HOW CONCRETE IS PHONOLOGY?

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This paper presents evidence for abstract phonology—that is, a phonology that recognizes underlying segments which are not realized phonetically. Two underlying vowel segments /o/ and /e/ are posited for Nupe (a Kwa language of Central Nigeria), both of which are realized as [a], therefore merging ('absolutely neutralizing') with /a/. Arguments based on pattern congruity, naturalness, and a 'weak' form of alternation are brought forth in support of this solution. Central, however, is the demonstration of the psychological reality of these two segments. In addition, various alternate solutions are shown to be inadequate. Finally, implications of the abstract Nupe solution are discussed.

Much of the recent discussion in generative phonology has centered around the issue of abstraction: to what extent do the underlying forms of the most highly valued phonological system of a language differ from those forms encountered in the surface phonetics? Although generative phonology has never advocated a position as abstract as the one taken by Lamb 1966, for example, or by Fudge 1967, phonologists have generally assumed that a considerable degree of abstraction is correct in phonological solutions. Independent of any claims one might wish to make concerning the reality of these phonological solutions, many phonologists express the feeling that somehow these (and only these) are explanatory, since they account for many otherwise unaccountable exceptions to general rules and conditions by postulating a deeper, more regular pattern. That this notion of 'explanation' differs from the more general notion of EXPLANATORY ADEQUACY of grammars (and often, some would claim, is at odds with it) is perhaps a point that has not been properly emphasized. Does a phonology that 'explains' certain processes at an abstract level necessarily coincide with the one explanatorily adequate (that is, the most highly valued) form of phonology? In other words, are these abstractions justified on a principled basis, and do we want them in our grammar? Kiparsky, in an unpublished paper entitled 'How abstract is phonology?' (1968), presents evidence from linguistic change to show that many of the so-called abstractions put forth by phonologists have no place in generative phonology. It is to this issue of abstractness in phonology that I shall address myself in this paper. The term 'abstract' will be used specifically to refer to those solutions that permit non-alternating underlying segments which do not emerge on the phonetic surface.

1. THE PROBLEM. In writing grammars, the aim of reaching explanatory adequacy entails a quest for language universals and the 'psychologically real',

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1 This paper is an extended version of the one I delivered in Urbana, Illinois, on 26 July 1969, at the Summer LSA Meeting. I would like to thank Victoria Fromkin for giving up much of her valuable time to help me revise the earlier version of this paper. I am also deeply indebted to my good friends and colleagues Isaac George and Danny Alford for many valuable insights.
since our aim is not merely to find new and neater ways to present data, but to
discover the nature of the mental mechanism activated by the child in language
acquisition. As has been pointed out so often by Chomsky, the nature of this
mechanism is an empirical question, and a theory of language seeks to explain
the principles on which it is constructed. Assuming the reality of this mecha-
nism, a further assumption is made: namely, that there is only one theoretically
correct and explanatorily adequate form of grammar that we seek to discover.
The question of determining the constraints on the underlying phonological
representations of the lexical entries in a grammar is motivated by this aim. In
relation to this problem, there are now at least four means (instead of just one)
of handling sub-patterning of non-alternating, phonetically identical segments.
Kiparsky calls these the diacritic use of phonological features, the phonological
use of diacritic features, rule features, and (to add a fourth for the sake of com-
pleteness) minor rules. As we have such a wide range of solvents, we are met by
an ever-occurring non-uniqueness of solution, since one linguist may prefer
diacritics, while another may choose to increase the number of underlying sys-
tematic phonemic oppositions. We obviously cannot tolerate such a variety of
solutions in a theory that claims explanatory adequacy as its goal, since we have
assumed that there is only one correct grammar. It is this one grammar that we
shall call 'psychologically real'. Therefore, we must find some appropriate means
to tell us which one of these solutions is the most highly valued in a given set of
circumstances. In this paper, diacritic features, rule features, and minor rules
are shown to be inadequate in at least one grammar. It will be demonstrated
that the most highly valued solution to a particular problem in Nupe (a Kwa
language of Central Nigeria), concerning labialized and palatalized consonants,
is an abstract one: namely, one that posits underlying segments which are not
realized phonetically—i.e., one that allows 'absolute neutralization'.

2. NUPE DATA AND SOLUTION. The most concrete phonology, a phonemic one,
is forced to set up the following phonemes:

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These are based on a distributional analysis of the occurring surface segments.
If we assume that the underlying segments are those above, we note the fol-
lowing:

(a) The general (V)CVCV... morpheme structure of Nupe is violated in the
case of what would be /Cw/ and /Cy/ clusters (ignoring syllabic nasals, which
possibly have an NV source).
(b) /Cw/ and /Cy/ occur only before /a/ and /ä/. (I shall hereafter ignore nasalized vowels and the one long phoneme /a:/ in this discussion.)

(c) /s z c j/ contrast with /s z ts dz/ only before /a/. In the only other contexts in which they occur, i.e. before /i/ and /e/, they are ‘allophones’ of /s z ts dz/, respectively.

Thus /Cw/ and /Cy/ clusters are exceptional in that (1) they alone violate the underlying regularity of (V)CVCV... and (2) they occur only before /a/. My focus will be on these ‘consonant-glide’ clusters. I shall be concerned with demonstrating that these clusters are representative of a more general process in the Nupe language than is directly observable from surface considerations.

While these consonant-glide clusters occur contrastively only before [a], there is a general assimilatory process in Nupe by which consonants are labialized (and velarized) before rounded back vowels, and palatalized before unrounded front vowels. The automatic rounding and fronting is not always readily discernible (like the English labialization of the /k/ in ‘coat’, for example), but is most noticeable in the velar consonants. Thus we find:

\[
\begin{align*}
\text{k} & \rightarrow [k^r] \\
\text{p} & \rightarrow [p^r] \\
\text{s} & \rightarrow [s^r] \\
\text{dz} & \rightarrow [dz^r] \\
\text{r} & \rightarrow [r^r] \\
\text{kp} & \rightarrow [kp^r] \\
\text{m} & \rightarrow [m^r]
\end{align*}
\]

孰 etc. etc.

(For the correct phonetic development of stridents, however, see below.)

