only
20% of the time (14 examples), ku 80% (56 examples).

In this count we have presented data bearing directly on the
geometric meaning assigned to pa. This geometric meaning--namely,
homogeneous, undifferentiated space--leads to the inference that only
a single space, and therefore a single entity, is being referred to.
Pa is therefore avoided in contexts where reference is made to a
plurality of entities. Other meanings assigned to pa such as
'definite place, position' [Ashton 1944:126], 'place near some object'
[Myachina 1960:23] would not predict the skewing with respect to
singular/plural nouns.

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[16]For this count, abstract nouns which are pluralia tantum such
as mauti 'death' were counted as singular, because they do not refer
to aggregates of bodies.

6. On Randomness

It might be argued (despite the Chi square) that all forms are skewed in their distributions and that the skewings reported above could be the result of chance. To test whether any arbitrarily chosen contextual factor will show a skewing, I also made a count of the ku/pa contrast with respect to nouns containing the letter d:

(18) Variable IV: nouns containing d vs. nouns not containing d
      Prediction IV:
      Neither pa nor ku will show a significant skewing with respect to nouns containing the letter d.

Here are the results of this count:

(19)

	Contain d	Do not contain d	Total
PA	11.1% (12)	88.9% (96)	100% (108)
KU	11.5% (20)	88.5% (153)	100% (173)

$p > .995$

The purpose of (19) is to show that distributions can be random. The meanings hypothesized for pa and ku did not lead me to predict any kind of skewing with respect to the letter d. And in fact, there is none.

A further point: even if the results of one test were due to chance, the likelihood that random factors would lead ku and pa to skew in the predicted manner in all tests is extremely low, i.e. if one were to claim that forms will always show some skewing or other (or that non-randomness is itself random), there would still be no explanation for the fact that the skewings all point in the same direction.

We conclude that observed skewings do in fact correlate with semantic characteristics of the forms being used.

7. Apparent Counterexamples

The statistical method corrects for idiosyncratic local variables affecting the use of forms in particular examples. We will now discuss

these cases, i.e. instances where the forms were used contrary to the predictions.

One may ask why pa is ever used with plurals or abstract nouns. Let us first discuss plurals: although it was argued above that a plurality of entities would lead to a de facto differentiation of space (each individual defining its own spot), nevertheless it is not impossible to imagine several entities occupying the same place, especially if it is known that the place being referred to is extensive. And in fact "existential" pa does occasionally occur with plural nouns. For example:

(20)   "Unamjua mtu ye yote aliyekuona ukiua?" Hatibu akajibu,
       "La, labda palikuwa na watu pale nje lakini wakati
       nilipotoka nje hapakuwa na mtu hai ndani wala nje." [SH 22]

       '"Do you know anyone who saw you [in the act of] killing?"
       Hatibu answered, "No, maybe there were people there
       outside [of the house], but by the time I went out
       there was not a person alive inside or out."'

Here the place itself is mentioned, pale nje or 'there outside'. Since an area thus defined, while homogeneous, is nevertheless extensive enough to accomodate several people, there is no contradiction in using pa.

However, if the plurality of entities in question is reinforced by additional lexical specification (such as numerals, words like 'several', 'various', conjoined noun phrases, etc.), then the implication that they all occupy the same space is that much less likely. For example:

(21)   Kwa juu ya daraja hizo kulikuwa na milango miwili
       iliyokaa mmoja mbali kidogo na mwenziwe.   [KG 85]

       'Over these steps there were two doors which were
       situated one a slight distance from the other.'

Indeed, we find that such reinforced plurals occur much more frequently with ku than with pa. Of the total number of examples of reinforced plurals in my sample (27 in all), only four were associated with pa, while 23 occurred with ku.

As to the occurrence of pa with abstract nouns, which are non-localizeable, the difference between it and ku is more difficult to pin down quantitatively. There may be other factors affecting the use of pa in these cases. For example, although a noun may be considered "abstract" on the basis of its dictionary definition, in some contexts an abstract noun may be viewed as localizeable in a precise spot. For example:

(22)   Hili jembe langu, siliachi hapa, lazima liende pale
  nyumbani, la sivyo patakuwa na mambo.   [SH 25]

  'This hoe of mine, I won't leave it here, it must go there
  to the house, otherwise there will be trouble.'

Here it is clear that the "trouble" will occur at the (homogeneous) spot where the speaker is located. However in order not to prejudice the results I kept strictly to a context free categorization of nouns for Prediction I.

Another variable possibly affecting the use of pa with abstracts is emphasis. A pa-existential may convey a slightly more emphatic flavor than a ku-existential, even when no specific place is intended, or when reference is made to an object which is not intrinsically locali-zeable. By indicating that something is associated with a homogeneous place, even if this is not literally true--perhaps because of this fact-- the speaker is able to convey a certain emphasis on the existence (or non-existence) of that entity. The use of metaphor generally has such an effect: if we say 'John is a dog' it is more emphatic than saying 'John is a man' (if John is in fact a man). Indeed, almost half of the abstract sample for pa (16 out of 39) consists of such emphatic ex-pressions as hapana shaka 'there is no doubt' and hapana ila ... 'there is no [alternative] but...' (as in hapana ila yeye ndiye aliyekwiba 'there is no alternative but that he is the one who stole [it]' [KG 82]), which inflated the abstract figures to some extent.

Note that the predictions made above should not be construed as "rules of government": $\text{LOC} \rightarrow \text{pa} \ / \ \underline{\quad} \begin{bmatrix} +\text{N} \\ +\text{singular} \\ +\text{concrete} \\ \vdots \end{bmatrix}$. Such a rule

would make these features part of the meaning of   pǝ, which would
clearly be false, since we do have cases of pǝ   being used with
abstract nouns, plurals, etc. The predictions state the nature of a
coherence relationship, which is necessarily relative. The skewings
give a measure of this relationship, but it may not be possible to isolate
all the factors relevant to the use of a form in every individual case.[17]

8. Conclusion

     To recapitulate: our statistical analysis of contextual variables
has revealed that:
1. Pǝ existentials are relatively skewed toward contexts where the
entity whose existence is predicated is concrete, while ku existen-
tials are skewed toward abstract entities.
2. Pǝ more than ku existentials favor contexts where a particular
location is explicitly mentioned.
3. Pǝ more than ku existentials avoid plural nouns.
     If ku and pǝ were in fact freely interchangeable in existential
contexts, as our language consultants appeared to suggest, we would
have expected the choice between them to be arbitrary, and their dis-
tribution to be random. We find that not only is this not the case,
but the departures from randomness in all cases lend support to the
spatial meanings hypothesized for the locatives. We therefore conclude
that the same forms are being used in both locative and existential
contexts.
     Underlying the analysis presented above are the following assump-
tions about language:
(a) that grammatical forms have constant meanings;
(b) that differences in form should lead one to check for differences
in meaning;[18]
(c) that meanings can be tested by means of statistical analysis of
semantically relevant contextual variables;

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[17]See also García [1975:495 ff] for a discussion of this subject.

[18]Bolinger [1968] argues similarly with reference to English com-
plementizers.

(d) that speakers may not be consciously aware of the meanings they are manipulating; therefore, "intuitive" judgments about meaning contrasts may not accurately reflect usage.[19]

Semantic hypotheses must be validated by observation of actual language use, not on the basis of intuitions.

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[19]These assumptions derive from the theoretical framework known as "form-content" grammar, an approach to the semantics of grammatical systems being developed at Columbia by Professor William Diver and his students. For a general introduction to the theory, see Diver [1975], introduction; Garcia [1975:Ch. 2]. For a detailed application of the theory, cf. Garcia [1975]. Other studies of Swahili within this framework are Leonard [1973], Port [1972] and Contini [1974]. For additional application of quantitative analysis of context, cf. Zubin [1974].

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SEMANTIC REALITY OF BANTU NOUN CLASSES:

THE KIKUYU CASE[1]

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Bantu noun classes, although primarily syntactic cate-
gories, may have some semantic properties. For example,
Leakey has suggested that several Kikuyu noun classes
can be rank ordered along an evaluative dimension. It
does not appear to be possible to define semantic rules
for noun class membership. However, noun class may
affect judgments which people make of the semantic simi-
larity of words. In the present paper we use the method
of triadic comparisons to assess the degree to which this
kind of effect occurs.

1. Introduction

    In this paper we are concerned with the nature and extent of the

semantic reality of a syntactic category in Bantu languages: the noun

class. We investigate the problem by means of a psycholinguistic ex-

periment, using a set of words from Kikuyu.

    In Bantu languages, every noun belongs to a noun class. These

classes are much more numerous than the genders of Indo-European lan-

guages; there are as many as 22 noun classes in some classification

systems for Bantu languages. Noun classes correspond with noun pre-

fixes: the members of a given noun class take one of a small number

of prefixes, and a given noun prefix is found in only a small number

of noun classes. Prefixes for adjectives, pronouns and verbs are

also determined by noun class membership; the rules governing these
prefixes are called concordance rules. Bennett [1970], writing about
Kikuyu, defines a noun class as a set of nouns which share a concordance
pattern of adjective,pronoun, and verb prefixes. Examples of concor-
dance from Kikuyu may be helpful at this point:[2]

(1)   Class 7
        kihaato kiega   'a good broom'
        kihaato kingi kiega   'another good broom'
        kihaato giakwa kiega   'my good broom'

        Class 11

        ruhiu ruega   'a good sword'
        ruhiu rungi ruega   'another good sword'
        ruhiu ruakwa ruega   'my good sword'

The syntactic function of Bantu noun classes is clear; less obvious
is the semantic status of noun classes. Linguists express conflicting
opinions concerning the semantic reality of noun classes. Welmers,
for example, speaks of a "partial semantic correlation" [1973:159],
while Hoffmann asserts that "noun classes are only morphological cate-
gories and void of any meaning whatsoever...." [1963:169]. These dis-
cussions of the meaning of noun classes have focused on distributions
of meaning across syntactic categories. Failure to find exact corres-
pondence between sets of denotata and syntactic categories has led
investigators such as Hoffman to deny that noun classes have meaning.

In one approach to the problem, the semantics of syntactic cate-
gories is determined by observation of the distribution of real world
phenomena, such as objects, across syntactic categories: if observ-
able phenomena correspond fairly consistently with syntactic categories,
it is easily concluded that the syntactic category has meaning; the
semantic status of the category is then described by the observed pat-
terns of distribution of words across syntactic categories. This

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[2]Throughout this paper, we will use Bennett's system for numbering
Kikuyu noun classes [Bennett 1970]. We will also deal only with singu-
lar forms.

approach is exemplified by Mathiot's study of Papago noun classes [1962] and by Carroll and Casagrande's study of Navaho and Hopi verbal categories [1958]. Mathiot found correlations between Papago noun classes and the location of words for plants and animals in a folk-biological taxonomy. Carroll and Casagrande discussed Navaho verbal classes in terms of the shape of the physical object to which one is referring.

In the case of Bantu languages, however, foreign investigators do not seem to be able to formulate systematic interpretations of observed distributional patterns. To our knowledge, Leakey has produced the most complete description of meanings of a Bantu noun class system. Leakey, a fluent speaker of Kikuyu from childhood, suggests that several of the noun classes are rank ordered. To take a few examples from Leakey's system:

(2)   Class 1:   primarily human

   Class 3:   most large trees and plants

   Class 9:   most living things not included in class 3

   Class 7:   primarily inanimate objects

   Class 5:   objects or beings with supernatural significance

   Class 11:   "The connecting link which unites all words in this
       class is a somewhat strange one, and that is the
       concept of undulation. Many words come into this
       class which, at first sight, seem to have no con-
       nection at all with other words in the same class,
       and yet investigation will always reveal this con-
       cept, even if only in a limited part of the use of
       the word." [Leakey 1959:15].
       Examples cited by Leakey of class members are river,
       rawhide, wind, tongue, whirlwind, dust (by exten-
       sion of whirlwind), wooden wand, bat ("because of the
       way it flies"), and fighting sword ("which tradi-
       tionally has a wavy edge").

   Class 13:   diminutiveness

There are exceptions to the rules, however, which serve to elevate or demote objects, so that one cannot know the class to which something belongs simply by knowledge of the above rules. A person, for instance, can be demoted to a lower class for the purposes of insult or expression of hatred:

(3)   mundu   'person'
       kindu   'thing'
       kirimu   'fool'
       gitonga   'miser'

Similarly, spirit-borne diseases are often promoted to class 3 (mutungu 'smallpox') along with some unusually important animals (muruthi 'lion'); a person may be placed in class 5 to indicate his spiritual significance (ithe 'father'); and an object may be a member of its class due to its association with another object in that class rather than to its own nature or form. (Examples from Leakey [1959]). Abstract nouns, in this system occur in at least two classes, humans in several classes, diseases in at least two classes, and so forth. With Leakey's analysis of Kikuyu, then, objects sometimes belong to noun classes by virtue of criteria which would be easily observable by the foreign investigator (such as their morphology), but some reasons for assignment to a noun class must be understood in terms of criteria which can be discovered only through a thorough knowledge of both the language and the belief system. An example from Kikuyu is 'lion', which has been elevated in noun class, according to Leakey, because it is felt to be a superior kind of animal. An outsider cannot look at a lion and decide by some feature such as shape, size, or biological taxonomy that it is an ex- alted creature. Hence, words are assigned to noun classes partially by the qualities of being which they have. In this sense, one meaning of the noun class is the rank ordering in qualities of beings. This involves an evaluation which is culturally learned.

A parallel analysis by Hale [1973] also discusses the possibility of evaluative rank ordering of syntactic categories along a semantic dimension. He shows that Navaho nouns are ranked in three classes (re- ference to people, animate, and inanimate, along an implicit continuum of degree of animateness) and that this rank ordering is necessary to an understanding of subject-object inversion, a purely syntactic pheno- menon.

In this study we will not attempt to validate Leakey's interpreta-

tions of Kikuyu noun classes, but we will attempt to show that the noun
class categories do have a semantic significance. Since in the case
of Kikuyu we cannot rely on etic   patterns such as shape or biological
relationship in judging whether two noun classes are semantically dis-
tinct, we conduct a psycholinguistic experiment in which we allow Kikuyu
respondents themselves to judge whether the members of different noun
classes are semantically distinct. The present approach differs from
most previous research in that it has heretofore been the foreign
linguist who makes the judgment about the semantic status of syntactic
categories, by looking for patterns which he himself can see in the
distribution of words across the syntactic categories; in the present
study, Kikuyu respondents themselves do the patterning through their
responses to a triads test. With this triads test, we focus on the
question of whether or not noun class membership has an effect on
Kikuyu classification of nouns on the basis of meaning.

Before we describe the present experiment, it will be useful to
discuss two previous experiments concerned with the semantic reality
of syntactic categories. These experiments were conducted by Ervin
[1962], who studied connotative meanings of Italian genders, and by
Carroll and Casagrande [1958], who studied the effects of Hopi and Nava-
ho verbal forms on classification of a) actions and b) physical objects.
Ervin obtained ratings on four scales for nonsense words to which had
been added masculine or feminine affixes. The scales, reminiscent
of semantic differential items, were good/bad, pretty/ugly, big/
little, and strong/weak. Ervin found that words with feminine affixes
were more likely to be judged pretty, weak, good, and little than were
words with masculine affixes. Ervin's study differs from our approach
in the use of semantic differential scales rather than triads, with
the consequent emphasis on connotative meanings. Carroll and Casa-
grande, using the method of triadic comparisons, found that Navaho ver-
bal categories had a measurable effect on the behavior of children who
were asked to sort physical objects. Navaho verbal stems are determined
by the physical shape of the object of the verb. Carroll and Casagrande
reasoned that the linguistically-determined necessity of making frequent
classifications of objects on the basis of shape should lead Navaho

children to classify physical objects on the basis of shape rather than color.
They presented two groups of children with a set of critical triads of
physical objects: for each triad the children could classify the objects
either on the basis of shape or on the basis of color. The first group,
consisting of Navaho-language dominant Navaho children, tended to
classify on the basis of shape more frequently than did the second
group, which consisted of English-language dominant Navaho children.
Carroll and Casagrande's research strategy is similar to our own,
which also uses critical triads; it differs in focusing on the classifi-
cation of physical objects rather than on the classification of words.

