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Inflectional Morphology

A Theory of Paradigm Structure

GREGORY T. STUMP

Inflectional Morphology

A new contribution to linguistic theory, this book presents a formal framework for the analysis of word structure in human language. It sets forth the network of hypotheses constituting Paradigm Function Morphology, a theory of inflectional form whose central insight is that paradigms play an essential role in the definition of a language's system of word structure. The theory comprises several unprecedented claims, chief among which is the claim that a language's realization rules serve as clauses in the definition of a paradigm function, an overarching construct which is indispensable for capturing certain kinds of generalizations about inflectional form.

This book differs from other recent works on the same subject in that it treats inflectional morphology as an autonomous system of principles rather than as a subsystem of syntax or phonology and it draws upon evidence from a diverse range of languages in motivating the proposed conception of word structure.

GREGORY T. STUMP is Associate Professor of English and Linguistics in the Department of English at the University of Kentucky. He is the author of *The Semantic Variability of Absolute Constructions* (1985) and has published numerous articles in such journals as the *Journal of Linguistics*, *Language*, *Linguistic Analysis*, *Linguistics*, *Natural Language and Linguistic Theory* and the *Yearbook of Morphology*.

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University of Kentucky

CAMBRIDGE
UNIVERSITY PRESS

PUBLISHED BY CAMBRIDGE UNIVERSITY PRESS (VIRTUAL PUBLISHING)
FOR AND ON BEHALF OF THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE
The Pitt Building, Trumpington Street, Cambridge CB2 IRP
40 West 20th Street, New York, NY 10011-4211, USA
477 Williamstown Road, Port Melbourne, VIC 3207, Australia

http://www.cambridge.org

First published in printed format 2001

A catalogue record for the original printed book is available
from the British Library and from the Library of Congress
Original ISBN 0 521 78047 0 hardback

ISBN 0 511 01378 7 virtual (netLibrary Edition)

for Robert and Jeanne Stump

for Marcia Hurlow

for Marjorie Hurlow Stump

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Acknowledgments

This book is a comprehensive elucidation of Paradigm Function Morphology, a theory of inflectional form that I have been developing over the past ten years. Over the years, the theory has changed in a number of subtle respects, and other evolutionary modifications are no doubt in the offing. Still, the fundamental premise underlying the theory remains the same: that paradigms are not the epiphenomenon that they are often assumed to be in other morphological frameworks, but are central to the definition of a language's inflectional system. This book is an attempt to justify this idea and to give it formal substance.

I began writing this book during the 1989–90 academic year at the Université de Bretagne Occidentale; I would like to thank the staff of the Centre de Recherche Bretonne et Celtique for their research hospitality during that year, and the National Endowment for the Humanities for granting me a fellowship which helped make that sabbatical possible. The manuscript took much of its present shape during the 1996–97 academic year at the University of Essex; I would like to thank the Department of Language and Linguistics at Essex for their invaluable assistance during this time. The manuscript was completed in the summer of 1999 at the University of Kentucky.

I thank my colleagues in the Department of English and the Linguistics Program for the many ways in which they have facilitated this work since its inception; thanks also to Raphael Finkel and Lei Shen in the University of Kentucky's Department of Computer Science for their work in realizing KATR, an extension of the DATR language (Evans and Gazdar 1996) which allows the theoretical conclusions advocated here to be implemented computationally in a straightforward fashion.

The insights of the community of morphologists in Brighton, Colchester, and Guildford have led to significant improvements in the theory developed here: thanks to Lynne Cahill, Roger Evans, Norman Fraser, Gerald Gazdar, Andrew Hippisley, and – with particular gratefulness for their comments on earlier drafts of the manuscript – Dunstan Brown, Greville Corbett, and Andrew Spencer.

My profound thanks to Ernest Scatton for his generous and invaluable advice on Bulgarian.

I thank the scholars whose research on inferential–realizational approaches to morphology has been an indispensable frame of reference for the proposals put forward in this book: Stephen Anderson, Mark Aronoff, P. H. Matthews, and especially Arnold Zwicky; no one familiar with their work should have any difficulty detecting its influence in these pages. I would also like to thank the many people whose interest in discussing issues of inflectional morphology has, in one way or another, helped me sharpen the ideas advanced here; without attempting to list all of these people, I should make particular mention of Geert Booij, Andrew Carstairs-McCarthy, Mark Donohue, Morris Halle, Martin Haspelmath, Richard Janda, Brian Joseph, the late Steve Lapointe, Alec Marantz, Rolf Noyer, David Perlmutter, Geoff Pullum, and Jerrold Sadock. Thanks also to the participants in my morphology seminar at the 1993 LSA Summer Institute at the Ohio State University and to the intrepid students in my autumn 1997 morphology seminar at the University of Kentucky.

Over the period during which this book was written, several native speakers of Breton have provided me with exceptionally useful information about the authentic morphology of their language; my sincerest thanks to Miek and Daïc Kervella, Anne-Marie Le Gall, the late Alain Le Gall, Fañch Yesou, Christiane and Jean-Louis Mallejac, Madeleine and Louis Jezequel, Lucien Cras, and the late Louis Bodénès.

For overseeing the review of the manuscript and for his guidance in putting it into its final shape, I heartily thank Andrew Winnard at Cambridge University Press.

Chapter 4 is a modified and abbreviated version of my 1995 article 'The uniformity of head marking in inflectional morphology' (in G. Booij and J. van Marle (eds.), *Yearbook of Morphology 1994*, pp. 245–96), which is used here with kind permission from Kluwer Academic Publishers.

Finally, I thank my family for their inspiration and unfailing encouragement.

Abbreviations

1	first person
2	second person
2M	double-marking subclass of headed expressions
3	third person
abl	ablative case
acc	accusative case
act	active voice
AGR	AGREEMENT feature
AGR(ob)	AGREEMENT(object) feature
AGR(su)	AGREEMENT(subject) feature
anim	animate class
ANIM	ANIMATE feature
aor	aorist tense
cl	noun class
compar	comparative degree
conj	conjunct mood
CONJ	CONJUGATION feature
CUG	Coderivative Uniformity Generalization
dat	dative case
DEG	DEGREE feature
DI	Differentiated Inflection (hypothesis concerning promiscuous inflections)
DIM	diminutive
DIR	DIRECT case feature
du	dual number
EM	external marking subclass of headed expressions
excl	exclusive
FCD	Function Composition Default
fem	feminine gender
fin	finite form

FLOH	Fixed Linear Ordering Hypothesis
FUT	Lingala FUTURE feature
gen	genitive case
GEN	GENDER feature
HAP	Head-Application Principle
HM	head-marking subclass of headed expressions
HOH	Head Operation Hypothesis
IFD	Identity Function Default
impf	imperfect tense
impv	imperative mood
inanim	inanimate class
incl	inclusive
INCL	INCLUSIVE feature
indic	indicative mood
inf	infinitive form
instr	instrumental case
loc	locative case
masc	masculine gender
mid	middle voice
MR	Potawatomi MAJOR REFERENCE feature
neg	negative polarity
neut	neuter gender
nom	nominative case
NUM	NUMBER feature
ob	object
obv	obviative
pass	passive voice
pcl	particle
PER	PERSON feature
PFM	Paradigm Function Morphology
pl	plural number
POL	POLARITY feature
pos	positive polarity; *also* positive degree
POSS	POSSESSOR feature
pple	participle
Pr	prefixal affix position
pres	present tense
PRES	Lingala PRESENT feature
PRET	PRETERITE feature

PUG	Paradigm Uniformity Generalization
REFL	REFLEXIVE feature
rel.past	Fula relative past tense
sg	singular number
su	subject
superl	superlative degree
TNS	TENSE feature
UMoR	Undifferentiated Mass of Rules (hypothesis concerning promiscuous inflections)
VCE	VOICE feature
VFORM	VERB FORM feature
voc	vocative case

1 *Inferential–realizational morphology*

1.1 Theories of inflectional morphology

In any language exhibiting inflection, each inflected word in a sentence carries a set of morphosyntactic properties; in English, for instance, the verb form *am* in the sentence *I am sure* carries the properties 'first-person singular (1sg) subject agreement', 'present tense', and 'indicative mood'. In very many cases, an inflected word's morphosyntactic properties are associated with specific aspects of its morphology; for instance, the properties of subject agreement, tense, and mood carried by the verb form *likes* in the sentence *She likes reading* are associated with the presence of the suffix *-s*. In recent years, grammatical theorists have devoted considerable attention to the nature of these associations between an inflected word's morphosyntactic properties and its morphology. Nevertheless, these efforts haven't yet led to anything like a consensus in current theories of inflection.

According to LEXICAL theories of inflection, these associations are listed in the lexicon; the affix *-s*, for example, has a lexical entry which specifies its association with the morphosyntactic properties '3sg subject agreement', 'present tense', and 'indicative mood'. Theories of this sort portray the association between an inflectional marking and the set of morphosyntactic properties which it represents as being very much like the association between a lexeme's[1] root and its grammatical and semantic properties. This conception is rejected by INFERENTIAL[2] theories, in which the systematic formal relations between a lexeme's root and the fully inflected word forms constituting its paradigm are expressed by rules or formulas. In theories of this sort, the associations between a word's morphosyntactic properties and its morphology are expressed by the morphological rules which relate that word to its root: the existence of the word *likes*, for instance, is inferred from that of the root *like* by means of a rule associating the appearance of the suffix *-s* with the presence of the properties '3sg subject agreement', 'present tense', and 'indicative mood'.

Crosscutting this distinction between lexical and inferential theories is a second distinction. According to INCREMENTAL theories, inflectional morphology is information-increasing; that is, words acquire morphosyntactic properties only as a concomitant of acquiring the inflectional exponents of those properties. On this view, *likes* acquires the properties '3sg subject agreement', 'present tense', and 'indicative mood' only through the addition of *-s* (whether this is inserted from the lexicon or is introduced by rule). According to REALIZATIONAL theories, by contrast, a word's association with a particular set of morphosyntactic properties licenses the introduction of those properties' inflectional exponents; on this view, the association of the root *like* with the properties '3sg subject agreement', 'present tense', and 'indicative mood' licenses the attachment of the suffix *-s* (whether this attachment is effected by lexical insertion or by the application of a morphological rule).

One can therefore imagine four types of theories of inflectional morphology: lexical–incremental theories, lexical–realizational theories, inferential–incremental theories, and inferential–realizational theories. At present, each of these four types of theories has its proponents.

Lieber (1992) advocates a lexical–incremental theory. In Lieber's theory, an affix's lexical entry is assumed to supply a subcategorization restriction limiting the kinds of contexts into which that affix might be inserted; for instance, the lexical entry of *-s* might be assumed to supply the restriction '[V_{stem} ____]' (= 'combines with a preceding verb stem'). As an affix joins with a stem, the morphosyntactic properties of the resulting whole are computed from those of its parts by a percolation mechanism; thus, *likes* acquires its syntactic category from its stem *like* and acquires the properties '3sg subject agreement', 'present tense', and 'indicative mood' from the suffix *-s*.

The theory of Distributed Morphology proposed by Halle and Marantz (1993) is of the lexical–realizational type. Halle and Marantz assume that rules of syntax construct hierarchical combinations of abstract 'morphemes' (sets of morphosyntactic properties) into which concrete formatives are inserted from the lexicon; in order for a lexically listed formative X to be inserted into a morpheme Y, the set of morphosyntactic properties associated with X must be a subset of those constituting Y. On this view, the syntax is assumed to supply an abstract structure [V Y] (where Y comprises the properties '3sg subject agreement', 'present tense', and 'indicative mood'); *-s* is then insertable into Y because the morphosyntactic properties specified in its lexical entry aren't distinct from those constituting Y.

Steele (1995) advocates an inferential–incremental theory ('Articulated

Morphology'), according to which morphological rules effect changes in both the form and the content of the expressions to which they apply. For instance, *likes* arises by means of a rule applying to verb stems which are unspecified for subject agreement, tense, and mood; the application of this rule to a verb stem X results in (a) the addition of the suffix -*s* to X and (b) the addition of the morphosyntactic properties '3sg subject agreement', 'present tense', and 'indicative mood' to X's property set.

Finally, Word-and-Paradigm theories of inflection (e.g. those proposed by Matthews (1972), Zwicky (1985a), and Anderson (1992)) are of the inferential–realizational type. In inferential–realizational theories, an inflected word's association with a particular set of morphosyntactic properties licenses the application of rules determining the word's inflectional form; *likes*, for example, arises by means of a rule appending -*s* to any verb stem associated with the properties '3sg subject agreement', 'present tense', and 'indicative mood'.

A careful evaluation of morphological evidence suggests that the most adequate theory of inflectional morphology must be inferential rather than lexical, and must be realizational rather than incremental. Numerous independent lines of reasoning converge on this conclusion. In section 1.2, I present two reasons for preferring realizational theories over incremental theories; in section 1.3, I discuss three poorly motivated theoretical distinctions none of which is entailed by inferential–realizational theories of inflection but which are, to varying degrees, inevitably resorted to by lexical theories and incremental theories. In section 1.4, I discuss the very limited interface between morphology and syntax implied by the assumptions of inferential–realizational theories of inflection; although this conception of the morphology–syntax interface is incompatible with the widely held conviction that inflectional affixes sometimes function as independent syntactic objects, it is nevertheless reconcilable with the phenomena that have been taken to justify this conviction, as I show in section 1.5. My conclusions are summarized in section 1.6, where, in anticipation of the next chapter, I outline the distinctive characteristics of the inferential–realizational theory that is the focus of this book: the theory of Paradigm Function Morphology.

1.2 Evidence favouring realizational theories over incremental theories

Two fundamental facts about inflectional morphology favour realizational theories over incremental theories. The first of these is (1):

(1) The morphosyntactic properties associated with an inflected word may exhibit EXTENDED EXPONENCE in that word's morphology.

That is, a given property may be expressed by more than one morphological marking in the same word. Examples are legion: in Breton, the productive pattern of pluralization for diminutive nouns involves double marking (*bagig* 'little boat', pl *bagoùigoù*); in Swahili negative past-tense verb forms, negation is expressed both by the use of the negative past-tense prefix *ku*- and by the negative prefix *ha*- (*tu*-*li*-*taka* 'we wanted', but *ha*-*tu*-*ku*-*taka* 'we did not want'); in French, the verb *aller* 'go' has a special suppletive stem *i*- appearing only in the future indicative and the present conditional – yet, *i*- doesn't resist the attachment of -*r(a)*, the suffixal exponent of the future indicative and the present conditional; German *gesprochen* is distinguished as a past participle both by its stem vocalism and by its affixes; and so on.

Realizational theories are fully compatible with the widespread incidence of extended exponence: in realizational theories, there is no expectation that a given morphosyntactic property will be realized by at most one marking per word; on the contrary, the possibility is left open that the same property may induce (or may participate in inducing) the introduction of a number of distinct markings.[3] In incremental theories, by contrast, it is customarily assumed that a given morphosyntactic property has at most one affixal exponent: in the lexical–incremental frameworks of Lieber (1992:77ff.) and Selkirk (1982:74ff.), the percolation mechanism is defined in such a way that an inflected word's morphosyntactic properties are each traceable to at most one affixal exponent; similarly, Steele (1995:280) states that '[b]ecause operations are informationally additive, multiple additions of identical information are precluded' in Articulated Morphology. Thus, incremental theories deny that instances of extended exponence actually arise, and must therefore resort to extraordinary means to accommodate those that do.

Consider, for example, the phenomenon of adjectival preprefixation in Nyanja, a Bantu language of Malawi. In Nyanja, as elsewhere in Bantu, nouns inflect for gender and number by means of noun-class prefixes. Generally, a given gender is associated with a pair <*x*,*y*> of noun classes, such that members of that gender exhibit the class *x* prefix in the singular and the class *y* prefix in the plural. The inventory of these nominal prefixes is given in row A of table 1.1.

The qualifying and concordial prefixes in rows B and C serve to express gender/number agreement. Verbs, for example, inflect for subject agreement by means of the concordial prefixes:

Table 1.1 *Class, qualifying, and concordial prefixes in Nyanja (Price 1958:52f.)*

Class:	1	2	3	4	5	6	7	8	9	10	12	13	14	16	17	18
A. Class prefixes:	*mu*[a]	*a*	*mu*[a]	*mi*	*li*[b]	*ma*	*ci*	*zi*	*n*	*n*	*ka*	*ti*	*u*	*pa*	*ku*	*mu*
B. Qualifying prefixes:	*wa*	*a*	*wa*	*ya*	*la*	*a*	*ca*	*za*	*ya*	*za*	*ka*	*ta*	*wa*	*pa*	*kwa*	*mwa*
C. Concordial prefixes:	*a*	*a*	*u*	*i*	*li*	*a*	*ci*	*zi*	*i*	*zi*	*ka*	*ti*	*u*	*pa*	*ku*	*mu*

Notes:

[a] *mu*- appears as *m*- before polysyllabic, consonant-initial stems.

[b] Many nouns belonging to gender 5/6 lack *li*- in their singular form.

(2) *ci-lombo* *ci-kula.*
CLASS:7-weed CONCORDIAL:7-grow
A weed grows.

Two types of adjectives can be distinguished according to the pattern of agreement marking they exhibit. In adjectives of the first type (*-bwino* 'good', *-cabe* 'no good, useless, bad', *-kale* 'ancient, former, old', *-makono* 'modern, present-day', *-mbili* 'many, much', *-pang'ono* 'few', *-tsopano* 'new'; Price 1958:53), the qualifying prefixes are used to express agreement with a modified noun:

(3) *ci-manga* *ca-bwino*
CLASS:7-maize QUALIFYING:7-good
good maize

In adjectives of the other type (*-fupi* 'short, low', *-kulu* 'large, great, important', *-ng'ono* 'small, young, insignificant', *-tali* 'long, tall, high', *-wisi* 'fresh, sappy, green'; Price 1958:54), agreement with a modified noun is instead encoded by means of two prefixes. The outer prefix is the appropriate qualifying prefix; the inner prefix is the appropriate concordial prefix unless the modified noun belongs to class 1, in which case the inner prefix is the class 1 nominal prefix. The examples in (4) illustrate this doubly prefixed pattern of agreement.

(4) Examples of preprefixation in Nyanja (Bandawe et al. 1965:251f.)

a. *mw-ana* *wa-m-kulu*
CLASS:1-child QUALIFYING:1-CLASS:1-large
a large child

b. *a-ana* *a-a-kulu* (→ *ana akulu*)
CLASS:2-child QUALIFYING:2-CONCORDIAL:2-large
large children

c. *m-sika* *wa-u-kulu*
CLASS:3-market QUALIFYING:3-CONCORDIAL:3-large
a large market

d. *mi-sika* *ya-i-kulu*
CLASS:4-market QUALIFYING:4-CONCORDIAL:4-large
large markets

e. *ci-pewa* *ca-ci-kulu*
CLASS:7-hat QUALIFYING:7-CONCORDIAL:7-large
a large hat

f. *zi-pewa* *za-zi-kulu*
CLASS:8-hat QUALIFYING:8-CONCORDIAL:8-large
large hats

The preprefixal pattern of adjectival inflection in (4) is easily accommodated by realizational theories: in an inferential–realizational theory, for example, one need only assume that a -*kulu*-type adjective's properties of gender and number induce the application of two successive prefixation rules;[4] in Distributed Morphology, one need only assume that a -*kulu*-type adjective's properties of gender and number are shared by two prefixal morphemes. Incremental theories, by contrast, furnish no ready account of the preprefixal pattern in (4). In lexical–incremental theories, for example, it is not obvious how one might rig the lexical entries of the qualifying prefix *ca*- and the concordial prefix *ci*- so as to guarantee the appearance of both prefixes in *ca-ci-kulu* 'large' (cf. (4e)): given that the two prefixes encode exactly the same morphosyntactic properties, the presence of *ca*- cannot be motivated by the need to specify some morphosyntactic feature or other; and given that *ci*- appears independently of *ca*- in some contexts (e.g. (2)), one cannot account for the presence of *ca*- by assuming that *ci*-prefixed forms are by stipulation bound. For analogous reasons, it is equally unclear how the appearance of both prefixes in *ca-ci-kulu* might be credibly guaranteed in inferential–incremental theories.[5]

A second fundamental fact about inflectional morphology which favours realizational theories over incremental theories is (5):

(5) The morphosyntactic properties associated with an inflected word's individual inflectional markings may underdetermine the properties associated with the word as a whole.