Although we find the above consonantal allophones before /u/ and /o/, /i/ and /e/, before /a/ we find no such simple complementary distribution, but instead a three way contrast: /Cw/, /Cy/, and /C/, as recognized above. It is for this reason that Smith 1967 proposed, in his phonemic solution, a sequence of consonant + glide before /a/, to account for the following contrasts:

- /eqwa/ ‘hand’ /twá/ ‘to trim’
- /eqya/ ‘blood’ /tyá/ ‘to be mild’
- /eqgá/ ‘stranger’ /tá/ ‘to tell’

There is good reason, however, to consider these ‘clusters’ as single underlying segments. The first argument is one of pattern. Under (a) and (b) above, we have noted the anomalous nature of /Cw/ and /Cy/. By treating these as /C^r/ and /C^s/, we could at least eliminate the first anomaly. There is, however, a further argument. Nupe has a tone rule by which a high tone becomes rising when the (pre-vocalic) consonant of the syllable is [+voiced] and when the preceding syllable has low tone. Thus we find:

- /èdê/ → [èdê] ‘cloth’
- /kùlê/ → [kùlê] ‘bell’

There are three underlying tones in Nupe: /ä/ low [1tone], /ã/ mid [2tone], and /á/ high [3tone]. Other tones are derived, such as a rising tone [ã] and a falling tone [ã]. A third derived, ‘lower-mid’ tone, somewhere between [1tone] and [2tone], is not dealt with in this paper.

This tone rule was pointed out to me by Isaac George.
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/hda/ → [hda] ‘father’
but: /yekó/ → [yèkó] ‘road’

However, compare the following, where /è/ has been prefixed to verb stems presented above, thereby yielding the ‘present’ tense:

/è/ + /twá/ → [ètwá] ‘is/are trimming’
/è/ + /tyá/ → [ètyá] ‘is/are mild’

Here, despite the fact that /w/ and /y/ are [+voiced], the high tone has not become a rising tone. If we look at the examples

/è/ + /bwá/ → [èbwá] ‘is/are sour’
/è/ + /gbyá/ → [ègbyá] ‘is/are stripping off’

we find that the glides are actually not relevant to the tone rule at all. The structural description of the rule is met or not met solely on the basis of the preceding consonant—suggesting that the glides are NOT identical to (and therefore function differently from) the /w/ and /y/ phonemes occurring independently, as in:

/èwú/ → [èwú] ‘puckering’
/èyè/ → [èyè] ‘no’

We conclude from this evidence that the analysis of these segments as consonant + glide is incorrect.

We may also consider—but will reject—an analysis which derives these phonetic entities from underlying vowel sequences. For instance, /ègùa/ could underlie the form for ‘hand’, but then we would require a rule to derive the phonetic form [ègwa] or [ègà]. Nupe in fact has a rule that reduces vowel sequences across morpheme boundaries (see Smith for a more detailed discussion of the data). In general (with a few further modifications), this late rule, applying after the labialization and palatalization rules, will delete the first of the two vowels in sequence (with lengthening of the second vowel under certain circumstances). For our purposes we can state it as follows:

\[ V_1 \rightarrow \emptyset / \ldots \# V_2 \]

For example, the underlying string of formatives /ù + dù + à/ ‘he cooked them’ is realized phonetically as [ùd*à]: first the /d/ of /dù/ ‘to cook’ is labialized, and then the /u/ is deleted. The steps for deriving the surface form of ‘hand’ would therefore be:

/ègùa/ → èg*ùa → [èg*à]

Since the proposed /ua/ sequence (and the corresponding /ia/ sequence) would always be intramorphemic, the effect of this solution would be to postulate /u/ in the underlying forms and then to obligatorily delete it in all instances. This, then, is equivalent to a solution that recognizes underlying /èg*à/, since the added machinery (intramorphemic vowel deletion), or rather the extending of old machinery, is unnecessary. A speaker of Nupe can isolate the individual forms underlying the phonetic utterance [ùd*à] ‘he cooked them’; in careful speech, as [ù-dù-à] from [i + dù + á]. He cannot and would not carefully pronounce *[è-gù-à] since the underlying form is not /è + gù + a/. This proposed solution thus simply replaces (a) and (b) above by the following: (a’). The first
vowel in a /VV/ sequence is /u/ or /i/. (b') The second vowel in a /VV/ sequence is /a/. And in this sense it is no solution at all.⁴

Therefore, given these distributional facts, and deciding against the consonant-glide sequence, as well as the /CVV/ sequence, we might conclude that an entire series of labialized and palatalized consonants must be posited as underlying segments only for formatives in which the vowel segment is /a/. Thus we re-analyse the forms given above as /ēgʷə/ 'hand'; /ēgʷà/ 'blood'; /ēgʷə/ 'stranger'. Note, however, that to account for the regular labialization and palatalization which occur before non-low vowels, we still need two rules which will derive phonetic segments identical to the phonological segments we have been forced to set up:

1) Labialization Rule (LR):
   \[ C \rightarrow Cʷ / \{u\} \]

2) Palatalization Rule (PR):
   \[ C \rightarrow Cᵣ / \{ə\} \]

Or, in distinctive-feature notation:⁵

3) \([+\text{cons}] \rightarrow \begin{bmatrix} +\text{round} \\ +\text{high} \end{bmatrix} / +\text{round} \] (LR)

4) \([+\text{cons}] \rightarrow \begin{bmatrix} -\text{back} \\ +\text{high} \end{bmatrix} / -\text{back} \] (PR)

With these rules, we have the following derivations:

5) /ēgʷ/ ‘mud’ → [ēgʷu] (LR)
   /ēgʷə/ ‘grass’ → [ēgʷə] (LR)
   /ēgʷ/ ‘child’ → [ēgʷi] (PR)
   /ēgʷ/ ‘beer’ → [ēgʷe] (PR). But:
   /ēgʷ/ ‘stranger’ → [ēgʷə] (no assimilation)

Since [ēgʷu] and [ēgʷə] share the segment [gʷ] with [ēgʷə] ‘hand’, we may ask: should we postulate in generative phonology underlying segments which are identical to those of traditional phonemics (i.e. /gʷ/ for ‘hand’), or could we in

⁴ Compare the following homophonous sentences (courtesy of Isaac George):
/ēts324\u00e6 u bē/ → [ētsʷəb:be] 'The chief will come.'
/ētsʷə a bē/ → [ētsʷəb:be] 'The moon will come.'