2. The Triads Experiment

The present experiment focuses on a domain of words to which we
refer as "flying animals", which contains five words from class 11,
three words from class 9, and one word from class 5. The words listed
in (4) are used as stimuli in an experiment using triadic comparisons.

(4)   Words Used in the Triads Test

	Kikuyu	English gloss	Noun class
1.	ruhuhu	'bat'	class 11 (undulation)
2.	ruigi	'hawk'	"
3.	ruoya	'feather'	"
4.	ruagi	'mosquito'	"
5.	ruruto	'preying mantis'	"
6.	nderi	'vulture'	class 9 (animals)
7.	ngi	'housefly'	"
8.	ndahi	'grasshopper'	"
9.	ithagu	'wing'	class 5 (ritual)

In triadic comparisons, stimuli are presented to the respondent
three at a time. For each triad, respondents were asked to select
from the three stimuli the one most different in meaning from the
other two. A triads test typically consists of a number of such items,
chosen to make systematic similarity comparisons within a set of
stimuli. Triads tests have been used extensively in cognitive anthro-

pology using verbal stimuli [Romney and D'Andrade 1964]. A standard triads test uses all possible triadic combinations of the words which comprise a semantic domain. Since time considerations did not permit presentation of all possible triads using the nine stimulus words, we focused primarily on triads which would provide critical information about the hypothesis that noun class affects semantic classification. An example of such a triad is the following:

(5)   ruigi 'hawk', ndahi 'grasshopper', ruruto 'preying mantis'

For this triad, two words (hawk and preying mantis) belong to the same noun class and another pair of words (grasshopper and preying mantis) are similar in western biological taxonomy. Thus, each person had a choice between classification on the basis of noun class membership and classification on the basis of biological similarity. Using several such critical triads, we can measure the degree to which the two classificatory principles are followed.

In addition to the critical triads, the test included triads whose purpose was to ensure that ample information was provided about the relative similarities of all of the pairs of words in the domain. This was accomplished by requiring that each pair of words be found together in at least one triad. The total test contained 46 triads. The test was administered[3] by a Kikuyu research assistant to 33 Kikuyu

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[3]Respondents were instructed in Kikuyu to sort words by the images which the words brought to mind. Instructions were worded in this way to discourage respondents from sorting on the basis of phonology. This precaution seems to have been effective in avoiding phonologically-based sorting, as the triads data contradict the hypothesis that sorting was done on the basis of the sounds of the words. Although the words ruigi and ruagi (hawk and mosquito) are phonologically very similar, they are judged to be similar in only 12.6% of triads in which they are included (25 out of 198 choices). By contrast, nderi and ngi (vulture and housefly), which are phonologically less similar, are judged to be similar in 24.2% of triads in which they are included (40 out of 165 choices). If there remains any doubt concerning the possibility of phonologically-based sorting, this can easily be tested with a triads experiment including words which belong to the same noun class, but which are phonologically divergent.

with no more than three years of schooling.[4]   Respondents were chosen
so as to be evenly distributed across age and sex categories. All
testing was done in September, 1973 in the community of Ngecha, Kiambu
district, Kenya.

Responses to the triads test were analyzed using two models: (a)
hierarchical clustering analysis,[5] and (b) analysis of choices within
minimal contrast sets.

3. Results

In this section we examine the cognitive organization of the verbal
stimuli used in the triads test. Here we show that although noun
class is not a major feature in the overall hierarchical organization
of the concepts, it appears clearly as a feature within small contrast
sets.

We began our analysis by examining the results of the hierarchical
clustering of the triads responses. The cluster analysis required a
measure of similarity among words. This was obtained from the triads
responses. For example, ithagu 'wing' and ngi 'housefly' occurred
in a triad with ruagi 'mosquito'. Seven out of 32 people chose ruagi
as most different. By so doing, they judged ithagu and ngi to be
similar. Thus, the similarity measure for ithagu and ngi was 7/32.
If a pair of words occurred in more than one triad, we took the
average of the similarities for the triads in which the pair occurred.

The diagram in (6) is the outcome of a hierarchical clustering
analysis of the triads test data.

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[4]We imposed this restriction on education to avoid contamination
by English-language bilingualism. Through extensive pretesting, we
found that nonliterate informants understood the test instructions and
the nature of the task,and gave meaningful responses.

[5]We use the all-possible pairs method of cluster analysis [D'Andrade
n.d.], which builds a tree structure from the bottom up: first the
two most similar words are merged together into a cluster; then the
next most similar words or clusters are merged. This process con-
tinues until the top-most node of the tree structure has been connected.

(6)   Hierarchical Clustering of Flying Animals Data

Ruhuhu	Ruigi	Nderi	Ruoya	Ithagu	Ruagi	Ngi	Ruruto	Ndahi
Bat	Hawk	Vulture	Feather	Wing	Mosquito	House-fly	Preying Mantis	Grass-hopper
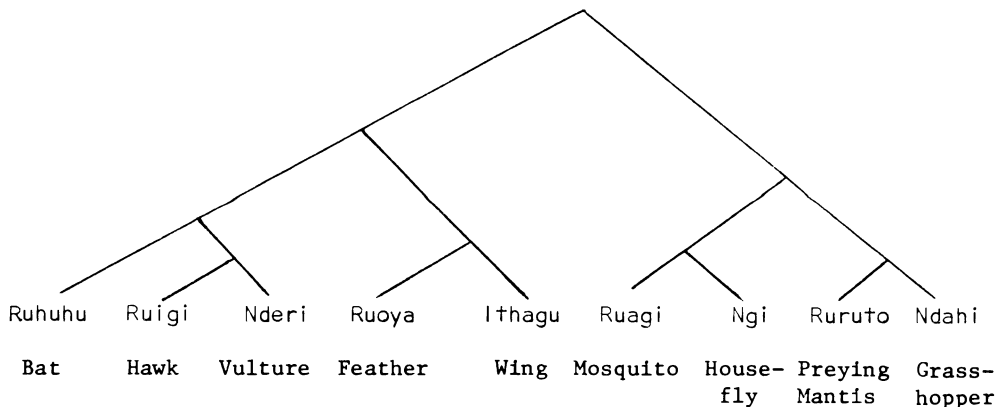
Number of taxonomic errors: 19

Number of correct predictions: 149

The structure of this diagram is straightforward. The first distinction contrasts insects with larger creatures 'bird, bat', and with the parts of the larger creatures 'wing, feather'. Among the insects, a size distinction contrasts 'mosquito' and 'housefly' with 'preying mantis' and 'grasshopper'. Within the non-insect cluster, the primary distinction contrasts the parts of the animals 'feather, wing', with the whole animals. 'Bat' is further distinguished from the two birds. There are five terminal categories in the hierarchical structure; the five members of class 11 are evenly distributed across these categories, so that no two are in the same category.[6] This structure, although consistent with a terminal distinction based on noun class, is not in itself evidence that sorting was done on the basis of noun class. Hence, we shall examine minimal contrast sets to test the hypothesis that noun class is a subsidiary semantic criterion, which operates only when taxonomic relationships are held constant.

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[6]Another model for representation of the similarities data from the triads responses is multidimensional scaling [Shepard 1962; Kruskal 1964], which can detect some kinds of relationships among words which are not visible in a hierarchical model. Multidimensional scaling represents

A familiar case of the existence of subsidiary semantic criteria can be found among English kin terms. Romney and D'Andrade [1964] and Nerlove and Burton [1972] have shown that sex is the fourth and least salient dimension in classification of English kin terms. Pairs of kin terms which differ only on sex are more similar in meaning than any other pairs of kin terms. Thus, a taxonomy of part of the domain of English kin terms (lineals) appears in (7). The most important

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the words as points in a space of one or more dimensions, so that words which are similar to each other will be close together while words which are highly dissimilar will be distant from each other. The data were scaled in two dimensions, given in (6'):

(6')   Multidimensional Scaling of Flying Animals Data

```
                            |
                            |   x   Ithagu
                            |        'wing
                            |
                            |
                            |   x Ruoya
                            |
                            |      'feather'
                            |
            x   Ngi          |
              'housefly'     |
                            |
          x                  |
           Ruagi             |
                            |
           'mosquito'        |
 _____|____x_____
     x Ndahi                 |    Nderi
                            |
      'grasshopper'          |    'vulture'
                            |        x
          x                  |
           Ruruto             |     Ruigi
           'preying           |     'hawk'
           mantis'            |
                            |  x Ruhuhu
                            |    'bat'
                            |
```
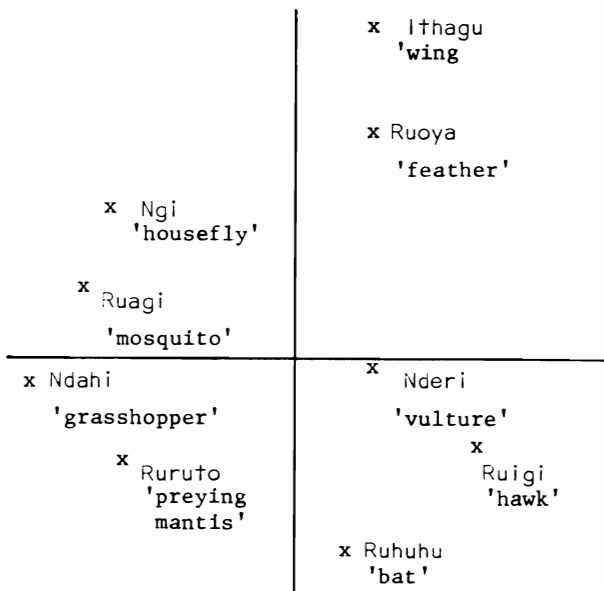
The multidimensional structure is consistent with the cluster structure, but shows some detail not visible from the cluster structure. In (6'), there are two interpretable dimensions. Dimension #1 contrasts insects with non-insects, and is identical with the first distinction of the cluster analysis. Dimension #2 is size: large insects, large birds, and the flying mammal are contrasted with small insects and parts of flying animals.

(7)   Taxonomy of English Kin Terms

```
                              One                    Two
                              Generation             Generations
                              Removed                Removed

                    Elder        Younger       Elder          Younger

Father   Mother   Son   Daughter   Grandfather   Grandmother   Grandson  Grand-
                                                                         daughter
```
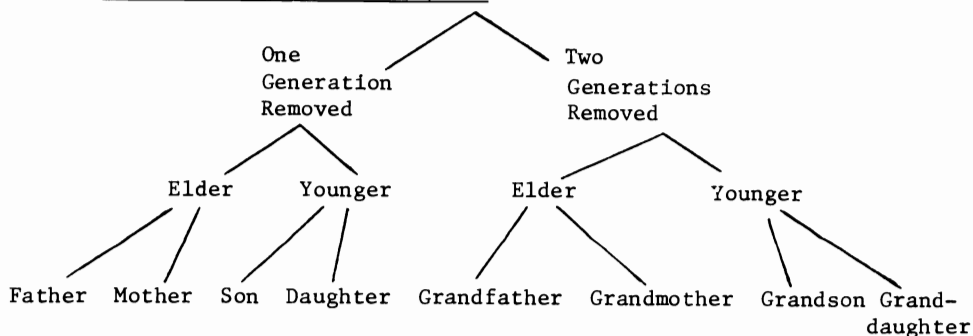
component distinguishes second generation kin from first generation kin.
The next most important component distinguishes elders (father, mother,
grandfather, grandmother) from younger kin (son, daughter, grandson,
granddaughter). As with the present hierarchical structure for flying
animals, where there is one and only one member of class 11 in each ter-
minal category, the hierarchy for English kinship shows one member
of each sex in each terminal category. Being speakers of English, we
know that distinctions within the terminal categories of (7) are made
on the basis of sex. However, were we not speakers of English, and
were we presented with the data of (7), we would not necessarily know
the basis on which the two members of each terminal category were dis-
tinguished. In other words, the taxonomy of (7) is suggestive but not
demonstrative of the fact that sex is a distinctive feature in English.
To demonstrate that sex is a distinctive feature for English kinship,
we would have to examine paradigms contrasting sex with one other com-
ponent at a time. An example of such a contrast set can be seen in (8).

(8)   Minimal Contrast Set for English Kindship

	Male	Female
Elder	Father	Mother
Younger	Son	Daughter

Here there are four words which differ on only two components: age and
sex. Within this paradigm all other dimensions of contrast are held
constant. By asking people to make triadic comparisons among words

from within such a set, we would make it possible for them to attend to the sex distinction without being distracted by other more salient features. We could then count the frequency of triads responses which select as most different words which differ on the feature of sex. This would enable us to judge whether people attend to sex more than would be expected by chance.

The flying animals cluster structure of (6) is parallel to the English kinship cluster structure of (7): the hierarchical structure for English kinship has one member of each sex in each terminal category, while the hierarchical structure for flying animals has one member of class 11 and one member not of class 11 in each terminal category. Our lesson from the English kinship example of (7) and (8) would suggest, therefore, that it would be appropriate to look for evidence that noun class is treated as a distinctive feature in Kikuyu by examining the distribution of triads choices within minimal contrast sets.

By virtue of their contrast on features of size, noun class membership and phylogeny, the words in the flying animals test form two paradigms which are analogous to the paradigm for English kinship, in that they each contain minimal contrast on two features. Paradigm 1 is formed by contrasting noun class membership with size, for insects only. Paradigm 2 is formed by contrasting noun class membership with phylogeny, holding size constant. A third paradigm contains a minimal contrast on noun class, but contrasts at the same time two other features by including large birds and small insects. The paradigms are listed in Table 1, p 169.

Four different triads can be constructed using the four words within each paradigm, for a total of twelve triads among the three paradigms. These twelve traids provide a critical test of the effect of noun class, as they are based on minimal contrast of semantic features. All twelve of these triads were included in the test. An example is the triad in (9):

(9)   ruagi 'mosquito', ruruto 'preying mantis', and ndahi 'grass-
                                                                      hopper'

Table 1. Three Paradigms Containing Minimal Contrast on Noun Class

Paradigm 1. Large Insects vs. Small Insects

	class 11	class 9
Large Insect	ruruto 'preying mantis'	ndahi 'grasshopper'
Small Insect	ruagi 'mosquito'	ngi 'housefly'

Paradigm 2. Large Birds vs. Large Insects

	class 11	class 9
Large Bird	ruigi 'hawk'	nderi 'vulture'
Large Insect	ruruto 'preying mantis'	ndahi 'grasshopper'

Paradigm 3. Large Birds vs. Small Insects

	class 11	class 9
Large Bird	ruigi 'hawk'	nderi 'vulture'
Small Insect	ruagi 'mosquito'	ngi 'housefly'

'Mosquito' and 'preying mantis' share the feature of noun class. 'Prey-
ing mantis' and 'grasshopper' share the feature of size. Thus, respon-
dents who attended to size would select mosquito as most different. It
is also possible to attend to neither of these two features and select
preying mantis as most different. For each of the twelve triads, one
of the three choices corresponds to judgment on the basis of each of
the two features. This has been done in Table 2. p. 171. Here we see that
for paradigm 1, 38% of the choices were made on the basis of noun
class, 44% on the basis of size, and 18% on the basis of other criteria.
For paradigm 2, 37% of the choices were made on the basis of noun class,
54% on the basis of phylogeny, and 9% on the basis of other criteria.

For paradigm 3, we no longer have minimal contrast on size or phy-
logeny; rather, the two features interact. In this case, the percen-
tage of choices made on the basis of noun class drops to 27%, as op-
posed to 50% made on the basis of size/phylogeny and 23% made on the
basis of other criteria. Paradigm 3 is not as useful for detecting
judgments on the basis of noun class as are paradigms one and two, as
it does not contain minimal contrast on either size or phylogeny alone.

