



1984

Two Approaches to Predictive Indeterminacy

Gregory Stump

University of Kentucky, gstump@uky.edu

Right click to open a feedback form in a new tab to let us know how this document benefits you.

Follow this and additional works at: https://uknowledge.uky.edu/lin_facpub

 Part of the [Linguistics Commons](#)

Repository Citation

Stump, Gregory, "Two Approaches to Predictive Indeterminacy" (1984). *Linguistics Faculty Publications*. 42.
https://uknowledge.uky.edu/lin_facpub/42

This Article is brought to you for free and open access by the Linguistics at UKnowledge. It has been accepted for inclusion in Linguistics Faculty Publications by an authorized administrator of UKnowledge. For more information, please contact UKnowledge@lsv.uky.edu.

Two Approaches to Predictive Indeterminacy

Digital Object Identifier (DOI)

10.1515/ling.1984.22.6.811

Two approaches to predictive indeterminacy

GREGORY T. STUMP

Abstract

In formal analyses of productive systems of stem gradation, it is commonly assumed (i) that each alternating stem possesses a single, basic grade form from which its other grade forms may be derived, and (ii) that all basic forms belong to the same grade; certain languages, however, present predictively indeterminate systems of gradation, for which these assumptions are not apparently valid. Two approaches to the analysis of such systems are discussed here: the first approach, exemplified by Anderson's (1976) analysis of initial consonant gradation in Fula, allows both assumptions (i) and (ii) to be maintained at the expense of an absolutely neutralized phonological distinction; the second approach, embodied in the traditional Pāṇinian analysis of Sanskrit vowel gradation, allows assumption (i) to be maintained at the expense of assumption (ii). It is argued that the Pāṇinian approach is superior, since it is more generally applicable and does not require the postulation of any phonetically unrealized phonological distinctions, relying instead on distinctions in grade among underlying stem forms.

0. The problem of predictive indeterminacy

In the formal description of productive systems of stem gradation, it is customary to assume that an alternating stem has a single, underlying grade form from which all of its other grade forms can be predicted by rule; this assumption, which has served as the basis for successful analyses of such diverse phenomena as ablaut, consonant mutations, and tone alternations, will here be called the *derivability assumption*. A usual corollary of this assumption is what might be called the *uniformity assumption*, according to which the basic grade forms in a system of stem gradation all belong to the same grade. Under this latter assumption, it is

Table 1. *Initial consonant gradation in Mende*¹

'Strong' grade	'Weak' grade	Examples
m	b	<i>m̄ba</i> 'rice', <i>m̄ya bei</i> 'my rice'
p	w	<i>pele</i> 'house', <i>m̄ya w̄elei</i> 'my house'
ng	w	<i>ngulu</i> 'tree', <i>m̄ya w̄ulii</i> 'my tree'
l	l	<i>law̄a</i> 'calabash', <i>m̄ya law̄ei</i> 'my calabash'
nd	l	<i>ndoma</i> 'shirt', <i>m̄ya lom̄ei</i> 'my shirt'
nj	y	<i>n̄ji</i> 'sleep', <i>m̄ya j̄ii</i> 'my sleep'
ng	y	<i>ngenge</i> 'work', <i>m̄ya ȳengei</i> 'my work'
k	g	<i>k̄ib</i> 'book', <i>m̄ya gal̄ei</i> 'my book'
kp	gb	<i>kp̄ato</i> 'outlass', <i>m̄ya gb̄atoi</i> 'my outlass'
f	v	<i>f̄ande</i> 'cotton', <i>m̄ya vand̄ei</i> 'my cotton'
s	j	<i>s̄ani</i> 'bottle', <i>m̄ya jan̄ii</i> 'my bottle'

not only possible to identify a single, basic grade form for each alternating stem; it is, in fact, possible to identify a single, basic grade.

Consider, for example, the case of Mende, a Mande language spoken in Sierra Leone. In Mende, the initial consonant in a stem may appear in either of two forms, depending on the grammatical context of the stem; examples are given in Table 1. As is clear from these examples, the weak grade form of a stem cannot be taken as basic, since this form is in certain cases insufficiently distinctive to allow the corresponding strong grade alternant to be predicted; for instance, given a weak grade form with an initial /l/, one cannot reliably say whether the corresponding strong grade form will have /l/ or /nd/ as its initial consonant. On the other hand, given a strong grade form, one can always predict the corresponding weak grade form; thus, in accordance with the assumptions of derivability and uniformity, one can reasonably conclude that the strong grade is basic in Mende, and that the weak grade of a stem derives from the strong form according to regular principles.

In this example, the assumptions of derivability and uniformity are tenable because the strong-grade consonants stand in one-to-one or many-to-one relations with their weak-grade counterparts. Consider, however, the possibility of a system of gradation conforming to the schema in Table 2.