The word for ‘chief’ in isolation is [ētsʷə] (having undergone lip-rounding); the word for ‘moon’ is [ētsʷə]. In both cases, the vowel (the /u/ of ‘chief’ and the /a/ of ‘moon’) has dropped in accordance with the vowel deletion rule. Because the preceding consonant is labialized in each case, the result is homophony. However, in slow, careful speech, a Nupe will say [ētsʷə u bē] for ‘The chief will come’, where we see that an underlying /u/ is warranted. But in a proposed /ētsʷə/ ‘moon’ (parallel to the proposed underlying form /ēgʷə/ for ‘hand’), we could never ‘recover’ the proposed underlying /u/, precisely because a Nupe speaker does not have such knowledge available to him. We shall see below how a preferred solution best accounts for the knowledge that the Nupe speaker does possess.

⁵ I treat palatalization as [+high, -back] and labialization (accompanied by velarization) as [+high, +round, +back] (thus far agreeing with Chomsky & Halle 1968). /kp/ and /gb/ are considered to have an additional feature specification [+suction] to distinguish [kpʷ] and [gbʷ] from [pʷ] and [bʷ], respectively.
some way reveal a more general process of labialization and palatalization involving the forms 'hand' and 'blood'? Specifically, and still with reference to surface phonetics, could we set up three distinct phonemic a's, one which functions to labialize preceding consonants (as in 'hand'), one which palatalizes preceding consonants (as in 'blood'), and one which has no assimilatory effect at all (as in 'stranger')? We could write these three underlying vowels as /ai/, /a2/, and /a3/, respectively. Having done this, it would then be possible to conceive of all phonetic labialized and palatalized consonants as resulting from LR and PR above. Let us examine what this would mean.

First, it would require us to alter our rules, changing the structural descriptions of LR and PR in accordance with our tripartite distinction above. The rules would then be:

(6) $C \rightarrow C^w / -$ \begin{align*}
\{ & u \\
\} & o \\
\{ & a_1 \\
\} & a_2
\end{align*}

(7) $C \rightarrow C^y / -$ \begin{align*}
\{ & i \\
\} & e \\
\{ & a_2
\}
\end{align*}

Where we have /a3/, of course, this underlying vowel fails to meet the structural description of either rule; the preceding consonant is thus neither labialized nor palatalized, as in [̄gä] 'stranger'. These rules operate on underlying forms such as /̄gä1/ 'hand', /̄gä2/ 'blood', /̄gä3/ 'stranger'. Such a solution would of course handle the data. However, it would seriously affect the feature specifications of LR and PR, since in each we have added a variant of [a] with the feature specifications [+low, +back, -round]. Thus, in the case of LR, [a] causes the pre-vocalic consonant to change its feature specification to [+round]; in the case of PR, it causes the preceding consonant to change its feature specification to [−back]. Neither of these phenomena would preserve any semblance of 'rule naturalness'. (The case of /a3/ presents no problem.) Insofar as possible, we want to preserve the notion that it is natural for a rounded vowel to round a preceding consonant, just as it is natural for a front (palatal) vowel to front (palatalize) a preceding consonant, but that it is highly unnatural for an unrounded vowel to round and a back vowel to front.

We want therefore to preserve our natural rules LR and PR. With this problem in mind, we arrive at the following analysis: the labializing /a1/ is /o/, and the palatalizing /a2/ is /e/. We shall therefore recognize /o/ with the feature specifications [+low, +back, +round], and /e/ with the feature specifications [+low, −back, −round]. Thus we obtain the following distinctive-feature matrix of the relevant Nupe vowels:

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<th>voc.</th>
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<th>/e/</th>
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Accepting provisionally the underlying seven-vowel system just proposed, we now posit the following underlying forms:

- /eɡɔ/ ‘hand’       /tɔ/ ‘to trim’
- /eɡɛ/ ‘blood’      /tɛ/ ‘to be mild’
- /eɡa/ ‘stranger’    /tɑ/ ‘to tell’

And we add /o/ and /e/ to the structural description of LR and PR respectively:

(8) \( C \rightarrow C^r / \quad \begin{array}{c} u \\ o \\ e \end{array} \)

(9) \( C \rightarrow C^l / \quad \begin{array}{c} i \\ o \\ e \end{array} \)

although the rules remain the same as stated above (3, 4) in distinctive-feature notation.

Thus the rules which yield the labialized consonant in ‘grass’ and the palatalized consonant in ‘child’ also operate on the underlying forms for ‘hand’ and ‘blood’:

(10) /eɡɔ/ \(-\ast\) [eɡ wɔ] (LR)
- /eɡɛ/ \(-\ast\) [eɡ wɛ] (PR)
- /eɡa/ \(-\ast\) [eɡ wɑ] (LR)
- /eɡɛ/ \(-\ast\) [eɡ wɛ] (PR)

At this point an additional (late) rule is required to take care of the following two phenomena:

(11) \( o \rightarrow a \)
- \( e \rightarrow a \)

both of which obligatorily yield surface [a]. This can be handled very simply:

(12) \([-\text{low}] \text{V} \rightarrow [[+\text{back}, -\text{round}] \text{V}] \)

This rule, which we shall refer to as ‘absolute neutralization’ (AN), applies only after LR and PR have derived [C^r o] and [C^l e] respectively.

Also dependent on the recognition of /o/ and /e/ is a rule which operates on underlying Nupe stridents. Although it must be considered as a separate, independent process, the effect of this rule is similar to that of PR. It has already been stated above that /s z c j/ are ‘phonemic’ only before /a/. In this preferred solution, utilizing /o/ and /e/, there is no longer any need to recognize these as underlying segments. Instead they are in all cases allophones of /s z ts dz/.

The Strident Rule (SR) thus derives the following palatal stridents:

(13) \( \begin{bmatrix} s \\ z \\ ts \\ dz \end{bmatrix} \rightarrow \begin{bmatrix} \hat{s} \\ \hat{z} \\ \hat{c} \\ \hat{j} \end{bmatrix} \quad / \quad \begin{array}{c} i \\ e \end{array} \)

or, in terms of distinctive features:

(14) \([+\text{strident}] \rightarrow [[+\text{high}, -\text{ant}] \text{V}] \)
Thus all cases of phonetic palatal stridents before [a] are analysed as basic dental stridents followed by /e/.