A statistical test verifies the effect of noun class on triads
judgments. Summing the results for the three paradigms, we find that
194 out of 393 choices correspond to distinctions of size and/or phy-
logeny (49.4%). Taking these as given, we ask whether or not the re-
maining choices were done at random. Half of the remaining triads
choices would correspond to the noun class distinction. Summing across
the three paradigms, we find in fact that 133 choices (67%) correspond
to the noun class distinction and that 66 (33%) do not. A Chi-square
test on these data rejects the hypothesis that these 199 judgments
were done at random ($X^2 = 22.56$, $p < .0005$). Thus, our triads data
are consistent with the hypothesis that noun class has an effect on
triads choices, but that the effect of noun class is subsidiary to the
effects of distinctions of size and phylogeny.

Table 2. Frequencies of Word Choice* within the Twelve Critical Triads

Paradigm 1: Large Insects vs. Small Insects

Noun Class**	Size	Other
ruruto 'preying mantis'	ngi 'housefly'	ndahi 'grasshopper'
17	5	11
ndahi 'grasshopper'	ruagi 'mosquito'	ruruto 'preying mantis'
6	21	6
ruagi 'mosquito'	ndahi 'grasshopper'	ngi 'housefly'
9	21	2
ngi 'housefly'	ruruto 'preying mantis'	ruagi 'mosquito'
18	10	5

Totals for Paradigm 1:	50 (38%)	57 (44%)	24 (18%)

Paradigm 2: Large Birds vs. Large Insects

Noun Class**	Phylogeny	Other
ruruto 'preying mantis'	nderi 'vulture'	ndahi 'grasshopper'
9	21	3
ndahi 'grasshopper'	ruigi 'hawk'	ruruto 'preying mantis'
12	17	3
ruigi 'hawk'	ndahi 'grasshopper'	nderi 'vulture'
9	21	3
nderi 'vulture'	ruruto 'preying mantis'	ruigi 'hawk'
18	12	3

Totals for Paradigm 2:	48 (37%)	71 (54%)	12 (9%)

Table 2. (continued)

Paradigm 3: Large Birds vs. Small Insects

	Noun Class**	Phylogeny & Size	Other
	ruigi 'hawk'	ngi 'housefly'	nderi 'vulture'
	12	19	2
	nderi 'vulture'	ruagi 'mosquito'	ruigi 'hawk'
	2	22	9
	ruagi 'mosquito'	nderi 'vulture'	ngi 'housefly'
	9	12	11
	ngi 'housefly'	ruigi 'hawk'	ruagi 'mosquito'
	12	13	8
Totals for Paradigm 3:	35 (27%)	66 (50%)	30 (23%)

* The three figures for each triad indicate the number of respondents who selected each word as most different.

** Selection of a word in this column as most different is consistent with classification on the basis of noun class.

4. Summary

This study has addressed itself to a controversy over the semantic status of the noun class, a syntactic category in Bantu languages. Previous investigators have failed to demonstrate whether in fact noun classes have a semantic reality to the speakers of Bantu languages. This problem has heretofore been addressed by examination of the distribution of denotata across syntactic categories; in these studies it has been the foreign researcher who has painted the semantic patterns. In the present study we attend, rather, to the classificatory behavior of Kikuyu, allowing Kikuyu respondents themselves to do the patterning through their responses to a test of triadic comparisons among a set of interrelated concepts.

From informants' responses to the triads test, we assess the effect of noun class membership on Kikuyu judgments of similarity of meaning. Using a hierarchical clustering procedure, we find that the primary distinctions to which people attend (size and phylogeny) are independent of noun class. By doing an additional evaluation, however, involving examination of minimal contrast sets, we demonstrate that noun class has a statistically significant effect on triads choices when other contrasts are controlled. We conclude that Kikuyu respondents treat noun class as a tertiary feature when doing semantic classification.

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DOWNDRIFT AND RULE ORDERING*

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This paper is concerned with the correct analysis of down-
drift and the implications this has for phonological theory
in general. In an examination of the analyses of downdrift
proposed by Peters [1973], Fromkin [1972], and Schachter
and Fromkin [1968] it is shown that the analysis proposed
by Schachter and Fromkin avoids all but one of the objec-
tions which can be raised against the other two analyses.
It is further shown that this final objection and thus,
that the correct analysis of downdrift requires the aban-
donment of this assumption.

1. Introduction

Downdrift is a phenomenon found in many tone languages in which a
high tone segment following a low tone segment is slightly lower in
pitch than the high tone segment immediately preceding the low tone seg-
ment; the same is generally true of low tone segments following high
tone segments. The phenomenon can be illustrated with the following
sentence from Twi, a West African language:[1]

(1)   èyé dùrù sɛ̃n búukù nó   'It is heavier than the book.'

      L H   L L   L   HL L   H   Distinctive tone

      3 2   4 4   4   35 5   4   Surface pitch[2]

      _ ‾

          ‾ ‾   ‾   _ _   ‾

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[1]All examples are taken from Redden, Owusu, et. al. [1963].

[2]The term 'surface pitch' is meant to be taken as a relative term,
thus, the exact pitch level will depend on a great number of physical
features, e.g., how long the phrase is and the pitch range of the
speaker.

Many analyses of downdrift have been proposed, including those of
Schachter and Fromkin [1968], Voorhoeve, Meeussen and de Blois [1969],
Carrell [1970], Stewart [1971], Schadeberg [1972], and Fromkin [1972].
More recently, Peters [1973] has attacked the analysis offered by From-
kin [1972] on a number of grounds, and offered another analysis of
downdrift in its place. The purpose of this paper is twofold. First,
Peters' proposal will be examined and it will be shown that it has a
serious problem associated with it. Second, it will be shown that out
of the three problems raised by Peters against Fromkin's analysis,
two are solved in the closely related solution proposed by Schachter
and Fromkin [1968] and the third is an artifact of an unproven assumption
concerning rule ordering. In conclusion, it will be proposed that the
correct analysis of downdrift requires rules which are unordered in re-
lation to each other.

2. Peters' Analysis of Downdrift

Both Peters [1973] and Fromkin [1972] assume that in a language
with two distinctive tones, high and low, high tones are marked by the
distinctive feature [+High], and low tones are marked by the distinctive
feature [-High]. Peters then proposes the following rules to account
for the surface downdrifted pitch levels:

(2)   R1. $[+syllabic] \rightarrow \begin{bmatrix} +syllabic \\ 0 \text{ Pi} \end{bmatrix}$

        R2. $[+high] \rightarrow [1 \text{ Pi}]$ / # ___

        R3. $[-high] \rightarrow [3 \text{ Pi}]$ / # ___

        R4. $[+high] \rightarrow [-2 \text{ Pi}]$ / [-high] ___

        R5. $[-high] \rightarrow [3 \text{ Pi}]$ / [+high] ___

        R6. $[q \text{ Pi}] \rightarrow [(p+q)]$ / [p Pi] ___

Rule R1 introduces the feature Pi on all syllabic[3] segments; this
feature is arbitrarily (according to Peters[4]) set at 0. R2 through R5

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[3]Apparently the feature [+syllabic] is meant to refer to any and all
tone bearing segments.

[4]Actually, this is not arbitrary, since if the original assignment
of Pi was anything other than 0 it would have to be changed to 0 by a
later rule for any segment not affected by R2, R3, R4, or R5. If this

then change the values of Pi in certain environments. Finally, R6 assigns the final pitches by adding the value for Pi to the value for Pi of the immediately preceding tone bearing segment. This rule is applied iteratively across the string from left to right as is predicted by the directional theory of rule application proposed by Howard [1972], that is, first the Pi of the second segment is determined by adding the value for the Pi of the second segment to that of the first segment, then the Pi of the third segment is determined by adding the value for the Pi of the third segment to that of the second, and so on. The application of these rules can be seen more clearly in the following derivation:

(3)

	èyé		dùrù		sẽñ	búùkù			nó
	L	H	L	L	L	HL		L	H
R1	0	0	0	0	0	00		0	0
R2									
R3	3								
R4		-2				-2			-2
R5			3			3			
R6	1								
R6		4							
R6			4						
R6				4					
R6						2			
R6						5			
R6							5		
R6									3
Output	3	1	4	4	4	25		5	3

$$
\begin{bmatrix}
\overline{} & & & & & \overline{} \\
\underline{} & - & - & - & - & \underline{} \;\underline{}
\end{bmatrix}
$$

This, then, is Peters' analysis of downdrift. In the rest of this section, it will be shown that the feature [Pi] is problematic in this analysis and thus the analysis must be rejected.

The examination of [Pi] will first deal with what its physical correlates are. Rules R2, R3 and R6 actually assign pitch values, that is, integers which correspond with the actual fundamental frequency of

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were not the case, two immediately adjacent segments with the same tone would not be assigned the same pitch.

the segment in question.[5] Thus, in acoustic terms, the physical cor-
relate for [Pi] in these cases could be considered to be 'fundamental
frequency' where 1 stands for the highest fundamental frequency and
higher numbers stands for lower fundamental frequencies. [Pi] in rules
R1, R4, and R5, however, does not refer to the actual pitch value of
the segment in question. This is immediately obvious for R1 and R4
in that although the segment with the highest pitch supposedly re-
ceives an integer value of 1, these two rules assign integer values of
0 and -2, respectively. If [Pi] in these rules did refer to fundamental
frequency, they would be assigning frequencies 'higher' than the 'high-
est possible' frequency. Indeed, that Peters does not intend these
three rules (R1, R4, R5) to refer to pitch value, or fundamental fre-
quency, is obvious when the descriptions of these rules as given by
Peters are examined. By R1

> "...all syllables are...assigned a pitch <u>increment</u> of
> 0." (p. 149, emphasis mine)

Then, by rules R4 and R5

> "...the pitch <u>increments</u> are reassigned wherever there
> is a step up or <u>down</u>..." (p. 150, emphasis mine)

Finally, [Pi] is used in both senses in R6, as can be seen in Peters'
prose statement of the rule:

> "Finally, pitch <u>values</u> are computed from left to right
> across the phrase by adding each pitch <u>increment</u> to the
> pitch <u>value</u> of the preceding syllable." (p. 150, empha-
> sis mine)

The feature [Pi] in these rules, then, represents the <u>difference</u> in
pitch, or fundamental frequency, between the segment in question and
the immediately preceding segment, that is, it <u>relates</u> the pitches of
these two segments.

This claim makes the feature [Pi] as used in R1, R4, R5, and in places
in R6 different from all other generally accepted phonological features.
While these other phonological features all have some physical correlates,
be it acoustic, articulatory, or perceptual, [Pi] in these instances

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[5]Like 'surface pitch' (fn. 2) 'actual fundamental frequency' is
meant as a relative term, subject to physical features.

does not. For this reason this use of [Pi] is highly suspect, for it
adds an entirely new type of distinctive feature to phonological theory
on the basis of only one set of observations.[6]

Even if this objection could be met, [Pi] in R2, R3, and part of
R6 definitely represents something entirely different than it does in
R1, R4, R5 and the rest of R6. This fact forces us to reformulate the
rules proposed by Peters in order to avoid the unsupported claim that
a given feature can represent different things in different rules.
This can be done by using the feature [Pi] to represent only the re-
lational feature [Pitch increment] and [Pv] to represent the feature
[Pitch value]. With this distinction made, the following rules are
obtained:

(4)   R1'.   [+syllabic] → $\begin{bmatrix} \text{+syllabic} \\ \text{0 Pi} \end{bmatrix}$

R2'.   [+high] → [1 Pv] / # ___

R3'.   [-high] → [3 Pv] / # ___

R4'.   [+high] → [-2 Pi] / [-high] ___

R5'.   [-high] → [3 Pi] / [+high] ___

R6'.   [q Pi] → [(q+p) Pv] / [p Pv] ___

However, given this formulation of the rules the feature [Pi] as it
has been more exactly defined is further suspect as can be shown in the
following derivation:

(5)

	è-	yé	dù-	rù	sɛ̃ñ	bú-	ù-	kù	nő
	L	H	L	L	L	H	L	L	H
R1'	OPi	OPi	OPi	OPi	OPi	OPi	OPi	OPi	OPi
R2'									
R3'	3Pv								
R4'		-2Pi				-2Pi			-2Pi
R5'			3Pi				3Pi		

result
of   Ŕ6' $\begin{bmatrix} \text{OPi} \\ \text{3Pv} \end{bmatrix} \begin{bmatrix} \text{-2Pi} \\ \text{1Pv} \end{bmatrix} \begin{bmatrix} \text{3Pi} \\ \text{4Pv} \end{bmatrix} \begin{bmatrix} \text{OPi} \\ \text{4Pv} \end{bmatrix} \begin{bmatrix} \text{OPi} \\ \text{4Pv} \end{bmatrix} \begin{bmatrix} \text{-2Pi} \\ \text{2Pv} \end{bmatrix} \begin{bmatrix} \text{3Pi} \\ \text{5Pv} \end{bmatrix} \begin{bmatrix} \text{OPi} \\ \text{5Pv} \end{bmatrix} \begin{bmatrix} \text{-2Pi} \\ \text{3Pv} \end{bmatrix}$

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[6]Even Foley [e.g., 1970], who claims that phonological features do
not need to have physical correlates, essentially sets up hierarchies
of _physical_ segments.

The first problem is that having the first syllable specified as [OPi]
is either false or meaningless depending on whether or not the phrase
it is in follows another phrase. In the case where its phrase does
follow another phrase it is false since the pitch of the first syllable
in a phrase is not generally the same as the pitch of the final syllable
in the preceding phrase; indeed, the two pitches are not systemati-
cally related in any way. On the other hand, in the case where its
phrase does not follow another phrase it is meaningless since there is
no preceding syllable to which the feature [OPi] can refer. These diffi-
culties could formally be avoided by complicating R1 so as not to assign
the feature [OPi] to the initial segment in a phrase. However, as this
complication is completely ad hoc, proposed only to avoid the problems
mentioned above, it does not really save the analysis.

The second problem with the newly defined feature [Pi] is that it
is completely redundant on the surface in all syllables other than the
first one in a phrase. This stems from the fact that the values for
[Pv] are necessary on the surface to determine the actual pitch of
the segment in question and that given the pitch values for any string
of syllables it is possible to determine unambiguously the pitch incre-
ments for all syllables excepting the first.

In conclusion, it has been shown in this section that the feature
[Pi] as used by Peters is extremely suspect. Since this analysis de-
pends crucially on the acceptance of this feature, it appears the ana-
lysis should be rejected.

3. Towards a More Adequate Analysis of Downdrift

In this section it will be proposed that there is already an analysis
of downdrift which, if not entirely correct, is very close to being
correct. This is the analysis proposed by Schachter and Fromkin [1968].
In addition, in the next section it will be proposed that such an ana-
lysis requires the abandonment of the assumption that all rules are
linearly ordered. Thus, this analysis has definite implications for
phonological theory concerning the application of rules.