Table 2. *A 'predictively indeterminate' system of gradation*

Grade I	Grade II	
A	X	(where A, B, X, Y represent alternating segments)
B	Y	

In such a system, Grade I alternants would stand in both many-to-one and one-to-many relations with their Grade II counterparts; on the face of it, this would seem to mean that neither Grade I nor Grade II could be viewed as the single, basic grade, since neither would provide a uniformly reliable basis for predicting forms in the other grade. Thus, any system of stem gradation conforming to the schema in Table 2 would apparently be inconsistent with the uniformity assumption, and at least potentially with the derivability assumption as well. Hereafter, systems possessing this property will be said to be *predictively indeterminate*. As I will demonstrate shortly, systems of this sort do appear from time to time; examples are the systems of root or stem gradation found in Sanskrit and in Fula, a West Atlantic language spoken widely in West Africa.

Faced with the task of formally describing a system of stem gradation exhibiting this sort of indeterminacy, one might pursue various possible approaches. One would simply be to abandon the derivability assumption (hence also the uniformity assumption). That is, one might simply concede that in a system of the sort represented in Table 2, both the Grade I and the Grade II forms of a stem must be specified as unpredictable components of its underlying representation. Such a solution, I think, would not be especially unpalatable. Any language with a reasonably rich morphology presents idiosyncrasies which make it necessary to include more than one stem form in some lexical entries; it would therefore be fairly unremarkable if a system of stem gradation should happen to present idiosyncrasies of this sort.

It is important to note, however, that this is not the only possible solution to the problem of predictive indeterminacy; on the contrary, there are at least two alternative approaches, both of them consistent with the derivability assumption. Given a predictively indeterminate system of stem gradation, one could, on the one hand, attempt to maintain both the derivability and the uniformity assumptions by arguing that the apparent indeterminacy is purely a superficial phenomenon — one which disappears at a suitably abstract level of description; as I shall show, Anderson (1976) has proposed just such an analysis for the system of stem-initial consonant alternations found in Fula. On the other hand, one might simply admit that the uniformity assumption is untenable for

systems exhibiting predictive indeterminacy; this, however, would not necessarily commit one to abandoning the derivability assumption, which is logically independent. In fact, I shall show that under the traditional Pāṇinian analysis of Sanskrit vowel gradation, the derivability assumption is upheld even though the uniformity assumption is set aside.

My purpose here is to evaluate the latter two approaches to the description of predictively indeterminate systems of stem gradation. Because the two approaches are so clearly exemplified by Anderson's analysis of Fula on the one hand and Pāṇini's analysis of Sanskrit on the other, I shall focus on these as a concrete basis for discussion. I shall argue, ultimately, that the Pāṇinian approach is the better of the two, on the grounds that it is more general in application, and that it avoids the need to postulate phonetically unmotivated phonological distinctions, relying instead on descriptive devices which are independently necessary. Before developing these arguments, however, I shall clarify the essential differences between the two analyses under discussion.

1. The predictive indeterminacy of Fula consonant gradation

Consider, first, the case of Fula, a language which has been widely discussed for its intricate patterns of stem-initial consonant alternation. In Fula, the initial consonant of a nominal stem² may appear in as many as three different forms, depending on the morphological context of the stem. Contexts of one sort induce the appearance of the so-called continuant grade of a stem-initial consonant; contexts of a second sort cause the stop grade to appear; and yet a third sort of context conditions the appearance of the nasal grade. Thus, the initial consonant of the noun *rim-* 'free man' may appear in three distinct forms, as in (1).³

- | | | | |
|-----|------------|-------|-------|
| (1) | Continuant | Stop | Nasal |
| | grade | grade | grade |

rim- *dim-* *ndim-* 'free man'

The grade in which a stem-initial consonant appears depends on the noun class to which the stem belongs. Fula possesses an elaborate system of 25 different noun classes, each distinguished by a characteristic suffix;⁴ in this system, a given noun will typically turn up in several different classes, appearing in one class in its basic singular form, in another as a singular pejorative diminutive, in still another as a plural augmentative, and so on. When a noun appears in any of the classes listed in (2a), its initial consonant assumes the continuant grade; a noun appearing in any

of the classes in (2b), however, shows the stop grade of its initial consonant; and the classes in (2c) condition the appearance of the nasal grade.

- (2) a. Classes in which the continuant grade is employed: 2, 9, 11, 13, 14, 20.
 b. Classes in which the stop grade is employed: 1, 3, 4, 5, 16, 17, 19, 21, 23, 24, 25.
 c. Classes in which the nasal grade is employed: 6, 7, 8, 10, 12, 15, 18, 22 (Arnott 1970: 93, 97).

This conditioning is evident in the pair of nouns given in (3), both of which have three distinct grade forms.

- | | | | |
|-----|---------------------------|---------------------------|----------|
| (3) | a. <i>rim-</i> 'free man' | b. <i>wur-</i> 'compound' | |
| | Class 1 | dim-o | Class 14 |
| | 2 | rim- <i>be</i> | 24 |
| | 3 | dim-el | 3 |
| | 5 | dim-um | 5 |
| | 6 | ndim-on | 6 |
| | 7 | ndim-a | 7 |
| | 8 | ndim-o | 8 |
| | | | gur-e |
| | | | gur-el |
| | | | gur-um |
| | | | gur-on |
| | | | gur-a |
| | | | gur-o |
- (basic sg.)
 (basic pl.)
 (dimin. sg.)
 (pej. dimin. sg.)
 (dimin. pl.)
 (augmen. sg.)
 (augmen. pl.)