Realizational theories are inherently compatible with this fact. In a theory of this sort, it is a word's association with a particular set of morphosyntactic properties that determines the manner in which that word is inflected (whether this inflection is effected by morphological rules or by lexical insertion); nothing excludes the possibility that the inflectional markings determined by a word's set of morphosyntactic properties may simply fail to realize some of the properties in that set. Incremental theories, by contrast, rest on the presumption that as an inflected word's form arises from that of its root (whether through the insertion of lexically listed affixes or through the application of morphological rules), the word's morphosyntactic properties are, in a parallel fashion, assembled from those associated with its individual inflectional markings (whether this association is encoded lexically or in rules). On this assumption, an inflected word's morphosyntactic properties are necessarily deducible from the properties

Table 1.2 *Imperfect and aorist forms of the Bulgarian verb* KRAD *'steal'*

	IMPERFECT	AORIST
1SG	*krad-'á-x*	*krád-o-x*
2SG	*krad-é-š-e*	*krád-e*
3SG	*krad-é-š-e*	*krád-e*
1PL	*krad-'á-x-me*	*krád-o-x-me*
2PL	*krad-'á-x-te*	*krád-o-x-te*
3PL	*krad-'á-x-a*	*krád-o-x-a*

associated with its individual inflectional markings. Thus, incremental theories deny that a word's form might underdetermine its morphosyntactic properties, and must therefore resort to extraordinary means to cope with observed instances of underdetermination.

Consider, for example, the imperfect and aorist paradigms of the Bulgarian verb *krad-* 'steal' in table 1.2.

In the inflection of Bulgarian verbs, the preterite suffix *-x* appears by default in imperfect and aorist forms such as those in table 1.2. (Before a front vowel, *-x* is palatalized to *-š*, as in the 2sg and 3sg imperfect forms; the appearance of a front vowel in the following syllable likewise causes the imperfect suffix *-'á* to be realized as *-é* in these two forms.)[6] In the 3sg aorist form, however, both the preterite suffix and the aorist suffix *-o* fail to appear; and since the 2sg forms in these paradigms are regularly syncretized with the corresponding 3sg forms, the preterite and aorist suffixes likewise fail to appear in the 2sg aorist form. The question here is: what guarantees the association between imperfect *krad'áx* or aorist *krádox* and the morphosyntactic property '1sg subject agreement', given that neither form has any overt exponent of 1sg subject agreement? Proponents of incremental theories might argue that first-person singular is the default person/number combination in Bulgarian, hence that *krad'áx* and *krádox* are associated with the property '1sg subject agreement' because there is nothing overriding that association; but this ad hoc assumption would not be obviously reconcilable with the unsurprising fact that the third person singular (neuter) functions as the default person/number(/gender) combination with respect to a range of syntactic phenomena (Scatton 1984:343ff.). The only way out of this dilemma for proponents of incremental theories is to assume that *krad'áx* and *krádox* acquire the property '1sg subject agreement' from a zero suffix (or, in inferential terms, from a rule effecting no change in form). Realizational theories, by contrast, require nothing so exotic to account for these facts; one need only assume that the inflectional markings determined by the morphosyntactic properties of *krad'áx* and *krádox* happen not to include any realization of the property '1sg subject agreement'.

1.3 Minimizing unmotivated theoretical distinctions in inflectional morphology

A theory of inflectional morphology must be preferred to the extent that it minimizes any dependence on theoretical distinctions which are not empirically motivated. To varying degrees, lexical theories and incremental theories rest upon distinctions which cannot be convincingly motivated. Since inferential–realizational theories do not entail these distinctions, they must to that extent be preferred. Three such distinctions are at issue here.

The first of these is the distinction between concatenative and nonconcatenative inflection. In their theory of Distributed Morphology, Halle and Marantz maintain a strict separation between the means by which affixational markings are introduced (namely lexical insertion) and the means by which nonconcatenative markings are introduced (through the operation of a battery of 'readjustment rules'); but although concatenative and nonconcatenative inflection differ in their phonological expression, there is no convincing basis for assuming that they perform different functions or occupy different positions in the architecture of a language's morphology; there is, in other words, no empirical obstacle to the assumption in (6).[7]

(6) There is no theoretically significant difference between concatenative and nonconcatenative inflection.

Thus, in inferential theories, the morphological rule associated with a given set of morphosyntactic properties may be either affixational or nonconcatenative; the difference between affixational rules and nonconcatenative rules has no theoretical importance. Lieber's lexical–incremental theory is likewise intended to incorporate assumption (6): Lieber's contention is that the principles of autosegmental phonology and prosodic morphology always make it possible to reduce apparently nonconcatenative inflection to affixal inflection (Lieber 1992:165ff.).

According to assumption (6), concatenative and nonconcatenative markings should be able to enter into direct competition. In an inferential–realizational theory, for example, the fact that the default rule of *-ed* suffixation doesn't apply in past-tense forms such as *sang*, *drank*, and *swam* can be directly attributed to the existence of a rule of *i*/*a* substitution, which is like the rule of -*ed* suffixation in expressing the property 'past tense': being the more narrowly applicable of the two rules, *i*/*a* substitution overrides -*ed* suffixation, in accordance with Pāṇini's principle. Because they reject assumption (6), Halle and Marantz (1993) must resort to a very different account of the complementarity of *i*/*a* substitution and -*ed* suffixation. They assume (pp. 126ff.) that *sang* carries an empty past-tense suffix which competes with the default past-tense suffix -*ed* for insertion into the same abstract morpheme and which, in some verbs, triggers a rule of vowel readjustment; on the assumption that this empty suffix subcategorizes for a narrower class of verbs than -*ed*, Pāṇini's principle predicts that the former suffix should prevail in instances in which it competes with -*ed*. By this logic, though, one must likewise assume that *men* carries an empty plural suffix which overrides the default plural suffix -*s* and which, in some nouns, triggers a rule of vowel readjustment; that Breton *mein* 'stones' (sg *maen*) carries an empty plural suffix which overrides the default plural suffix -*où* and which triggers vowel readjustment; that German *darf* 'is permitted' (inf. *dürfen*) carries an empty 3sg present indicative suffix which overrides the default 3sg present indicative suffix -*t* and which triggers vowel readjustment; that Sanskrit *śatrāu* 'enemy (loc sg)' (stem *śatru*-) carries an empty locative singular suffix which overrides the default locative singular suffix -*i* and which triggers vowel readjustment; and so on. What emerges is a grand coincidence: again and again, both within and across languages, a default affix is overridden by an empty affix whose presence triggers a readjustment rule; this recurrent pattern is portrayed not as the consequence of any overarching principle, but as the accidental effect of innumerable piecemeal stipulations in the lexicon of one language after another. If one searched the languages of the world for a class of overt and phonologically identical affixes having the same sort of distribution that Halle and Marantz must logically attribute to their proposed class of empty affixes, one would inevitably come back empty-handed.

A second poorly motivated distinction in inflectional morphology is the distinction which is sometimes drawn between properties of content and properties of context. Lexical theories make it possible to associate an affix with a morphosyntactic property in two different ways: a given property may, on the one hand, serve as part of an affix's content; on the other hand, it may serve as part of an affix's subcategorization restriction, limiting the range of contexts into which that affix may be inserted. A similar distinction exists in Steele's theory of Articulated Morphology, in that a given morphosyntactic property may serve to define either a rule's input (the class of expressions to which the rule applies) or its output (the class of expressions resulting from its application). The problem is that there is no universally applicable criterion which determines whether a property belongs to an affix's content or to the context for which it subcategorizes. Bulgarian provides a case in point. In Bulgarian, there is a class of verbs (specifically, the nontruncating vocalic verbs) which exhibit a special suffix *-m* in the first person singular of the present tense (e.g. *dávam* 'I give'). The question is: Is *-m* a 1sg suffix which subcategorizes for a present-tense stem, or is it simply a 1sg present-tense suffix? That is, is it an exponent of present tense, or is it simply restricted to the context of forms that are present in tense? Lexical theories demand that a choice be made, but the choice is inevitably an arbitrary one. In lexical theories, the need to choose in such cases is an artifact of the assumption that affixes are inserted from the lexicon and may therefore subcategorize for particular types of contexts; in Articulated Morphology, the need to choose is an artifact of the assumption that inflectional morphology is information-increasing. In inferential–realizational theories, by contrast, an affix's morphosyntactic properties are not artificially sorted into properties of content and properties of context; the purported choice cannot even arise. That is, inferential–realizational theories, unlike lexical theories and incremental theories, are compatible with assumption (7).[8]

(7) Exponence is the only association between inflectional markings and morphosyntactic properties.

In the absence of any universal criterion distinguishing properties of content from properties of context, a theory which rejects assumption (7) in favour of the assumption that affixes may be associated with morphosyntactic properties in either of two ways affords no credible account of the learnability of inflectional systems.

A third poorly motivated distinction in inflectional morphology relates to the nature of morphological representations. Lexical theories entail that like the syntactic structure of a phrase, the morphological representation of an inflected word is a branching structure of hierarchically organized constituents. Lieber (1980:51), for example, proposes that *dīxerāmus*, the first-person plural pluperfect indicative active form of Latin *dīcere* 'to say', has the structure [[*dīx* -*erā*] -*mus*], whose terminal nodes are occupied by 'three morphemes, *dix*-, the past stem of *dicere*, *erā* the perfect morpheme, and *mus* the first person plural morpheme'. For most words, however, evidence favouring the postulation of internal hierarchical structure is weak to nonexistent, as Janda (1983) and Anderson (1992: chapter 10) have cogently argued. The principal exceptions to this generalization are compound words of various types; for instance, the fact that *dog breeders* and *cat breeders* can be conjoined as *dog and cat breeders* implies internal hierarchical structure. That said, it is methodologically preferable to adopt the maximally restrictive assumption in (8) – an assumption with which inferential theories are in general consistent.

(8) An uncompounded word's morphological form is not distinct from its phonological form.

The foregoing considerations lead to the conclusion – adopted here – that the most adequate theory of inflectional morphology must be inferential rather than lexical, and must be realizational rather than incremental.

1.4 The interface between syntax and inflectional morphology

The assumptions of inferential–realizational morphology presuppose a very limited interface between inflectional morphology and syntax; indeed, they would be compatible with the hypothesis that this interface is the maximally simple one defined in (9).

(9) An inflected word X of category Y associated with a set σ of morphosyntactic properties is inserted as head of a phrase YP whose morphosyntactic properties are not distinct from σ.

According to this hypothesis, the set of morphosyntactic properties with which a word form is associated by the rules of morphology is the only factor mediating its syntactic distribution.

The range of inflected words whose syntactic distribution implies an interface no more complicated than (9) is vast. Nevertheless, there are at least four phenomena that apparently do involve a more complicated interface. First, the lexical insertion of words inflected for 'edge' properties is subject to the special requirement in (10).

(10) If X is associated with a right-edge (or left-edge) property *p*, X is inserted at the right (left) edge of a phrase carrying *p*.

Thus, because the property 'possessive' realized by *-'s* is a right-edge property of noun phrases in English, the word *children's* must (by (10)) be inserted at the right edge of a possessive noun phrase – but must, at the same time, be inserted as head of a plural noun phrase, in accordance with (9). Similarly, because the property 'definite' realized by word-final accent is a right-edge property of noun phrases in Tongan (Poser 1985), the word *lahí* 'big' must (by (10)) be inserted at the right edge of a definite noun phrase. There may, in fact, be instances in which the same property functions both as an ordinary head property (subject to (9)) and as an edge property (subject to (10)): in Sanskrit, a vocative noun phrase is marked as such on its head (which exhibits its vocative case form) and is unaccented unless it is sentence-initial, in which case it is accented at its left periphery (Whitney 1889: section 314); thus, in the vocative noun phrase in (11), the vocative singular case form *napāt* 'son' seemingly carries 'vocative' as a head property, while the genitive singular form *ū́rjas* (sandhi form *ū́rjo*) carries 'vocative' as a left-edge property (without which it would instead have final accent: *ūrjás*/*ūrjó*).

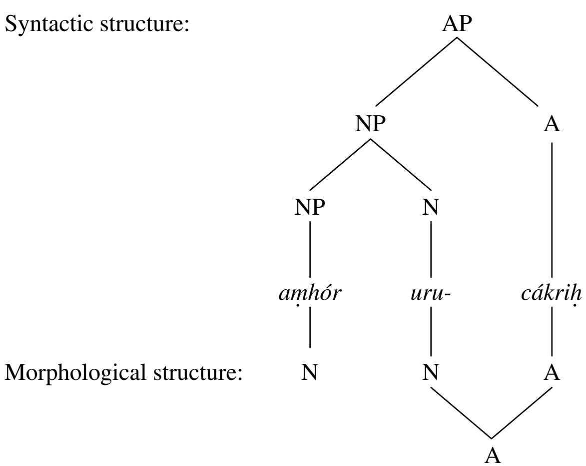
(11)	*ū́rjo*	*napāt*	*sahasvan*	(*Ṛg Veda*)
	strength: GEN.SG	son: VOC.SG	mighty: VOC.SG	
	O mighty son of strength!			(Whitney 1889: section 314d)

See Lapointe (1990), Miller (1991), and Halpern (1992) for extensive discussion of edge properties.

A second phenomenon involving a morphology–syntax interface more complicated than (9) is the phenomenon of shape alternations: if a word has more than one available 'shape', the shape chosen for insertion into a particular syntactic context is determined by a class of shape rules (Zwicky 1992). For instance, the choice between the two shapes *a* and *an* of the English indefinite article is determined by a rule licensing the preconsonantal insertion of *a* and the prevocalic insertion of *an*; in Parisian French, the choice between the two shapes /ø/ and /œf/ for *œufs* 'eggs' is determined by a rule licensing the insertion of /ø/ after /z/ and of /œf/ elsewhere (Grevisse 1993:791) – *deux œufs* /døz ø/ 'two eggs', but *quatre œufs* /katr œf/ 'four eggs'; in Breton, the choice among the three shapes *tad*, *dad*, and *zad* for the noun 'father' is determined by a rule licensing the insertion of *zad* after a spirantization trigger (such as *va* 'my'), the insertion of *dad* after a lenition trigger (such as *e* 'his'), and of *tad* elsewhere – *va zad* 'my father', *e dad* 'his father', *ho tad* 'your (pl) father'; and so on. A thoroughgoing elucidation of the formal characteristics of shape rules awaits future research.

A third, dramatic complication of the morphology–syntax interface involves what Zwicky (1992:364) calls SUPERLEXEMES. Whereas an ordinary word is inserted into a single terminal node in syntactic structure, a superlexemic word is associated with two or more adjacent nodes. Superlexemic words are of various types, including portmanteau words (such as French *du*), compound words (such as *dog breeder*), and clitic groups of the bound-word type (such as *I'd*), among others. The nodes with which a superlexemic word is associated needn't form a syntactic constituent. Moreover, a compound's morphological structure needn't be isomorphic to its syntactic structure; in the Sanskrit expression (12), for example, the NP *aṃhór* 'distress (abl sg)' is syntactically dependent on *urú-* 'distance, relief' but is not itself part of the compound *uru-cákriḥ* 'causing relief (nom sg)'. An important task for morphosyntactic theory is that of identifying the limits on such mismatches; Sadock (1991) proposes substantive advances on this front.

(12) *aṃhór uru-cákriḥ* 'causing relief from distress'



A final complication of the morphology–syntax interface is presented by the phenomenon of PERIPHRASIS. Börjars, Vincent and Chapman (1997) argue that at least some periphrastic combinations function as part of a lexeme's inflectional paradigm. As a case in point, they cite the Latin perfective passive, which is expressed by means of a past participle (inflected for number, gender, and nominative case) in combination with an appropriately inflected form of *esse* 'to be'. The morphosyntactic properties 'perfective' and 'passive' are independently motivated in Latin inflectional morphology: because a verb's paradigm includes imperfective passive forms (e.g. *laudātur* 's/he is praised') and perfective active forms (*laudāvit* 's/he has praised') as well as imperfective active forms (*laudat* 's/he praises'), 'perfective passive' is a combination of morphosyntactic properties which is in principle available to Latin verbs; yet, the only expressions of this combination are periphrastic (e.g. *laudātus sum* 'I have been praised'). Morphologists and syntacticians therefore have a choice to make. On the one hand, one might assume that Latin verbal paradigms are always defective, systematically lacking perfective passive forms whose existence would otherwise be expected and whose absence is compensated for by the use of a loosely equivalent syntactic combination. On the other hand, one could (following Börjars, Vincent and Chapman) assume that Latin verbal paradigms aren't defective in this way at all, but actually contain periphrastic forms in their perfective passive cells. The former approach entails that the perfective passive meaning of a periphrastic combination such as *laudātus sum* is an effect of semantic compositionality; in the latter approach, by contrast, a periphrastic combination such as *laudātus sum* has a perfective passive meaning purely because that meaning is associated with the cell which it occupies within its paradigm. Unlike the former approach, the latter predicts that periphrastic combinations such as *laudātus sum* should tend to exhibit the same sorts of semantic idiosyncrasies as simple forms marked with passive morphology. This prediction is borne out: just as a deponent verb's imperfective active forms have the appearance of inflected passives (e.g. *loquor* 'I speak'), so do their perfective active forms have the periphrastic appearance of perfective passives (*locūtus sum* 'I have spoken'). Börjars, Vincent and Chapman's approach captures this generalization directly; in the defective-paradigm approach, by contrast, the mismatch of form and meaning exhibited by deponent verbs must be seen as the coincidence of two separate idiosyncrasies – one morphological (as in the case of *loquor*), the other syntactic (as in the case of *locūtus sum*).