One might consider an alternate solution with intermediate steps [sy tSy dzY], resulting from PR and then being further modified by an additional low-level phonetic rule:

\[
\begin{bmatrix}
    sY \\
    zY \\
    tSy \\
    dzY
\end{bmatrix} \rightarrow \begin{bmatrix}
    ʃ \\
    z \\
    c \\
    j
\end{bmatrix}
\]

or, in distinctive features:

\[
\begin{bmatrix}
    +\text{strident} \\
    +\text{high}
\end{bmatrix} \rightarrow [-\text{ant}]
\]

where the [+-high] in the structural description is the result of PR. By this alternative, there would be no need to recognize an independent process deriving palatal stridents, but merely a further phonetic modification on the output of PR. However, the fact that SR is independent of PR is seen in the surface realization of /eSy 'olives'—which is [eSy3], not [eSy4]. (Standard Nupe orthography would record this word as eSyia, where s = [s].) Similarly, /guzSy 'peanuts' is realized as [guzSy4], in which there is both a creation of a palatal strident and an additional palatalization of the newly created segment. The solution proposed in this paper therefore includes two phonological rules: one (SR) that creates s z c j from /s z ts dz/, as in 13 and 14; and a second, more general, rule of palatalization (PR) that creates palatalized palatalals in addition to palatalized labials, dentals, velars, etc. as in 2 and 4.6 Thus /si/ 'to buy' will be realized as [sYl].

Further evidence for the recognition of an independent SR will be presented below in conjunction with reduplication (§3.2).

3. JUSTIFICATION OF THE ABSTRACT NUPE SOLUTION. Up to this point we have only provisionally accepted this 'abstract' solution. There are, however, two arguments one can advance in its favor. The first (and weaker) argument is that this solution, in positing /a/ and /e/, is in some sense 'explanatory' with regard to the limitations on surface distributions of the bi-unique phonemes. In recognizing the single segments [Cw] and [Cy], rather than the clusters [Cw] and [Cy], we can dismiss an apparent but non-existent exception to the CVCV pattern regularity of Nupe. We can also explain why such segments are distinctive only before [a]. Of course, the solution recognizing /al/, /a2/ and /a3/ satisfies the first part of this explanation, and for this reason can be valued as slightly superior

6 In the current feature system of Chomsky & Halle, there is no way to distinguish palatalized palatals (e.g. [sy]) from palatals (e.g. [i]) except by scalar values. Clearly in Nupe, palatals are equally subject to the palatalization rule (PR); but there is no way to represent this with the Chomsky & Halle features. I shall simply ignore this problem, since it is not the purpose of this paper to propose an alternate set of features. The reasons for not representing palatalized palatalals as, e.g., [Sy] are the same as those presented against the analyses as /egwa/ and /egya/, above.
to the phonemic solution offered at the outset of this paper. However, using
diacritic features rather than phonological features, it does not account for why
'phonemic' [Cʷ] and [Cē] occur only before [a].

But it can be argued that, since /o/ and /e/ never occur phonetically, the use
of phonological features is a 'trick' in that they are being used as diacritics. The
answer to this is the claim that the underlying systematic phonemes /o/ and
/e/ reveal a deeper pattern regularity than is evident from the surface, because
they are psychologically real.

3.1. The basis of this claim is the observed productivity of the absolute neu-
tralization rule (12) which derives [a] from /o/ and /e/ after these latter segments
have labialized or palatalized the preceding consonant. We are assuming that a
rule is productive if new forms coming into a language are subject to its applica-
tion. For example, several of the stress rules in English have been shown (Lade-
foged & Fromkin 1968) to be productive in this way, since when nonsense words
are contrived, stress is assigned to them according to the stress rules of English.
The absolute neutralization rule of Nupe constitutes such a case. My evidence
comes from cases of recent borrowing, although 'productivity tests' such as
those performed by Ladefoged & Fromkin could also be run, to focus on the
'living' aspect of the process. Thus we can note the following borrowings from
Yoruba, a distantly related Kwa language:

(18) Yor. [kèkè] → Nupe [kʷəkʷə] 'bicycle'
    Yor. [ègbè] → Nupe [ègbə] (a Yoruba town)
    Yor. [tɔrê] → Nupe [tʰərə] 'to give a gift'
    Yor. [kɔbɔ] → Nupe [kʰəbʰə] 'penny'

A Nupe speaker will consistently 'nativize' [Co] as [Cʷa] and [Ce] as [Cēa]. This
is also sometimes perceptible in the way Nupes attempt to speak Yoruba, which
has /o/ and /e/. What this means, in the case of /o/, for instance, is that the
Nupe 'perceives' the two features [+round] and [+low] and that he identifies
/o/ with the class [+round] already represented in his language by /u/ and /o/;
he accordingly labializes the preceding consonant of the incoming word. Also,
since Nupe has only one [+low] vowel (which can be long or nasalized, however),
/o/ merges (absolutely neutralizes) with /a/, and the distinction between the
two is lost (except insofar as the preceding labialization accompanies the [a]
derived from /o/). In the case of /e/, this segment is perceived as [-back], such
that the consonant preceding it undergoes PR (as in the case of /i/ and /e/); and
only then is /e/ merged with /a/, as it is recognized as [+low] and is not tolerated
in surface forms. It is as if the Nupes do a feature analysis in these terms, apply
LR in the case of /o/ and PR in the case of /e/, and then simplify the three-way
opposition in [+low] vowels. We can propose no clearer justification for distinc-
tive feature theory.

The position supported by this evidence is that the nativization of foreign
sounds is a valid indicator of what rules have been internalized—that is, which
rules are real. And accordingly we must presume that the proposed absolute

7 For a more detailed account of the relevance of borrowing to the justification of phono-
logical grammars (especially with reference to Nupe), cf. Hyman 1970.
neutralization represents something real in the Nupe speaker's language and mind. The Nupe does not merely replace foreign sounds with those closest to them in his own language; rather, it is the existence of LR, PR, and AN that causes borrowed words to be nativized in just this fashion. Of course it turns out that [Cʷa] and [Cʷa] preserve both the [+round] and [−back] feature, respectively, as well as the [+low] specification of /o/ and /e/; but when such rules do not exist, different nativizing processes are observed. Hausa is a nearby, though unrelated, language which exhibits similar labialization and palatalization processes; but for Hausa we would not want to posit /o/ and /e/ and a corresponding AN rule. Thus, though Hausa has the vowels /i: i: e e: a: a: o o: u u:/, when Hausa borrowed [kêkê] 'bicycle' from Yoruba, it was nativized not as [kʷákʷá] (a possible Hausa word), but as [kːːkːː].