Since most of the consonants in the sound system of Fula do participate in gradation of this sort, the pattern of substitutions is quite elaborate; the full set of alternations may be schematized as in Table 3.

To all appearances, the pattern of alternations in Table 3 is inconsistent with the uniformity assumption mentioned above. Observe, on the one hand, that neither the stop nor the nasal grade form of an alternating stem would be sufficiently distinctive as a basis for predicting the corresponding continuant grade form; for example, given the stop and nasal grade forms in (4a), one cannot reliably decide whether the appropriate continuant grade forms would be as in (4b) or as in (4c).

- | | | | |
|-----|-------------------|-------|---------|
| (4) | a. 'sleeping mat' | daag- | ndaag- |
| | | 'hoe' | demer- |
| | b. *raag- | | ndemer- |
| | rem- | | |
| | c. daag- | | |
| | *demer- | | |

For stems participating in the alternations in Table 3a, only the continuant grade form is sufficiently distinctive to allow the other grade forms to be predicted. Just the reverse is true, however, of stems participating in

Table 3. Initial consonant gradation in Fula (Arnott 1970: 41ff.)

	Continuant grade	Stop grade	Nasal grade
a.	b _____	b _____	mb _____
	d _____	d _____	nd _____
(before back vowels)	y _____	j _____	nj _____
(before front vowels)	y _____	g _____	ng _____
	f _____	p _____	p _____
	sh _____	sh _____	sh _____
	k _____	k _____	k _____
	w _____	b _____	mb _____
		g _____	ng _____

(before all vowels) (before back vowels)

the alternations in Table 3b: for stems of this sort, the continuant grade form isn't distinctive enough to serve as the basis for deriving the stop and nasal grade forms; given the continuant grade forms in (5a), for example, it is unclear whether the corresponding stop and nasal grade-forms are as in (5b) or as in (5c).

- (5) a. woi- 'hare'
 wol- 'cheek'
- b. *goj- *ngoj-
 gol- ngol-
 boj- mboj-
 *bol- *mbol-
- c.

Thus, on the face of it, the pattern of alternations in Table 3 has no single grade from which the other grades can be uniformly predicted; accordingly, Fula consonant gradation must apparently be viewed as a case of predictive indeterminacy.

2. Anderson's (1976) account of Fula consonant gradation

Notwithstanding this apparent indeterminacy, Anderson (1976) has proposed an analysis of Fula consonant gradation which actually allows the derivability and uniformity assumptions both to be maintained. Anderson has suggested that in Fula, two sorts of labiovelar glides are phonologically distinguished: one is primarily labial, or [+anterior], and only secondarily velar, while the other is primarily velar, or [-anterior], and only secondarily labial. The labial /w/, he claims, is what alternates with the labial segments in Table 3b; the velar /w/, on the other hand, is the alternant of the velar segments. This analysis allows the indeterminacy of the Fula system to be eliminated at the phonological level, since its effect is to replace the one-to-many relation in Table 3b with the pair of one-to-one relations in Table 4. Thus, Anderson's analysis makes it possible to regard the continuant grade as the single, basic grade in Fula, and to derive the stop and nasal grade forms of a stem in a uniform way, in accordance with rules such as those in (6).

- (6) [+N] /C.../ → /C'.../ (in classes 1, 3, 4, 5, 16, 17, 19, 21, 23, 24, 25)
 → /C''.../ (in classes 6, 7, 8, 10, 12, 15, 18, 22)
 (where C', C'' are, respectively, the stop and nasal grade alternants of C)

This analysis would also necessitate one additional rule, however: because the proposed phonological distinction between two sorts of /w/ is never realized phonetically, this distinction must be neutralized by a low-level phonetic rule something like (7).

- (7) /w₁/ /w₂/ → [w]

Anderson's analysis of Fula consonant gradation differs strikingly from the traditional approach to a similar case of predictive indeterminacy in

Table 4. Anderson's (1976) analysis of the w/b/mb and w/g/ng alternations in Fula

Continuant grade	Stop grade	Nasal grade
w ₁ _____	b _____	mb _____
w ₂ _____	g _____	ng _____

(where w₁ is [+anterior], and w₂ [-anterior])

Sanskrit: whereas Anderson's approach seeks to maintain the uniformity assumption by denying any indeterminacy, the traditional analysis of the Sanskrit case is, as I now show, to acknowledge the indeterminacy at the expense of the uniformity assumption.

3. The predictive indeterminacy of Sanskrit vowel gradation

Sanskrit possesses a system of vowel gradation which is, in part, responsible for the elaborate allomorphy of its verbal roots. In most roots, the radical vowel may appear in three distinct grades, as summarized in Table 5. The grade in which a root appears depends on its morphological context; for example, in Table 5b, the roots *mī-* 'lead' and *jī-* 'conquer' appear in the weak grade in their past participial forms, in the full grade in their present tense forms, and in the lengthened grade in their third person singular perfect active forms.