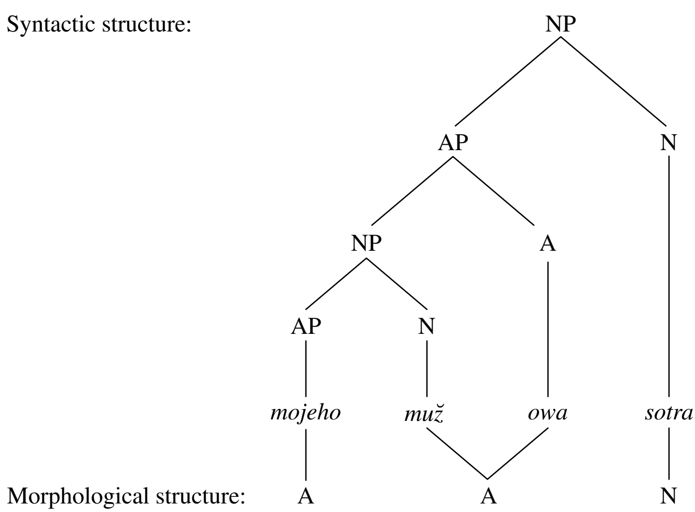
In those instances in which a periphrastic combination functions as part of a lexeme's inflectional paradigm, the morphology–syntax interface is more complicated than (9): the parts of the periphrastic combination must be inserted into two nodes (one heading the other's complement), which may, of course, be linearly discontinuous.

There is no sense in which these four complications of the morphology–syntax interface are logically incompatible with the assumptions of inferential–realizational morphology. Nevertheless, the apparently exceptional nature of these complications poses an important challenge for grammatical theory: that of identifying principled limits on departures from the maximally simple interface in (9). The task is a subtle one; whether a particular phenomenon is seen as involving an interface more complex than (9) necessarily depends on a range of more specific assumptions. Consider, for example, the well-known problem of Upper Sorbian possessive adjectives (a problem definitively articulated by Corbett 1987; see also Spencer 1991:439ff.). In Upper Sorbian, animate nouns (principally those that are human in reference) give rise to possessive adjectives which are referentially singular and which agree in gender, number, and case with the noun they modify. A possessive adjective of this sort, however, may itself be modified by an adjective in the genitive case; in instances of this sort, the genitive adjective agrees in number and gender with the noun from which the modified possessive adjective arises. Thus, in the expression 'my husband's sister' in (13), the possessive adjective *mužowa* 'husband's' agrees in gender, number, and case with *sotra* 'sister', but the genitive adjective *mojeho* 'my' which modifies *mužowa* agrees in number and gender with the noun *muž* 'husband' from which *mužowa* arises. What sort of interface do such examples imply?

(13)	*mojeho*	*mužowa*	*sotra*
	my: GEN.SG.MASC	husband's: NOM.SG.FEM	sister: NOM.SG.FEM
	'my husband's sister'		

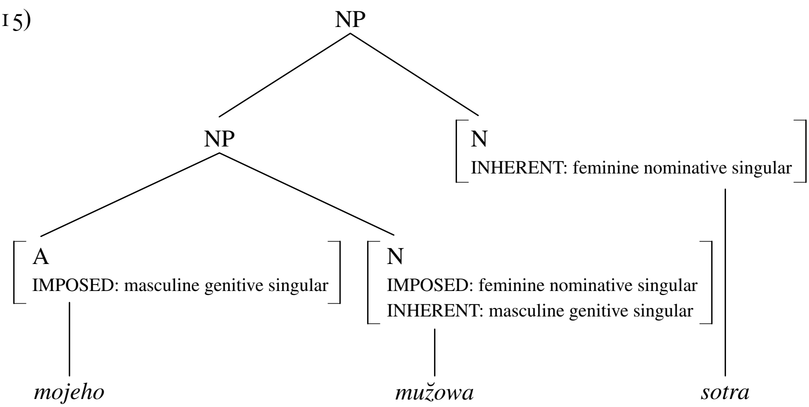
One might hypothesize that *mužowa* is superlexemic – that although it is a single word morphologically, it is associated with two distinct terminal nodes in syntax: a nominal node N carrying the gender and number of *muž* and an adjectival node A; on this hypothesis (essentially that of Sadock (1985:416ff., 1991:159ff.)), N would determine the agreement properties of *mojeho* while those of A would be determined by *sotra*. This analysis entails that (13) embodies the morphosyntactic mismatch represented in (14).

(14)



Zwicky (1986:98), however, proposes a very different account of the Upper Sorbian facts. In this account, the set of morphosyntactic properties carried by the possessive adjective *mužowa* is partitioned into two groups: an inherent group and an imposed group. The inherent group comprises genitive case and the properties of gender and number associated with *muž*; it is this group which determines the inflection of the agreeing modifier *mojeho* 'my'. The imposed group, by contrast, comprises the properties of gender, number, and case which *mužowa* acquires as the dependent member of the agreement relation between it and *sotra*. This partitioning of properties makes it possible to regard the Upper Sorbian expression (13) as involving nothing more than the simple interface (9); on this view, (13) embodies no morphosyntactic mismatch, but has the syntactic structure in (15).

(15)

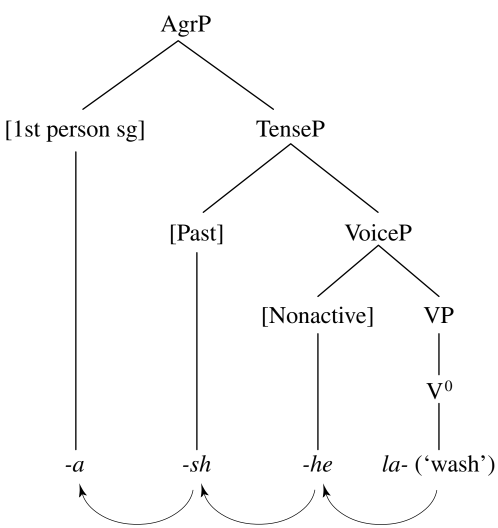


As this example shows, the range of phenomena involving a departure from the simple interface in (9) depends, in part, on the extent to which one can convincingly motivate a distinction between inherent and imposed property sets. Because the case which Zwicky (1986) makes for this distinction is compelling, Upper Sorbian possessive adjectives might well be assumed to fall within the compass of the simple interface in (9); but a principled delimitation of the range of phenomena falling outside its compass is, for the moment, wanting.

1.5 On certain properties that make some affixes SEEM like syntactic objects

Inferential–realizational morphology entails that inflectional morphology and syntax have, in Zwicky's (1992:356) terms, a FEATURE INTERFACE rather than a FORMATIVE INTERFACE; that is, the metalinguistic vocabulary shared by a language's system of morphological rules and its system of syntactic rules includes morphosyntactic properties such as 'plural number' and 'past tense', but excludes affixal formatives such as -*s* and -*ed*, and indeed the very notion of affix. This conception of the morphology–syntax interface is not compatible with what might be called the CONCRETE FUNCTIONAL HEAD HYPOTHESIS (CFHH), according to which inflectional affixes head phrasal projections in syntax, so that the combinations into which inflectional affixes enter are effected by head movement rather than by rules of morphology (Rivero 1990, Speas 1990, Mitchell 1991, et al.); it is, for example, incompatible with Rivero's (1990:138ff.) proposal that the Albanian verb form *lahesha* 'I was washed' arises as an effect of the three instances of head movement in (16).[9]

(16) *lahesha* 'I was washed'



This incompatibility might be seen as grounds for questioning the assumptions of inferential–realizational morphology, since inflectional markings sometimes seem to exhibit properties which do not obviously follow from those assumptions but which follow readily from the CFHH. The properties in question are listed in (17).

(17) a. From language to language, there is a disproportionate preference for inflection to be affixal.

b. Affixes belonging to the same position class are often featurally coherent.
c. From language to language, affixal exponents of the same morphosyntactic properties tend to appear in the same sequence.

Careful consideration reveals that each of these properties can, in fact, be explained without abandoning the assumptions of inferential–realizational morphology. Consider each of the three properties in turn.

1.5.1 The preference for affixal inflection

The disproportionate preference for affixation in inflectional systems (property (17a)) follows automatically from the CFHH: according to this hypothesis, inflection involves adjunction to a concrete functional head, and affixation is the most direct morphological analogue of adjunction. The assumptions of inferential–realizational morphology, by contrast, seem to leave open the possibility that nonconcatenative rules might be just as usual as rules of affixation in inflectional systems. How can the observed preference for affixation be reconciled with these assumptions?

Bybee and Newman (1995:635ff.) argue that the preference for affixal inflection has a purely historical basis. Inflectional markings tend to develop historically from full words or phrases by a gradual process of grammaticization. Affixal inflections can arise from free expressions comparatively easily. Nonaffixal inflections, by contrast, arise only by indirect means, and over a longer period of time. Typically, a nonaffixal inflection itself comes from a well-established affix, whose long and frequent association with a given stem causes stem and affix to become phonologically fused; ultimately, the (nonaffixal) stem modification associated with the affix may take on the affix's grammatical significance, allowing the affix itself to wither away. As Bybee and Newman emphasize, the inexorable processes of grammaticization may cause existing affixes to be crowded out by newly emerging affixes; consequently, 'most affixes do not last long enough to produce stem changes, and even if they do, they are usually replaced by some other affix, leaving the stem change only as residue in highly frequent items' (p.638). This reasoning suggests that property (17a) is purely an effect of diachronic forces, not (as the CFHH implies) an inevitable consequence of how grammars are organized.

Table 1.3 *Position–class analysis of six Swahili verb forms*

Slot A	Slot B	Slot C	Stem	Gloss
tu-	*ta-*	*ku-*	*ona*	'we will see you (sg)'
tu-	*ta-*	*mw-*	*ona*	'we will see her/him'
m-	*ta-*	*mw-*	*ona*	'you (pl) will see her/him'
tu-	*li-*	*ku-*	*ona*	'we saw you (sg)'
tu-	*li-*	*mw-*	*ona*	'we saw her/him'
m-	*li-*	*mw-*	*ona*	'you (pl) saw her/him'

1.5.2 The featural coherence of affix position classes

A group of affixes (or, in inferential–realizational terms, a group of inflectional rules) is FEATURALLY COHERENT if and only if every member of the group expresses one or another specification of exactly the same morphosyntactic feature or features. Consider, for example, the Swahili verb forms in table 1.3. Each of the three affix position classes in table 1.3 is featurally coherent: the Slot A affixes *tu-* and *m-* express subject agreement and nothing else; the Slot B affixes *ta-* and *li-* express tense and nothing else; and the Slot C affixes *ku-* and *mw-* express object agreement and nothing else. An inferential–realizational definition of the forms in table 1.3 would involve six prefixation rules organized into three featurally coherent 'blocks', as in (18):

(18)		Operation:	Applies to:	Realizes the property set:
Block A				
	a.	*tu*-prefixation	Verbs	{'1pl subject agreement'}
	b.	*m(w)*-prefixation	Verbs	{'2pl subject agreement'}
Block B				
	c.	*ta*-prefixation	Verbs	{'future tense'}
	d.	*li*-prefixation	Verbs	{'past tense'}
Block C				
	e.	*ku*-prefixation	Verbs	{'2sg object agreement'}
	f.	*m(w)*-prefixation	Verbs	{'3sg (class 1) object agreement'}

Under the CFHH, the featural coherence of affix position classes (property (17b)) follows straightforwardly from the assumption that each affixal slot corresponds to a different functional head; the three affixal slots in table 1.3, for example, might be identified with a subject-agreement node, a tense node, and an object-agreement node. In inferential–realizational theories, by contrast, it's not immediately obvious why such instances of feat-

Table 1.4 *Some indicative forms of four Bulgarian verbs*

		KRAD 'steal' (nontruncating consonantal conjugation)	IGRÁJ 'play' (truncating consonantal conjugation)	KOVA 'forge' (truncating vocalic conjugation)	DÁVA 'give' (nontruncating vocalic conjugation)
PRESENT	1PL	*kradé-m*	*igráe-m*	*kové-m*	*dáva-me*
	2PL	*kradé-te*	*igráe-te*	*kové-te*	*dáva-te*
IMPERFECT	1PL	*krad'áx-me*	*igráex-me*	*kov'áx-me*	*dávax-me*
	2PL	*krad'áx-te*	*igráex-te*	*kov'áx-te*	*dávax-te*
AORIST	1PL	*krádox-me*	*igráx-me*	*kováx-me*	*dávax-me*
	2PL	*krádox-te*	*igráx-te*	*kováx-te*	*dávax-te*

ural coherence should arise; indeed, inferential–realizational theories seem to accommodate featurally heterogeneous rule blocks just as well as featurally coherent ones. How is the frequent incidence of featural coherence to be accounted for in an inferential–realizational theory?

In answering this question, one must of course bear in mind that rule blocks aren't always featurally coherent. Consider, for instance, the Bulgarian forms in table 1.4. The terminal suffixes -*m*, -*me*, and -*te* in these forms can be plausibly assumed to be introduced by a single block of rules, since they occupy precisely the same syntagmatic position in a verb's morphology.[10] The block of rules responsible for introducing these suffixes might be informally characterized as in (19).

(19)	Operation:	Applies to:	Realizes the property set:
a.	-*m* suffixation	Verbs in the truncating or consonantal conjugations	{'1pl subject agreement', 'present tense'}
b.	-*me* suffixation	Verbs	{'1pl subject agreement'}
c.	-*te* suffixation	Verbs	{'2pl subject agreement'}

The rule block (19) is not featurally coherent, since rule (19a) realizes a feature (that of tense) which rules (19b) and (19c) fail to realize. This is, of course, a familiar state of affairs; thus, if the frequent incidence of featural coherence requires an explanation, so does the fact that rule blocks may fail to exhibit featural coherence. How can these facts be accounted for?

These facts are a consequence of the way in which Pāṇini's principle regulates inflectional rule systems. Two notions are central to understanding this claim: the notions of rule compatibility and rule narrowness. First, I will say that rules Q and R are COMPATIBLE relative to an expression X and a complete and well-formed set σ of morphosyntactic properties appropriate to X if and only if Q and R are both applicable to X and each rule realizes a subset of σ. Thus, rules (18a) and (18c) are compatible relative to the verb *-ona* 'see' and the set of morphosyntactic properties in (20); on the other hand, they are not compatible relative to *-ona* and the set of properties in (21). As they are defined, rules (19a) and (19b) are compatible relative to *krad-* 'steal' and the property set in (22) but not relative to *dáva-* 'give' and (22), since *dáva-* belongs to the nontruncating vocalic conjugation. If there is some choice of expression and property set relative to which two rules are compatible, those rules will be said to be POTENTIALLY COMPATIBLE; thus, rules (18a) and (18c) are potentially compatible, as are rules (19a) and (19b). Rules (19b) and (19c), by contrast, are FULLY INCOMPATIBLE – that is, they aren't compatible relative to any choice of expression and property set, since no well-formed property set will contain both the property '1pl subject agreement' and the property '2pl subject agreement'.

(20) {'1pl subject agreement', 'future tense', '2sg object agreement'}

(21) {'1pl subject agreement', 'past tense', '2sg object agreement'}

(22) {'1pl subject agreement', 'present tense'}

Second, I will say that rule Q is NARROWER than rule R if and only if either (a) the class of expressions to which Q applies is a proper subset of that to which R applies, or (b) Q and R apply to the same class of expressions, but the set of properties realized by R is a proper subset of that realized by Q.[11] Thus, rule (19a) is narrower than rule (19b) because it applies to a proper subset of the set of forms to which (19b) applies; and even if they applied to the same set of forms, (19a) would still be narrower, because the set of properties realized by (19b) is a proper subset of that realized by (19a). On the other hand, there is no difference in relative narrowness between rules (19b) and (19c): they apply to the same class of expressions, and neither realizes a proper subset of the property set realized by the other.

Given these notions of compatibility and narrowness, Pāṇini's principle might be stated as follows: if two or more rules in the same block are compatible relative to an expression X and a complete and well-formed set σ of morphosyntactic properties, then the narrowest of these rules takes precedence over the others in the inflection of X for σ. Defined in this way, Pāṇini's principle correctly predicts that (19a) should take precedence over (19b) in the inflection of *krad-* 'steal' for the set of properties in (22).

There are various ways in which Pāṇini's principle might be assumed to regulate inflectional rule systems. One might, for example, assume that it is but one of several devices used to resolve competition among members of the same rule block. But one of the hypotheses which I shall attempt to motivate in this book is the much stronger hypothesis in (23):

(23) The Pāṇinian Determinism Hypothesis:
Competition among members of the same rule block is in all cases resolved by Pāṇini's principle.

This hypothesis entails that for any expression X and any complete and well-formed set σ of morphosyntactic properties appropriate to X, if certain members of some rule block are compatible relative to X and σ, then there is necessarily one competitor which is narrower than all the others. That is, (23) entails that rule blocks are universally subject to the well-formedness condition in (24).

(24) Pāṇinian well-formedness condition on inflectional rule blocks:
If Q and R are inflectional rules belonging to the same block b, then for any expression X and any complete and well-formed set σ of morphosyntactic properties appropriate to X,
either a. Q and R are not compatible relative to X and σ
or b. Q and R are compatible relative to X and σ and
either i. one is narrower than the other
or ii. there is a third rule in block b which is compatible with Q and R relative to X and σ and is narrower than both Q and R.

Consider the consequences of this well-formedness condition for the six Swahili rules in (18). Many imaginable ways of grouping these six rules into blocks are excluded by (24). For instance, these rules couldn't be grouped into a single block without violating (24), nor is there any way of grouping them into two blocks without violating (24). Mathematically, there are ninety ways in which these six rules might be grouped into three blocks; only one of these groupings conforms to (24), however, and that is the featurally coherent grouping in which (18a) and (18b) belong to one block, (18c) and (18d) to another, and (18e) and (18f) to a third. ((24) does not, of course, determine the relative order in which these three blocks apply.)

The well-formedness condition in (24) constrains the grouping of these six rules as it does because of the relationships which hold among these rules. For each rule Q in (18), there is a fully incompatible rule R, which is such that Q and R realize alternative specifications of the same feature; Q is potentially compatible with and is neither more nor less narrow than every other rule in (18). By (24), no rule block can contain potentially compatible rules no one of which is either more or less narrow than any other; a rule block may, however, contain fully incompatible rules. Thus, the smallest number of blocks into which the rules in (18) can be grouped without violating (24) is three: in that case, each block contains two incompatible rules and is featurally coherent. As this example shows, (24) has the effect of enforcing featural coherence in instances in which a rule stands in one of two relations to all of the other rules in the system: either (a) a relation of full incompatibility or (b) a relation of potential compatibility without greater or lesser narrowness.

On the other hand, (24) allows potentially compatible rules which DO participate in relations of comparative narrowness to be grouped in a featurally heterogeneous way. For example, although the Bulgarian rules (19a) and (19b) are compatible, (24) does not exclude the possibility of situating these two rules in a single, featurally heterogeneous block, since (19a) is narrower than (19b); moreover, Pāṇini's principle correctly predicts that rule (19c) – which is fully incompatible with both (19a) and (19b) – should be able to be situated in this same block.

Hypothesis (23) therefore affords a simple explanation both for the frequent incidence of featural coherence and for the fact that rule blocks may fail to exhibit featural coherence. The rules in a featurally coherent rule block are fully incompatible, because they realize contrasting values of the same feature(s); featural coherence is therefore one way of satisfying the well-formedness condition (24). It is not, however, the only way: (24) can also be satisfied by a featurally heterogeneous rule block provided that its potentially compatible members participate in relations of comparative narrowness.