Finally, it is irrelevant for our analysis whether each of the forms with underlying /o/ and /e/ is genetically Nupe or is borrowed. In some cases, in fact, the positing of /o/ and /e/ is clearly unjustified from a purely historical point of view. Thus [Jâmá] 'crowd', which we would enter in the lexicon as /dzêmá/, is an Arabic word borrowed through the Hausa form [Jâmâ:]. However, there is an ungraded continuum of phonetic resemblance between Nupe and Yoruba, the apparent prime source of borrowed /o/ and /e/. Some examples are extremely close and borrowed recently, as in 18. Others are extremely close, but not necessarily recent borrowings, such as

(19) Yor. [ákʰ] : Nupe [ékʷá] 'spear'
    Yor. [kpʰ] : Nupe [kpʰá] 'to be cheap'

Finally, some forms are fairly distant in phonetic shape, such that we may be tempted to ascribe their resemblance to Proto-Kwa:

(20) Yor. [êjʼ] : Nupe [êgʷá] 'blood'
    Yor. [bwá] : Nupe [êgʷá] 'hand'

Not only are the consonants less similar phonetically than in the previous examples, but these cognates also differ in tone. Where these [Cʷ]’s and [Cʼ]’s ultimately came from, although a worth-while line of pursuit for Africanists, does not bear on the analysis.

3.2. Although the argument of productivity is central to the justification of this abstract Nupe solution, we can get further support from what might be termed a 'weak' form of alternation. Although /o/ is never realized phonetically, it would be significant if we could show that the underlying [+low] vowel of [êgʷá] functions elsewhere like a rounded vowel, as it apparently does in satisfying the structural description of LR. (We shall focus our attention on /o/ and arrive at /e/ by extending our conclusions.) Such evidence is available in the process of reduplication that nominalizes verbs of one morpheme. This reduplication is relatively simple:

(21) /gʰ/ ‘to eat’ → gígí ‘eating’
    /gʰ/ ‘to be good’ → gígê ‘goodness’
    /gʰ/ ‘to puncture’ → gígú ‘puncturing’
    /gʰ/ ‘to receive’ → gígô ‘receiving’
(The surface forms of ‘trimming’ and ‘mildness’ are seen in 23 and 24 below.) In all of these cases (and typically for Kwa languages) the reduplicated vowel is [+high]-/i/ when the stem vowel is not rounded, /u/ when it is rounded. Then /o/ and /e/ fall accordingly into line. By recognizing the two underlying vowels /o/ and /e/, we are able to state the general reduplication rule:

\[
\text{(22) RED} \rightarrow C_1 \begin{bmatrix} \text{+high} \\ \text{round} \\ \text{back} \\ \text{2tone} \end{bmatrix} \quad \text{where } C_1 = C_1
\]

That is, the vowel in the reduplicated syllable agrees in roundness and backness with the roundness of the vowel in the verb stem, and, in addition, the tone on the reduplicated syllable is always mid [2tone]. The full derivations for ‘trimming’ and ‘mildness’ will therefore look something like this:

\[
\text{(23) } /t\ddot{\text{o}}/ \rightarrow \text{tut\ddot{o}} \rightarrow t^*\dddot{\text{u}}t^*\ddot{\text{d}} \rightarrow [t^*\dddot{\text{u}}t^*\ddot{\text{d}}] \\
\text{RED LR AN}
\]

\[
\text{(24) } /t\ddot{\text{e}}/ \rightarrow \text{tit\ddot{e}} \rightarrow t^*\dddot{\text{t}}t^*\ddot{\text{e}} \rightarrow [t^*\dddot{\text{t}}t^*\ddot{\text{e}}] \\
\text{RED PR AN}
\]

Similarly, the phonetic forms for ‘eating’ and ‘puncturing’ will be [gYgYi] and [gwugwu], respectively. Since the labialization of the initial consonant in [t\ddot{\text{a}}] ‘to trim’ is introduced by rule, and is not a segment on the systematic phonemic level, there must be something in the [a] of this morpheme that marks it as [+round] and causes it (once again) to be grouped with /u/ and /o/. Thus the reduplicated form is [t^*\dddot{\text{u}}t^*\ddot{\text{a}}]—not *[t^*\dddot{\text{t}}t^*\ddot{\text{a}}], as would be required by a concrete analysis of the stem vowel [a]. This latter point, that the vowel of ‘to trim’ forms a class with /u/ and /o/ for two general rules in Nupe (LR and RED), is crucial: it means that the relationship of the underlying vowel of [t\ddot{\text{a}}] (whatever it might be) to /u/ and /o/ is a non-arbitrary one. Furthermore, this underlying vowel is DISTINCT from /u/ and /o/, and is therefore justifiably identified as /o/, in accordance with our present (however limited) knowledge of naturalness and natural systems. /o/ differs from /a/ solely in its [+round] specification, the minimum differentiation necessary for a natural labialization rule and a plausible reduplication rule. The same arguments of naturalness hold for /e/, which differs from /a/ only in that it is [−back].

3.3. One additional note is significant regarding the process of reduplication in monosyllabic Nupe verbs. This concerns the application of SR. Note the following:

\[
\text{(25) } /s\ddot{\text{a}}/ \quad \text{‘to cut’} \rightarrow s\dddot{\text{s}}\ddot{\text{a}} \ ‘cutting’} \\
/\ddot{\text{z}}\ddot{\text{a}}/ \quad \text{‘to wander’} \rightarrow \ddot{\text{z}}\dddot{\text{z}}\ddot{\text{a}} \ ‘wandering’ \\
/ts\ddot{\text{a}}/ \quad \text{‘to choose’} \rightarrow ts\dddot{\text{t}}\ddot{\text{s}}\ddot{\text{a}} \ ‘choosing’ \\
/d\ddot{\text{z}}\ddot{\text{a}}/ \quad \text{‘to break’} \rightarrow d\dddot{\text{z}}\ddot{\text{z}}\ddot{\text{d}}\ddot{\text{z}} \ ‘breaking’
\]

That is, where we expect $\ddot{s} \ddot{z} \ddot{c} \ddot{f}$, before /i/, we have instead $s \ z \ ts \ dz$ at this stage in the derivation. We have already seen that [ts] and [c] contrast before [a], and
have accounted for this by recognizing underlying /ɛ/. Given the two verbs [ɛŋ] and [tsa], we recognize the underlying forms /tsɛ/ 'to begin' and /tsa/ 'to choose'. We would thus expect the following derivations:

(26) /tsɛ/ → tsɛtsɛ → ċɛɛ → ċɛɛɛ → [ɛŋɛa]
RED SR PR AN

(27) /tsa/ → tsatsa → ċitsa → [ɛŋitsa]
RED SR PR

But the form for 'choosing' is not *[ɛŋitsa], but [tsɛŋitsa]. This form seems strange, since we previously assumed that the normal (obligatory) allophone of /ts/ before /i/ is [ɕ], not [ts]. In fact, reduplication seems to offer the only exception to the strident rule; there is no tendency for the Nupe speaker to utter forms such as [ɛŋitsa], which are considered totally wrong. The simplest way to handle this situation is to order SR before RED. Thus we have the derivation

(28) /ts/ → ts → tsitsa → [tsɛŋitsa] 'choosing'
SR RED PR

where SR fails to apply, and RED reproduces the post-SR consonant of the verb stem. Since in this system SR is not applicable before /a/, the dental allophone is reduplicated. Note, however, that LR and PR must be ordered after RED in order to obtain the palatalized [tsɛ] segment in [tsɛŋitsa] 'choosing'. Thus SR and PR must be considered separate and independent rules.

4. ALTERNATIVE SOLUTIONS TO THE NUPE DATA. This paper was motivated in part by the fact that current phonological theory offers no convincing way to choose between alternate solutions to problems such as the one just illustrated. As already stated, four methods have been proposed in the literature to deal with such phenomena. I have attempted to justify the adoption of the very solution which would be disallowed by Kiparsky's alternation condition, i.e. the positing of underlying segments which have no distinct phonetic realization. Further justification is apparent also from a comparison of the type of labialization and palatalization rules which one would be forced to set up under each of the three alternatives mentioned. I shall not discuss the use of minor rules, since they are clearly the least general of these three alternatives; it is thus assumed that minor rules should be utilized only in the event that other means fail.

In the discussion of the Nupe data (§2), it was shown how diacritics could be used to account for the data. An underlying /a1/ would be set up for those /a/'s that satisfy the structural description of LR; similarly, /a2/ was proposed for those /a/'s that meet the structural description of PR; finally, those /a/'s that fail to meet the structural description of either rule could be represented by /a3/, or, perhaps better, simply by /a/. Some of the shortcomings of the diacritic technique have already been pointed out. If labialization occurs before a [+round] vowel as in Rule 3, then the rule must be expanded to include /a1/ (which is [−round]). Marking the segment /a1/ with the additional feature [+R], we would then rewrite the labialization rule as

(29) [+cons] → [+round] / [+high] — [(+round) [+R] V]

However, /a1/—that is, an [a] that functions as if it were [+round] by virtue of
the additional marking [+R]—is merely a notational variant of /a/. In either case, when we write /a/ or /a/, we are dealing with underlying segments differing from any surface ones we might encounter. In a similar fashion we can use a diacritic feature, say [+P], to differentiate /a/ from either /a/ [+R] or /a/. The palatalization rule would then be rewritten as

\[
(+\text{cons}) \rightarrow \begin{cases} 
\text{[back]} \\
\text{[high]} \\
\text{[+P]} \\
\end{cases}
\]

But labialization and palatalization are clearly assimilatory rules and should exhibit some sense of naturalness. And since [R] and [P] are not phonological features, 29 and 30 do not reveal the naturalness of assimilation. The abstract solution, on the other hand, reveals the conditioning factors for the assimilation in both cases. It is significant that the inclusion of /a/ and /e/, which have been shown to be psychologically real on independent grounds, results in more natural assimilation rules (see especially the collapsed rule 55 below).

4.1. The remaining alternative, namely the use of rule features, is the solution favored by Kiparsky. Kiparsky argues against Zwicky's abstract solution for Sanskrit, where an underlying short /e/ is posited to permit /k/ to palatalize to [c]. Zwicky's solution is:

\[ (31) /ka/ \rightarrow [ka] \\
/ke/ \rightarrow [ca] \]

Since there are no occurrences of phonetic [e] in Sanskrit, /e/ is actualized as [a]—another case of absolute neutralization. Kiparsky's solution involves the use of a rule-exception feature: 'The alternative which I propose posits only a single phoneme /a/, the ones which do not cause palatalization being designated in the lexicon by the appropriate rule feature.' (p. 15). Presumably he would have the following lexical entries with their phonetic derivations:

\[ (32) /ka/ \rightarrow [ka] \\
/ka/ \rightarrow [ca] \]

We can only suppose that the same type of solution would be extended by Kiparsky and others to cover the Nupe data. In so doing, we would need two such rule-exception features, [−LR] and [−PR]. A single phoneme /a/ could then be posited with the variants /a/ [−LR], /a/ [−PR], and /a/ [−LR, −PR]. We would then set up the two rules

\[ (33) C \rightarrow C^* \rightarrow \{u, o, a\} \]
\[ (34) C \rightarrow C^* \rightarrow \{i, e, a\} \]

which in distinctive-feature notation would be equivalent to

\[ (35) (+\text{cons}) \rightarrow \begin{cases} 
\text{[round]} \\
\text{[high]} \\
\text{[+back]} \\
\end{cases}
\]
\[ (36) (+\text{cons}) \rightarrow \begin{cases} 
\text{[back]} \\
\text{[high]} \\
\text{[−round]} \\
\end{cases}
\]
If we accept one phonemic low vowel, then we must accept these rules, however 'implausible'. Setting up the equivalent implicational schemes (using $>$ to mean 'implies') we get

$$
(37) \left[ \begin{array}{c} +\text{back} \\ V \end{array} \right] > [+LR] \text{ (by 35)}
$$

$$
(38) \left[ \begin{array}{c} -\text{round} \\ V \end{array} \right] > [+PR] \text{ (by 36)}
$$

Therefore, if we look at the feature specification for /a/-i.e., [+back, -round]-implicational schemes 37 and 38 show that /a/ 'implies' [+LR, +PR], which in the absence of rule-exception features on each occurrence of /a/ would give us something like *Cw+y. But this is impossible, given the mutual exclusivity of labialization (accompanied by velarization) and palatalization. In other words, by Rules 35 and 36, a sequence /Ca/ will undergo both LR and PR; but what we want is a sequence /Ca/ that will satisfy the structural description of LR exclusively, another that will satisfy PR, and a third that will satisfy neither one nor the other. In other words, the rule-exception feature solution forces us into an odd constraint, where every occurrence of post-consonantal /a/ in Nupe is an exception. This is of course extremely suspect. On the other hand, if we follow the abstract course, we replace 37 and 38 by the following:

$$
(39) \left[ \begin{array}{c} +\text{round} \\ V \end{array} \right] > [+LR] \text{ (by Rule 3)}
$$

$$
(40) \left[ \begin{array}{c} -\text{back} \\ V \end{array} \right] > [+PR] \text{ (by Rule 4)}
$$