As Table 5 shows, it is possible to predict the quality of a weak-grade vowel from that of the corresponding vowel in the full or lengthened grade; but the length of a weak-grade vowel cannot be so predicted. Thus, if there is a single, basic grade for Sanskrit roots, it would seem to have to be the weak grade. There are, however, at least two classes of roots whose

Table 5. Vowel gradation in Sanskrit⁵.

Weak grade	Full grade (= <i>guna</i>)	Lengthened grade (= <i>vriddhi</i>)
i	ay (= e/_ _)	āy (= āi/_ _)
ī		
u	āv (= o/_ _)	āv (= āu/_ _)
ū		
ī	ar	ār
ī		
ī	al	

b.

(root <i>mī-</i>) 'lead'	<i>mī-ta</i> 'led'	<i>māy-a-ti</i> 'the leads'	<i>mī-nāy-a</i> 'the led'
(root <i>jī-</i>) 'conquer'	<i>jī-ta</i> 'conquered'	<i>jāy-a-ti</i> 'the conquers'	<i>jī-gāy-a</i> 'the conquered'

Table 6. Vowel gradation in nasal roots in Sanskrit

Weak grade	Full grade (= <i>guna</i>)	Lengthened grade (= <i>vriddhi</i>)
	an	ām
	am	ām

b.

(root <i>han-</i>) 'strike'	<i>ha-ta</i> 'struck'	<i>han-ti</i> 'the strikes'	<i>ja-ghān-a</i> 'the struck'
(root <i>nam-</i>) 'bow'	<i>na-ta</i> 'bowed'	<i>nam-a-ti</i> 'the bows'	<i>na-nān-a</i> 'the bowed'

patterns of vowel gradation cast doubt on this conclusion. First, there is a class of nasal roots showing the alternations in Table 6a, as in the examples in Table 6b.

Clearly, the weak grade form of such a root is insufficiently distinctive as a basis for predicting the full and lengthened grade forms. The same is true of roots in the so-called *samprasāraṇa* class, which participate in the alternations in Table 7. In the weak grade, a *samprasāraṇa* root cannot be systematically distinguished from a normal root whose vowel is *i*, *u*, or *r*; only in the full and lengthened grades does the difference between such roots appear.

Thus, if the patterns in Tables 5–7 are integrated, it is clear that the system of Sanskrit vowel gradation includes both many-to-one and one-to-many relations between alternants, and so presents an instance of predictive indeterminacy similar to the Fula case. Faced with this puzzling

Table 7. Vowel gradation in *samprasāraṇa* roots in Sanskrit

Weak grade	Full grade (= <i>guna</i>)	Lengthened grade (= <i>vriddhi</i>)
i	ya	yā
u	vā	vā
r	ra	rā

b.

(root <i>yaj-</i>) 'sacrifice'	<i>is-ta</i> 'sacrificed'	<i>yaj-a-ti</i> 'the sacrifices'	<i>i-yāj-a</i> 'the sacrificed'
(root <i>vāp-</i>) 'scatter'	<i>up-ta</i> 'scattered'	<i>vāp-a-ti</i> 'the scatters'	<i>u-vāp-a</i> 'the scattered'

array of facts, one might abandon the hypothesis that each Sanskrit root has a single, basic grade form from which its other grade forms may be predicted — that is, one might adopt the view that both the weak and the full grade forms of a Sanskrit root must simply be specified as idiosyncratic components of its underlying representation. This isn't a necessary conclusion, however, for although the facts of Sanskrit vowel gradation are apparently incompatible with the uniformity assumption, they are compatible with the logically independent assumption of derivability: it is perfectly feasible to assume that each Sanskrit root has a single, basic grade form if one abandons the requirement that there is one grade which is basic for all roots. This latter approach to Sanskrit vowel gradation is at least 24 centuries old, since it is, essentially, that assumed by the ancient Indian grammarian Pāṇini in his grammar of Sanskrit, the *Aṣṭādhyāyī*.

4. The Pāṇinian analysis of Sanskrit vowel gradation

Pāṇini assumes that the weak grade form is basic for most roots — specifically, for those roots exhibiting the alternations in Table 5. In weak grade contexts, these roots undergo no change; for example, the sūtra in (8) guarantees that such roots will remain weak before the past participial suffix *-ta*.⁶

(8) *Aṣṭādhyāyī* I.1.5 (trans. by Vasu 1891: 7)

And that, which otherwise would have caused *guna* or *vṛiddhi*, does not do so, when it has an indicator [k], [ḡ], or [ḥ].

[N.B.: By III.4.114, the past participial suffix *-ta* belongs to a class of suffixes (*ārdhadhātuka* suffixes) which normally cause a root to assume the full grade; but by I.1.26, *-ta* bears the index k. Thus, *mī* 'lead' is unchanged in *mī-ta* 'led'.]