Before examining the analysis of Schachter and Fromkin [1968], how-
ever, we will examine the closely related analysis of Fromkin [1972]

and Peters' objections to it as this will afford us a way of evaluating Schachter and Fromkin's analysis more easily. Fromkin's analysis consists of the following two rules:[7]

(6)   R7. a. [+high] → [p 1]

          b. [-high] → [p 3]

      R8. RL: [αhigh] → [αhigh, p<+1>] / [αhigh, p]< [-αhigh]$_1$> ___

R8 is a conflation of the following four rules:

(7)   R8. a. [+high] → [+high, p+1] / [+high, p] [-high]$_1$ ___

          b. [+high] → [+high, p] / [+high, p] ___

          c. [-high] → [-high, p+1] / [-high, p] [+high]$_1$ ___

          d. [-high] → [-high, p] / [-high, p] ___

The notation 'RL' at the beginning of R8 in (6) indicates this is a Right Linear Rule (Johnson [1970]), applying iteratively across the string from left to right. The operation of these rules can be seen in the following derivation from Twi:

(8)

	èyé		dùrù		sĕñ	búùkù		nő
	L	H	L	L	L	HL	L	H
R7a		1				1		1
R7b	3		3	3	3	3	3	
R8c			4					
R8d				4				
R8d					4			
R8a						2		
R8c						5		
R8d							5	
R8a								3
Output	3	1	4	4	4	25	5	3

$$\left[\begin{array}{ccccccc} & ^{-} & & & & ^{-} & \\ ^{-} & & ^{-} & ^{-} & ^{-} & & ^{-}\ ^{-} \end{array}\right]$$

Peters attempts to demonstrate that Fromkin's analysis is problematic in at least three areas: 1) it makes certain empirically incor-

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[7]R8 is not the final rule given by Fromkin but just the part which deals with downdrift. The final rule, which also attempts to account for downstep, will be discussed below.

rect predictions, 2) it is 'notationally extravagant', and 3) it
makes use of an unjustified 'syllabic cycle'. Peters notes cases of
empirically incorrect predictions both with regard to downstep and to
the size of pitch intervals between a high tone and a low tone.

Downstep is the phenomenon by which a high tone is slightly lower
in pitch than an immediately preceding high tone but where there is
no independent motivation to pósit an intervening low tone to 'trigger'
this lowering. This phenomenon can be illustrated by the following sen-
tence from Twi (' indicates a downstepped tone):

(9)   mé sèkǎn fófóró kèséέ nő ȵyέ   'My other big knife is no

        H   D D   H D H L HH   H   L H   good.'

        1   2 3   3 4 4 6 55   5   7 6

$$\begin{bmatrix} - & & - & & - & & & & & \\ & - & & - & - & & - & & - & \\ & & & & & & - & -- & & - & \\ & & & & & & & & - & - & - \end{bmatrix}$$

To account for downstep, Fromkin marks all 'downstepped' tones [+high,
+mid] and adds the following rule to those given in (7) as R8 a–d:

(10)   R8. e. [+high] →[+high, p+1] / [+high, p] $\begin{bmatrix} \underline{\quad} \\ +\text{mid} \end{bmatrix}$ [8]

This can then be conflated with R8a–d to give R8':

(11)   R8'. RL:

        [αhigh] →[αhigh, p<+1>$_{1,2}$]/[αhigh, p]<[-αhigh]$_1$>$_2$ $\begin{bmatrix} \underline{\quad} \\ <+\text{mid}>_1 \end{bmatrix}$ [9]

---

[8] The rule actually given by Fromkin is:

[+high] → [+high, p+1] / $\begin{bmatrix} +\text{high} \\ -\text{mid} \end{bmatrix}$ $\begin{bmatrix} \underline{\quad} \\ +\text{mid} \end{bmatrix}$

However, this formulation would not apply to a downstepped tone follow-
ing a downstepped tone, so that the second downstepped tone in such a
sequence would be assigned a pitch by R8b and thus be on the same pitch
level as the immediately preceding downstepped tone instead of one step
below it. This problem can be eliminated by removing the [-mid] speci-
fication on the first high tone.

[9] This conflation actually contains one other subrule, R8f:

R8f. [-high] → [-high, p+1] / [-high, p] $\begin{bmatrix} \underline{\quad} \\ +\text{mid} \end{bmatrix}$

However, as no segment can ever be marked [-high, +mid], this expansion
can by definition never apply.

However, when this rule is applied to the sentence in (9) the following derivation is obtained:

(12)   mẽ́ sěkã̌n fófóró kèséέ nṍ ñ̀yέ

Rule	H	D	D	H	D	H	L	H	H	H	L	H
R7a	1	1	1	1	1	1		1	1	1		1
R7b							3				3	
R8e		2										
R8e			3									
R8b				3								
R8e					4							
R8b						4						
R8a								5				
R8b									5			
R8b										5		
R8c											4	
R8a												6
Output	1	2	3	3	4	4	3	5	5	5	4	6

```
⎡ -                                ⎤
⎢      -  -      -  -     -         ⎥
⎢                    --     -  -    ⎥
⎣                              -   ⎦
```

According to these rules, the final low tone in the sentence is higher than either the high tone immediately preceding or following it! As was noted by Peters, this problem arises because

> "...the Downdrift rule (6) [R8' in (11) – JMC] assigns pitch to a Low tone immediately following a sequence of [+Hi] tones by referring only to the pitch of the last overt Low tone, without regard to how many covert Low tones (in the form of Drop [that is, downstepped – JMC] tones) might be intervening..." (p. 146)

That is, although downstepped 'act' as though they are immediately preceded by a low tone (in that they are slightly lower than the immediately preceding high tone) this 'low tone' never appears. Thus, when a low tone following a downstepped tone is assigned a pitch value, this other 'low tone' is not taken into account. One possible solution to this problem, noted both by Fromkin and Peters, would be to posit a low tone before each surface downstepped tone. This low tone could trigger the lowering and would then be deleted. However, this possibility is rejected by both, primarily on the basis that it would violate

Kiparsky's [1968, 1971] constraint against 'absolute neutralization'.[10]

The second area in which Fromkin's analysis makes empirically incorrect predictions concerns the size of the pitch intervals from high to low and vice versa.[11] To see this, (13) can be compared with (8).

(13)   mɛ́kɔ̀ hɔ́   'I will go there.'

	H	L	H
R7a	1		1
R7b		3	
R8a			2
Output	1	3	2

$$\begin{bmatrix} - & & - \\ & - & \end{bmatrix}$$

The interval from a high tone to a low tone is three in (8) where the initial segment is a low tone while it is only two in (13) where the initial segment is a high tone. Likewise, the interval from a low tune to a high tone is two in (8) but only one in (13). In other words, this analysis claims that pitch intervals are less when the initial segment is a high tone than when it is a low tone. Unless it can be shown

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[10] This rationale, however, would not hold if the analysis of downstep discussed in Clifton [1975] is correct. In this article it is argued that phonological theory needs to refer to 'nonsegmental tones', that is matrices which are marked [-segmental, -high]. These matrices interact with other tone bearing segments but, like boundaries which are also nonsegmental, have no surface realization themselves. This seems to be what Schachter and Fromkin [1968] have in mind when they talk about the Habitual low tone morpheme, which consists of a low tone which, for example, can trigger downdrift, but never has any direct surface representation. Like boundaries, these matrices do not have to be deleted by rule to escape having a surface representation, instead, the feature [-segmental] ensures this. Thus, they are no more subject to Kiparsky's constraint against absolute neutralization than are boundaries. Because of this, it would be possible to posit a nonsegmental low tone before any surface downstepped high tone which would trigger downdrift, not have to be deleted, not have any surface representation, and not be objected to because of absolute neutralization.

[11] I had also noted this failure of Fromkin's analysis, as was reported in Maddieson, Shopen and Okello [1973].

that this is indeed the case, Fromkin's analysis must be modified so
that the size of the pitch intervals does not depend on the tone of the
initial segment.[12]   This can be done by changing R7 in (6) in either
of the following two ways:

(14)   R7'. a.   [+high] → [p 1] / #___

        b.   [+high] → [p 2] / [$\overline{\text{-high}}$] ___

        c.   [-high] → [p 3]

    R7''.a.   [+high] → [p 1]

        b.   [-high] → [p 3] / #___

        c.   [-high] → [p 4] / [$\overline{\text{+high}}$] ___

However, there are two objections against such a reanalysis. First, we
are faced with a completely arbitrary decision as to which of the
two reformulations of PA is correct. Second, and more important, is
that given either reformulation we are forced to complicate the grammar,
claiming that pitch is assigned differently to high tones as opposed
to low tones, with no concommitant increase in explanatory power.

      The second objection advanced by Peters against Fromkin's analysis
is that:

> "This rule (6) [R8' in (11) -JMC] is notationally extra-
> vagant, using some of the most powerful devices of
> generative phonology, such as the sub-one notation
> to indicate one or more segments of a specified kind
> (e.g. [-Hi]$_1$), as well as indexed angle brackets which
> are costly at the least and of questionable validity
> in general." (pp. 147-8)

This objection is not especially convincing as nowhere does Peters
even attempt to give any justification for claiming that these nota-
tions are 'extravagant'. It is not even clear as to whether Peters
simply wants to make the use of these notations more costly in some
unspecified way, or to eliminate them from phonological theory completely.

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    [12]This seems to have been the assumption in all previous studies
of downdrift. It is clear that in none, not even Fromkin's analysis,
is the claim explicitly made that the size of the intervals depends
in any way on the tone of the first segment in the phrase.

However, as will now be shown, both this 'problem' and the problem
of empirically incorrect predictions are resolved by the closely re-
lated analysis of Schachter and Fromkin [1968].

The analysis of downdrift proposed by Schachter and Fromkin [1968]
can be formalized in terms of the following rules:[13]

(15)   R9.   a.   [+high] → [Pv 1] / [+phrase boundary] ___

               b.   [-high] → [Pv 3] / [+phrase boundary] ___

        R10.   a.   [+high] → [Pv n-2] / [-high, Pv n] ___

               b.   [-high] → [Pv n+3] / [+high, Pv n] ___

               c.   [+high] → [Pv n] / [+high, Pv n] ___

               d.   [-high] → [Pv n] / [-high, Pv n]

The operation of these rules can be seen in the following derivations
using the sentences used to illustrate Fromkin's analysis in (8) and
(13) respectively:

(16)   èyé dùrù sɛ̃̀ɛ̃ búùkù nő

                        L H L L L   HL L H

        R9b   3
        R10a   1
        R10b   4
        R10d   4
        R10d   4
        R10a   2
        R10b   5
        R10d   5
        R10a   3

    Output   3 1 4 4 4   25 5 3

$$\begin{bmatrix} \bar{} & & & & & \bar{} & & \\ \text{-} & & \text{-} & \text{-} & \text{-} & & \text{-} & \text{-} \end{bmatrix}$$

---

[13]As Schachter and Fromkin use their own set of conventions for
formulating these rules, those presented here are essentially 'trans-
lations' into the conventions proposed by Chomsky and Halle [1968].

(17)   mɛ́kɔ̀ hɔ́

                 H L H

        R9a   1
        R10b   4
        R10a   2

     Output   1 4 2

        $$\begin{bmatrix} - & & - \\ & - & \end{bmatrix}$$

This analysis can be expanded to account for downstep also by marking downstepped tones [+mid] as they are in Fromkin's analysis and adding the following subrule to rule 10 in (15):[14]

(18)   10.e. [+mid] → [Pv n+1] / [+high, Pv n] ___

The operation of this subrule can be seen in the following derivation using the sentence used to illustrate Fromkin's analysis in (12):

(19)   mɛ̌ sèkằn fófóró kὲséέ nǒ ̀nyέ

                H D D   H D H L HH H L H

        R9a   1
        R10e   2
        R10e   3
        R10c   3
        R10e   4
        R10c   4
        R10b   7
        R10a   5
        R10c   5
        R10c   5
        R10b   8
        R10a   6

     Output   1 2 3   3 4 4 7 55 5 8 6

        $$\begin{bmatrix} - & & & & & & & & \\ & - & - & & - & - & - & & & - \\ & & & & & & & - & - & & - \end{bmatrix}$$

As has already been mentioned, the analyses of Fromkin [1972] and

---

[14]This rule is entirely my own, since Schachter and Fromkin do not try to account for downstep by marking downstepped tones [+mid].

Schachter and Fromkin [1968] are very similar. The main difference is
that while in Fromkin's analysis the immediately preceding tone with
the same coefficient for the feature high is referred to when pitch
is assigned, in Schachter and Fromkin's analysis the immediately pre-
ceding tone is referred to regardless of its coefficient for the feature
[high]. However, as can be seen from examining (16), (17) and (19),
this difference resolves the problems Peters advances against Fromkin's
analysis. As can be seen in (19), low tones following downstepped
tones are given the correct pitches. Furthermore, the pitch interval
from a high tone to a low tone is always three while that from a low
tone to a high tone is always two, regardless of the tone of the first
tone bearing segment in the phrase. It is also the case that none of
the notations found to be objectionable by Peters are needed in this
analysis.[15] It should also be pointed out that the objections advanced
in the first section of this paper against the analysis proposed by
Peters do not apply to either the analysis proposed by Fromkin or that
proposed by Schachter and Fromkin. In each of these analyses the p
(in Fromkin's) or Pv(in my formalization in (15) of Schachter and From-
kin) represent one thing only, fundamental frequency. Thus, they are
like other features given by Chomsky and Halle [1968], especially a
feature like stress.

4. <u>Downdrift and Rule Ordering</u>

In the preceding section we discussed the first two objections
Peters raises against the analysis of downdrift proposed by Fromkin
and showed that the analysis proposed by Schachter and Fromkin did
not encounter similar objections. In this section we will examine
Peters' third objection against Fromkin's analysis. In doing this,

---

[15]R10c and R10d in (15) could be collapsed by variables as follows:

$$[\alpha high] \rightarrow [Pv\ n] / [\alpha high,\ Pv\ n] \underline{\qquad}$$

However, if any objections are raised against variables, they are not
required as can be seen from the fact that the rules are formulated
without them.

we will attempt to demonstrate that although this objection can also be raised against Schachter and Fromkin's analysis, it arises from an unproven assumption concerning the ordering of phonological rules. Thus, we will suggest that a correct analysis of downdrift requires that the rules for downdrift be unordered in relation to each other.

The third objection raised by Peters is as follows:

> "...each of the six sub-rules [of R8' in (11) - JMC] must be tried on the first syllable until a sub-rule is found that will apply to the tone of that syllable or until all six sub-rules have been unsuccessfully tried on that syllable. Then, and only then, does the focus of the application move to the second syllable, where again all the sub-rules are tried until one is found that will apply. Any other mode of application will give the wrong results... Thus, in effect, this one "schema" constitutes a <u>cycle</u> of rules that is to be applied <u>syllable by syllable from left to right.</u>"
> (p. 148, Peters' emphasis)

Peters then goes on to note concerning this "cycle" that

> "(t)he little evidence that has been advanced to support such a mode of rule application (Anderson [1968]) has been tellingly argued against by Johnson [1970:92-118]."
> (p. 148)

Although this is not noted by Peters, upon further examination it becomes apparent that the reason Peters seems compelled to appeal to a syllabic cycle to ensure proper application of R8' is that without it an ordering paradox ensues. This paradox can be shown by referring back to (8) (reproduced as (20) for reference).

(20)   èyé dùrù sẽ̃ñ búùkù nő

	L	H	L	L	L	HL	L	H
R7a		1				1		1
R7b	3		3	3		3	3	
R8c			4					
R8d				4				
R8d					4			
R8a						2		
R8c						5		
R8d							5	
R8a								3
Output	3	1	4	4	4	25	5	3

```
        ⌈     -              -        ⌉
        |  -      -  -  -       -  -   |
        ⌊                             ⌋
```

In this derivation R8c must apply both before and after R8d and R8a.
Likewise, R8a must apply both before and after R8c and R8d, and R8d
must apply both before and after R8a and R8c. The same type of order-
ing paradox can be found in the analysis proposed by Schachter and From-
kin as can be seen from (16) (reproduced here as (21) for reference).