In the abstract solution the structural descriptions of LR and PR are mutually exclusive and we therefore cannot derive the segment *Cw+y. All phonemic /a/s are characterized as [−LR, −PR] as they should be, since /a/ is basically a non-labializing, non-palatalizing vowel. In the rule-exception feature solution, the only way to avoid *Cw+y is to add a condition on the systematic phonemic level that states that every occurrence of /a/ must be marked [−LR], [−PR], or [−LR, −PR]. By making each [+low] vowel in Nupe an exception, this notational device is used, at best, taxonomically; and the whole concept of 'exception' is destroyed. There can be exceptions only when some forms are NOT exceptions. Furthermore, exceptions can exist only when they are outnumbered by non-exceptions. This seems to be fundamentally incorporated in the definition of 'exception', and is definitely crucial to the notion 'exception to a rule'. Thus it appears that this approach is somewhat less than well-motivated.

It is also of interest at this point to consider the 'alternation condition' which Kiparsky develops (p. 10) along with the rule-exception feature solution. In §2 I noted that an autonomous phonemic solution to the Nupe data would have to recognize a whole series of phonemic labialized and palatalized consonants, phonemic only before /a/. This solution was said to be unsatisfactory. In addition, it is much weaker in explanatory power than the abstract solution, in that it offers no explicit account for the nature of the nativization of [o] and [e] in borrowed words. However, compare what Kiparsky (p. 12) says about the effect of his alternation condition: 'One of the effects of restricting phonology like this is to enter non-alternating forms in the lexicon in roughly their autonomous
phonemic representation. Accordingly, /Cw/ and /Cy/ would have to be recognized as underlying segments in a concrete solution, since they do not alternate (as opposed to [Cw] and [Cy] before non-low vowels, which are derived from [C] by low-level phonetic rules). Thus, although the abstract solution has to recognize two additional phonemes /o/ and /e/, a proponent of the alternation condition would have to accept an even larger phonemic inventory.

4.2. It might be proposed that /a/ with no assimilatory effect should be the basic underlying entry, while those /a/’s that cause labialization or palatalization are less ‘basic’. The first argument is naturalness, which has already been presented at length above. The second argument is frequency (in the Nupe example specifically). There are simply many times more instances of non-labializing, non-palatalizing /a/’s than there are of the labializing and palatalizing varieties (taken separately or combined). These latter should, according to the argument, rather be seen as carrying something extra. Thus, instead of viewing the full value of /a/ as [+LR, +PR], we might wish to view it as [−LR, −PR] (as in the abstract solution), and to propose rule-addition features or plus-rule features. Morphemes with /a/’s that cause labialization of the preceding consonant could be marked [+LR], while those /a/’s palatalizing preceding consonants would be marked [+PR]. No morphemes would have an /a/ marked [+LR, +PR], and ‘basic’ /a/ would fail to meet the structural description of either rule. This solution would at least satisfy our preliminary notions of naturalness and markedness. The whole concept of rule-exception features as outlined by Kiparsky (p. 12) is that ‘they can simply be designated in the lexicon as exceptions to the particular rules which they should, but do not, undergo.’ However, in the case of Sanskrit (cf. the Nupe rules 35–6), Kiparsky manipulates the rules, altering them so that the appropriate segments can be marked as ‘exceptions’ to rules that they never should have undergone in the first place. It would have been more natural, looking at the Nupe data, to leave LR and PR as assimilatory rules and to consider the /a/ [+LR] and /a/ [+PR] as the true exceptions. In the case of rule-exception features, the stipulation that all such phenomena must be handled by manipulating the form of the rules of the phonology leads, as we have seen, to a certain arbitrariness; on the other hand, plus-rule features, while truer to the idea of ‘exception in a grammar’, destroy the notions ‘rule of a grammar’ and ‘structural description of a rule’. If we admit plus-rule features, then whenever the grammar contains the rule

(41) \(A \rightarrow B / \_C\)

we can always extend it to

(42) \(A \rightarrow B / \_\{C\} / \_D\)

by means of a plus-rule feature on D, where D does not necessarily bear any relationship to C. Thus, in Halle’s illustrative rules (1964/337),

(43) \(a \rightarrow æ / \_i\)
\(a \rightarrow æ / \_p\)
\(a \rightarrow æ / \_z\)

* Kalon Kelley has informally proposed a similar solution in a personal communication.
we could very well (in the absence of constraints against such abuses) simply state the natural rule

\[(44) \ a \rightarrow æ / \_ \_ \_ i\]

and mark all morphemes with the sequences /ap/ and /az/ as [+44] to account for the data of 43. Rule 44 is natural and well-formed in itself; but more importantly, the plus-rule features would have to be further defined for naturalness, since they do not, in this case at least, represent a linguistically significant generalization, but rather an ad hoc association of two implausible environments with an unrelated plausible one. Significantly, then, we should want to strike out such wild rule play for the same reason Halle dismisses the pseudo-generalization

\[(45) \ a \rightarrow æ / \_ \_ \_ \{ i \_ p \_ z \}\]

In the case of 45 we have an explicit (however imperfect) built-in means of ruling it out (feature-counting), while we have no such way of permitting a feature such as [+44] to 'add' sequences like /ae/ to 44, but not sequences such as /ap/ and /az/. Plus-rule features are equivalent to brace notations in the structural description of a rule, and therefore should be subject to the same scrutiny in determining what is and what is not 'linguistically significant'. In the case of rule-exception features, violations of our notions of what constitutes a 'natural class' are evident in the form of the proposed rules; but in the case of plus-rule features, such violations, though still present, are more subtly disguised.

However, we might ask ourselves what it means to posit a given form of a rule, if a sizable number (say one-third to one-half) of the morphemes with a certain segment or sequence of segments are marked [+rule X]. Shouldn't such segments enter into the structural description of that rule, and if not, why not? If these segments are considered in the structural description of rule X, then we are right back at the [-rule X] solution, in which we were forced to accept unnatural assimilation rules whose validity we have no reason to suspect.