In full or lengthened grade contexts, these same roots undergo the vowel substitutions in Table 5; for example, the sūtra in (9) converts a root such as *mī* 'lead' to its full grade form in the present tense; and the one in (10) converts roots of this sort to their lengthened grade form in the third singular perfect active.

(9) VII.3.84 (Vasu 1891: 1441)

The *Guṇa* is substituted for the final [ik] vowel of a stem before the affixes called *sārvadhātuka* and *ārdhadhātuka*.

[i] *ik* vowel = i, ī, u, ū, ṛ, ṝ, ṝ̄, or ḷ;

[ii] By III.1.68, III.4.113, the present tense suffix *-a* is a *sārvadhātuka* suffix.⁷ Thus, *mī* 'lead' becomes *māy-* in *māy-a-ti* 'he leads'.]

(10) VII.2.115 (Vasu 1891: 1406)

Before the affixes having an indicator [ḥ] or [ḡ], *Vṛiddhi* is substituted for the end-vowel of a stem.

[By III.4.82, the third singular perfect active suffix bears the index ṇ. Thus, *mī* 'lead' becomes *māy-* in *mī-māy-a* 'he led'.]

Now, although it is the weak grade form which he treats as basic for most roots, Pāṇini assumes that for nasal and *samprasāraṇa* roots, it is instead the full grade form which is basic. Roots in these two classes remain unchanged in full-grade contexts, as, for example, in the present tense forms in (11).

(11) Nasal roots: *han-* 'strike' remains unchanged in *han-ti*

Samprasāraṇa roots: *yaj-* 'sacrifice' remains unchanged in *yaj-a-ti*
'the strikes',
'the sacrifices'.

In weak grade contexts, their weak alternants are introduced by special rules: for example, the sūtra in (12) causes nasal roots to lose their final nasals before the past participial suffix; and the one in (13) causes the vocalization of the semivowel in a *samprasāraṇa* root appearing before this suffix.

(12) VI.4.37 (Vasu 1891: 1266)

The final nasal of those roots which ... have an unaccented root-vowel, as well as of [*van-*] and [*tan-*] &c, is elided before an affix beginning with a consonant (except a semivowel or a nasal), when these have an indicator [k] or [ḥ].

[Thus, *han-* 'strike' becomes *ha-* in *ha-ta* 'struck'.]

(13) VI.1.15 (Vasu 1891: 1047)

The semivowels of the roots [*vac-*], [*svap-*] and [*yajātī*] verbs are vocalised when followed by an affix having an indicator [k].

[Thus, *yaj-* 'sacrifice' becomes *īj-* (→ *īḡ-*) in *īḡ-ta* 'sacrificed'.]

In lengthened grade contexts, nasal and *samprasāraṇa* roots, like other roots, undergo a change in vowel quantity; the sūtra in (14), for instance, causes roots of these sorts to become lengthened in the third singular perfect active.

(14) VII.2.116 (Vasu 1891: 1406)

In a stem ending in a consonant with an [a] immediately preceding it, the *Vṛiddhi* is substituted for such [a], when an affix having an indicator [ḡ] or [ḥ] follows.

Table 8. *The Pāṇinean approach to Sanskrit vowel gradation*

Root	Weak grade	Full grade	Lengthened grade
'normal' (e.g. <i>mī-</i>)	<i>mī-</i> (basic)	<i>mā-</i> (derived)	<i>mā-</i> (derived)
nasal (e.g. <i>han-</i>)	<i>ha-</i> (derived)	<i>han-</i> (basic)	<i>hān-</i> (derived)
samprasāraṇa (e.g. <i>yaj-</i>)	<i>yi-</i> (derived)	<i>yaj-</i> (basic)	<i>yā-</i> (derived)

[Thus, *han-* 'strike' becomes (*ḡ*)*hān-* in *ja-ghān-a* 'he struck'; *yaj-* 'sacrifice' becomes *yā-* in *i-yā-a* 'he sacrificed'.]

This Pāṇinean approach to Sanskrit vowel gradation may be schematically summarized as in Table 8.

5. Discussion

If the approach to predictive indeterminacy embodied in Pāṇini's analysis is compared with the one assumed in Anderson's description of Fula consonant gradation, some rather subtle differences emerge. First, however, it should be noted that the two analyses share an important virtue, namely, they both allow the derivability assumption to be maintained at the expense of only a single special stipulation. In Anderson's analysis, the derivability assumption is upheld by the postulated distinction between two sorts of /w/, a distinction whose effect is to eliminate the indeterminacy of the Fula system. In the Pāṇinean analysis, the derivability assumption is rescued by the distinction between those roots whose underlying form is in the full grade and those with underlying weak grade; given this distinction, it is perfectly possible to predict a stem's various alternants from a single basic form in Sanskrit.

Despite this similarity, a number of differences exist between these two approaches to predictive indeterminacy. The clearest of these is the fact that only Anderson's approach is consistent with the uniformity assumption. This would seem to count as an advantage for his approach, since a theory of grammar incorporating a requirement of derivational uniformity in systems of stem gradation would be a good deal more restrictive than one incorporating no such requirement. Careful consideration, however, raises some real doubts about the apparent advantage here.