(21)   èyé dùrù sɛ̀ñ búùkù nő

                   L H L L L   HL L H

R9b	3							
R10a	1							
R10b		4						
R10d			4					
R10d				4				
R10a					2			
R10b						5		
R10d							5	
R10a								3
Output	3 1	4 4	4		25	5	5	3

$$\begin{bmatrix} - & & & & - & & - \\ - & - & - & - & & - & - \end{bmatrix}$$

The syllabic cycle, then, is proposed to avoid such a paradox. This
cycle can be characterized by a series of bracketings, the innermost pair
being around the first syllable, the next pair around the first two
syllables, the third pair around the first three syllables, and so on.
According to this characterization, the sentence used in (20) and (21)
would be bracketed as follows:

(22)   [[[[[[[[[è]yé]dù]rù]sɛ̀ñ]bú]ù]kù]nő]

Given such bracketing, only one rule will be able to apply nonvacuously
on each cycle, [16] since there is only one tone bearing segment in each
cycle which will not have been assigned a pitch in an earlier cycle.
Thus, the ordering of the rules is no longer at issue. However, as
Peters notes, this solution is not a pleasant one since there does not
seem to be any independent motivation for such a syllabic cycle. Thus,

---

[16] If vacuous application was not prohibited, the disjunctivity as-
sociated with both variables and angle brackets would block the proper
application of rules in certain instances.

if Peters is correct in stating that "(a)ny other mode of application
will give the wrong results", Schachter and Fromkin's analysis must be
abandoned.

The claim that a syllabic cycle is required to ensure the proper
application of R8' and R10 is, however, based on the assumption that
rules must be linearly ordered, that is, that if a rule A precedes rule
B in one point in any given derivation within the same cycle it must
also precede rule B at any other point in that derivation or in any
other derivation in any given cycle. This assumption, however, is
being increasingly questioned, in part at least, because of cases
like this where a given rule seems to need to apply both before and
after another rule within one cycle. Furthermore, cases in which it
has been claimed that rules cannot be linearly ordered have been found
in both phonology and syntax. In syntax, for example, we find Fau-
connier's [1971] analysis of agreement in French, Hastings' [1973]
analysis of several pairs of rules in English, and Hudson's [1975]
analysis of Conjunction Reduction, while in phonology we find Anderson's
[1969] theory of local ordering, Dinnsen's [1974] analysis of glide
formation in Spanish, and Escure's [1974] analysis of vowel lengthen-
ing in French.

If, then, we assume like Koutsoudas, Sanders and Noll [1974] that
rules cannot be linearly ordered but apply instead whenever their
structural descriptions are met unless a universal principle predicts
otherwise, and, like Ringen [1973], that one of these principles is
that a rule cannot apply vacuously, Schachter and Fromkin's analysis
will apply properly.[17] For example, given the underlying form

̀eyé dùrù sɛ̃ñ búùkù nő

L H L L L   HL L H

the only rule which can apply is R9b. After this applies, we obtain

---

[17]For the proper application of R10e, the rule accounting for down-
step, we also have to assume Proper Inclusion Precedence (Koutsoudas,
Sanders and Noll [1974]). This is because for any tone marked [+mid],
two rules, R10c and R10e could potentially apply. For example, given

èyé dùrù sè̃ń búùkù nő

L H L L L   HL L H

3

to which only R10a can apply nonvacuously. After this applies, we
obtain

èyé dùrù sè̃ń búùkù nő

L H L L L   HL L H

3 1

to which only R10b can apply nonvacuously, yielding

èyé dùrù sè̃ń búùkù nő

L H L L L   HL L H

3 1 4

to which only R10d can apply nonvacuously, yielding

èyé dùrù sè̃ń búùkù nő.

L H L L L   HL L H

3 1 4 4

Only R10d can apply nonvacuously at this point, and so it does even
though it has already applied, yielding

èyé dùrù sè̃ń búùkù nő.

L H L L L   HL L H

3 1 4 4 4

Now only R10a can apply nonvacuously, so it is applied even though it

---

the sequence

$$\begin{bmatrix} +\text{high} \\ \text{Pv n} \end{bmatrix} \quad \begin{bmatrix} +\text{high} \\ +\text{mid} \end{bmatrix}$$

where we are assigning pitch to the second segment, R10c could apply
assigning a pitch of n, and R10e could apply assigning a pitch of
n+1. Since R10c could potentially apply in all instances where R10e
could apply and in others, Proper Inclusion Precedence correctly pre-
dicts R10e will apply and not R10c.

applied before R10c, yielding

èyé dùrù sɛ̃̀ búùkù nő.

L H L L L   HL L H

3 1 4 4 4   2

This process continues until there are no rules which can apply non-vacuously to the input string. At this point the derivation ends. Thus, downdrift seems to be one more case where rules need to apply in an unordered fashion. If this is indeed the case, this is simply one more nail in the assumption of linearly ordered rules' coffin.

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RULE INVERSION IN CHADIC: AN EXPLANATION

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An alternative to the rule inversion solution in Kanakuru
is presented along with some evidence from Pero. It is
shown that the proposed analysis not only makes the rule
inversion unnecessary but that it explains other facts
in Kanakuru phonology as well, in particular it makes
predictions about the verb final vowels in that lan-
guage.

1. <u>Introduction</u>[1]

Leben [1974] presented an alternative analysis for most of the in-

stances for which Schuh [1972] has postulated a rule inversion. The

most important case for which Leben did not present an alternative solu-

tion is the formation of verb and noun plurals in Kanakuru. Schuh

[1974] defends the necessity of the rule inversion in Chadic by point-

ing that his proposal for the analysis of plurals in Kanakuru was not

countered.

In what follows I will present an alternative analysis of plurals

which will render the rule inversion unnecessary and will explain some

facts which could not be explained by rule inversion.

Newman [1970] postulates the following diachronic rules for Kana-

kuru:

(1)   *T → r   in which *T stands for *t, *d, or *ɗ

        *P → w   in which *P stands for *p, *b, or *ɓ

        *K → h

---

[1]This is the first opportunity which I have had to express my
thanks to Paul Newman for his encouragement in the study of Pero and
numerous discussions on the problems of Chadic linguistics. The work
on Pero was conducted during A.Y. 1974/1975 with the help of the Ahmadu
Bello University. The research grant from the Ahmadu Bello University
is gratefully acknowledged. The present paper is a by-product of a
larger project partially supported by the Council on Research and
Creative Work, University of Colorado. I would like to thank David
Rood who kindly read the paper and made helpful remarks on the style
of the paper.

Thus in the following singular verbs the medial consonants are sup-
posed to represent the result of these diachronic rules: (Schuh
[1972:387])

(2)   Singular   Gloss   Plural

        ɗowe   'tie'   ɗope

        boi ← buwi   'shoot'   bupe

        pui ← puwi   'get out'   pupe

        muri   'die'   muti[2]

        pori   'go out'   poɗe

In order to account for the plural forms of these verbs Schuh postu-
lates the inverse rules, by which:

(3)   r → t, r → ɗ, and w → p

This account of the plural forms has two serious disadvantages,
both noted by Schuh. One is that the r of the singular results in a
t one time and in a ɗ another time. In order to account for this
fact Schuh proposes an explanation by which /t/ in mute is a histori-
cal retention and the ɗ in poɗe is a recent replacement occasioned
by what has been traditionally called analogical leveling.

The second difficulty, for which Schuh does not see an explanation,
is why the stops in the plural form did not change to sonorants.

2. Analysis of the Plural Forms of Verbs

As an alternative solution I propose to treat the rules in Newman
[1970] as synchronic rather than diachronic. Thus in the underlying
forms of the verbs in the singular we would have stops rather than
sonorants. The underlying forms would be:

---

[2]This is a mistake. It should be mute. Cf. Newman [1974:72].

(4)   'tie'   /ɗope/ → [ɗowe]

       'shoot'   /bupe/ → *[buwi] → [boi]

       'die'   /muti/ → [muri]

       'go out'   /poɗi/ → [pori]

The immediate advantage of this solution is that we do not have to
postulate rather arbitrary rules by which r → ɗ one time and r → t
another. One synchronic rule could account for the phonetic representa-
tion of the verbs in the singular:

(5)   Obstruent Weakening

$$\begin{bmatrix} C \\ [-cont] \end{bmatrix} \rightarrow [+son] / V\_\_V$$

In order to account for the plural forms of the verb I propose the
following rule instead of the "hardening" postulated by Newman [1974:4]
and Schuh [1972:388].

(6)   Reduplication
       C V C V → 1 2 3 3 4
       1 2 3 4   [Plural]

The order of those rules should be explicitly stated as:[3]
       Reduplication (6)
       Obstruent weakening (5)

Rule (6) states that the second consonant of the verb is redupli-
cated to mark the plural. The underlying form of the plural stems de-
rived from the verbs in (2) by rule (6) would be:

(7)   Plural
       /ɗoppe/   'tie'
       /buppe/   'shoot'
       /puppe/   'get out'
       /mutte/   'die'
       /poɗɗe /   'go out'

_____

[3]I am grateful to Russell Schuh for pointing this out to me.

There is no longer an environment for the application of the rule
of stop weakening, thus answering Schuh's question of "why the stops in
the plural were not always changed into sonorants". One must of course
also postulate the following rules:

(8)   /tt/ → [t:]   /ɗɗ/ → [ɗ:]   /pp/ → [p:][4]

While the form of the plural is evidence for the claim that stop →
sonorant is a synchronic rule, the following is presented as evidence
that the plural form of the verb is indeed a result of the reduplication
of the second consonant of the verb. The first part of the evidence is
from Kanakuru.

Notice that there is a change of final i to e when the verb be-
comes plural, e.g.:

(9)   múrì   mútè   'die'

       pòrí   pòɗé   'go out'

Newman [1974:72] considers this vowel change to be a property of the
plural verbs.

I would like to postulate the following rule in order to account
for this change:

(10)   i → e / ʒ C——

i.e., the vowel i becomes e when the preceding syllable of the verb

---

[4]There is an indirect indication that phonetically long consonants
might exist in Kanakuru. There is no indication in Newman [1974] how
the two abutting consonants are realized phonetically, and one cannot
say what if any might be the difference in the pronunciation between
't' and 'tt' or 'k' and 'kk' in the words below.

       e.g. atto   'her hand'   átè   'to dip out'

             a ɓakke   'he ignored you' àkəré 'to bite'

             anni   'his hand'   àní   'to lie down'

It is of course quite possible that /tt/ → [t] and /kk/ → [k] in inter-
vocalic position, and that what appears phonetically as [k] derives from
the underlying /kk/ and what appears phonetically as [h] derives from
the underlying /k/, etc.

is heavy (long).   (Cf. Newman [1972] for the importance of this variable
in Chadic.)

An examination of all the verbs in Newman [1974] has shown that all
the verbs in Kanakuru which meet the above condition do have the -e
ending, e.g.,

Verbs with the first syllable of the form CVV;

(11)   béelè   'choose'

        bóorè   'make a hole'

        bàaré   'grow up'

        dúulè   'bang against'

        góomè   'be bothered by thirst'

        jáalè   'spoil, deteriorate'

        wáarè   'beat thing'

Verbs which have the first syllable closed, or in other words, verbs
which have the structure CVCCV, e.g.,

(12)   kwàhlé   'fight'

        ángè   'pay'

        ɓìndé   'squeeze'

        kùmbé   'beseech, request of'

        làmbé   'court or seek a woman'

The above are only some of the examples of the verbs with the first
syllable long. In view of this evidence, the change from i to e in
the plural form is caused by the change in the syllabic structure of
the verb from CVCV →CVCCV, i.e., the first syllable of the verb became
heavy.

The trisyllabic verbs in Kanakuru have only the -e ending. Notice
that those verbs have a stop rather than an expected continuant in inter-
vocalic positions. It is postulated that the trisyllabic verbs in
fact have the first syllable heavy, i.e. (C)VCCVCV. The following are

some of the examples of trisyllabic verbs from Newman [1974]:

(13)   bómbəlè   'scrape'

        woòbəré   'say good-bye to'

        yùmburé   'submerge under water'

        téngəlè   'stir'

        shùmburé   'quiet'

        pàapəré   'punish, scold'

        màngəlè or múngulè   'metamorphose'

        kwàmbəré   'embrace'

        lámbərè   'become dull (knife)'

        géndəlè   'roll heavy t. off t.'

        gúngulè   'bend out of shape'

        àkəré   'bite'

        àpəré   'shed, pour out'

        dwátəlè   'break up'

        tàkəlé   'deceive'

Notice that the penultimate vowel is predictable from the first vowel of the verb. If the first vowel is high the penultimate (or the second vowel) is high as well and agrees in fronting with the first vowel. There are two exceptions to this rule, viz.

(14)   wúshilè   'scatter'

        ɗìbəré   'buy'

If the first vowel of the trisyllabic verb is other than 'i' or 'u' then the penultimate vowel of the verb is ə. This may be an indication that -le and/or -re may in fact be suffixes.

     There is another class which almost exclusively ends in -e in Newman's corpus. The verbs in this class have a stop consonant at the on-

set of the second syllable. Newman [1970] lists six such verbs, but
in the 1974 corpus there are more than fifty to be found with these
characteristics. Those from the 1970 paper are:

(15)   àɗé   'eat meat'

         kàpé   'sow'

         tùké   'hide'

         ɗìté   'pick out'

         wúɓè   'knot'

         lákè   'untie'

Of the almost fifty verbs with a stop at the onset of the second syl-
lable, only four have the vowel -i at the end of the word; the rest
have the vowel -e.

The following list of exceptions is exhaustive:

(16)   jópì   'leak'

         lòpí   'cave in'

         ɗəkí   'drip'

         àbí   'open'

In addition, there are five verbs which have an alternation ɓ/w at
the beginning of the second syllable. This alternation seems to be a
product of the rule w→ ɓ. For some Kanakuru speakers, w and ɓ are
in free variation (cf. Newman [1974:4-5]). The following is an almost
exhaustive list based on Newman [1974]:

(17)   yéɓì   'ascend, climb'

         jíɓì   'screen off, dam off'

         ɗəɓí   'ferment'

         dúɓì   'mix into paste'

         làɓí   'want, look'

         láɓì   'agree, answer'

I would claim that the verbs which have a stop in intervocalic
position in Kanakuru are actually plural verbs, formed by the re-
duplication (doubling) of the second consonant of the stem, just like
the small group of verbs mentioned by Newman [1970, 1974:72] and by
Schuh [1972]. According to the present analysis those verbs have the
underlying form CVCCV. The reason why they were not analyzed by New-
man as plural verbs was the fact that he apparently did not come across
the counterparts with a sonorant at the onset of the second syllable,
either because the singular forms of the verbs do not exist any more
or because they were not a part of the corpus of data collected. In New-
man [1974] there is at least one pair not recognized by Newman as re-
presenting the singular-plural contrast, viz.

(18)   àrí   'eat'   àɗé   'eat meat'

From the formal point of view the verbs which have a stop at the onset
of the second syllable do not differ from the recognized plural verbs
mentioned at the beginning of this paper. Verbs ending in -e include
in addition several verbs with sh [š] in intervocalic position. Con-
cerning this consonant Newman [1974:2] writes: "Though phonetically a
fricative, sh structurally fills the C slot in the voiceless stop
series". Because of this characteristic it is assumed that those verbs
do not differ structurally from other plural verbs.

(19)   kàshé   'cut (fish)'

       gáshè   'drive away'

       dúshè   'pound'

It is assumed that the following verbs where the medial consonant
is a liquid or nasal and the final vowel is e, are also plural verbs.
It is thus possible that in Kanakuru there is no difference between the
phonetic realizations of single and reduplicated sonorants.

(20)   álè   'pour (into a small calabash)'

       ámè   'pull'

bálè   'say'

mómè   'forget'

Liquids and nasals occur in the -i ending verbs as well, e.g.,

(21)   àlí   'see'

The other evidence for a rule like (6) is from Pero, a language
closely related to Kanakuru. The abundance of data allows for a tho-
rough analysis of plural formation. Reduplication of the consonant in
the second syllable is a device used in several classes of verbs to form
the plural. The examples which follow are from the class in which re-
duplication is the only device used. Note that the examples are sub-
ject to the following rule in Pero:

(22)
$$
\begin{bmatrix} C \\ -\text{glottal} \\ -\text{cont} \\ -\text{voice} \end{bmatrix} \rightarrow \begin{bmatrix} +\text{cont} \\ +\text{voice} \end{bmatrix} \quad /V\_\_V
$$

This rule is further constrained depending on the quality and length of
the surrounding vowels.