The whole problem with rule features is the relative freedom to do as one pleases, in the absence of well-motivated constraints on the behavior of these mechanisms. Not only are we left with the task of deciding between rule-exception features and plus-rule features (hopefully deciding on some principled ground), but it is also entirely possible to propose a solution combining both of these techniques. Furthermore, in this last case, even if we were able to demonstrate the correctness of a hybrid approach, we are still left with an arbitrary decision, since there are two equally valid solutions within this framework. These are represented as follows:

\[(46) /ègā/ 'hand' /ègā/ 'blood' /ègā/ 'stranger' \]
\[\[-PR, +LR\] [−PR]\]

\[(47) /ègā/ 'hand' /ègā/ 'blood' /ègā/ 'stranger' \]
\[\[-LR, +PR\] [−LR]\]

In the case of 46, the following rules are assumed:

\[(48) C \rightarrow C^* / \_ \_ \_ \{ u \_ o \}\]

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Here /a/ will cause palatalization unless the appropriate morpheme contains a \([-PR\)]. Labialization is obtained by means of \([-PR\] and \([+LR\]. In the case of 47, we have just the reverse:

\[
(50) \quad C \to C^* /-\begin{cases} u \\ o \\ a \end{cases} \\
(51) \quad C \to C' /-\begin{cases} i \\ e \end{cases}
\]

Here /a/ causes labialization unless marked \([-LR\]), and palatalization is obtained by means of \([-LR\] and \([+PR\]. Thus there are two equally valid possible descriptions and no apparent non-arbitrary means of telling us which is to be preferred.

4.3. In this discussion we have assumed Rules 3 and 4 to be the correct forms of LR and PR, respectively. Looking at the distinctive feature matrix of the relevant Nupe vowels (§2), we note the following redundancies, which hold for both consonants and vowels in Nupe:

\[
(52) \quad [+round] -*[+back]
\]

Note that neither converse is true, because of /a/. Therefore, filling in some of the redundancies, we can rewrite 3 and 4:

\[
(53) \quad [+cons] \to \begin{cases} +\text{high} \\ +\text{back} \\ +\text{round} \end{cases} /-\begin{cases} +\text{back} \\ +\text{round} \end{cases}
\]

\[
(54) \quad [+cons] \to \begin{cases} +\text{high} \\ -\text{back} \\ -\text{round} \end{cases} /-\begin{cases} -\text{round} \end{cases}
\]

And these collapse into

\[
(55) \quad [+cons] \to \begin{cases} +\text{high} \\ \beta\text{back} \\ \beta\text{round} \end{cases} /-\begin{cases} \alpha\text{back} \\ \alpha\text{round} \end{cases}
\]

to form a single assimilation rule. This rule says that when a postconsonantal vowel is both \([+\text{round}]\) and \([+\text{back}]\) (i.e. /u o a/), then \(C \to C^*\); and when it is \([-\text{round}]\) and \([-\text{back}]\) (i.e. /i e e/), then \(C \to C'\). Appropriately, when the vowel is /a/, there is no assimilation, since /a/ (which is \([-\text{round}]\) and \([+\text{back}]\)) is not \([\alpha\text{back}, \alpha\text{round}]\), and the structural description of 55 is not met.

In a similar fashion, we would be required by our conventions to collapse 35 and 36, and we obtain

\[
(56) \quad [+\text{cons}] \to \begin{cases} +\text{high} \\ \beta\text{round} \end{cases} /-\begin{cases} \alpha\text{back} \\ \beta\text{round} \end{cases}
\]
Note first that 56 is much less general than 55 and should cost more, since it utilizes two variables. Second, an exception feature (which in effect says 'ignore rule 56 even though the structural description is met') could not give us the desired results, since in the structural description [aback, bround, V] all vowels are subjected to the rule, and the only effect of a feature [−56] would be to prevent assimilation of any kind. In the solution utilizing plus-rule features, labializing and palatalizing /a/'s are 'added' to the structural description of a collapsed rule equivalent to 55. But somehow these plus-rule features will have to tell you how the labializing and palatalizing /a/'s satisfy the structural description of 55, which is composed of variables. Thus it is extremely important to recognize that, if the theory of rule features is to be retained, these features will operate on non-collapsed rules. This would seem to cast serious doubts on the reality of the abbreviated forms. Rule features are therefore incompatible with the all but universally accepted conventions of generative phonology.9

5. SUMMARY AND CONCLUSION. We have seen that an abstract approach to phonology provides, at least in one instance, the most highly valued solution to a language problem. A more concrete solution would fail to capture significant linguistic information, such as pattern congruity and psychological reality. In the case of pattern congruity, for instance, we are able to explain a variety of facts about Nupe morpheme structure and surface phenomena. The reality argument is, however, central. LR, PR, SR, and AN constitute the only means by which we are able to account explicitly for the observed nativization of foreign words. The reduplication rule further supports the decision to mark the underlying vowel of [bwa] 'to lose skin' as /o/ and that of [pY6] 'to dodge' as /e/, in accordance with the manner in which they function. Finally, alternate solutions can be shown to be arbitrary and unrevealing. The first conclusion to be drawn from this is that alternation is only one possible justification of phonological solutions (though possibly the most accessible, and hence most common). The burden of proof falls on anyone who ventures deeply beneath the surface phonetics, though the form of that proof (or justification) need not be limited to the surface phonetics. In other words, we need not require that all underlying segments surface phonetically, though we require that the positing of non-surfacing underlying oppositions be justified by some acceptable means. The complete range of justifications open to phonologists will hopefully be further delimited by future investigators. In this paper, borrowing and naturalness, supported by pattern considerations and a 'weak' form of alternation, have led us to posit /o/ and /e/, which are justified on those grounds. There has recently been too much insistence on what the child actually hears, phonetically, and this is evident in the unrevea-
ing solution enforced by the alternation condition, where we must recognize underlying /Cw/ and /Cy/ because they do not alternate before /a/—and therefore, according to the argument, the child must hear them and store them as such. In this paper, then, it is claimed that a child need not hear the phonetic shape of an underlying segment to have stored it in his brain. The implication of this claim is that the child does not learn an abstract underlying representation solely from the phonetics of the individual morphemes (the extreme American taxonomic view), but rather has the additional ability to ‘reason’, instead of merely mimicking. Thus it has been shown that in borrowing, the Nupe speaker ‘extrapolates’ /a/ and /ɛ/ on the basis of the processes relevant to /u/ and /ø/, /i/ and /ɛ/.

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