First, the uniformity assumption can only be maintained in Anderson's analysis at the expense of a phonological distinction which never receives phonetic expression. Thus, unlike the Pāṇinean analysis, Anderson's analysis is subject to the familiar objections regarding absolute neutralizations in phonology. Note, however, that the underlying distinction postulated by Anderson is in fact quite different from those proposed in the most familiar neutralization analyses: in such classic analyses as Kisseberth's (1969) account of Yawelmani long vowels, or Hyman's (1970) analysis of labialized and palatalized consonants in Nupe, the distinction neutralized has always been one which at least could be realized phonetically in some language. The underlying distinction proposed by Anderson, however, is one which is never realized phonetically in ANY language; see Ohala and Lorentz (1977) for discussion.

Despite the inherent implausibility of a phonological distinction that is without concrete phonetic motivation in any known language, there is one piece of evidence cited by Anderson (1976: 131) which could potentially be used to justify the proposed distinction. Anderson claims that in the Yola dialect of Adamawa Fula, those instances of /w/ that alternate with labials have begun to be realized phonetically as [v], while those which alternate with velars have remained unchanged; in order to view this development as the effect of a regular phonological change, one would seemingly have to assume that two kinds of /w/ are underlyingly distinguished in Fula, exactly as Anderson has proposed. What remains to be shown, however, is that this is indeed an innovation rather than a retention in this dialect. Anderson (1976: 111ff.) asserts that in most dialects of Fula, /w/ is the result of a historical merger of *w and *y, which were originally distinguished as the continuant grade alternants of *b/*mb and *g/*yg, respectively; if this is so, however, then it is perfectly possible that the phonetic distinction between *w and *y was never neutralized in the Yola dialect, but has been preserved to the present day as the distinction between [v] and [w], respectively.

Even if one is willing to accept the proposed neutralization, it is, in any event, unlikely that the uniformity assumption can be maintained for the Fula system. According to this assumption, the continuant grade should be basic for all stems in the language. Yet, as Arnott (1970: 100-103) shows, there are certain stems which never appear in any of the continuant grade contexts listed in (2a); examples are the stems in (15), whose 'paradigms' consist entirely of forms in the stop and nasal grades.

(15) a.	<i>baat-</i> 'needle'	b.	<i>borr-</i> 'young sheep'	c.	<i>baal-</i> 'sheep'
Class 16	<i>baat-al</i>	Class 12	<i>mborr-a</i>	Class 15	<i>mbaal-u</i>
24	<i>baat-e</i>	25	<i>borr-i</i>	25	<i>baal-i</i>
3	<i>baat-el</i>		<i>borr-el</i>		<i>baal-el</i>
5	<i>baat-um</i>		<i>borr-um</i>		<i>baal-um</i>
6	<i>mbaat-on</i>		<i>mborr-on</i>		<i>mbaal-on</i>
7	<i>mbaat-a</i>		<i>mborr-a</i>		<i>mbaal-a</i>
8	<i>mbaat-o</i>		<i>mborr-o</i>		<i>mbaal-o</i>

It would be fatuous to try to choose between the unattested continuant grade forms in (16) in attempting to come up with an underlying form for these stems.

- (16) a. *baat- b. *bort- c. *baal-
 *waaat- *wort- *waaal-

If a basic form has to be chosen, the stop grade form is the best candidate,⁸ but if the stop grade is chosen as basic for these stems, then the uniformity assumption must be abandoned.

The existence of forms such as those in (15) should, incidentally, come as no surprise. It is a commonplace in morphology that what is basic in one paradigm cannot be so in another: for instance, although the unmarked infinitive form is regarded as basic for most English verbs, certain verbs (such as the modals or the verb *used to*) lack nonfinite forms and must therefore be viewed as basically present or past in tense. The fact that this heterogeneity among basic stem forms is so routinely encountered might be viewed as evidence favoring the Pāṇinian approach to predictive indeterminacy: in allowing basic stem forms to vary in grade, this approach exploits a descriptive option which is independently and abundantly well motivated.

The one really clear advantage of the Pāṇinian analysis, however, is its very general applicability. Observe, for example, that this sort of analysis can easily be developed for the case of Fula consonant gradation. Abandoning the uniformity assumption, one can view the continuant grade form as basic for those Fula stems participating in the alternations in Table 3a but regard the stop grade form as basic for stems exhibiting the alternations in Table 3b. Under such an approach, a stem whose continuant grade form is basic would undergo the substitutions in (17a) and (17c), while a stem whose stop grade form is basic would be subject to the replacements in (17b) and (17c).