The extent to which a given language exploits the second of these two means of satisfying (24) apparently depends on independent typological factors. For instance, while some languages allow inflectional rules to realize large property sets, others favour rules which realize single properties: thus, the Sanskrit rule of *-tha* suffixation applying in the inflection of *dadā́tha* 'you (sg) gave' simultaneously realizes four properties (2sg subject agreement, perfect tense, indicative mood, and active voice); in Swahili, by contrast, many inflectional rules realize no more than a single property. All else being equal, there are, in a language adhering to this latter tendency, fewer opportunities for relations of comparative narrowness to exist among inflectional rules; the well-formedness condition in (24) accordingly entails that the incidence of featurally coherent rule blocks should be an especially prominent phenomenon in languages of this type.[12]

The Pāṇinian Determinism Hypothesis (23) makes it possible to account for the frequent incidence of featural coherence without abandoning the premises of inferential–realizational morphology. It is, however, difficult to see how the frequent incidence of featural heterogeneousness might be reconciled with the CFHH without appealing to ad hoc stipulations; how, for example, can this hypothesis plausibly accommodate the Bulgarian suffix -*m* in (19a), an exponent of both 1pl subject agreement and present tense? Does it head TenseP or AgrP?

1.5.3 Cross-linguistic regularities in the sequencing of inflectional affixes

Now consider property (17c) – the fact that affixal exponents of the same morphosyntactic properties tend to appear in the same sequence from language to language. Under the CFHH, this fact can be attributed to universal principles governing the nesting of functional categories in syntactic structure; the assumptions underlying inferential–realizational theories, by contrast, do not obviously lead one to expect that languages should exhibit any consistency in the ways in which they sequence affixes. How can this sort of consistency be accounted for in an inferential–realizational theory?

At the outset of discussion, it should be emphasized that (17c) describes a tendency to which there are frequent exceptions. In the morphology of Albanian *lahesha* 'I was washed', the voice suffix -*he* precedes the tense suffix -*sh*, while in Latin *lavābar* 'I was washed', the tense morphology precedes the voice suffix -*r*; in Latin *amābam* 'I loved', the subject-agreement morphology follows the tense morphology, while in Welsh Romany *kamá-v-as* [love-1SG-IMPERFECT] 'I loved' (Sampson 1926:192), the tense morphology follows the agreement morphology; and so on. Facts such as these pose problems for the CFHH. Proponents of this hypothesis assume that the ordering of a word's inflectional affixes directly reflects the nesting of the phrasal projections headed by those affixes. On that assumption, pairs such as *lahesha*/*lavābar* and *amābam*/*kamávas* entail that the nesting of functional categories varies idiosyncratically from language to language; for instance, if one assumes (following Rivero 1990) that -*he* precedes -*sh* in *lahesha* because the phrasal projection of tense dominates that of voice in Albanian, one must instead apparently assume that the phrasal projection of voice dominates that of tense in Latin; there is, however, no independent syntactic motivation for this assumption. Moreover, the assumption that the ordering of inflectional affixes reflects the nesting of their phrasal projections sometimes entails the existence of alternative nestings within the same language. In Fula, for example, a relative past-tense verb form's subject-agreement suffix generally precedes its object-agreement suffix, as in (25a); but in the particular cases in which 1sg subject agreement coincides with either 2sg or 3sg (class 1) object agreement, the object-agreement suffix instead precedes the subject-agreement suffix, as in (25b) and (25c).

(25) a. *mball-u-mi-be'*
help-REL.PAST.ACT-I-them:CLASS.2
I helped them

b. *mball-u-maa-mi'*
help-REL.PAST.ACT-you:SG-I
I helped you (sg)

c. *mball-u-moo-mi'*
help-REL.PAST.ACT-him:CLASS.1-I
I helped him (Arnott 1970: Appendix 15)

In cases such as *lahesha/lavābar*, *amābam/kamávas*, and *mballumibe'/mballumaami'*, treating the difference in affix ordering as a syntactic rather than purely morphological difference entails a significant weakening of otherwise well-motivated constraints on syntactic theory (a point forcefully made by Janda and Kathman (1992)).

Notwithstanding the difficulties which differences in affix ordering present for the CFHH, generalization (17c) clearly requires some sort of explanation. Why is the relative ordering of inflectional affixes as regular as it is from one language to the next?

Bybee (1985) proposes an illuminating account of this phenomenon. She begins with the assumption that a verbal inflectional category 'is *relevant* to the verb to the extent that *the meaning of the category directly affects the lexical content of the verb stem*' (p.15). Given this assumption, she shows that verbal inflectional categories can be ranked according to their degree of relevance; she argues that aspect, for example, is more relevant than tense, which is itself more relevant than mood, which is in turn more relevant than person agreement (pp.20ff.). In order to determine the significance of this ranking for the ordering of a verb's inflectional markings, she examines the morphological expression of aspect, tense, mood, and person agreement in inflected verb forms from fifty languages (chosen so as to avoid genetic and areal biases). In this investigation, she finds a strong tendency for a marking's degree of semantic relevance to the verb stem to correlate positively with its proximity to that stem: where independent markings for aspect and tense coincide within the same verb form, there is a strong tendency for the aspectual marking to be situated closer to the verb stem than the tense marking; similarly, tense markings tend to appear closer to the verb stem than mood markings, which in turn tend to appear closer than markings for person agreement.

As Bybee shows, this correlation between an inflectional marking's degree of semantic relevance to the verb and its proximity to the verb stem is largely an effect of diachronic processes (pp.38ff.). It is uncontroversial that many verb inflections arise historically through the reduction of independent words. Bybee reasons that the words most susceptible to this sort of reduction are those with high semantic relevance to the affected verb: by virtue of their high relevance, they tend to accompany that verb with some frequency, and to appear adjacent to it when they do accompany it; in addition, their combination with the verb results in a unit having the semantic coherence typical of individual words. The less semantic relevance a word has to the verb which it accompanies, the less its susceptibility to diachronic reduction: auxiliaries expressing aspect, tense, or mood, for example, are more likely to develop into inflectional markers than pronominal subjects are.

These diachronic regularities are reflected not only in the synchronic sequence of inflectional markings, but in the cross-linguistic frequency with which particular categories are realized inflectionally and in the degree to which a particular category's inflectional expression is fused with verb stems. Thus, in Bybee's fifty-language sample, many more languages exhibited verb inflections for tense, aspect, or mood than exhibited inflections for subject agreement, and those exhibiting the latter always exhibited the former (p.33); similarly, verb-stem alternations conditioned by aspect were more frequent than those conditioned by tense or mood and much more frequent than those conditioned by person agreement (pp.36f.).

Bybee's observations suggest that cross-linguistic similarities in the sequencing of inflectional affixes don't require the synchronic explanation supplied by the CFHH; diachronic processes, together with the notion of relevance, suffice to account for these similarities.

1.6 Conclusion

In summary, each of the properties in (17) can be explained without recourse to the CFHH; none must be seen as casting doubt on the fundamental assumptions of inferential–realizational morphology. By contrast, numerous inflectional phenomena – overlapping and extended exponence, nonconcatenative markings, featural incoherence among affixes belonging to the same position class, cross-linguistic and intralinguistic variation in the sequencing of affixal exponents of the same morphosyntactic properties, the lexical integrity of inflected words – have been cited as counterevidence to the CFHH (see e.g. Joseph and Smirniotopoulos 1993, Janda and Kathman 1992, Bresnan and Mchombo 1995). More generally, there are serious grounds for questioning any theory of inflectional morphology which is lexical or incremental rather than both inferential and realizational.

Up to this point, I have made no attempt to differentiate among inferential–realizational theories. In the following chapter, I set forth the constellation of assumptions which distinguishes one such theory – Paradigm Function Morphology (PFM) – whose guiding idea is that in the domain of inflectional morphology, the primary object of analysis (both for the linguist and for the language learner) is the paradigm rather than merely the word. My objective in this book is to develop this idea as precisely and explicitly as possible, and to demonstrate the particular merits of the theory which it engenders.

A brief preview of the distinctive properties of PFM may prove helpful at this point. PFM is distinguished from other imaginable inferential–realizational theories in several ways. First, PFM presumes the existence of several different rule types. Chief among these are paradigm functions, realization rules, and morphological metageneralizations: these three basic rule types are organized hierarchically in the sense that paradigm functions are defined in terms of realization rules, whose evaluation is in turn determined by morphological metageneralizations. The distinguishing characteristics of these three rule types are discussed in chapter 2.

The postulation of paradigm functions – a theoretical construct unique to PFM – is principally motivated by two independent considerations: on the one hand, paradigm functions afford a fully adequate account of the phenomenon of inflectional head marking (chapter 4); on the other hand, they afford a fully adequate account of the dependencies between a word's morphosyntactic properties and the number, identity, and sequence of realization-rule blocks responsible for spelling out its inflectional morphology (chapter 5).

The postulation of morphological metageneralizations is likewise motivated by two independent considerations: besides making it possible to capture morphophonological generalizations about sets of realization rules (chapter 2), morphological metageneralizations make it possible to distinguish two broadly different categories of stem choice (chapter 6).

Realization rules, whose application always expresses some set of morphosyntactic properties, belong to the class of inflectional rules; but this class also includes purely 'morphomic' rules, which make no direct reference to morphosyntactic properties, instead simply serving to define a class of stems to which some set of inflectional rules systematically applies. PFM distinguishes two subtypes of morphomic rules (rules of stem formation and rules of stem indexing) as well as two subtypes of realization rules (rules of exponence and rules of referral). The former distinction affords a refined theory of stem classes (chapter 6); the latter forms part of a highly variegated theory of inflectional syncretism (chapter 7), and plays an essential role in accounting for the phenomena of position-class morphology (chapter 5). A paradigm function's definition is stated in terms of realization rules, not morphomic rules; nevertheless, a realization rule may itself be defined as selecting a stem from among a class of forms defined by morphomic rules.

Rejecting the naive view that morphological phenomena may exhibit language-specific idiosyncrasy without constraint, inferential–realizational theories of inflection generally presume that the interaction of a language's inflectional rules is – in some way – regulated by a universally invariant set of principles. Nevertheless, PFM may be more relentlessly optimistic than other theories in pursuing this assumption to its conclusions: unlike other inferential–realizational theories, PFM incorporates the Pāṇinian Determinism Hypothesis (the hypothesis in (23) that rule competition is in all cases resolved by Pāṇini's principle), whose tenability is examined at length in chapter 3; moreover, PFM rejects the possibility that a language might impose parochial restrictions on the interaction of inflectional rules with rules of category-preserving derivation (chapter 4).

Let me conclude with a comment on formalism. In elucidating the properties of the theory under discussion here, I have been faced with the choice of developing an explicitly interpreted formalism or of developing an informal system of metaphors which helps readers arrive at a purely intuitive conception of the theory. In the chapters which follow, I adhere to the former approach. Some readers may feel that in doing so, I have given formalism 'pride of place' over the linguistic generalizations which motivate it. But once a certain depth of understanding is reached in morphology, the very articulation of linguistic generalizations depends upon the assumption of a sufficiently constraining formalism. Theories lacking this kind of representational rigour inevitably lack the degree of precision necessary for objective, scientific evaluation; many readers no doubt know the frustration of working through a system of metaphors which, however vivid, fails at some crucial juncture to make explicit predictions beyond the range of data it was originally devised to explain. Whether or not the reader accepts the proposals advanced in the pages which follow, I have taken pains to present these proposals with sufficient precision to head off any possible doubt as to their substance.

2 *Paradigm functions*

In this chapter, I present the fundamental principles and claims underlying Paradigm Function Morphology; in particular, I elucidate the notion 'paradigm function' and its centrality to the organization of a language's inflectional morphology. A detailed exploration of the evidence motivating the properties of Paradigm Function Morphology is undertaken in chapters 3 to 8; the present chapter is concerned less with justifying these properties than simply with making them as explicit as possible.

After a preliminary discussion of the foundational ideas upon which Paradigm Function Morphology rests (section 2.1), I proceed to a detailed formal account of the architecture of the theory. In this discussion, it is useful to have a rich inflectional system to draw upon as an exemplificatory frame of reference; in order to make the principles and claims of Paradigm Function Morphology maximally explicit, I will demonstrate their implications for the analysis of an extensive fragment of Bulgarian verb morphology. Accordingly, an informal overview of this system is presented in section 2.2; the range of linguistically significant generalizations pertinent to this system favours the postulation of a richly differentiated inventory of rule types. I examine the nature of morphosyntactic properties (section 2.3) and their relationship to the notions of paradigm and paradigm function (section 2.4); the nature of realization rules and their organization into 'blocks' (section 2.5); the role of morphophonological rules in the evaluation of realization rules (section 2.6); and the role of realization rules in the definition of a language's paradigm function (section 2.7). The characteristics which distinguish Paradigm Function Morphology from other inferential–realizational theories of inflectional morphology are recapitulated in section 2.8, where I preview the evidence used to motivate these characteristics in subsequent chapters.

2.1 Paradigm Function Morphology

In view of the evidence discussed in chapter 1, inferential–realizational theories of inflectional morphology must be favoured over lexical–incremental, lexical–realizational, and inferential–incremental theories; that is, the assumption in (1) must be favoured over possible alternatives.

(1) A word's association with a particular set of morphosyntactic properties determines a sequence of rule applications defining that word's inflectional form.

Myriad theories consistent with this assumption are imaginable. In the pages which follow, I elucidate and defend one such theory: Paradigm Function Morphology (PFM).[1]

The fundamental insight underlying PFM is that paradigms play a central role in the definition of a language's inflectional morphology. This centrality is manifested in a variety of ways: for example, the sequence in which inflectional rules apply in the realization of a word's morphosyntactic properties may systematically depend on the cell which that word occupies within its paradigm; members of the same paradigm may participate in relations of systematic homophony according to the cells which they occupy; the word form occupying a particular cell in one paradigm may be systematically deducible from that occupying the corresponding cell in another paradigm; and so on. In PFM, paradigms are not the epiphenomenon that they are often assumed to be in other theories, but constitute a central principle of morphological organization.

PFM gets its name from the formal device by which this idea is elaborated. A paradigm function is a function which, when applied to the root of a lexeme L paired with a set of morphosyntactic properties appropriate to L, determines the word form occupying the corresponding cell in L's paradigm. In German, for instance, there is a paradigm function PF which applies to the pairing <*Buch*-,{'genitive', 'singular'}> to determine the form *Buches* occupying the genitive singular cell in the paradigm of BUCH;[2] PF likewise applies to the pairing <*Frau*-,{'nominative', 'plural'}> to determine the form *Frauen* occupying the nominative plural cell in the paradigm of FRAU; and so on. I refer to pairings such as <*Buch*-,{'genitive', 'singular'}> as form/property-set pairings (or FPSPs), and I assume that each cell in an inflectional paradigm is itself an FPSP consisting of a word and its associated morphosyntactic property set. Thus, in formal terms, a paradigm function is a function in the set of FPSPs: it applies to an FPSP (e.g. <*Buch*-,{'genitive', 'singular'}>) to yield an FPSP (e.g. <*Buches*,{'genitive', ‘singular’}>). One of the principal characteristics distinguishing PFM from other inferential–realizational theories (e.g. those of Matthews (1972) and Anderson (1992)) is that it equates the definition of a language’s inflectional morphology with the definition of its paradigm function.[3]

In the morphology of any given language, a paradigm function is defined in terms of more specific REALIZATION RULES; for instance, when the German paradigm function PF applies to the pairing <*Mutter*-,{‘dative’, ‘plural’}>, its value is defined as the result of applying two realization rules, one of which selects MUTTER’s umlauted stem *Mütter*- and the other of which suffixes -*n* to that stem. A language’s realization rules are organized into BLOCKS such that rules belonging to the same block compete for the same position in the sequence of rule applications defining a word’s inflectional form. In the evaluation of a paradigm function applying to a root paired with a property set σ, the sequence of blocks may vary according to the identity of σ, but choices among rules belonging to the same block are determined by a single universal principle (Pāṇini’s principle), according to which the narrowest applicable rule always overrides other applicable members of the same block.

Morphological expressions are of three types: roots, stems, and words. A lexeme’s ROOT is its ultimate default form, devoid of any overt inflectional marking and therefore potentially a bound expression. The syntactically free forms occupying the cells of a lexeme’s paradigm are WORDS. (A language’s inventory of roots and its inventory of words needn’t be disjoint, of course: *dog*, for example, is both the root of the lexeme DOG and the singular member of its paradigm.) A STEM is any expression to which inflectional exponents may potentially be added. Thus, all roots qualify as stems, but not all stems qualify as roots; the perfect stem *dūk*-*s*- of Latin DUCERE ‘lead’, for example, is not a root. I assume that every lexeme has a single root, but may have a multitude of distinct stems.[4]

No word has distinct underlying and superficial morphological representations; rather, each word in a language has a single morphological representation whose well-formedness depends on its conformity to the language’s paradigm function.[5] Paradigm functions are static well-formedness conditions on cells: in particular, a cell <W,σ> in the paradigm of some lexeme L in some language ℓ is well-formed only if ℓ’s paradigm function relates <W,σ> to <X,σ>, where X is L’s root (as the German paradigm function PF relates <*Bücher*,{‘nominative’,‘plural’}> to <*Buch*-,{‘nominative’,‘plural’}>). Accordingly, the realization rules in terms of which a paradigm function is defined are themselves static conditions on FPSPs: in a language ℓ, an FPSP <Y,σ> in which Y is not the root of a lexeme is well-formed if ℓ has a realization rule which relates <Y,σ> to a well-formed FPSP <X,σ> such that if X is the root of a lexeme L, then σ is a set of morphosyntactic properties appropriate to L.

In order to develop these ideas further, it will be useful to make illustrative reference to a complex system of inflectional morphology. I will draw upon the Bulgarian system of conjugation to provide a detailed exemplification of the principles and assumptions of PFM; accordingly, the following section is devoted to a preliminary sketch of this system.

2.2 Bulgarian verb inflection

Schematically speaking, a Bulgarian verb's inflectional paradigm has thirty-six cells in it, as in table 2.1; every nondefective verb in the language has a paradigm fitting this general pattern.[6] Consider, for example, the verbal lexemes KRAD 'steal', IGRÁJ 'play', KOVA 'forge', and DÁVA 'give', whose indicative subparadigms are given in table 2.2. Each of these verbs belongs to a different conjugation; accordingly, each of the subparadigms in table 2.2 exhibits a slightly different way of filling the indicative cells of table 2.1.

One way in which the four conjugations represented in table 2.2 are distinguished is by the stem forms they involve. The roots of the lexemes KRAD and IGRÁJ end in consonants, while those of the lexemes KOVA and DÁVA end in vowels. IGRÁJ, however, differs from KRAD in that its root's final consonant is truncated in the aorist; similarly, KOVA differs from DÁVA in that its root's final vowel truncates in the present and the imperfect. Following Aronson (1968:67f.), I refer to the conjugations to which KRAD, IGRÁJ, KOVA, and DÁVA belong as the nontruncating consonantal (or [−T,+C]), the truncating consonantal ([+T,+C]), the truncating vocalic ([+T,−C]), and the nontruncating vocalic ([−T,−C]) conjugations, respectively.[7] Moreover, I assume that Bulgarian verbs generally have two stems: the FIRST STEM is used in the present and the imperfect (as well as in the imperative and the gerund), while the SECOND STEM is used in the aorist (as well as in the past passive participle and the verbal substantive). For verbs in the nontruncating ([−T]) conjugations, the First and Second stems are segmentally identical to the root. For verbs in the truncating ([+T]) conjugations, the First stem ends in a consonant and the Second stem ends in a vowel: thus, a [+T,+C] verb's First stem is identical to its root, and its Second stem arises by truncation of a root-final consonant; by contrast, a

[+T, −C] verb's Second stem is identical to its root, and its First stem arises by truncation of a root-final vowel.