(23) | Gloss | Singular | Plural |
|-------|----------|--------|
| 'eat' | /adɗù/ → [adɗu] | /adɗò/ → [adɗò][5] |
| 'shoot, sting' | /becò/ → [pejò] | /beccò/ → [peccò] |
| 'throw away' | /tedɗò/ → [tedɗò] | /tedɗo/ → [tedɗò] |
| 'touch' | /nafù/ → [navù] | /naffò/ → [naffò] |
| 'discuss' | /deefò/ → [deevò] | /deeffò/ → [deffò] |
| 'open' | /afù/ → [avù] | /affò/ → [affò] |
| 'cut' | /betò/ → [però] | /bettò/ → [pettò] |
| 'stand' | /cetò/ → [cerò] | /cettò/ → [cettò] |
| 'pour in' | /baato/ → [paarò] | /baattò/ → [pattò] |
| 'hang' | /lookò/ → [lookò] | /lookkò/ → [lokkò] |

---

[5]There is a change of gloss between the singular and the plural forms
The plural form means 'to eat something hard'. Cf. this verb in Kanakuru
in (18).

The last two examples provide evidence that what really happens here is reduplication rather than "hardening". In Pero there is a constraint on the syllable structure similar to the constraint in Hausa: in closed syllables long vowels cannot occur. After reduplication of the second consonant in paato and looko the syllabic division produces an impossible structure *CVVCCV. Therefore the vowels in the first syllable are reduced. Conditions of the fieldwork on Pero did not allow for an instrumental description of the sound system; therefore, I can only offer an impressionistic description of the geminate stops in Pero. It seems that in the articulation of a geminate stop there is longer time between the stop of the air and its release than for simple stops. In terms of syllabic structure, in deliberately slow speech the stop is produced at the end of the first syllable and the release is at the beginning of the following syllable. If it is of any help, the time between the stop and the release in normal speech seems slightly shorter than in the normal articulation of geminate stops in Polish or Italian.

3. Plural of Nouns

It seems that one can postualte that the plurals of nouns in Schuh [1972:187] are formed by reduplication of the second consonant just as are the plurals of verbs. This is a common device in the Chadic languages, e.g. for Fyer, Jungraithmayr [1970:36] provides the following examples:

(24)   Singular   Plural

        ràdon   'bull'   rà-dd-dôn
         ~   ~~

        batìn   'bush'   ba-tì-tín

        gwènè   'rooster'   gwe-ni-né

Reduplication is used as one of the devices for the formation of plural in the other Ron languages, e.g. Bokkos, Daffo and Butura (Jungraithmayr [1970]). In Hausa, reduplication of the second syllable is a part of the stem preparation for the formation of plural with the class of nouns which have the first syllable short (light) (Newman [1972:314]).

4. Conclusions and Implications

To recapitulate the results of the above analysis: 1. It has been postulated that the form of plural verbs and nouns in Kanakuru provides evidence that the underlying consonants in the verbs involved are stops rather than sonorants. 2. The evidence for the postulated rule of plural formation is provided by the formation of the plural in the closely related language Pero, and indirectly by the analysis of vowel endings in Kanakuru verbs.

The concept that the stop → sonorant change is synchronic rather than diachronic will have several implications for the analysis of Kanakuru, mainly in the reformulation of some of the rules in Newman [1974]. In the discussion below, P-1.1, etc. refer to the rules as given in Chapter 1 of Newman [1974].

Epenthetic shwa insertion:

(25)   P-1.1.   a. $(C_3)C_1C_2 \rightarrow (C_3)C_1 \vartheta C_2$

        b. $\mathrm{d\!\!/r} \rightarrow \mathrm{d\!\!/\vartheta r}$

Instead of the rules in (25) I propose the following ordered rules:[6]

(26)   1. $C_1 \quad C_2 \quad + \quad C_3 \qquad \rightarrow \quad C_1 \; C_2 \vartheta \; C_3$

$$[\alpha \text{ place}] \quad \left\{ \begin{array}{l} [- \text{ nasal}] \\ [-\alpha \text{ place}] \end{array} \right\}$$

        2. $C_1 \; C_2 \; C_3 \rightarrow C_1 \; C_3$

Some examples of derivation from Newman [1974:3] reanalyzed:

(27)   /a/ /wupp/+ /to/ → / a wuppəto → [a wupəro] (cf. footnote 4) 'he sold it to her'

        /a/ /daɗɗ/+ /to/ → / a daɗɗəto/ → [a daɗəro] 'he sewed it for her'

        /shi/ /kukk/+ /mai/ → /shi kukkəmai/→ [shi kukəmai] 'he is learning'

        /a/ /daɗɗ/ +/no/   → [a daɗno] (Rule (26)2.) 'he sewed it for me'

        /shi/ /wuɓɓ/ +/mai/ → [shi wuɓmai] (Rule (26)2.) 'he is knotting it' (Newman [1974:6])

The **shwa insertion rule** does not operate when only two consonants are involved:

(28)   /shit/ + /te/ → [shitte]   'steal it'

   /a/ /ak/ + /ko/ → [a akko] 'he honed it for you'

One can understand the phonetic form of Newman's example (p. 3) [a gup-tǝru] 'he forged (it)' if one derives it from the following underlying structures:
/gúpì/ 'to forge' + /ttǝ/[7] (pre-pronoun form) (Newman [1974:73]) and /-tu/ (non-pronoun form) (Newman [1974:75]) of the ventive marker. Since the verb does not have the vowel ending before a suffix the form of the morphemes in this construction is /gúp/ + /ttǝ/ + /tu/.

   After the stop weakening rule we obtain *guptteru

   After the rule 2 we obtain guptǝru.

If one accepts that the stop→ sonorant change is a synchronic rule there is no need to postulate existence of "archiphonemes" R, H, and W, and the rules in which those archiphonemes were involved would have to be changed. The intention in presenting the following alternatives to Newman's rules P -1.2 through P -1.6 is to show that such changes are possible. The examples are those that accompany those rules in Newman [1974].

_____

[7]Newman postulates for this morpheme /tǝ/. However, this morpheme displays the same irregularity as many verbs have, viz. 't' is not weakened to [r]. E.g.,

   à kòotǝ̀ né 'he caught (and brought) me' kóì

   nà àmtǝ̀ wú 'I pulled them (here)'   ámè

   (One would expect *[àmrè].)

I conclude therefore that this morpheme has the structure /ttǝ/.

Instead of P-1.2., given here as (29):

(29) $\begin{Bmatrix} W \\ R \\ H \end{Bmatrix} \rightarrow \begin{bmatrix} [-son] \\ [+son] \end{bmatrix} \Big/ \begin{bmatrix} ---\# \\ V---V \end{bmatrix}$

one rule is proposed,

(30)   C → [+cont] / V---V

       e.g., /mot/ 'oil' /mot/ + /i/ → [mori] 'the oil'

Instead of P-1.3 given here as (31):

(31)   a. $\begin{Bmatrix} R \\ H \end{Bmatrix} \rightarrow \begin{bmatrix} [-son] \\ [+son] \end{bmatrix} \Big/ \begin{bmatrix} [\alpha cor] \\ [-\alpha cor] \end{bmatrix}$ _____

       b. W → [+son] / C---

the following rule is proposed:

(32)   C → [+son] / C
                         [-αcor]   ____
       $\begin{bmatrix} -lab \\ \alpha cor \end{bmatrix}$

       e.g., /a jaŋ/ + /te/ → [a jaŋre]   'he cured her'

             /a/ + /shen/ + /ke/ → [a shenhe] 'he remembered you'

Rule P-1.5, given here as (33):

(33) $\begin{Bmatrix} W \\ \langle R \rangle \\ \langle H \rangle \end{Bmatrix} \rightarrow$ [+son, +nas]/----C$_{[+son, +nas]}$
                                    $\langle \alpha cor \rangle$

could be rewritten as (34):

(34)   C
       $\begin{bmatrix} -glott \\ \langle -lab \rangle \\ \langle \alpha\ cor \rangle \end{bmatrix} \rightarrow$ [+nasal] / --- $\begin{matrix} C \\ \begin{bmatrix} +nasal \\ \langle \alpha\ cor \rangle \end{bmatrix} \end{matrix}$

e.g. /a dup/ + /no/ → [a dumno]   'he mixed it for me'

/a kət/ + /ne/ → [a kənne]   'he tested me'

/a ɗək/ + /mu/ → [a ɗəŋmu]   'he built it for us'

but /a ɗək/ + /no/ → [a ɗəhno] 'he built it for me'

The last rule which is involved in Newman's P-1.6 Stop/sonorant specification (C_1 of an abutting pair), which consists of three rules and one exception, given here as (35):

(35)   a.   W → [-son] / ----C

b.   H → [+son] / ----C$_{[\alpha son]}$

c.   R → [-αson] / ----C$_{[\alpha cor]}$

(Exception: R → r / ----)

Instead of these four rules, the following two could do if one accepts the existence of the underlying stops:

$$(36) \quad \begin{array}{l} C \\ [+cor] \end{array} \rightarrow [+son] \ / \ ---- \left\{ \begin{array}{l} C \\ [-cor] \\ \begin{bmatrix} +cor \\ +son \end{bmatrix} \end{array} \right\}$$

$$\begin{array}{c} C \\ \begin{bmatrix} -\ ant \\ -\ cor \end{bmatrix} \end{array} \rightarrow [+son] \ / \ ---- \begin{array}{c} C \\ [+son] \end{array}$$

Some examples of derivation, using the modified rules, are given in (37).

(37)   a.   'he stole a bow'   [a shir rəha]

/a/ /shiti/ 'steal' rəha 'bow'

/a/ /shit/ + /rəha/

[a shir rəha]   by rule (36)

b. 'her tongue'   [yilihro]

/yilik/ 'tongue'   /to/ 'her'

/yilik/ + /to/

/yilik/ + [ro]   by rule (32)

[yilihro]   by rule (36)

The modified rules account for all the examples with which Newman illustrates his original rules. They must, however, be treated as tentative for Kanakuru, since I did not have the possibility of checking them against the complete corpus of data.

The advantages of the above analysis over the previous analyses are the following:

1. It explains satisfactorily the phonetic form of the large class of verbs which have a stop in intervocalic position. This fact was not previously understood, cf. Newman [1974:4]. Instead of fifty, only four verbs remain unexplained.

2. It explains the vowel change from i → e in the verbs of Kanakuru. Previously, -i and -e were considered to be unpredictable verb endings (Cf. Newman [1974:40], Newman 1975:78]).

3. It is no longer necessary to postulate the existence of archiphonemes along with systematic phonemes to account for the phonetic form of the Kanakuru verb.

4. The phonological rules are less numerous and more general.

The most important conclusion of this paper is that the stop → continuant sound change is not a diachronic but a synchronic rule in Kanakuru and that there is no need for unnatural rules (cf. Hyman [1974: 178]) in order to explain the formation of plurals of verbs and nouns in Kanakuru. This together with Leben's discussion of the postulated rule inversion in Hausa (Leben [1974]) indicates that if there is a rule inversion in Chadic it remains to be shown.

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PARADIGMATIC INITIATION OF A

SOUND CHANGE IN HADIYYA

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A sound change *l > r/V___V in Hadiyya left original *ll
unaffected with the result that modern Hadiyya has alterna-
tions in verbs between r in intervocalic environments but
ll (often < *l-n) when certain inflectional suffixes are
added. This alternation has spread to roots which had
original *r/*rr, and moreover *rr has changed to ll out-
side the verb paradigms. The extension of the r/ll alterna-
tions to all verbs followed by the eventual creation of a regu-
lar sound change by extension of the originally paradigmatically
conditioned *rr > ll change to all instances of *rr is ex-
plained by Peirce's notion of abductive inference.

1. Introduction

Among the "pressing problems" for diachronic linguistics which a few
years ago Yakov Malkiel identified as needing attention was the possi-
bility of "the paradigm as a stimulus for a sound change". His article
proposed that the Spanish sound change of (palatalized) ǵ > z in the
environment after l, r, n, and related developments was due to exten-
sion of the alternation found in a single verb paradigm. "Every scrap
of evidence," he said, "points to the powerful analogical influence ex-
erted, in the two moods of the present tense, by DĪCŌ, ERE, a verb
whose paradigm is characterized by the neatly patterned interchange of
-g- and -z-: (ind.) digo, dize(s)..., (subj.) diga(s) " [Malkiel
1968:41].

It does seem entirely reasonable that analogical pressures created
by an alternation in common and frequent words could lead, under the
right conditions, to spread of the alternation as a sound change. Com-
pletion of the sound change would then make internal reconstruction of
the alternation which brought it about quite difficult.

The first purpose of the present paper is to present another case
in which an alternation of verb paradigms seems to have been extended
to eventually effect a general sound change. Owing to the clarity of
the comparative evidence, however, the present case constitutes a more

convincing example, perhaps, than that presented by Malkiel [1968]. A
second purpose of the paper is to exemplify the little recognized but
important psychological process involved in such linguistic change:
abduction, or abductive reasoning.[1] The language is Hadiyya, a Highland
East Cushitic language spoken in central Ethiopia, and the paradigmatic-
ally initiated sound change is *rr > ll.

2. Initiation of the sound change.

   Besides the change *rr > ll there was another, certainly related
sound change in Hadiyya, about which discussion must begin: *l > r/
V__V. Following in (1) is a short selection of basic-word cognates in
the five Highland East Cushitic languages. Notice the comparison of
Hadiyya r with l in the other languages in most of the items. In
'fire', 'butter', and 'long', in which original r can be reconstructed
all have r.

(1)

	Burji	Darasa	Hadiyya	Kambata	Sidamo
'butter'	--	buuro	buuro	buuru	buuro
'cattle'	lali	--	laro	lalu	--
'claw'	t'unga	--	t'uranka	t'ulankata	č'ulunk'a
'fire'	ǰiira	giira	giira	giirata	giira
'four'	foola	šoole	sooro	šolo	šoole
'liver'	afala	--	afare	afalita	afale
'long'	--	k'eerra	k'eera?la	k'eerrarru	--
'meat'	maala	maala	maara	maala	maala
'seven'	lamala	--	lamara	lamala	lamala
'smoke'	hilila	wiliila	wuriira	wiliilita	wiliile

The change in Hadiyya of *l to r between vowels created an alternation in verb paradigms. Intervocalic stem-final secondary r of most forms alternated with original l which remained in geminate clusters resulting from the assimilation by stem-final l of following suffix-initial n in the 1st pl. (of four conjugations) and of an unreconstructable suffix-initial segment in the imperative pl. This is seen in the two conjugations of (2). The stem-final intervocalic r of 'go out' is secondary, coming from l; 'cut', however, has original r.

(2)   Imperfect

	'go out'		'cut'	
1st sing.	firoommo	< *filoommo	muroommo	
3rd. m. sing.	firookko	< *filookko	murookko	
3rd. pol.	firaakkamo	< *filaakkamo	muraakkamo	
1st pl.	filloommo	< *filnoommo	mulloommo	< *murroommo
				< *murnoommo

Imperative

2nd sing.	fire	< *file	mure	
2nd pl.	fillehe	< *fil-Xehe	mullehe	< *murrehe
				< *mur-Xehe

The suffix-initial n of the 1st pl. is seen in e.g. waaččinoommo 'we swim' (stem waačč-), and yinoommo 'we say' (stem y-), with epenthesis of i between stem and suffix. Judging from the comparative evidence, one might guess the suffix-initial segment of the imperative pl. to be *h, or *y. These considerations are unessential here, however, where the reconstruction of the forms with rr is sufficient, and relatively uncontroversial.