- (17) a.
$$\left[\begin{array}{l} +N \\ +\text{Continuant Grade} \end{array} \right] \rightarrow /C\dots/ \text{ (in classes 1, 3, 4, 5, 16, 17, 19, 21, 23, 24, 25)}$$

 b.
$$+N \rightarrow /C\dots/ \text{ (in classes 2, 9, 11, 13, 14, 20)}$$

 c.
$$\left[\begin{array}{l} +\text{Stop Grade} \\ +N \end{array} \right] \rightarrow /w\dots/ \text{ (in classes 6, 7, 8, 10, 12, 15, 18, 22)}$$

 (where C is the stop-grade alternant of C)
 (where C is the nasal-grade alternant of C)

Thus, the Pāṇinian approach to predictive indeterminacy provides a serious alternative to Anderson's neutralization analysis of Fula consonant gradation.

Note, on the other hand, that for the Sanskrit facts, there isn't even a marginally credible analogue of the neutralization analysis. The plausibility of Anderson's argument that the Fula labiovelar glide corresponds to two underlyingly distinct segments — one labial and the other velar — hinges purely and simply on the fact that [w] is doubly articulated. There is, however, no such phonetic (or pseudophonetic) basis for claiming that the weak grade alternant in Table 6 actually represents two distinct segments underlyingly, or that the weak-grade vowels in Table 7 are underlyingly distinct from their weak-grade counterparts in Table 5. In short, it isn't possible to resort to the postulation of absolutely neutralized distinctions in order to eliminate the predictive indeterminacy inherent in the system of Sanskrit vowel gradation.

Vowel gradation and consonant mutation are, of course, two very different phenomena; for example, they arise historically in completely different ways. Vowel gradation is, typically, a historical consequence of earlier accentual alternations, while consonant mutations generally arise as the effect of earlier sandhi phenomena.⁹ Because of this fundamental genetic difference, one might speculate that predictive indeterminacies occurring in systems of vowel gradation are in general of a different kind from those arising in systems of consonant gradation: if so, then it isn't necessarily a disadvantage of the neutralization analysis that it cannot be exploited in an account of Sanskrit vowel gradation. It is important to recognize, however, that there are predictively indeterminate systems of consonant gradation for which a neutralization analysis is not feasible. Consider, for example, the dialect of Breton spoken on the island of Groix (located off the coast of southern Brittany). As is typical of the Celtic languages, this dialect of Breton has an elaborate system of grammatically

Table 9. Initial lenition in Breton. Groix dialect (Ternes 1970: 143)

Unlenited form	Lenited form
a. p _____	b
t _____	d
ç _____	j
k _____	g
m _____	v
b _____	v
d _____	z
b.	
j _____	∅ (normally only before rounded glides)
j _____	j (elsewhere)
g _____	∅ (normally only before rounded segments)
g _____	x (normally elsewhere)

conditioned mutations of initial consonants; among the alternations shown by initial consonants are those in Table 9.

The system represented in Table 9 would not be predictively indeterminate if the choice of alternants in section b were always strictly determined by the phonological context; and though it almost is, it isn't quite. For example, although /j/ normally only alternates with ∅ before labiovelar or labiodental glides, this alternation does show up exceptionally in other environments,¹⁰ and although the alternation of /g/ with ∅ normally only appears before rounded segments, this condition is neither necessary nor sufficient for the appearance of this alternation. Thus, as the exceptional contrasts in (18) reveal, the choice of alternants in Table 9b does not always depend merely on phonological context. For this reason, the system in Table 9 includes both many-to-one and one-to-many relations between alternants and must accordingly be viewed as predictively indeterminate.

- (18) a. $j \sim \emptyset / _i$: $j\text{v}\text{in}$ 'fingernail'
 but $j \sim j / _i$: $i _j\text{v}\text{in}$ 'his fingernail'
 j 'guy' (a piece of boat rigging)
 i j 'his guy'
 b. $g \sim \emptyset / _w$: $g\text{w}\text{er}\text{an}$ 'I know'
 but $g \sim x / _w$: $_w\text{er}\text{an}$ çet 'I don't know'
 gwel 'leaven'
 karged-o xwel 'there's plenty of leaven'

- c. $g \sim \emptyset / _r$: $g\text{ran}$ 'I do'
 but $g \sim x / _r$: $pe _r\text{an}$ ma la:bur 'when I do my work'
 grān 'grain'
 i xrān 'his grain'

(cf. Ternes 1970: 144–146)

Unlike the Fula system of consonant gradation, the Breton system in Table 9 does not submit plausibly to a neutralization analysis; neither the lenited alternants having more than one unlenited counterpart nor the unlenited consonants having more than one lenited alternant possess the sort of double articulation cited as justification for the postulation of two distinct /w/s in Fula. Thus, absolute neutralization is not only unsatisfactory as a general approach to solving the problem of predictive indeterminacy; it doesn't even provide a reliable account of predictively indeterminate systems of consonant mutation.

On the other hand, a Pāṇinian analysis of the Breton facts is straightforward. In such an analysis, unlenited stem forms could normally be regarded as basic, and subject to the lenition rule in (19).

- (19) $\left[\begin{array}{l} \pm N, \pm V \\ -\text{Lenited} \end{array} \right] \rightarrow /C \dots /$ in leniting environments
 (where C is the lenited form of C)

Stems having the nonnull lenited alternants in Table 9b could, however, be regarded as basically lenited, and subject to the 'deletion' rule in (20).