A verb's First and Second stems sometimes differ in their accentuation. I assume that if a verb stem is not stipulated as being stressed, then forms built on that stem follow the default stress pattern, according to which stress falls 'on the last vowel before the first suffixal consonant or, in the absence of a suffixal consonant, on the last vowel' (Scatton 1984:110); but if a verb stem is by stipulation stressed, then this stipulation overrides the default stress pattern. Verbs belonging to the [−T, +C] conjugation exhibit a distinctive pattern of accentual alternation (Aronson 1968:144, Scatton 1984:111), with postradical stress in the present (e.g. *kradém* 'we steal') and imperfect (*krad'áxme* 'we were stealing') but radical stress in the aorist (*krádoxme* 'we stole'); verbs belonging to this conjugation may be seen as having an unstressed First stem alongside a Second stem which is by stipulation stressed. Verbs in the other conjugations exhibit a distinct tendency, by which aorist forms lacking a syllabic prefix and having root-initial stress have optional alternants exhibiting the default stress pattern (Aronson 1968:145f., Scatton 1984:111): e.g. *dávaxme* ~ *daváxme* 'we gave'. A verb exhibiting this alternation may be seen as having two competing Second-stem forms, one stipulated as carrying initial stress, the other unstressed (so that forms based on the latter alternant exhibit the default stress pattern). The incidence of this optional alternation in spoken varieties of Bulgarian is somewhat variable; Aronson (1968:145ff.) notes a trend among some speakers to use the default stress pattern only in 2sg and 3sg aorist forms which would otherwise be homophonous with their 3sg present-tense counterpart (thus: *dáva* 's/he gives', *davá* 'you (sg)/ s/he gave').

One conjugation is distinguished not only by the form of its stems, but by its suffixal morphology: verbs in the [−T, −C] conjugation (the largest conjugation class in the language) exhibit -*m* rather than -ə in the first-person singular present and -*me* rather than -*m* in the first-person plural present.[8]

The inflectional regularities among the forms in table 2.2 are obscured by at least one rule of automatic phonology and by a number of morphophonological modifications. The automatic rule is that of *j*-deletion (Scatton 1984:76f.), which causes *j* to be omitted before a front vowel; because of this rule, IGRÁJ's root-final *j* is absent throughout the imperfect and in all present-tense forms but *igráj*-ə and *igráj*-ə*t*.

The morphophonological complications in table 2.2 are more extensive. The preterite suffix -*x* becomes alveopalatal (-*š*) before front vowels; hence *krad'á*-*x*-*me*, but *kradé*-*š*-*e*. The imperfect suffix exhibits considerable variation in form; when it isn't simply elided, it appears sometimes as *-'á* (i.e. as *-á* with concomitant palatalization of a preceding consonant, as in *krad-'á-xme*), sometimes as *-e* (*igrá-e-xme*), and sometimes as *-é* (*krad-é-še*). (This is an instance of what is traditionally referred to as the *jat* alternation.) I assume that the basic form of this suffix is *-A*, a morphophoneme whose phonological realization depends on at least three rules (cf. Scatton 1984:79): in unstressed positions, *A* is realized as *e*; *A* is also realized as *e* in certain stressed positions in which the following syllable contains a front vowel (though not in the plural of the first and second persons: *krad'áxme*, *krad'áxte*); by default, *A* is realized as *'á*.[9] The present-tense suffix *-e* elides before the vowel-initial agreement suffixes *-ə* (first-person singular) and *-ət* (third-person plural). Moreover, all suffix-initial vowels (including those of the present-tense suffix *-e*, the 3pl present-tense suffix *-ət*, and the imperfect suffix *-A*) elide after the stems of [−T,−C] verbs (e.g. DÁVA); indeed, the aorist suffix *-o* and the 3sg suffix *-e* exhibit vowel elision in any postvocalic position.

Were it not for *j*-deletion, vowel elision, the alveopalatalization of *x*, the variable realization of *A*, and the default stress rule, the paradigms in table 2.2 would comprise the more obviously regular forms in table 2.3.[10]

As these various considerations reveal, an explicit definition of the paradigms in table 2.2 must account for a diverse range of regularities; in PFM, the expression of these regularities involves a rich inventory of rule types.

The architecture of the paradigm structure schematized in table 2.1 is determined by a system of cooccurrence restrictions on the set of morphosyntactic properties relevant to Bulgarian grammar; for instance, the lack of non-second-person imperative forms in a Bulgarian verb's paradigm is the effect of a cooccurrence restriction making the property 'second person' a necessary correlate of the property 'imperative'. I discuss the nature of such restrictions in section 2.3, and in section 2.4, I demonstrate their relevance to refining the notions of paradigm and paradigm function.

In an inferential–realizational theory of inflection, the association of a word's morphosyntactic properties with particular details of its morphological form is, by assumption, effected by realization rules. Following Zwicky (1985a), I assume that realization rules are of two different types. On the one hand, RULES OF EXPONENCE directly associate a particular set of morphosyntactic properties with a particular inflectional exponent; for instance, the association of the property set '1pl subject agreement' with the suffix *-me* is expressed by a rule of exponence in Bulgarian. On the other hand, RULES OF REFERRAL identify the morphological realization of one

Table 2.1 *Paradigm schema for Bulgarian verbs*

FINITE FORMS:

MOOD:	INDICATIVE			IMPERATIVE	
TENSE:	PRESENT	IMPERFECT	AORIST		ACTIVE
1SG					
2SG					
3SG					
1PL					
2PL					
3PL					

PARTICIPIAL FORMS:

TENSE:	PRESENT	IMPERFECT	AORIST	
FEM/SG				ACTIVE
MASC/SG				
NEUT/SG				
PLURAL				
		FEM/SG		PASSIVE
		MASC/SG		
		NEUT/SG		
		PLURAL		

set of morphosyntactic properties with that of some contrasting property set; for instance, the fact that a 2sg preterite verb form is regularly syncretized with its 3sg counterpart is expressed by a rule of referral in Bulgarian. I discuss the general characteristics of realization rules in section 2.5, with particular attention to the kinds of rule interactions entailed by their organization into blocks.

The formulation of a language's rules of exponence is complicated by the fact that the forms that they define must satisfy an independent set of generalizations – the language's morphophonological rules. For instance, Bulgarian has a rule of exponence which associates the suffix -*x* with the property 'preterite', but it also has a morphophonological rule requiring a velar to appear as its alveopalatal counterpart before a front vowel; for this reason, the preterite suffix -*x* appears as -*š* in the imperfect form *dávaše* 's/he was giving'. Various ways of accommodating this complication are imaginable.

The traditional assumption of generative phonology would be that *dávaše* has an underlying representation (**dávaxe*) upon which a morphophonological rule acts to produce the corresponding surface representation. An alternative assumption, which I pursue here, is that the rule of exponence introducing the 3sg agreement suffix -*e* defines a phonological string *dávaxe′* whose properties default to those of **dávaxe* but are subject to override by any applicable morphophonological rule. On this approach, *dávaše* does not arise from a distinct underlying form; instead, *dávaše* = *dávaxe′* by virtue of the linkage between rules of exponence and rules of morphophonology in Bulgarian. In section 2.6, I discuss the principles regulating this linkage; central to this discussion is the notion of MORPHOLOGICAL METAGENERALIZATIONS – generalizations about the specific sorts of override to which the default phonological properties of an expression defined by a particular rule of exponence are subject.

A precise inferential–realizational account of a language's inflectional system must specify the identity and sequence of the realization rules determining the form of a given inflected word in that language; in Bulgarian, for example, the determination of the aorist form *krádoxme* 'we stole' involves some rules but not others (e.g. the rule of exponence associating the suffix -*me* with the property-set '1pl subject agreement' and the one associating the suffix -*x* with the property 'preterite', but not the one associating the suffix -*e* with the property 'present tense') and presupposes a particular sequence of rule application (e.g. the -*x* rule must precede rather than follow the -*me* rule in the definition of *krádoxme*). In PFM, this specification of rule identity and rule sequence follows from the definition of the language's paradigm function. In section 2.7, I discuss the way in which a language's realization rules enter into this definition.

With the paradigms in table 2.2 available as a source of concrete examples, each of these formal characteristics of PFM can now be discussed in greater depth.

2.3 Morphosyntactic properties

The notion MORPHOSYNTACTIC PROPERTY is central to understanding the organization of a language's inflectional paradigms. A morphosyntactic property is a property which serves to distinguish phrases of the same category according to the different ways in which they participate in syntactic relations such as agreement and government. I assume that a morphosyntactic property takes the form of a pairing of a MORPHOSYNTACTIC

Table 2.2 *Indicative paradigms of four imperfective verbs in Bulgarian (Scatton 1984:211ff.)*

		KRAD 'steal'	IGRÁJ 'play'	KOVA 'forge'	DÁVA 'give'
Conjugation:		−T,+C	+T,+C	+T,−C	−T,−C
PRESENT	1SG	*krad-ə́*	*igráj-ə*	*kov-ə́*	*dáva-m*
	2SG	*krad-é-š*	*igrá-e-š*	*kov-é-š*	*dáva-š*
	3SG	*krad-é*	*igrá-e*	*kov-é*	*dáva*
	1PL	*krad-é-m*	*igrá-e-m*	*kov-é-m*	*dáva-me*
	2PL	*krad-é-te*	*igrá-e-te*	*kov-é-te*	*dáva-te*
	3PL	*krad-ə́t*	*igráj-ət*	*kov-ə́t*	*dáva-t*
IMPERFECT	1SG	*krad-'á-x*	*igrá-e-x*	*kov-'á-x*	*dáva-x*
	2SG	*krad-é-š-e*	*igrá-e-š-e*	*kov-é-š-e*	*dáva-š-e*
	3SG	*krad-é-š-e*	*igrá-e-š-e*	*kov-é-š-e*	*dáva-š-e*
	1PL	*krad-'á-x-me*	*igrá-e-x-me*	*kov-'á-x-me*	*dáva-x-me*
	2PL	*krad-'á-x-te*	*igrá-e-x-te*	*kov-'á-x-te*	*dáva-x-te*
	3PL	*krad-'á-x-a*	*igrá-e-x-a*	*kov-'á-x-a*	*dáva-x-a*
AORIST	1SG	*krád-o-x*	*igrá-x*	*ková-x*	*dáva-x, davá-x*
	2SG	*krád-e*	*igrá*	*ková*	*dáva, davá*
	3SG	*krád-e*	*igrá*	*ková*	*dáva, davá*
	1PL	*krád-o-x-me*	*igrá-x-me*	*ková-x-me*	*dáva-x-me, davá-x-me*
	2PL	*krád-o-x-te*	*igrá-x-te*	*ková-x-te*	*dáva-x-te, davá-x-te*
	3PL	*krád-o-x-a*	*igrá-x-a*	*ková-x-a*	*dáva-x-a, davá-x-a*

FEATURE with one of its permissible VALUES. Consider, for example, the set of morphosyntactic properties relevant for the description of Bulgarian verb inflection. Arguably, these are the feature–value pairs entailed by (2).[11]

(2)

FEATURE	PERMISSIBLE VALUES
VFORM	fin, pple
VCE	act, pass
TNS	pres, imp, aor
PRET	yes, no
MOOD	indic, impv
NUM	sg, pl
PER	1, 2, 3
GEN	masc, fem, neut
AGR	sets of morphosyntactic properties

Table 2.3 *The paradigms in Table 2.2 as they would appear were it not for j-deletion, vowel elision, the alveopalatalization of x, the variable realization of A, and the default stress rule*

		KRAD 'steal'	IGRÁJ 'play'	KOVA 'forge'	DÁVA 'give'
Conjugation:		−T,+C	+T,+C	+T,−C	−T,−C
PRESENT	1SG	*krad-e-ə*	*igráj-e-ə*	*kov-e-ə*	*dáva-e-m*
	2SG	*krad-e-š*	*igráj-e-š*	*kov-e-š*	*dáva-e-š*
	3SG	*krad-e-e*	*igráj-e-e*	*kov-e-e*	*dáva-e-e*
	1PL	*krad-e-m*	*igráj-e-m*	*kov-e-m*	*dáva-e-me*
	2PL	*krad-e-te*	*igráj-e-te*	*kov-e-te*	*dáva-e-te*
	3PL	*krad-e-ət*	*igráj-e-ət*	*kov-e-ət*	*dáva-e-ət*
IMPERFECT	1SG	*krad-A-x*	*igráj-A-x*	*kov-A-x*	*dáva-A-x*
	2SG	*krad-A-x-e*	*igráj-A-x-e*	*kov-A-x-e*	*dáva-A-x-e*
	3SG	*krad-A-x-e*	*igráj-A-x-e*	*kov-A-x-e*	*dáva-A-x-e*
	1PL	*krad-A-x-me*	*igráj-A-x-me*	*kov-A-x-me*	*dáva-A-x-me*
	2PL	*krad-A-x-te*	*igráj-A-x-te*	*kov-A-x-te*	*dáva-A-x-te*
	3PL	*krad-A-x-a*	*igráj-A-x-a*	*kov-A-x-a*	*dáva-A-x-a*
AORIST	1SG	*krád-o-x*	*igrá-o-x*	*kova-o-x*	*dáva-o-x, dava-o-x*
	2SG	*krád-e*	*igrá-e*	*kova-e*	*dáva-e, dava-e*
	3SG	*krád-e*	*igrá-e*	*kova-e*	*dáva-e, dava-e*
	1PL	*krád-o-x-me*	*igrá-o-x-me*	*kova-o-x-me*	*dáva-o-x-me, dava-o-x-me*
	2PL	*krád-o-x-te*	*igrá-o-x-te*	*kova-o-x-te*	*dáva-o-x-te, dava-o-x-te*
	3PL	*krád-o-x-a*	*igrá-o-x-a*	*kova-o-x-a*	*dáva-o-x-a, dava-o-x-a*

Note: Stress is marked only where its placement is lexically stipulated.

Following Gazdar et al. (1985:25), I assume a distinction between two types of morphosyntactic features: ATOM-VALUED and SET-VALUED. In (2), all of the features but the last are atom-valued; their values are unanalysable units. The feature AGR, by contrast, is set-valued: its value is itself a set of morphosyntactic properties. For present purposes, I assume that the feature–value pairings entailed by (2) constitute the full range of morphosyntactic properties available to lexemes of category V in Bulgarian.[12]

A set τ of morphosyntactic properties for a lexeme of category C is

WELL-FORMED in some language ℓ only if τ satisfies the following conditions in ℓ:

(3) a. For each property F:v $\in \tau$, F:v is available to lexemes of category C and v is a permissible value for F.
b. For any morphosyntactic feature F having v_1, v_2 as permissible values, if $v_1 \neq v_2$ and F:$v_1 \in \tau$, then F:$v_2 \notin \tau$.

The well-formedness of a language's morphosyntactic property sets also depends on the notions of extension and unification. Extension is a relation among sets of morphosyntactic properties; this relation is recursively defined in (4) (cf. Gazdar et al. (1985:27)).

(4) Where σ and τ are well-formed sets of morphosyntactic properties, σ is an EXTENSION of τ iff (i) for any atom-valued feature F and any permissible value v for F, if F:v $\in \tau$, then F:v $\in \sigma$; and (ii) for any set-valued feature F and any permissible value ρ for F, if F:$\rho \in \tau$, then F:$\rho' \in \sigma$, where ρ' is an extension of ρ.

For example, {TNS:pres, AGR:{PER:1, NUM:pl}} is, according to (4), an extension of each of the ten sets of morphosyntactic properties in (5):

(5)
a. {TNS:pres, AGR:{PER:1, NUM:pl}}
b. {TNS:pres, AGR:{PER:1}}
c. {TNS:pres, AGR:{NUM:pl}}
d. {TNS:pres, AGR:{}}
e. {TNS:pres}
f. {AGR:{PER:1, NUM:pl}}
g. {AGR:{PER:1}}
h. {AGR:{NUM:pl}}
i. {AGR:{}}
j. {}

Unification, an operation on sets of morphosyntactic properties, is defined in terms of extension:

(6) Where σ and τ are well-formed sets of morphosyntactic properties, the UNIFICATION ρ of σ and τ is the smallest well-formed set of morphosyntactic properties such that ρ is an extension of both σ and τ.

For example, the unification of {TNS:pres, AGR:{PER:1}} and {TNS:pres, MOOD:indic, AGR:{NUM:pl}} is {TNS:pres, MOOD:indic, AGR:{PER:1, NUM:pl}}; the unification of {TNS:pres, AGR:{PER:1}} and {AGR:{PER:2}}, by contrast, is undefined.

The notion of extension is central to defining the PROPERTY COOCCURRENCE RESTRICTIONS on which a property set's well-formedness depends in a given language. A Bulgarian verb, for example, can't be associated with just any combination of morphosyntactic properties from the range entailed by (2), even if this combination satisfies the two necessary conditions in (3); the only well-formed property sets are those that conform to the language-specific cooccurrence restrictions in (7).

(7) A set τ of morphosyntactic properties for a lexeme of category V is well-formed only if τ has a well-formed extension σ such that
  a. σ is an extension of {VFORM:fin} iff for some permissible α, σ is an extension of {MOOD:α};
  b. if σ is an extension of {MOOD:impv}, then σ is an extension of {AGR:{PER:2}};
  c. for any permissible α, σ is an extension of {TNS:α} iff σ is an extension of {MOOD:indic} or of {VFORM:pple};
  d. for any permissible α, σ is an extension of {AGR:{GEN:α}} iff σ is an extension of {VFORM:pple}, and σ is an extension of {AGR:{PER:α}} iff σ is an extension of {VFORM:fin};
  e. if σ is an extension of {VCE:pass}, then σ is an extension of {VFORM:pple, TNS:aor};
  f. σ is an extension of {PRET:yes} iff σ is an extension of {TNS:impf} or of {TNS:aor};
  g. if σ is an extension of {AGR:α}, then α has an extension of the form {PER:β, NUM:γ, GEN:δ}, where β, γ, δ are permissible values;
  h. where F is PER, NUM, or GEN, σ is not an extension of {F:α} (for any permissible value α of F).

Restriction (7a) entails that a form in the paradigm of a Bulgarian verb is associated with the property 'VFORM:fin' if and only if it is also associated with some permissible specification of the feature MOOD: that is, only finite verb forms are specified for mood and everything specified for mood is a finite verb form. Restriction (7b) entails that if a verb form is imperative in mood, then it must exhibit second-person agreement. By (7c), a verb form is specified for tense if and only if it is indicative in mood or is a participle. By (7d), a verb form is specified for gender agreement if and only if it is a participle, and a verb form is specified for person agreement if and only if it is finite. Restriction (7e) entails that if a verb form is passive, then it has to be both a participle and aorist in tense. By (7f), a verb form is preterite if and only if it is either imperfect or aorist. Restrictions (7g) and (7h) limit the kinds of property sets that may serve as values for AGR: by (7g), the property set α serving as AGR's value can only contain properties of person, number, and gender; the effect of (7h) is to restrict properties of person, number, and gender to property sets serving as values for AGR.