The interesting words in (2) are mulloommo 'we cut', and mullehe 'cut! (pl.)'. That this morpheme has etymological stem-final r is clear from its cognates in Highland East Cushitic, which have r: cf. Kambata murraammi, Sidamo murreemmo 'we cut'; K. murre, S. murre 'cut! (pl.)'. Cognates of 'go out' have l: K. fullaammi, S. fulleemmo, 'we go out'.

The alternation of r and l existing today in Hadiyya verbs such as 'cut' can be reasonably explained as resulting from analogical extension of the alternation in the more frequent verbs, those with original intervocalic stem-final l, into the paradigms of the less numerous class, those with original intervocalic stem-final r. That verbs with original l were more numerous than those with original r seems apparent. Of forty verbs in my Hadiyya word-list which have stem-final r (i.e., r before the vowel-initial suffixes), seven are probably late borrowings from Amharic, the Ethiopian lingua franca (makkar- 'advise', karaar- 'be bitter', šaar- 'demote', barar- 'fly', wak'ar- 'pound', jammar- 'begin', masakkar- 'testify'); thirteen are of uncertain reconstruction, lacking cognates in the other languages (war- 'bring', atorar- 'converse', t'or- 'escape', kar- 'tie', sibaar- 'be hungry', tiir- 'remember', haraar- 'stir', naar- 'pile up', gomar- 'be ripe (corn)', geer- 'run', šišir- 'have leprosy', diriir- 'go to sleep', jar- 'be worse'); thirteen can unquestionably be reconstructed with l on the basis of their cognates in the other Highland East Cushitic languages (kur- 'tell', dabar- 'answer', sar- 'cook', waar- 'come', fir- 'go out', č'ir- 'defecate', hoor- 'forbid', k'ar- 'give birth', gar- 'pass the night', inkiir- 'pour', afuur- 'sit', allaar- 'watch cattle', osar- 'laugh'), and only seven can be reconstructed with original r (giir- 'burn', mur- 'cut', mar- 'go', tiir- 'untie', haar- 'scratch', ur- 'leave (vt.)', eger- 'wait'). Verbs with original *l include such household and fundamental morphemes as 'tell', 'come', 'go out', 'cook', bake', and 'sit', and those with original *r only 'go' with a presumably similar frequency of occurrence. The basic-word list sample in (1) seems representative, with original intervocalic l's outnumbering r's by something less than two to one, wherever cognates in the sister languages to Hadiyya make reconstruction clear.

In Hadiyya's close sister language Kambata, which has not seen the sound changes *l > r/V___V and *rr > ll, my word list shows twenty-five verb stems with final l and twenty-one with final r. Again those in final l include such basic meanings as 'tell', 'sit', 'give

birth', etc., and those in final r markedly fewer such basic meanings.
Such meaning/frequency relationships are, of course, difficult to specu-
late about with confidence. However, a very large frequency difference
between the two original stem-final consonants in Hadiyya is not re-
quired. Recall Malkiel's argument, in which an alternation in a single
verb is said to have been the model for a sound change. We are here al-
so considering a sound change that must have taken several centuries
for completion, and all that is required for the argument to be effec-
tive is sufficient weight on the side of stem-final *l to push the
very delicate evolutionary balance in its favor.

    This suggested account of the rise of the l ~ r alternation and
its extension into other verbs is shown in the three-stage chronology of
(3).

(3)	Stem-final, inter- vocalic segment	Cluster in 1st pl. and pl. imperative
Stage I	r *l	*r-n > *rr *l-n > ll
Stage II	r *l > r	*rr ll
Stage III	r r	*rr > ll ll

    In Stage I suffix-initial segments of the 1st pl. and pl. imperative
suffixes are assimilated to stem-final r and l yielding rr and ll
respectively. In Stage II the change of intervocalic l to r takes
place producing the alternation of r and l in verbs with original
stem-final l.   Finally, in Stage III the irregularity but not the al-
ternation is regularized, by the change of the minority rr clusters of
verbs with stem-final r to ll. In contrast with leveling of the al-
ternation, this spread of the alternation at least had the advantage of
regularization of a useful sort, creating then complete predictability
in both directions: intervocalic r implied 1st pl. and pl. imperative
ll, and vice versa.

    The change of *rr to ll has occurred not only in the stem-final
segment of verbs such as 'cut' in (2), as a regularization of verb para-
digms, but as a general Hadiyya sound change, as seen in the list of

Highland East Cushitic cognates of (4). In (4) we have comparisons of
Hadiyya ll with rr in four other Highland East Cushitic languages.
(The fifth, Burji, tends to be too divergent to show useful cognates
here.)

(4)

		Darasa	Hadiyya	Kambata	Sidamo
'he chased'		šorre	hollukko	šarro	sorrí
'he stood'		urre	ullukko	urro	urrí
'he descended'		dirre	dillukko	--	--
'day'		barra	balla	bari	baarra
'donkey'		harre	hallič̌čo	--	harrič̌čo
'tongue'		arrabo	allabo	arrabita	arrabo
'he learned'		--	losukko	rosso	rosí
'he cooked, fried'		ra?isse	li?issukko	re?iso	ra?isí
'he died'		ree	lehukko	reho	reí
'corpse'		renša	leešša	reeša	reeša

The last four items in (4) are examples of initial *r > l/#___ .
These are included on the hypothesis that they are also instances of *rr
> ll, based on the observation that initial r is commonly [rr] (e.g.
in Spanish and Amharic) and that in Hadiyya's sister languages initial
[rr] and [r] are in free variation. But in the word-initial environment
ll is necessarily replaced by l (this is discussed further in the con-
text of rule (10), below). Note that the first three items in (4), the
verbs 'chased', 'stood', and 'descended', do not show ll and rr clus-
ters resulting from assimilations in suffixing. Rather they have stem-
final clusters. The 1st plurals of these verbs have epenthesis before
suffixes with initial n, e.g. urrinenne, ullinummo, urrinoommi,
and urrinummo 'we stood' in Darasa, Hadiyya, Kambata, and Sidamo re-
spectively. Comparisons such as these in (4) offer evidence of a general
sound change in Hadiyya *rr > ll. That is, the change takes place not
only in the two grammatical environments, as seen in (2), but everywhere.

Indeed, the two sound changes led to the merger of the r and l
phonemes. The contrast of r and l was thereby lost in all positions.
This seems likely since there are no final consonants in the language

(with a few modern exceptions), if the few existing cases today of r
and l in clusters are assumed to be relatively recent innovations,
and if *rr > ll is understood to include initial *r > l. Some words
that show the cluster position as contrastive in modern-day Hadiyya are
t'ulbe 'ball', girda 'chaff', ilkollo 'face' (lit. 'eye-area'),
hurbaata 'grain, crop', malte?ukko 'he lied', and marte?ukko 'he
chose'. But such cases are few, and it seems clear that a basically CV
syllable structure with only geminate clusters is not an extremely
archaic state for Hadiyya. In the modern language verb stem-final r's
in contact with suffix-initial t's are assimilated: e.g. matto?o <
*mar-to?o 'she went', mattamo 'she will go' < *mar-tamo, fitto?o
'she went out' (stem fir- < *fil-), fittamo 'she will go out'.

But if there was such complete, grammatically unconditioned sound
change, then the explanation I have given above of verb paradigm regu-
larization in alternating r ~ l as the result of analogical change is
perhaps unnecessary, since the change of *rr to ll in 1st pl. and
pl. imperatives of verbs with etymological stem-final r could be just
a part of the sound changes which led to the merger of r and l.

Yet it is a striking fact about Hadiyya that both sound changes oc-
curred: *l > r/V___V, and, as well, *rr > ll. Rather than being ex-
planations of the rise and spread of r ~ l   alternations in the verb
system, the pair of sound changes of more or less opposite effect them-
selves require explanation. This point deserves emphasis. "Sound
change leading to merger" does not constitute explanation of the Hadiyya
phenomenon. I can think of no coherent account in terms of complemen-
tary phonetic changes, presumably physiologically motivated, which can
explain why laterals became taps in one position (intervocalic), and
taps became laterals in another (geminate), changes which could be ex-
pressed *l and *r > R, where R is [l] when long or word initial,
and [r] otherwise (alternatively: R is [r] short between vowels and
[l] otherwise). The question remains: why R?

Now the change *rr > ll will offer no suggestions toward explana-
tion of a consequent change *l > r/V___V. This is so since in the verb
paradigms which are the environments for inducing analogical change, the

geminate clusters occur in forms semantically more marked and less fre-
quent (the 1st pl. and pl. imperative) than the stem-final, single in-
tervocalic consonant, which appears in the most common 1st and masc. 3rd
sing. and other forms (cf. (2)). Without the preceding change *l > r/
V___V, secondary ll clusters from *rr would have stood defenseless
against analogical pressures in their verb paradigms to revert to rr.
This is apparent in (5), where the results of the two possible sequences
of the two sound changes are compared:

(5) a. Initial change *rr > ll

	Primary, frequent categories (Stem-final intervo-calic consonant is:)	Secondary, infrequent categories (Cluster in 1st pl. and pl. imperative is:)
Frequent verbs:	l	ll
Less frequent verbs:	r	*rr > ll

b. Initial change *l > r/V___V

	Primary, frequent categories	Secondary, infrequent categories
Frequent verbs:	*l > r	ll
Less frequent verbs:	r	rr

Analogical pressures for change are in the lower right-hand quadrant in
both sequences: on ll in (5a), and on rr in (5b). With the hypo-
thesis of (5a) the initial sound change *rr > ll produces an alterna-
tion in which the secondary alternate occurs in the less frequent verb
morphemes, and in the semantically secondary, infrequent verb forms or
allomorphs. Analogical pressures are therefore focused on the result of
the sound change in (5a). With the hypothesis of (5b), however, we get
an opposite result. The sound change *l > r/V___V produces an alterna-
tion in which the secondary alternate (in terms of the overall paradigm)
occurs in the frequent verbs, and in the semantically primary, frequent
verb allomorphs. Analogical pressures are focused on rr clusters in
(5b).

Therefore the hypothesis of (5b), an initial change of *l > r/V___V
provides an explanation of the change *rr > ll as subsequent. Further-

more, the sound change of *l > r/V___V also occurred in the Western
Gurage languages, a Semitic group in intense contact with Hadiyya, so
this change can itself have been initiated by borrowing from these lan-
guages.[2] The Hadiyya sound change *rr > ll seems likely to have been
initiated by alternations in verb paradigms. The change of rr clus-
ters to ll, begun in order to regularize these verb paradigms, was ap-
parently then generalized to extend throughout the lexicon. Generalized
as a context-free rule, *rr > ll affected even word-initial r, pho-
netically [rr], for which, in the absence in this position of ll dis-
tinct from l, simply l was substituted. It remains to discuss the
process psychologically, and in terms of grammar change.

3. Abduction in the sound change

I wish now to describe from a different perspective how this result
may have been obtained by Hadiyya grammar, relying on the notion abduc-
tive inference of Charles Sanders Peirce (cf. Peirce [1955:150-156]),
and its linguistic application abductive change, following discussions
by Raimo Anttila [1972:196-202] and Henning Andersen [1973].

At Stage II, referring again to (3) above, after the sound change
*l > r/V___V, learners of Hadiyya--and this includes full-fledged adult
speakers where unfamiliar and new words such as borrowings are

---

[2]Sound changes in the Western Gurage languages are intriguingly simi-
lar to those in Hadiyya; not only did *l > r/V___V, but in other posi-
tions *l and *r were merged as n [Leslau 1950:13; Hetzron 1972:83].
The fact that n figures in the Gurage merger shows that the two Hadiyya
sound changes are not explainable, by reference to Gurage, as borrowings,
or diffusion of an area feature. Rather we seem clearly to have parallel
but partially independent developments in Gurage languages and Hadiyya.
Furthermore, "diffusion of an area feature" no more constitutes an ex-
planation of the Hadiyya sound changes than does "sound change leading
to merger". The area feature itself needs an explanation. It appears
to me that the Gurage sound changes are indeed explainable, along lines
similar to those developed here, as involving paradigmatically initiated
sound change. This argument, important as it would be for substantiating
the present one, would carry us far afield, however, and it is sufficient
for present purposes to simply reemphasize that the Hadiyya sound changes
can certainly not be explained as simple borrowings from Gurage lan-
guages, the sound changes in which are themselves in need of explanation.
I expect to deal with the Gurage situation in a future paper.

concerned--are faced with the necessity to accomplish the correct rela-
tionship between intervocalic stem-final r's and either ll or rr
in lst plurals and pl. imperatives. Here abduction is required.

As induction is making rules given cases and results, and deduction
is producing results given cases and rules, abduction is providing
cases given rules and results. Thus given the three statements (a)
Socrates was a man; (b) Socrates was mortal; and (c) All men are mortal,
reasoning (a) & (b) ∴ (c) is induction; reasoning (a) & (c) ∴ (b) is
deduction; and reasoning (b) & (c) ∴ (a) is abduction. Obviously the
latter is a very faulty way of reasoning. What is important is that in
language learning abductive reasoning is often successful even when
wrong, as we shall see in the case under discussion.

In the Hadiyya situation of Stage II in (3), the given results are
numerous verbs which have the alternation r ~ l, and the rule is the
universal tendency for "one form, one function", or "one form, one mean-
ing" [Anttila 1972:100], termed "Humboldt's Universal" by Vennemann
[1972:183]. Abduction will yield new cases of alternation. (If non-
alternation is a possibility favored by the probabilities, abduction
will of course lead to leveling of the alternation.) The learning model
after Andersen [1973:778], is the diagram of (6):

(6)
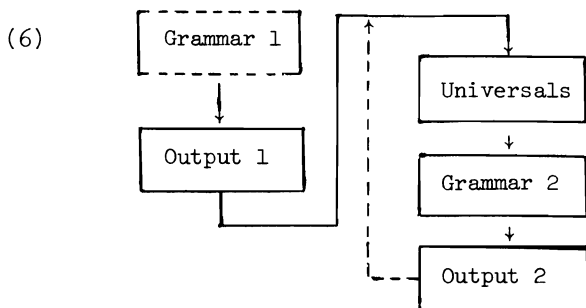
The data which learners have are Output 1 in (6); they have no ac-
cess to Grammar 1. Output 1 is filtered through the universals, at
least and perhaps no more than general learning principles, especially
what Peirce himself called "the one primary and fundamental law of men-
tal action", "a tendency to generalization" [Peirce 1955:320]. The ab-
ductions and inductions of Grammar 2 are deductively tested as Output 2,

which tests constitute further results for processing. In morpho-
phonology the tendency to generalization ordinarily means the one form,
one function principle: irregularities should be regularized.

In (3) again, at Stage II, there are two possibilities: provide all
1st plural and plural imperative l's (in geminate clusters) in alterna-
tion with r, or provide 1st plural and plural imperative r's (rr),
leveling the alternation.

I have already suggested that the former course was favored due to
the greater frequency of ll's in relation to rr's in Output 1. At-
tempted regularizations in Output 2 in favor of rr would have too of-
ten been rebuffed, whereas ll was more usually acceptable. The more
successful abductive inference would thus have made perceived new cases
of intervocalic stem-final r cases of alternation with l. Insofar as
these abductions succeed (by deductive testing: a result with 1st pl.
or pl. imperative ll is pronounced), they suggest the rule, or induc-
tion (7), which makes l an exponent of the 1st pl. and pl. imperative.
The rule neutralizes the contrast of r and l in this grammatical
environment.[3]

$$(7) \quad \left\{ \begin{array}{l} \text{1st pl.} \\ \text{pl. imper.} \end{array} \right\} \rightarrow \text{[+Lateral]}/ \left[\begin{array}{l} \text{+Sonorant} \\ \text{-Nasal} \\ \underline{\hspace{1.5cm}} \end{array} \right] \begin{array}{l} \\ ] \\ \text{V-stem} \end{array}$$

Rule (7) affects only the verb stem-final segment, assuming that gemi-
nate l is then the product of a synchronic rule with the effect of as-
similation (roughly, ln → ll).