- (20) $\left[\begin{array}{l} \pm N, \pm V \\ +\text{Lenited} \end{array} \right] \rightarrow / C \dots /$ except in leniting environments
 [-cont]
 [+voi]

These facts, I think, lead inevitably to the conclusion that the Pāṇinian approach to predictive indeterminacy must be preferred to the neutralization approach for reasons of economy. Unlike the latter sort of analysis, the Pāṇinian approach doesn't require the postulation of any phonological distinctions which aren't phonetically motivated; and although it does entail that the basic forms within a system of root or stem gradation may not all belong to the same grade, this sort of underlying heterogeneousness is commonly encountered in the study of inflectional morphology. Moreover, the Pāṇinian approach is much more widely applicable than the neutralization approach. If one accepts Anderson's analysis of the Fula facts, one must provide a completely different kind of explanation for predictively indeterminate systems such as those of Sanskrit and

Breton; but if one accepts the Pāṇinean analysis of Sanskrit vowel gradation, then one need look no further for a workable approach to the predictive indeterminacies of Fula and Breton.

Received 16 January 1985

Department of English
University of Kentucky
Lexington, Kentucky 40506
USA

Notes

1. These examples are from Crosby and Ward (1944: 4f). Tones have been omitted. Note that orthographic *ny* represents a palatal nasal; *mb*, *nd*, *yg* represent prenasalized stops; *kp*, *gb* represent labiovelar stops; and *j*, *nj* represent palatal affricates.
2. The Fula verbal system incorporates an equally intricate pattern of initial consonant gradation. Those features of Fula consonant gradation which are relevant to the present discussion are adequately reflected in the nominal system, to which attention will be restricted in what follows.
3. The Fula examples are cited from Arnott (1970: 47, 98–103). Note that *ny* represents a palatal nasal; *mb*, *nd*, *yg* represent prenasalized stops; *j* and *nj* represent palatal affricates; *sh* represents a palatal fricative; and *ḍ* represents a laryngealized labial stop.
4. These class suffixes themselves show initial consonant gradation; in this case, however, the choice of suffix grade is governed by the specific stem to which the suffix is attached.
5. In the standard transliteration of Sanskrit, *r*, *l* represent the velar nasal; *ṛ* represents semivowels *r*, *l*; *v* represents a labial semivowel; *ṅ* represents the velar nasal; *ṅ* represents the palatal nasal; *j* represents a palatal stop; and *f*, *ṣ*, *ś* represent retroflex consonants.
6. This is not the place for an account of the notorious intricacies of Pāṇini's metathory. It should be noted, however, that Pāṇini assigns to each affix an abstract index which determines the various morphological processes triggered (or blocked) by the affix. These indices, which might be likened to rule features in a generative grammar, are symbolized simply as individual consonants in Pāṇini's metalanguage; examples are the indices *k*, *g*, and *ṅ* mentioned in (8).
7. For a cogent summary of the distributional and functional differences between *sārvadhātuka* and *ārdhadhātuka* suffixes, see Shefts (1961: 13–16).
8. In systems of initial consonant gradation, rules of nasalization are widely motivated; rules of denasalization, on the other hand, appear to be very rare.
9. Of course, in a full-fledged system of either sort, the original phonetic motivation for the observed alternations is no longer apparent.
10. Ternes (1970: 143) also notes that */j/* has */y/* as its lenited alternant in a single stem: *jalni* 'to be able to'. I assume that both the unlenited and the lenited forms of this stem would have to be listed lexically.

References

- Anderson, Stephen R. (1976). On the description of consonant gradation in Fula. *Studies in African Linguistics* 7 (1), 93–136.
- Arnott, D. W. (1970). *The Nominal and Verbal Systems of Fula*. London: Oxford University Press.

- Crosby, K. H., and Ward, Ida C. (1944). *An Introduction to the Study of Mende*. Cambridge: Heffer.
- Hyman, Larry M. (1970). How concrete is phonology? *Language* 46, 58–76.
- Kisseberth, Charles W. (1969). On the abstractness of phonology: the evidence from Yawelmani. *Papers in Linguistics* 1, 248–282.
- Ohala, John, and Lorentz, James (1977). The story of [w]: an exercise in the phonetic explanation for sound patterns. In K. Whistler et al. (eds.), *Proceedings of the Third Annual Meeting of the Berkeley Linguistics Society*. Berkeley: Berkeley Linguistics Society.
- Shefts, Betty (1961). *Grammatical Method in Pāṇini: His Treatment of Sanskrit Present Stems*. New Haven: American Oriental Society.
- Ternes, Elmar (1970). *Grammatik struktural de breton de l'île de Groix*. Heidelberg: Winter.
- Yasu, Sītā Chandra (ed., trans.) (1891). *The Aṣṭādhyāyī of Pāṇini*, 2 vols. (Reprinted 1962, Delhi: Motilal Banarsidass.)