Given the well-formedness conditions in (3) and the property cooccurrence restrictions in (7), a related notion of completeness can be defined as follows: a set σ of morphosyntactic properties (for a lexeme of some category) is COMPLETE if and only if σ is well-formed and for any morphosyntactic property-set τ such that σ is not an extension of τ, the unification of τ

and σ is not well-formed. That is, a well-formed set of properties is complete if it can't be augmented and still remain well-formed.

2.4 Paradigms and paradigm functions

The PARADIGM of a lexeme L is a set of CELLS; each such cell is the pairing <Y,σ> of an inflected form Y of the lexeme L with a complete[13] set σ of morphosyntactic properties for L. Each complete set of morphosyntactic properties for a lexeme of some category corresponds to a cell in that lexeme's paradigm; for instance, each complete set of properties for a Bulgarian verb corresponds to a cell in the schematic paradigm represented in table 2.1. There are thirty-six possible complete sets of morphosyntactic properties for Bulgarian verbs, hence thirty-six cells in the Bulgarian verbal paradigm. The cell <Y,σ> in any given paradigm will be referred to as that paradigm's σ-CELL, and will be said to be OCCUPIED BY the form Y.

A paradigm function, again, is a kind of function in the set of FPSPs: in particular, a paradigm function applies to a ROOT PAIRING <X,σ> (where X is the root of a lexeme L and σ is a complete set of morphosyntactic properties for L) to yield the σ-cell <Y,σ> in L's paradigm. In what follows, I shall use the format in (8) in representing the association of a σ-cell <Y,σ> with a root pairing <X,σ> by a paradigm function PF:

(8) Format for paradigm functions: PF(<X,σ>) = <Y,σ>

For instance, the Bulgarian paradigm function PF applies to the root pairing <*krad*,σ> (where *krad* is the root of the verbal lexeme KRAD 'steal' and σ is the complete set (9) of morphosyntactic properties for Bulgarian verbs) to yield the 1pl present indicative cell <*kradém*,σ> in KRAD's paradigm; the format in (8) allows this association to be represented as the equation in (10).

(9) {VFORM:fin, VCE:act, TNS:pres, PRET:no, MOOD:indic, AGR:{PER:1, NUM:pl}}

(10) PF(<*krad*,σ>) = <*kradém*,σ>

In general, it is necessary to regard a root X as being indexed for its association with a particular lexeme, since phonologically identical roots associated with distinct lexemes may exhibit distinct morphological behaviour; in English, for example, the root *lie* of the lexeme LIE$_1$ 'recline' must be distinguished from the root *lie* of the lexeme LIE$_2$ 'prevaricate', since their paradigms are different (e.g. past tense *lay* vs. *lied*). I shall treat this indexing as covert, but shall use a function 'L-index' to make overt reference to it where necessary: thus, *lie* 'recline' carries a covert index $\textsc{lie}_1$ (so that L-index(*lie*) $= \textsc{lie}_1$), while *lie* 'prevaricate' carries a covert index $\textsc{lie}_2$ (so that L-index(*lie*) $= \textsc{lie}_2$).

2.5 Realization rules and rule blocks

In PFM, the definition of a language's inflectional system is equated with the definition of its paradigm function. In all cases, a language's paradigm function is defined in terms of its realization rules – the individual rules of morphology realizing the language's morphosyntactic properties.

Following Anderson (1992:129), I assume that a language's realization rules are organized into BLOCKS such that rules belonging to the same block compete for the same position in the sequence of rules determining a word's inflectional exponence. This organization of rules into blocks is most clearly revealed by rules introducing affixal exponents: each 'slot' in a word's sequence of inflectional affixes corresponds to a distinct block of realization rules. In the paradigm of KRAD in table 2.3, for example, the 1pl aorist form *krádoxme* exhibits three affixal slots, one for the aorist suffix *-o*, another for the preterite suffix *-x*, and a third for the agreement suffix *-me*. But the organization of realization rules into blocks doesn't always boil down to a system of affix position classes, since in many languages, some or all blocks in a word's inflectional morphology may include rules of a nonaffixational nature. To account for the morphology of *krádoxme*, for instance, one additional block is necessary, which houses the rule inducing the choice of a verb's Second stem in the aorist. Thus, each block corresponds to a position that a realization rule might occupy in the sequence of rules needed to determine a word's inflectional form;[14] there are four such positions in Bulgarian.

Realization rules, like paradigm functions, are a kind of function in the set of FPSPs; but they are unlike paradigm functions both in that their argument isn't necessarily a root pairing and in that their value isn't necessarily a cell in some lexeme's paradigm. The format that I shall use for the definition of realization rules is as in (11):[15]

(11) Format for realization rules: $\mathrm{RR}_{n,\tau,\mathrm{C}}(\langle \mathrm{X},\sigma\rangle) =_{\mathrm{def}} \langle \mathrm{Y}',\sigma\rangle$

Each realization rule $\mathrm{RR}_{n,\tau,\mathrm{C}}$ is represented as carrying three indices: the BLOCK INDEX *n* identifies the particular block to which the rule belongs; the CLASS INDEX C indicates the particular class of lexemes whose paradigms the rule may participate in defining; and the PROPERTY-SET INDEX τ identifies the particular well-formed set of morphosyntactic properties (for a lexeme of category C) that the rule realizes through its application. Thus, the value of $\mathrm{RR}_{n,\tau,\mathrm{C}}(<\mathrm{X},\sigma>)$ is defined if and only if the conditions in (12) are met.

(12) Rule–argument coherence:
$\mathrm{RR}_{n,\tau,\mathrm{C}}(<\mathrm{X},\sigma>)$ is defined iff (a) σ is an extension of τ; (b) L-index(X) $\in$ C; and (c) σ is a well-formed set of morphosyntactic properties for L-index(X).

The form Y′ defined by a realization rule having the format in (11) is a phonological string whose properties default to those of Y but are subject to override by any applicable morphophonological rules. In accordance with (13), this form inherits the L-index of the form X from which it is deduced.[16]

(13) Persistence of L-indexing:
For any realization rule $\mathrm{RR}_{n,\tau,\mathrm{C}}$, if $\mathrm{RR}_{n,\tau,\mathrm{C}}(<\mathrm{X},\sigma>) = <\mathrm{Y}',\sigma>$, then L-index(Y′) = L-index(X).

Four blocks of realization rules are necessary to account for the indicative paradigms in table 2.2; in the assumed rule format, the rules of exponence belonging to these four blocks may be stated as in (14).

(14) **Block A**

A1. $\mathrm{RR}_{\mathrm{A},\{\mathrm{TNS:aor}\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{Y}',\sigma>$, where Y is X's Second stem

A2. $\mathrm{RR}_{\mathrm{A},\{\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{Y}',\sigma>$, where Y is X's First stem

Blocks B and C

B1. $\mathrm{RR}_{\mathrm{B},\{\mathrm{TNS:pres}\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}e',\sigma>$

B2. $\mathrm{RR}_{\mathrm{B},\{\mathrm{TNS:impf}\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}A',\sigma>$

B3. $\mathrm{RR}_{\mathrm{B},\{\mathrm{TNS:aor,\ PRET:yes}\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}o',\sigma>$

B4/C1. Where $n = \mathbf{B}$ or $\mathbf{C}$,

$\mathrm{RR}_{n,\{\mathrm{TNS:aor,\ PRET:yes,\ AGR:\{PER:3,\ NUM:sg\}}\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}',\sigma>$

C2. $\mathrm{RR}_{\mathrm{C},\{\mathrm{PRET:yes}\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}x',\sigma>$

Block D

D1. $\mathrm{RR}_{\mathrm{D},\{\mathrm{TNS:pres,\ AGR:\{PER:1,\ NUM:sg\}}\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}ə',\sigma>$

D2. $\mathrm{RR}_{\mathrm{D},\{\mathrm{TNS:pres,\ AGR:\{PER:1,\ NUM:sg\}}\},[\mathrm{CONJ:-T,-C}]}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}m',\sigma>$

D3. $\mathrm{RR}_{\mathrm{D},\{\mathrm{TNS:pres,\ AGR:\{PER:2,\ NUM:sg\}}\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}\check{s}',\sigma>$

D4. $\mathrm{RR}_{\mathrm{D},\{\mathrm{AGR:\{PER:3,\ NUM:sg\}}\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}e',\sigma>$

D5. $\mathrm{RR}_{\mathrm{D},\{\mathrm{TNS:pres,\ AGR:\{PER:1,\ NUM:pl\}}\},([\mathrm{CONJ:+T}] \cup [\mathrm{CONJ:+C}])}(<\mathrm{X},\sigma>)$
$=_{\mathrm{def}} <\mathrm{X}m',\sigma>$

D6. $\mathrm{RR}_{\mathrm{D},\{\mathrm{AGR:\{PER:1,\ NUM:pl\}}\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}me',\sigma>$

D7. $\mathrm{RR}_{\mathrm{D},\{\mathrm{AGR:\{PER:2,\ NUM:pl\}}\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}te',\sigma>$

D8. $\mathrm{RR}_{\mathrm{D},\{\mathrm{TNS:pres,\ AGR:\{PER:3,\ NUM:pl\}}\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}ət',\sigma>$

D9. $\mathrm{RR}_{\mathrm{D},\{\mathrm{AGR:\{PER:3,\ NUM:pl\}}\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}a',\sigma>$

Block A contains the rules of stem selection, which determine the choice between a verb root's First and Second stems: rule **A2** specifies that the First stem is the default choice, while **A1** specifies that the Second stem is used in the aorist.

Block B contains the rules introducing suffixes which are exponents of tense but not agreement: rule **B1** realizes the property 'present tense' through the suffixation of *-e*; rule **B2** realizes the property 'imperfect tense' through the suffixation of *-A*; and rule **B3** realizes 'aorist tense' through the suffixation of *-o*. The Block **C** rule **C2** realizes the property 'preterite' through the suffixation of *-x*. The rule schema **B4/C1** conflates the block **B** rule **B4** and the block **C** rule **C1**; these are identity functions which prevent the other rules in blocks **B** and **C** from applying in the inflection of a 3sg aorist form.

Block D contains the rules introducing suffixes which are exponents of agreement (as well as of tense, in some instances): rule **D1** realizes the properties '1sg present tense' through the suffixation of *-ə*; rule **D2** realizes these same properties through the suffixation of *-m*, but is restricted to [−T,−C] verbs; rule **D3** realizes the properties '2sg present tense' by suffixing *-š*; rule **D4** realizes the property '3sg' through the suffixation of *-e*; rule **D5** realizes the properties '1pl present tense' through the suffixation of *-m* to verbs in the [−T,+C], [+T,+C], and [+T,−C] conjugations; rule **D6** realizes 1pl agreement through the suffixation of *-me*; rule **D7** realizes 2pl agreement by means of *-te*; rule **D8** realizes the properties '3pl present tense' by suffixing *-ət*; and **D9** realizes 3pl agreement by suffixing *-a*.[17]

The system of realization rules in (11) is incomplete in one respect: the rules in **A–D** do not include any rules realizing the second person singular in the imperfect and the aorist. In Bulgarian, 2sg preterite verb forms are syncretized with their 3sg counterparts. In instances of syncretism, however, a rule of referral can be used to assure that the morphosyntactic property set associated with one cell in a paradigm is realized in whatever way the property set associated with some distinct cell is realized. For instance, the Bulgarian syncretism might be seen as the effect of the (informally stated) rule of referral (15):[18]

(15) In the preterite tenses, a verb's 2sg forms are inflected however its 3sg forms are inflected.

I return to the precise formulation of (15) in section 2.7.

2.6 Morphophonological rules and morphological metageneralizations

A morphophonological regularity associated with one morphological rule may or may not be associated with others. In English, for instance, the regularity known as trisyllabic laxing is associated with the suffixation of *-ity* (*div*[ay]*ne*, *div*[ɪ]*nity*) but not with the suffixation of *-able* (*def*[ay]*ne*, *def*[ay]*nable*, **def*[ɪ]*nable*). Various means of representing this difference are imaginable. In the theory of Lexical Phonology (Kiparsky 1982, 1983, 1985), the Level-Ordering Hypothesis (Siegel 1979, Allen 1978) is invoked to account for the association of particular morphophonological regularities with particular morphological rules: according to this hypothesis, *-ity* suffixation and trisyllabic laxing belong to the same 'level' (Level I), so that any application of the former rule entails the concomitant application of the latter rule; but because *-able* suffixation belongs to a different level (Level II), its application is not associated with that of trisyllabic laxing.

In the most familiar formulation of the Level-Ordering Hypothesis, Level I rules are, as a class, held to be strictly ordered before Level II rules; on this formulation, the Level-Ordering Hypothesis entails the Affix Ordering Generalization (Selkirk 1982:91), according to which a word's Level II affixes are necessarily peripheral to its Level I affixes. The validity of the Affix Ordering Generalization has, of course, been widely – and rightly – questioned (see e.g. Aronoff and Sridhar 1983, Spencer 1991:179ff., Bochner 1993:203ff., Zwicky 1992:358ff.); but as Anderson (1992:244) observes, one can abandon the Affix Ordering Generalization without relinquishing the fundamental hypothesis that a particular class of morphological rules may, by stipulation, be associated with a particular class of morphophonological regularities. Thus, rejecting the notion of lexical levels, Zwicky (1994) argues for an alternative approach to expressing associations between morphological rules and morphophonological regularities: in this approach, the morphophonological regularities associated with a given morphological rule are assumed to function as part of that rule; where two or more rules exhibit the same regularities, this fact is expressed by means of a MORPHOLOGICAL METAGENERALIZATION – a rule about those rules. In this section I shall develop this idea.[19]

I assume that for each realization rule R, there is an unordered set ϕ_R of morphophonological rules constraining the evaluation of R in any instance of its application. Where R has the definition in (16), the prime notation 'Y′' indicates both (a) that Y is the default phonological form which R prescribes for its value, and (b) that the default phonological properties of Y are overridden by all applicable members of ϕ_R. Y′ differs from Y only to the extent required by the rules in ϕ_R; if Y isn't subject to any of the rules in ϕ_R, then by default, Y′ = Y. In the evaluation of a realization rule R, more specific members of ϕ_R are assumed to override more general ones: that is, if *a*,*b* are morphophonological rules such that (i) *a*,*b* $\in \phi_R$ and (ii) in the evaluation of R, *a* is applicable in only a proper subset of those instances in which *b* is applicable, then *a* applies, excluding the application of *b*. Otherwise, the applicable members of ϕ_R apply jointly.

(16) $\mathrm{RR}_{n,\tau,C}(<\mathrm{X},\sigma>) = <\mathrm{Y}',\sigma>$

The morphophonological rules relevant to the Bulgarian realization rules in **A**–**D** are those in (17):

(17) Where $\mathrm{RR}_{n,\tau,C}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{Y}',\sigma>$:

a. If L-index(X) ∈ [CONJ: −T, −C] and Y = X[vowel]Z, then the indicated [vowel] is absent from Y′.
b. If X = W[vowel_1] and Y = X[vowel_2]Z, then the indicated [vowel_1] is absent from Y′ and the indicated [vowel_2] is stressed in Y′ iff [vowel_1] is stressed in Y.
c. If X = W[vowel_1] and Y = X[vowel_2]Z, then the indicated [vowel_2] is absent from Y′.
d. If Y is unstressed, then Y′ is stressed on its final syllable.
e. If X = WC, C is a velar having Č as its alveopalatal counterpart, Y = XVZ, and V is a front vowel, then Y′ has Č in place of the indicated C.
f. If Y = WĂZ, then Y′ has *e* in place of the indicated *Ă*.
g. If Y = W*Á*C_1VZ and V is a front vowel, then Y′ has *é* in place of the indicated *Á*.
h. If Y = W*Á*Z, then Y′ has *á* (with concomitant palatalization of an immediately preceding consonant) in place of the indicated *Á*.

Summarizing the effects of these rules:

Rule (17a) causes a suffix-initial vowel to elide after a [CONJ: −T, −C] stem's final vowel; because (17a) is associated with the realization rule **B1**, $\mathrm{RR}_{\mathrm{B},\{\mathrm{TNS:pres}\},\mathrm{V}}$(<*dáva*,σ>) is evaluated as <*dáva*,σ>.

Rule (17b) causes a stem-final vowel to elide before a suffix-initial vowel; because (17b) is associated with the realization rule **D8**, $\mathrm{RR}_{\mathrm{D},\{\mathrm{TNS:pres},\ \mathrm{AGR:}\{\mathrm{PER:3},\ \mathrm{NUM:pl}\}\},\mathrm{V}}$(<*igráje*,σ>) is evaluated as <*igrájət*,σ>. If the stem-final vowel is stressed, the elision of this vowel causes the suffix-initial vowel to be stressed; thus, $\mathrm{RR}_{\mathrm{D},\{\mathrm{TNS:pres},\ \mathrm{AGR:}\{\mathrm{PER:3},\ \mathrm{NUM:pl}\}\},\ \mathrm{V}}$(<*kradé*,σ>) is evaluated as <*kradə́t*,σ>.

Rule (17c) causes a suffix-initial vowel to elide after a stem-final vowel;

because (17c) is associated with the realization rule **B3**, $\mathrm{RR}_{\mathrm{B},\{\mathrm{TNS{:}aor,PRET{:}yes}\},\mathrm{V}}$ (<*igrá*,σ>) is evaluated as <*igrá*,σ>.

Rule (17d), the default stress rule, causes final stress to be imposed on an unstressed form; because (17d) is associated with the realization rule **B1**, $\mathrm{RR}_{\mathrm{B},\{\mathrm{TNS{:}pres}\},\mathrm{V}}$(<*kov*,σ>) is evaluated as <*kové*,σ>.

Rule (17e) causes a stem-final velar to be realized as the corresponding alveopalatal before a suffix-initial front vowel; because (17e) is associated with the realization rule **D4**, $\mathrm{RR}_{\mathrm{D},\{\mathrm{AGR{:}\{PER{:}3,\ NUM{:}sg\}}\},\mathrm{V}}$(<*dávax*,σ>) is evaluated as <*dávaše*,σ>.

Rule (17f) causes unstressed *A* to be realized as *e*; because (17f) is associated with the realization rule **D6**, $\mathrm{RR}_{\mathrm{D},\{\mathrm{AGR{:}\{PER{:}1,\ NUM{:}pl\}}\},\mathrm{V}}$(<*igrájAx*,σ>) is evaluated as <*igrájexme*,σ>. (Outside of the morphology, the automatic phonological rule of *j*-deletion causes *igrájexme* to be realized as *igráexme*.)

Rule (17g) causes stressed *A* to be realized as *é* when the next syllable contains a front vowel; because (17e) and (17g) are associated with the realization rule **D4**, $\mathrm{RR}_{\mathrm{D},\{\mathrm{AGR{:}\{PER{:}3,\ NUM{:}sg\}}\},\mathrm{V}}$(<*kradÁx*,σ>) is evaluated as <*kradéše*,σ>.

Rule (17h) causes stressed *A* to be realized as *'á* (i.e. *á* with concomitant palatalization of the preceding consonant); because (17h) is associated with **D6**, $\mathrm{RR}_{\mathrm{D},\{\mathrm{AGR{:}\{PER{:}1,\ NUM{:}pl\}}\},\mathrm{V}}$(<*kradÁx*,σ>) is evaluated as <*krad'áxme*,σ>.