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[3]Abduction may also be considered rule inference. In this interpre-
tation the syllogistic rule is the one form, one function universal, the
results the given alternations, and the abduced case is the linguistic
rule, e.g. (7). Thus abduction can be considered a type of induction,
imperfect induction that is, since it consists of overgeneralization (cf.
Anttila [1975:268ff]). This more complex conception of abduction is
that ordinarily intended by Peirce. In this paper I emphasize a simpler,
but I think linguistically equally interesting interpretation of abduc-
tion, in which the abduced syllogistic case is also the linguistic 'case',
or morpheme inferred to conform to an induced rule, the linguistic 'rule'.

This induction, or rule, is in an important sense less 'instrumental' in bringing about the regularization than is the abduction, or positing of new cases. It is the abduction of new cases which constitutes language change, or at least apparent language change, and the success of these neologisms makes possible the eventual, general rules which appear in retrospect to describe a sound change. This is so since, even if the induction is wrong--and rule (7) is a wrong statement of the facts at Stage II--the abductions of new cases may often, in two sorts of cases, be accepted: (i) in neologisms for which the majority case of alternation is the model, and (ii) among learners, especially children, whose peers also favor the abductions even in verbs historically without the alternation, but also among adult or mature speakers of Hadiyya where the abductions are infrequent verbs not recognized by them as historically without alternation. In this way, the abductions of new cases of alternation whittle away at the inventory of non-alternating r's, and the language changes, even when (7) is inaccurate as a general rule, and not an adult rule of Hadiyya.

Rule (7) is true for most verbs with intervocalic stem-final r but not for those with etymological r in this position, and for this minority, (7) implies wrong results (i.e., wrong at Stage II in (3)): innovative mulloommo 'we cut', instead of original *murroommo, etc. The older generation, by insisting on 1st pl. and pl. imperative in rr for these proved rule (7) a wrong induction, and the major rule (7) would have had to be replaced by learners with a rule with the effect of (8), which applies only to morphemes specifically marked for alternation, such as the verb 'go out', with a lexical representation effectively equivalent to (9).

(8)
$$\left[\left\{ \begin{matrix} +\text{Tap} \\ +\text{Lateral} \end{matrix} \right\} \right] \rightarrow [+\text{Lateral}] / \underline{\quad}]_{\substack{\text{1st pl.} \\ \text{pl. imper.}}}$$

(9)
$$\begin{bmatrix} +\text{Obstruent} \\ +\text{Continuant} \\ +\text{Labial} \end{bmatrix} \begin{bmatrix} +\text{Vocalic} \\ +\text{Front} \\ +\text{High} \end{bmatrix} \begin{bmatrix} +\text{Sonorant} \\ -\text{Nasal} \\ \left\{ \begin{matrix} +\text{Tap} \\ +\text{Lateral} \end{matrix} \right\} \end{bmatrix}$$

$$\quad\quad\quad\quad f \quad\quad\quad\quad\quad i \quad\quad\quad\quad \left\{ \begin{matrix} r \\ l \end{matrix} \right\}$$

Rule (8) is stated in an unorthodox manner, as a rule applying to
suppletive representations, i.e. to segments such as the third in (9),
in which both tap and lateral are specified. The ordinary way of
handling such alternations in transformational-generative phonology is
to derive one feature from the other. The argument for suppletive rep-
resentation of all alternations is presented in Hudson [1975], and is
unessential here, where my point is simply that when regularization in
favor of alternation becomes impossible, the alternative is to set up
two classes of verbs in stem-final r: those which alternate (marked
in some way) and those which do not. Rule (8) and lexical representa-
tion (9) express this analysis of the facts clearly.[4]

But abduction based on (7) would have been the better analysis in
terms of the one form, one function universal, since it would make the

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[4]The equivalent in standard transformational-generative phonology to
the 'suppletion analysis' of (8) and (9) would be a 'minor' rule $r \rightarrow l/$
___n in the environment of a lexical diacritic (e.g. '+X'). This would
be an adequate alternative to (8) and (9), as merely a description. I
prefer not to use the minor rule formalism here, however, considering
it inaccurate, unreal, or unexplanatory.
    The three main arguments for suppletion of all alternations should
perhaps therefore be summarized, but briefly. These are: (i) When
formerly unexceptioned alternations begin to be leveled, the minor-rule,
diacritic representation of the leveling requires spread of the diacritic.
The situation is a simplifying, but the representation is a spread of
marks, or complicating. (ii) The shift from major to minor rule nota-
tion (respectively absence or presence of diacritics) and vice versa,
which certainly occurs in rule histories in standard transformational-
generative phonologies (as the shift takes place from alternation via
derivation from a basic form, where there are many cases, to suppletion,
where there are a few, or one) cannot conceivably be determined in a
principled way in that system of formalisms; the descriptive theory re-
mains hopelessly vague at a crucial point. The simple principle that
all alternations involve suppletion, on the other hand, solves the prob-
lem represented by this continuum, and is an accurate description of the
usual case of alternation: markedness leading to leveling. (The excep-
tional case, spread of alternation, can still be accounted for as in this
paper.) (iii) The uncontradicted and desirably strong descriptive princi-
ple of no extrinsic rule order requires suppletion of alternations, since
the 'spelling rules', or statements of segmental composition of morphemes
in the lexicon, unordered, imply that lexical entries must be true on
the surface; alternating morphemes do have two or more surface forms, as
accurately represented in suppletion of alternations.

majority cases of alternation expressions of an obligatory grammatical
function, and hence would lead to paradigm regularity and complete pre-
dictability of the alternation. Abductions based on (7) would continu-
ally be attempted by consecutive generations of Hadiyya learners, and
before (7) is replaced by (8) in learners' grammars, the abductive in-
ference of new alternations (the replacement by ll of rr in 1st pl.
and pl. imperatives) in the two sorts of situations mentioned above
would have led to an increase of alternation at the expense of non-
alternation. The abductions, that is, would have been repeatedly suc-
cessful, even though the induction (7) was subsequently and repeatedly
rejected. More and more verbs came to alternate, and eventually only
very common verbs like 'cut' and 'go', with etymological r, remained
without alternation. And finally, these too must have yielded to the
spread alternation dictated by the persistent abductions by learners of
new cases of alternation; *murroommo > mulloommo 'we cut', *marroommo
> malloommo 'we go'. Thus (7) became unexceptioned at Stage III.

I have so far tried to describe the grammatical changes leading to
regularization by generalization of the alternation of r ~ l in 1st pl.
and pl. imperative verbs. It remains to describe how other rr-clusters
were replaced by ll outside these two verb environments, as a general
sound change in Hadiyya. Once again abductive inference is involved,
and once again the one form, one function universal is the important law
of language which requires abductions crucial for explaining the spread
of the alternation, not only in the verb system, but throughout the
lexicon.

We need to refer again to the three stages of (3). After *l > r/
V___V occurring at Stage II, learners of Hadiyya are required to learn
the alternations of r and l in a large group of verbs. This output
of the grammars of their elders is perceived in light of the one form,
one function tendency, or universal, which disfavors alternation, and
above I have suggested that the analysis of alternations which accom-
plishes the desired result is (7), a rule which treats the alternation
as the expression of a grammatical function. An equally favored alterna-
tive, or perhaps even a superior one, since it treats the alternation as

owing to a phonetic constraint of the language, an "automatic alterna-
tion" [Hockett 1958:282], and not an alternation at all in this sense,
is (10).

(10) $\begin{bmatrix} +\text{Sonorant} \\ -\text{Nasal} \end{bmatrix}$ → $[+\text{Lateral}]/$ $\begin{bmatrix} \underline{\hspace{2em}} \\ +\text{Long} \end{bmatrix}$

Rule (10) is a segment structure rule: non-nasal sonorants, if
long, are laterals. Alternatively, manner of articulation, the contrast
of tap vs. lateral in non-nasal sonorants, is neutralized in geminates
in favor of the latter. Again the rule is written to affect only the
stem-final segment, assuming gemination to result then from a rule as-
similating suffix-initial n to stem-final r (then by (10) rr → ll).[5]

We can imagine how, with the sound change *l > r/V___V, learners of
Hadiyya, finding ll-clusters in some verb forms (imperative and 1st
plurals) where they expect to find rr, and perhaps having their occas-
ional rr's rebuffed in favor of ll's, would begin to abductively
change all geminate r's to geminate l's, a change consistent with
analysis (10). Learners of Hadiyya, including adult native Hadiyyas who
are unsure of themselves regarding a given verb form and its non-nasal
sonorant geminate cluster, will not distinguish between such clusters
which they may indeed have heard before in words which, however, they may
not often use, e.g. in a noun such as 'tongue' (allabo < *arrabo), and
those they in fact have not heard, e.g. in verbs for which they must
hypothesize from a familiar stem-final intervocalic r the 1st pl. and
pl. imperative in which the stem-final sonorant is geminated. But at
the instant of articulation they will apply the one form, one function
rule on the basis of the given results of alternation, and abduce cases
of geminate l.

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[5]Standard TG phonology actually makes available several possible
synchronic analyses of the situation: r-n → rr → ll; r-n → l-n → ll;
or, where L is the archiphoneme of r and l, r-n → LL → ll; or
r-n → ll, in one step. Fortunately, the apparently arbitrary choice
among these alternatives is not necessary here. Rule (10) is intended
to express the state of language when geminate r was precluded in favor
of geminate l by a phonetic constraint, however this is to be expressed
in synchronic grammar.

In modern-day Kambata, in Hadiyya's other sister languages, and com-
monly in languages with both r and rr but no contrast of these in
initial position, initial r is commonly [rr]. Rule (10) will affect
these cases of geminate r the same as intervocalic cases. But in these
cases an adjustment is required, since, unlike long r, long l does
not occur in initial position, or if it does, it is a free variant with
short l. When applied to *rehukko [r:ehuk:o] (10) yields lehukko,
and in this way the sound change *rr > ll would have affected initial
as well as intervocalic cases of rr.

When abductions of new cases of geminate l in non-verbs are reject-
ed or fail in common, everyday words such as 'day' (balla < *barra) and
'he died' (lehukko < *rehukko), which were ungrammatical with l at
Stage II, (10) might still be replaced by (7), which applies only to the
stem-final l of verbs, until (7) too leads to rejected abductions, e.g.
mulloommo (< *murroommo) 'we cut', wrong at Stage II. Yet as with in-
novative abduced verb forms consistent with (7), innovative abduced non-
verbs and word-initial l's consistent with (10) could have succeeded in
the two cases already mentioned: (i) where the abduction is in a new
word, and (ii) in merely unfamiliar items among peers, child or adult,
who also favor the abduction. And even when rule (10) is given up,
whether in favor of (7) or (8), these innovations would have remained
with ll. With the continual increase of these innovative abductive
ll-clusters, rr-clusters would at some point in time have remained only
in a few frequent and common items. Perhaps non-verbs such as *arrabo
'tongue' and *barra 'day' survived after all such rr-clusters in 1st
pl. and pl. imperative verbs had given way to ll, and rule (7) was an
adult rule in Hadiyya. Anyway, with repeated generations repeatedly ab-
ducing new cases such as balla and allabo, these too eventually would
have been accepted, as they are today, and segment structure rule (10)
would have persisted to become a part of Hadiyya grammar.

Here again it should be emphasized that abduction in this way brings
about language change even when the innovative induction (10) repeatedly
fails to survive as an adult rule of Hadiyya. The one form, one function
universal tendency or <u>rule</u>, plus the given <u>results</u> of numerous l's in

alternation with r analyzed in terms of (10) justify the abduction of
new cases of ll. The gradual persistence and acceptance of these ab-
ductions, over generations of Hadiyya speakers, makes (10) a description
of the accomplished sound change; but rule (10) is not an adult rule of
Hadiyya until the last abduction changes the last geminate r to gemi-
nate l.

4. Conclusion.

The Hadiyya sound change *rr > ll can be understood as the result
of over-generalized regularization of verb paradigm alternations which
resulted from the prior sound change *l > r/V___V. In such regulariza-
tions abduction, the inferring of new cases of a perceived regularity,
brings about change gradually over generations by conforming morpheme
after morpheme to the regularity, even though the regularity itself does
not represent at any incomplete stage of the change a rule of the gram-
mar of mature speakers.

It is noteworthy that in this conception of sound change, unlike in
the standard conception of transformational-generative (TG) phonology,
the rule which the sound change represents need not be posited as a syn-
chronic rule of adult grammar. In TG phonology it is the existence of
the sound change as a synchronic, major rule in the grammar which is sup-
posed to explain the sound change, as item after item, exceptions to the
major rule, lose their exceptional status. The above historical analysis
of Hadiyya *rr > ll shows how such a change can be understood without
recourse to the unnecessarily hypothetical positing of synchronic rules
of alternation, as in standard TG phonology, to which numerous native-
word exceptions exist. The detailed comparison of the two modes of analy-
sis and the argumentation which should probably accompany the comparison
cannot be broached here, where it would detract from the primary objec-
tives: the presentation of an apparent case of paradigmatic initiation
of a sound change, and its further explanation as abductive change.

The existence of at least one familiar Hadiyya lexical item with rr,
harra 'silk' (< Amharic harr < Arabic harir), is sufficient to make
rule (10) a poor analysis for modern Hadiyya, though this does not deny
the likelihood that it is a part of the grammar of many Hadiyya speakers.

The existence of this word as a native-word of Hadiyya (as well as I can tell; note the nativized form, with final a), and the presence of Amharic and of Gurage languages with rr clusters as contact languages in the Hadiyya area clearly makes the revival of rr clusters favored. Furthermore there are today intervocalic l's in e.g. č'iila 'baby', salalo 'cheese', and even two verbs borrowed from Amharic with stem-final l: nakkalukko 'he uprooted' (Amh. nakkala), and sankaalukko 'he hobbled (a horse, mule)' (Amh. sanakkala).

Rule (7), by which alternation is perceived as the expression of the 1st pl. and imperative pl., can persist in Hadiyya grammar until, with the rise of rr clusters outside the verb system, it no longer is imposed on learners through the rejection of their persistent abductive innovations with rr in 1st pls. and imperative pls. A new generation will then account for r ~ l alternations by marked lexical representations such as the lexical entry for 'go out', (9), in which the features for tap and lateral are suppletive, and by a rule with the effect of (8). Then leveling of the alternation will begin, as marked lexical items are simplified by loss of the mark of alternation. We may then expect leveling in favor of r, as the alternate in the more basic and frequent allomorphs.

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ERRATA

The following corrections should be noted in Robert W. Wilkinson's article, "Contrast preservation in Yoruba", which appeared in SAL 7:65-92 (1976):

1. The symbol ⌐ used for the falling tone on fẹ́rã̀ is said to represent a mid-to-low fall on page 80, but the derivation of fẹ́rã̀ under (7a) on page 82 produces a high-to-low fall (indicated as 1-5) differing from the fall on dípô (1-6) by not reaching as low a terminal pitch. Since the exact phonetic difference between these two falling tones is not made clear in Bamgboṣe (1966), the symbol ought not to be specifically interpreted as M-L. If this fall in pitch is correct for fẹ́rã̀, derivation (7a) can be modified accordingly in several possible ways.

2. It is incorrectly stated on page 83 that the only surface allomorphs of /ìgbó/ would be ìgbǒ and !gbó with the rule order TE-6). This is falisified by any CV verb whose vowel replaces the prefix vowel of /ìgbó/, for the collocation /CV ìgbó/ should then yield CV̀gbǒ with the order PT-TE- 6). The minimization of allomorphy argument as presented at the bottom of page 83 is thus vitiated, but the rephrasing of this argument on page 84 still holds, taking into account that the three allomorphs ìgbǒ, gbǒ and !gbó represent as much obscuring of the underlying second syllable H as just ìgbǒ and !gbó would.