Not all of the morphophonological rules in (17) are associated with every realization rule in **A**–**D**; the only valid associations are those stipulated by the morphological metageneralizations in (18).[20]

(18)
a. For any rule R in block **B**, **C**, or **D**, rules (17a,e) $\in \phi_R$.
b. For any rule R in block **B**, **C**, or **D**, (17b) $\in \phi_R$ iff R realizes some extension of {TNS:pres}; otherwise, (17c) $\in \phi_R$.
c. Where R is in block **B**, (17d) $\in \phi_R$.
d. Where R is in block **D**, (17f,h) $\in \phi_R$.
e. (17g) $\in \phi_{\mathbf{D4}}, \phi_{\mathbf{B1}}$.

Given these morphological metageneralizations, the makeup of ϕ_R for each realization rule R in **A**–**D** is as follows:

Where R is	**A1**, ϕ_R =	{}
	A2	{}
	B1	{(17a), (17b), (17d), (17e), (17g)}
	B2	{(17a), (17c), (17d), (17e)}
	B3	{(17a), (17c), (17d), (17e)}
	B4	{(17a), (17c), (17d), (17e)}
	C1	{(17a), (17c), (17e)}
	C2	{(17a), (17c), (17e)}

D1	{(17a), (17b), (17e), (17f), (17h)}
D2	{(17a), (17b), (17e), (17f), (17h)}
D3	{(17a), (17b), (17e), (17f), (17h)}
D4	{(17a), (17c), (17e), (17f), (17g), (17h)}
D5	{(17a), (17b), (17e), (17f), (17h)}
D6	{(17a), (17c), (17e), (17f), (17h)}
D7	{(17a), (17c), (17e), (17f), (17h)}
D8	{(17a), (17b), (17e), (17f), (17h)}
D9	{(17a), (17c), (17e), (17f), (17h)}

Thus, consider the evaluation of $\mathrm{RR}_{\mathrm{B},\{\mathrm{TNS:pres}\},\mathrm{V}}$(<*dáva*,σ>), an application of **B1**. Of the morphophonological rules associated with **B1** by the metageneralizations in (18), two are potentially relevant to the evaluation of $\mathrm{RR}_{\mathrm{B},\{\mathrm{TNS:pres}\},\mathrm{V}}$(<*dáva*,σ>), namely (17a) and (17b); but since every instance in which (17a) is applicable is likewise an instance in which (17b) is applicable (while the reverse is not true), (17a) overrides (17b). The evaluation of $\mathrm{RR}_{\mathrm{B},\{\mathrm{TNS:pres}\},\mathrm{V}}$(<*dáva*,σ>) is therefore constrained by (17a), whose application entails the value <*dáva*,σ>. Similarly, consider the evaluation of $\mathrm{RR}_{\mathrm{D},\{\mathrm{AGR}:\{\mathrm{PER}:3,\ \mathrm{NUM:sg}\}\},\mathrm{V}}$(<*kradÁx*,σ>), an application of **D4**. Of the morphophonological rules associated with **D4** by the metageneralizations in (18), three are potentially relevant to the evaluation of $\mathrm{RR}_{\mathrm{D},\{\mathrm{AGR}:\{\mathrm{PER}:3,\ \mathrm{NUM:sg}\}\},\mathrm{V}}$(<*kradÁx*,σ>), namely (17e), (17g), and (17h); but since every instance in which (17g) is applicable is likewise an instance in which (17h) is applicable (while the reverse is not true), (17g) overrides (17h). The evaluation of $\mathrm{RR}_{\mathrm{D},\{\mathrm{AGR}:\{\mathrm{PER}:3,\ \mathrm{NUM:sg}\}\},\mathrm{V}}$(<*kradÁx*,σ>) is therefore constrained by (17e) and (17g), whose joint application entails the value <*kraděše*,σ>.[21] Notice finally that because the morphological metageneralizations in (18) do not associate the morphophonological rule (17g) with rules **D6** and **D7**, the imperfect suffix assumes its default form in *krad'áxme* and *krad'áxte*, notwithstanding the presence of a front vowel in the following syllable.

2.7 Defining a language's paradigm function in terms of its realization rules

A language's paradigm function is defined in terms of its realization rules. The task of defining a language's paradigm function is not, however, as straightforward as it might seem, for two reasons. Consider first the fact that the realization rules spelling out the morphology of the word occupying the σ-cell in a lexeme's paradigm aren't necessarily the same from one lexeme to the next. Suppose, for instance, that σ is the set of morphosyntactic properties given in (9), repeated below. If the Bulgarian paradigm function PF applies to the root pairing <*krad*,σ>, the corresponding value (the 1pl present indicative active cell in the paradigm of KRAD 'steal') must be defined as the result of applying rules **A2**, **B1**, and **D5**, as in (19a), to produce <*kradém*,σ>.[22] But if PF applies to <*dáva*,σ>, where DÁVA 'give' belongs to the [−T,−C] conjugation, the corresponding value (the 1pl present indicative active cell in the paradigm of DÁVA) is the result of applying rules **A2**, **B1**, and **D6**, as in (19b). The dilemma is clear: PF must be defined in such a way that it is uniformly valid for any root pairing to which it might apply, but words occupying the same cell in different paradigms don't always arise through the application of the same realization rules.

(9) {VFORM:fin, VCE:act, TNS:pres, PRET:no, MOOD:indic, AGR:{PER:1, NUM:pl}}

(19) a. $\mathrm{PF}(<\textit{krad},\sigma>) = \mathrm{RR}_{[\mathbf{D5}]}(\mathrm{RR}_{[\mathbf{B1}]}(\mathrm{RR}_{[\mathbf{A2}]}(<\textit{krad},\sigma>))) = <\textit{kradém},\sigma>$

b. $\mathrm{PF}(<\textit{dáva},\sigma>) = \mathrm{RR}_{[\mathbf{D6}]}(\mathrm{RR}_{[\mathbf{B1}]}(\mathrm{RR}_{[\mathbf{A2}]}(<\textit{dáva},\sigma>))) = <\textit{dávame},\sigma>$

The second, converse problem is that words occupying different cells within the same paradigm exhibit structural similarities. Suppose, on the one hand, that σ is the set of morphosyntactic properties in (20a); on that assumption, PF applies to <*krad*,σ> to yield the 1pl imperfect active cell <*krad'áxme*,σ> in KRAD's paradigm, which arises through the application of **A2**, **B2**, **C2**, and **D6**, as in (20b). Suppose, on the other hand, that σ′ is the set of morphosyntactic properties in (21a); on that assumption, PF applies to <*krad*,σ′> to yield the 1pl aorist active cell <*krádoxme*,σ′>, which arises through the successive application of **A1**, **B3**, **C2**, and **D6**, as in (21b). Although <*krad'áxme*,σ> and <*krádoxme*,σ′> are distinct cells in the paradigm of KRAD, they nevertheless display a structural similarity: rules **C2** and **D6** apply in the same sequence in the definition of PF(<*krad*,σ>) as in the definition of PF(<*krad*,σ′>). Thus, there is a second dilemma: PF must be defined in such a way that it allows words occupying distinct cells in a paradigm to arise through the application of distinct sets of rules; yet it must not portray structural similarities such as that of <*krad'áxme*,σ> and <*krádoxme*,σ′> as simply coincidental.

(20) a. {VFORM:fin, VCE:act, TNS:impf, PRET:yes, MOOD:indic, AGR:{PER:1, NUM:pl}}

b. $\mathrm{PF}(<\textit{krad},\sigma>) = \mathrm{RR}_{[\mathbf{D6}]}(\mathrm{RR}_{[\mathbf{C2}]}(\mathrm{RR}_{[\mathbf{B2}]}(\mathrm{RR}_{[\mathbf{A2}]}(<\textit{krad},\sigma>)))) =$ $<\textit{krad'áxme},\sigma>$

(21) a. {VFORM:fin, VCE:act, TNS:aor, PRET:yes, MOOD:indic, AGR:{PER:1, NUM:pl}}

b. $\mathrm{PF}(<\mathit{krad},\sigma'>) = \mathrm{RR}_{[\mathbf{D6}]}(\mathrm{RR}_{[\mathbf{C2}]}(\mathrm{RR}_{[\mathbf{B3}]}(\mathrm{RR}_{[\mathbf{A1}]}(<\mathit{krad},\sigma'>)))) =$ $<\mathit{krádoxme},\sigma'>$

In short, a theory of paradigm functions must somehow account for both 'horizontal' differences (i.e. the fact that from paradigm to paradigm, parallel cells may arise through the application of distinct realization rules) and 'vertical' similarities (i.e. the fact that within a paradigm, distinct cells may exhibit important structural similarities).

Pāṇini's principle provides the means of satisfying these two desiderata. Notice, for example, that it is Pāṇini's principle that unifies the Bulgarian examples in (19)–(21): given any complete set σ of morphosyntactic properties for verbs and any verb root X, the value of the paradigm function PF for the root pairing <X,σ> is always the result of applying the NARROWEST APPLICABLE RULE from each of blocks **A** to **D**; thus, the Bulgarian paradigm function can be most simply defined in terms of the notion 'narrowest applicable rule'.

In making the notion 'narrowest applicable rule' precise, two distinct notions must be explicitly defined. Consider first the NARROWER relation, a relation between realization rules:

(22) a. $\mathrm{RR}_{n,\sigma,C}$ is NARROWER than $\mathrm{RR}_{n,\tau,C}$ iff σ is an extension of τ and $\sigma \neq \tau$.
b. Where $C \neq C'$, $\mathrm{RR}_{n,\sigma,C}$ is NARROWER than $\mathrm{RR}_{n,\tau,C'}$ iff $C \subseteq C'$.

The Bulgarian rules in (14) illustrate: clause (22a) entails that rule **D8** is narrower than rule **D9**, and clause (22b) entails that **D2** is narrower than **D1**.

Second, the APPLICABILITY relation defined in (23) is a relation between rules and FPSPs:

(23) $\mathrm{RR}_{n,\tau,C}$ is APPLICABLE to <X,σ> iff $\mathrm{RR}_{n,\tau,C}(<X,\sigma>)$ is defined (according to (12)).

For instance, where σ is the set of morphosyntactic properties in (9), rules **D5** and **D6** are both applicable to the FPSP <*kradé*,σ> (given that KRAD ∈ [−T,+C]).

With these two definitions at hand, the result of applying the 'narrowest applicable rule' (Nar) in any given instance can be notationally distinguished as in (24):

(24) Nar_n notation:
Where $\mathrm{RR}_{n,\tau,C}$ is the narrowest rule in block *n* which is applicable to <X,σ>, '$\mathrm{Nar}_n(<X,\sigma>)$' represents the result of applying $\mathrm{RR}_{n,\tau,C}$ to <X,σ>.

Where σ is as in (9), for instance, **D5** is the narrowest rule in block D which is applicable to <*kradé*,σ>; $\mathrm{Nar}_{\mathrm{D}}$(<*kradé*,σ>) is therefore the result of applying rule **D5** to <*kradé*,σ>, namely <*kradém*,σ>.

By definition, the notation 'Nar_n(<X,σ>)' presupposes the existence of exactly one rule in block *n* which is applicable to <X,σ> and is narrower than any other rule in block *n* that is applicable to <X,σ>; 'Nar_n(<X,σ>)' would therefore be undefined if there were no rule in block *n* which was applicable to <X,σ>. I assume, however, that this possibility is excluded by a universal realization rule, the Identity Function Default (IFD):

(25) Identity Function Default (preliminary formulation)[23]:
$$\mathrm{RR}_{n,\{\},\mathrm{U}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X},\sigma>.$$

In the context of a language ℓ, (25) is to be interpreted as follows: the variable *n* ranges over the indices of all rule blocks in ℓ's system of inflectional morphology; {} is the empty set of ℓ's morphosyntactic properties; and U designates the class containing every lexeme in ℓ. Thus, the least narrow rule in every rule block *n* in every language ℓ is an identity function $\mathrm{RR}_{n,\{\},\mathrm{U}}$ which may participate in defining the paradigm of every lexeme in ℓ. Accordingly, 'Nar_n(<X,σ>)' is never undefined for lack of a rule in block *n* which is applicable to <X,σ>. Where σ is as in (9), for instance, $\mathrm{Nar}_{\mathrm{C}}$(<*kradé*,σ>) is the result of applying $\mathrm{RR}_{\mathrm{C},\{\},\mathrm{U}}$ to <*kradé*,σ>, namely <*kradé*,σ> itself.

'Nar_n(<X,σ>)' would also be undefined if block *n* contained two or more applicable rules no one of which was narrower than all the others. A central claim of PFM is that this situation never arises; in chapter 3, I discuss this claim in detail.

The Nar_n notation affords the means of defining a language's paradigm function in a way which accounts for all horizontal differences and all vertical similarities among the paradigms of lexemes belonging to the same category. For instance, the (partial)[24] definition (26) of the Bulgarian paradigm function generalizes over every cell of every verbal paradigm in the language.

(26) Where σ is a complete set of morphosyntactic properties for lexemes of category V, $\mathrm{PF}(<\mathrm{X},\sigma>) =_{\mathrm{def}} \mathrm{Nar}_{\mathrm{D}}(\mathrm{Nar}_{\mathrm{C}}(\mathrm{Nar}_{\mathrm{B}}(\mathrm{Nar}_{\mathrm{A}}(<\mathrm{X},\sigma>))))$

This paradigm function correctly describes the morphology of the indicative forms given in table 2.2. Consider, for example, the following illustrative 'proofs'.

Suppose that σ is the set of morphosyntactic properties in (21a), repeated below; in that case, PF(<*krad*,σ>) is the 1pl aorist indicative active cell in the paradigm of the [−T,+C] verb KRAD 'steal'. By (26), PF(<*krad*,σ>) is evaluated as in (27a). Nar$_{A}$(<*krad*,σ>) = <*krád*,σ> is the result of applying **A1** to <*krad*,σ>; Nar$_{B}$(<*krád*,σ>) = <*krádo*,σ>, the result of applying rule **B3** to <*krád*,σ>; Nar$_{C}$(<*krádo*,σ>) = <*krádox*,σ>, the result of applying rule **C2** to <*krádo*,σ>; and Nar$_{D}$(<*krádox*,σ>) = <*krádoxme*,σ>, the result of applying **D6** to <*krádox*,σ>. Thus, PF(<*krad*,σ>) is ultimately evaluated as in (27b). The IFD plays no role in this example because each of the four rule blocks has a narrower rule which is applicable.

(21a) {VFORM:fin, VCE:act, TNS:aor, PRET:yes, MOOD:indic,
AGR:{PER:1, NUM:pl}}

(27) PF(<*krad*,σ>)
a. = Nar$_{D}$(Nar$_{C}$(Nar$_{B}$(Nar$_{A}$(<*krad*,σ>))))
b. = RR$_{[\mathbf{D6}]}$(RR$_{[\mathbf{C2}]}$(RR$_{[\mathbf{B3}]}$(RR$_{[\mathbf{A1}]}$(<*krad*,σ>))))
= <*krádoxme*,σ>

Suppose now that σ is the set of morphosyntactic properties in (9), repeated below; in that case, PF(<*krad*,σ>) is the 1pl present indicative active cell in KRAD's paradigm. By (26), PF(<*krad*,σ>) is evaluated as in (28).

(9) {VFORM:fin, VCE:act, TNS:pres, PRET:no, MOOD:indic,
AGR:{PER:1, NUM:pl}}

(28) PF(<*krad*,σ>)
a. = Nar$_{D}$(Nar$_{C}$(Nar$_{B}$(Nar$_{A}$(<*krad*,σ>))))
b. = RR$_{[\mathbf{D5}]}$(RR$_{C,\{\},U}$(RR$_{[\mathbf{B1}]}$(RR$_{[\mathbf{A2}]}$(<*krad*,σ>))))
= <*kradém*,σ>

By the IFD, Nar$_{C}$(<*kradé*,σ>) is simply the result of applying an identity function; this is because there is no other rule in block **C** that is applicable.

The schematic definition in (26) makes it possible to generalize across horizontal differences among Bulgarian verb paradigms. Thus, suppose again that σ has the value in (9). In that case, PF(<*dáva*,σ>) is evaluated as in (29); notice that whereas Nar$_{D}$(<*kradé*,σ>) is the result of applying **D5** (as in (28b)), Nar$_{D}$(<*dáva*,σ>) is instead the result of applying **D6**. Here and elsewhere, the schematic definition in (26) accommodates differences in the sorts of values which a paradigm function assigns to the root pairings to which it applies.

(29) PF(<*dáva*,σ>)
a. = Nar$_{D}$(Nar$_{C}$(Nar$_{B}$(Nar$_{A}$(<*dáva*,σ>))))
b. = RR$_{[\mathbf{D6}]}$(RR$_{C,\{\},U}$(RR$_{[\mathbf{B1}]}$(RR$_{[\mathbf{A2}]}$(<*dáva*,σ>))))
= <*dávame*,σ>

Moreover, the schematic definition in (26) makes it possible to generalize across vertical similarities among Bulgarian verb paradigms. Where σ is as in (21a) and σ′ is as in (20a) (repeated below), definition (26) entails (i) that the evaluation of PF(<*krad*,σ′>), like that of PF(<*krad*,σ>), involves rules **C2** and **D6**, and (ii) that the sequence in which these rules apply is the same in the evaluation of PF(<*krad*,σ′>) as in that of PF(<*krad*,σ>); a comparison of the proofs in (27) and (30) reveals this. Here and elsewhere, definition (26) accounts for the structural similarities that exist among members of the same paradigm.

(20a) {VFORM:fin, VCE:act, TNS:impf, PRET:yes, MOOD:indic, AGR:{PER:1, NUM:pl}}

(30) $\mathrm{PF}(<\mathit{krad},\sigma'>)$
a. $= \mathrm{Nar}_D(\mathrm{Nar}_C(\mathrm{Nar}_B(\mathrm{Nar}_A(<\mathit{krad},\sigma'>))))$
b. $= \mathrm{RR}_{[\mathbf{D6}]}(\mathrm{RR}_{[\mathbf{C2}]}(\mathrm{RR}_{[\mathbf{B2}]}(\mathrm{RR}_{[\mathbf{A2}]}(<\mathit{krad},\sigma'>))))$
$= <\mathit{krad'áxme},\sigma'>$

In section 1.2, it was observed that the morphosyntactic properties associated with an inflected word's individual inflectional markings may underdetermine the properties associated with the word as a whole. The Bulgarian form *krad'áx* was cited as an example: although this is the 1sg imperfect form of KRAD, it has no overt exponent of 1sg subject agreement. In the analysis proposed here, this asymmetry between form and content follows from the fact that none of the rules which apply in the realization of the property set (31) realizes subject agreement; the proof in (32) illustrates.

(31) {VFORM:fin, VCE:act, TNS:impf, PRET:yes, MOOD:indic, AGR:{PER:1, NUM:sg}}

(32) $\mathrm{PF}(<\mathit{krad},\sigma>)$
a. $= \mathrm{Nar}_D(\mathrm{Nar}_C(\mathrm{Nar}_B(\mathrm{Nar}_A(<\mathit{krad},\sigma>))))$
b. $= \mathrm{RR}_{D,\{\},U}(\mathrm{RR}_{[\mathbf{C2}]}(\mathrm{RR}_{[\mathbf{B2}]}(\mathrm{RR}_{[\mathbf{A2}]}(<\mathit{krad},\sigma>))))$
$= <\mathit{krad'áx},\sigma>$

The Nar_n notation employed in the partial definition (26) of the Bulgarian paradigm function also facilitates the formulation of the rule of referral stated informally in (15). In the format for realization rules proposed in (11), this rule may now be formulated as in (33).

(33) Where τ is any complete extension of {PRET:yes, AGR:{PER:2, NUM:sg}}, *n* is any of rule blocks **A** to **D**, and σ′ = σ/{AGR:{PER:3}}, $\mathrm{RR}_{n,\tau,V}(<X,\sigma>) =_{\mathrm{def}} <Y,\sigma>$, where $\mathrm{Nar}_n(<X,\sigma'>) = <Y,\sigma'>$.

The notation 'σ/ρ' on the right-hand side of the equation in (33) is to be interpreted in accordance with the recursive definition (34); for instance, if

σ = {VFORM:fin, VCE:act, TNS:impf, PRET:yes, MOOD:indic, AGR:{PER:2, NUM:sg}} and ρ = {AGR:{PER:3}}, then σ/ρ = {VFORM:fin, VCE:act, TNS:impf, PRET:yes, MOOD:indic, AGR:{PER:3, NUM:sg}}.

(34) Where σ and ρ are well-formed sets of morphosyntactic properties, σ/ρ is the smallest set such that
   a. for any atom-valued feature F:
      i. if ρ is an extension of {F:v}, then σ/ρ is an extension of {F:v}, and
      ii. if σ is an extension of {F:v} but there is no v′ such that ρ is an extension of {F:v′}, then σ/ρ is an extension of {F:v};
   b. for each set-valued feature F:
      i. if ρ is an extension of {F:v} and σ is an extension of {F:v′}, then σ/ρ is an extension of {F:v′/v},
      ii. if ρ is an extension of {F:v} and there is no v′ such that σ is an extension of {F:v′}, then σ/ρ is an extension of {F:v},
      iii. if σ is an extension of {F:v′} and there is no v such that ρ is an extension of {F:v}, then σ/ρ is an extension of {F:v′}.

The rule in (33) entails that in each of blocks **A** to **D**, 2sg preterite forms exhibit the same inflectional exponents as their 3sg counterparts. Suppose, for example, that σ is the set of morphosyntactic properties in (35). In that case, PF(<*krad*,σ>) is (in accordance with (26)) evaluated as in (36a). In accordance with (24), (36a) is in turn evaluated as in (36b), where $RR_{A,\sigma,V}$, $RR_{B,\sigma,V}$, $RR_{C,\sigma,V}$, and $RR_{D,\sigma,V}$ are all instantiations of (33). By (33), (36b) is evaluated as in (36c), since (37a) is, by (24), evaluated as in (37b), where the formulations of **D4**, **C2**, **B2**, and **A2** are as given in (14).

(35) {VFORM:fin, VCE:act, TNS:impf, PRET:yes, MOOD:indic, AGR:{PER:2, NUM:sg}}

(36) PF(<*krad*,σ>)
   a. $= Nar_D(Nar_C(Nar_B(Nar_A($<*krad*,$\sigma$>$))))$
   b. $= RR_{D,\sigma,V}(RR_{C,\sigma,V}(RR_{B,\sigma,V}(RR_{A,\sigma,V}($<*krad*,$\sigma$>$))))$
   c. = <*kraděše*,σ>

(37) a. $Nar_D(Nar_C(Nar_B(Nar_A($<*krad*,σ/{AGR:{PER:3}}>$))))$
   b. $= RR_{[D4]}(RR_{[C2]}(RR_{[B2]}(RR_{[A2]}($<*krad*,$\sigma$/{AGR:{PER:3}}>$))))$
   = <*kraděše*,σ/{AGR:{PER:3}}>

With the rule of referral in (33), the analysis of the indicative paradigms in table 2.2 is now complete; all of the forms in these paradigms, including the syncretic, 2sg preterite forms, are correctly associated with their morphosyntactic property sets by the paradigm function (26). This analysis embodies the essential assumptions of PFM. The focal object of inquiry in this analysis is not simply the individual words in table 2.2, but rather their coherent organization into paradigms. This organization is expressed by the paradigm function (26), whose definition draws together every aspect of the Bulgarian system of verb inflection: the inventory (2) of morphosyntactic properties and the set (7) of restrictions governing their cooccurrence; the system (14) of rule blocks; the set (17) of morphophonological rules regulating the evaluation of the individual realization rules, and the set (18) of morphological metageneralizations specifying the manner in which particular morphophonological rules are associated with particular realization rules. Two universal principles play a central role in the evaluation of the paradigm function (26): Pāṇini's principle (which is inherent in the Nar_n notation (24) in terms of which (26) is defined) and the IFD (25). One of the central claims of PFM is that the optimal representation of any inflectional system in any human language will exhibit this same architecture.

2.8 Summary and prospect

The purpose of the foregoing discussion has been to set forth the fundamental assumptions of PFM as precisely and as concretely as possible; this discussion has highlighted certain key characteristics which distinguish PFM from other inferential–realizational theories of inflectional morphology. First, PFM presumes a broader range of rule types than other inferential–realizational theories. In theories such as those of Anderson and Matthews, rules of exponence comparable to those in (14) are the fundamental device by which a language's inflectional system is defined; in such theories, these rules do not enter into the definition of higher-order rules, nor is their evaluation in any way dependent on lower-order rules. In PFM, by contrast, three distinct types of rules participate interdependently in the definition of a language's inflectional system: its realization rules serve as clauses in the definition of a higher-order rule (the language's paradigm function) and are in turn dependent on lower-order rules (the language's morphological metageneralizations) for their evaluation. Moreover, the class of realization rules subsumes two subtypes, namely rules of exponence and rules of referral. Thus, a key claim setting PFM apart from other inferential–realizational theories is the claim that paradigm functions, rules of referral, and morphological metageneralizations are essential to the definition of a language's inflectional morphology.

Rules of referral have no analogue in theories such as those of Anderson and Matthews, in which the problem of elucidating the phenomenon of syncretism remains unaddressed. Furthermore, these theories draw upon other sorts of devices to achieve the effects that PFM attributes to paradigm functions and morphological metageneralizations. Anderson (1992), for example, assumes that the effect of a paradigm function such as (26) can be achieved by means of a relation of fixed linear ordering among blocks of realization rules; in addition, he assumes that the effect of a set of morphological metageneralizations such as in (18) can be achieved by an interleaving of morphological rule applications and phonological rule applications.

A second key difference between PFM and other inferential–realizational theories of inflection is the central position which it accords to Pāṇini's principle: in PFM, it is hypothesized that realization rules belonging to the same block are unordered, and that every instance of competition among members of the same block is resolved by Pāṇini's principle (as embodied in the Nar_n notation (24)); this is the Pāṇinian Determinism Hypothesis (section 1.5.2). In Anderson's A-Morphous Morphology, by contrast, this hypothesis is rejected: realization rules belonging to the same block are assumed to be linearly ordered, and competition among members of the same block is in all instances resolved by a principle of disjunctive ordering (according to which the application of the first competitor precedes and excludes that of all subsequent competitors).

My concern in this chapter has been to describe the distinctive characteristics of PFM in a precise way rather than to justify these characteristics; so far, I have not presented any detailed account of the kinds of linguistic phenomena that make it desirable to incorporate paradigm functions, rules of referral, morphological metageneralizations, and the Pāṇinian Determinism Hypothesis into morphological theory. In the course of the chapters which follow, I present a range of evidence which decisively favours PFM over other existing theories of inflectional morphology.

Chapter 3 concerns the tenability of the Pāṇinian Determinism Hypothesis. The analysis of Bulgarian verb inflection proposed above is compatible with this hypothesis, but the question arises whether this is simply a contingent fact about Bulgarian. Anderson (1992) presents strong prima facie evidence (from Georgian and Algonkian) that the hypothesis is too strong – that override relations among members of a realization-rule block must, in some cases, simply be stipulated on a language-specific basis. Examining the relevant evidence in detail, I argue that the Pāṇinian Determinism Hypothesis can in fact be upheld, and that it affords a more restrictive theory of realization-rule interactions than the alternative of stipulated rule ordering.

The next two chapters develop two independent arguments for the postulation of paradigm functions. The first of these (chapter 4) relates to the matter of headedness. In the proposed analysis of Bulgarian, none of the rules is sensitive to the internal morphological composition of the forms to which it applies. Nevertheless, one commonly encounters instances in which a HEADED root (one arising through the application of a category-preserving rule of derivation or compounding) inflects through the inflection of its head; for instance, the past participle of German *ausgehen* is *ausgegangen*, in which the prefix *ge-* is situated on the head rather than on the whole. The question therefore arises: what is it that determines the incidence of head marking in inflectional morphology? One widely espoused idea is that realization rules are of two distinct types – those defined as marking a word's head and those defined as marking a word as a whole; but this idea fails to account for either of the following empirical generalizations.

(38) Paradigm Uniformity Generalization:
In a given language, those headed roots that exhibit head inflection do so categorically, throughout their paradigm of inflected forms.

(39) Coderivative Uniformity Generalization:
Where two headed roots X and Y arise by means of the same category-preserving rule (e.g. the German rule of preposition + verb compounding), either X and Y both exhibit head inflection or neither does.

In PFM, however, the phenomenon of head marking can be attributed to the HEAD-APPLICATION PRINCIPLE, a universal principle for the evaluation of a paradigm function in the definition of a headed lexeme's paradigm; because this principle correctly entails both (38) and (39), it furnishes a powerful argument for the postulation of paradigm functions in morphological theory.

Chapter 5 concerns what has traditionally been called position class morphology and is now (somewhat misleadingly) called template morphology. In the Bulgarian analysis, the organization of rules into blocks is highly regular, in at least three ways: (i) the evaluation of every paradigm function involves exactly one realization rule from each block (granting, of course, that some of these rules are simply instantiations of the IFD (25)); given any two rule blocks B_1 and B_2, (ii) the rules belonging to B_1 apply in the same sequence relative to those belonging to B_2 in the definition of every word in the fragment; and (iii) B_1 and B_2 introduce distinct sets of inflectional exponents. Inflectional systems, however, sometimes fail to exhibit one or more of these regularities, a fact which invalidates the hypothesis that rule blocks apply in a fixed linear order. A theory incorporating paradigm functions, by contrast, straightforwardly accommodates the range of observable departures from regularities (i)–(iii); moreover, departures from these regularities motivate the postulation of rules of referral which have nothing to do with syncretism in the strict sense.

In the Bulgarian analysis presented above, I assume that Bulgarian verbs generally have two stems, distinguished by the (arbitrary) indices 'First stem' and 'Second stem'. In the fragment of Bulgarian at issue, the rule by which a stem's form is deduced from that of its root also allows its index to be deduced: for instance, a stem arising from a verb's root by truncation of its final consonant is that verb's Second stem; similarly, a stem arising from a verb's root by truncation of its final vowel is its First stem. The question therefore arises of whether stem formation and stem indexing always go hand-in-hand in this way. In chapter 6, I examine a case in which they dramatically fail to do so; such instances, I argue, motivate a theory of stems in which three kinds of rules are in principle distinguished – rules of stem formation, rules of stem indexing, and rules of stem choice. Rules of the first two types don't directly realize sets of morphosyntactic properties. Thus, languages must sometimes be assumed to possess two different types of inflectional rules: realization rules (rules of exponence and rules of referral) and 'morphomic' rules (rules of stem formation and stem indexing): the former enter directly into the definition of a language's paradigm function; the latter enter only indirectly, serving to define the classes of stem forms to which the rules of stem choice apply.

I further argue that in some instances, stem choice is effected by realization rules, while in others, it is instead effected by morphological metageneralizations. That is, morphological metageneralizations are motivated not only by the need to account for the morphophonological modifications associated with particular realization rules (as in the Bulgarian analysis), but also by the need to account for the observed types of stem alternation. As I show, the theory of stem alternation which emerges from this discussion affords a clean resolution of some long-standing problems in inflectional morphology.

As noted above, the Bulgarian paradigms exhibit a syncretism of 2sg and 3sg forms in the preterite tenses. In chapter 7, I examine the phenomenon of syncretism more closely. I argue that syncretism is not a unitary phenomenon: some syncretisms are stipulated, while others are not; of those that are, some are directional, while others are not. Accordingly, I argue that syncretisms arise synchronically in at least three different ways. The proposed theory of syncretism has a rich array of desirable consequences: it affords an insightful conception of rule interactions involving syncretized forms; it accounts for the fact that a word may exhibit syncretism in part but not all of its morphology; it is fully compatible with the incidence of bidirectional syncretism – directional syncretism in which two complementary classes of forms exhibit the opposite directionality; it accommodates the incidence of syncretism across paradigms; and it is compatible with the existence of substantive restrictions on patterns of syncretism.

In chapter 8, I summarize the evidence motivating the introduction of paradigm functions into morphological theory and I review the principal theoretical claims of PFM. I also discuss some wider implications of the proposed theory: in particular, I present a paradigm-based conception of inflectional semantics which resolves a large class of supposed 'bracketing paradoxes', and I examine the analogy of derivational 'paradigms' to inflectional paradigms. Finally, I explore the similarities and differences between PFM and Network Morphology, with particular attention to some alternative formulations which the latter theory suggests for the former.

3 *Rule competition*

3.1 Two approaches to resolving rule competition

According to Pāṇini's principle, competition among realization rules belonging to the same block is resolved in favour of the narrowest applicable rule. A central assumption in PFM is the Pāṇinian Determinism Hypothesis (=(23), section 1.5.2), according to which Pāṇini's principle is the SOLE determinant of override relations among competing members of the same block. The analysis of Bulgarian verb morphology developed in chapter 2 reflects this assumption; for instance, the fact that **D8** overrides **D9** in the realization of the property set in (1) is treated as a simple consequence of the fact that **D8** is the narrower rule (cf. (14), section 2.5).

(1) {VFORM:fin, VCE:act, TNS:pres, PRET:no, MOOD:indic, AGR:{PER:3, NUM:pl}}

An alternative approach to the resolution of rule competition is also conceivable, however. This is to assume that the rules constituting a given block form a linearly ordered list such that in any given case, the first applicable rule in the list overrides all subsequent rules. On this approach, the fact that **D8** overrides **D9** in the realization of the property set in (1) would be accounted for by ordering **D8** before **D9** in the list of rules constituting Block D.

According to the Pāṇinian Determinism Hypothesis, all override relations within a realization-rule block are determined by a universal principle; the possibility is excluded that such relations might ever be stipulated on a language-specific basis. The rule-ordering approach, by contrast, does not exclude this possibility. If it can be maintained, the Pāṇinian approach must be preferred as the more restrictive of the two approaches. It has sometimes been argued, however, that the Pāṇinian approach cannot be maintained: this approach presupposes that in the inflection of a lexeme for a set σ of morphosyntactic properties, it is always possible to identify exactly one rule in each of the relevant rule blocks that is the narrowest applicable rule in that block; if one could find instances in which no one member of a rule block could be identified as the narrowest applicable rule, then the Pāṇinian approach to rule competition would have to be abandoned in favour of the rule-ordering approach.

Anderson (1992:128ff.) argues that instances of this sort do arise, and therefore concludes that it is necessary to adopt the rule-ordering approach. In this chapter, I examine some well-known evidence for this claim from Potawatomi and Georgian (sections 3.2 and 3.3). I argue (i) that this evidence can be reconciled with the Pāṇinian approach by assuming that realization rules may apply in two different modes – 'unexpanded' and 'expanded' (section 3.4) – and (ii) that a theory of realization-rule competition based on this bimodal assumption is substantially more restrictive than one based on the assumption of rule ordering (section 3.5). Moreover, I demonstrate that certain heretofore unnoticed generalizations about verb inflection in Potawatomi and Georgian motivate the postulation of metarules licensing the inference of whole classes of realization rules applying in expanded mode (sections 3.6 and 3.7). In the appendix to this chapter, I present a complete analysis of Potawatomi verb morphology based on the theoretical assumptions motivated here.

3.2 Evidence from Potawatomi

One well-known instance of alleged stipulated ordering comes from Potawatomi, whose verbs, like those of other Algonkian languages, exhibit an elaborate system of subject and object agreement involving contrasts in animacy and obviation as well as person and number. Potawatomi verbal lexemes fall into four main classes (Hockett 1948:7): members of the transitive animate ([+TA]) class inflect for agreement with both an animate subject and an animate object; members of the transitive inanimate ([+TI]) class inflect for agreement with an animate subject and an inanimate object; members of the animate intransitive ([+AI]) class inflect for agreement with an animate subject only; and members of the inanimate intransitive ([+II]) class inflect for agreement with an inanimate subject only.

At the heart of this system of agreement is a hierarchy of person and animacy which might be informally characterized as in (2).

(2)	1st person, 2nd person	>	3rd person animate	>	obviative animate, inanimate

The principal way in which rules of Potawatomi verb inflection reflect this hierarchy is through their sensitivity to what Hockett (1948:141) calls a verb's MAJOR REFERENCE. Given any verb having two arguments of distinct rank in hierarchy (2), the verb's major reference is the argument of higher rank; for instance, a verb having a third-person subject and a first-person object has its object as its major reference, while a verb having only a single argument or having two arguments of equal rank has no major reference. Thus, the inflected forms of verbs belonging to the two transitive classes can be sorted into three groups: direct forms, whose major reference is the subject argument; inverse forms, whose major reference is the object argument; and 'you-and-me' forms, which lack a major reference. In the indicative mood, for example, the transitive animate verb WAPUM 'see' has the direct forms in table 3.1,[1] the inverse forms in table 3.2, and the 'you-and-me' forms in table 3.3; the transitive inanimate verb WAPUT 'see' has the indicative paradigm in table 3.5, all of whose forms are necessarily direct. An intransitive verb's forms (e.g. the forms of the animate intransitive verb KAS·UKUMI 'start running' in table 3.4) never have a major reference. (In these tables, the words' affixes are arranged into columns such that members of the same column are introduced by realization rules belonging to the same block; thus, prefixes are introduced by a single rule block labelled 'Pr', and suffixes are introduced by a range of rule blocks, labelled with the Roman numerals I to VI.)

I shall assume that distinctions of major reference are encoded by means of a major-reference feature MR – that direct forms are specified MR:su, inverse forms are specified MR:ob, and forms lacking a major reference (including intransitive verb forms and a transitive verb's 'you-and-me' forms) are specified MR:no. Thus, notice that in tables 3.1, 3.2, 3.3, and 3.5, direct forms exhibit the slot I suffix -*a*, inverse forms instead show the suffix -*UkO*, and 'you-and-me' forms have no suffix in slot I; the intransitive forms in table 3.4 likewise lack any slot I affix. Given the major-reference feature MR, the rules responsible for introducing -*a* and -*UkO* can therefore be formulated as in (3).

(3) a. $RR_{\mathrm{I},\{\mathrm{MOOD:indic,\ MR:su}\},\mathrm{V}}(<X,\sigma>) =_{\mathrm{def}} <Xa',\sigma>$
b. $RR_{\mathrm{I},\{\mathrm{MOOD:indic,\ MR:ob}\},\mathrm{V}}(<X,\sigma>) =_{\mathrm{def}} <XUkO',\sigma>$

Two rules of Potawatomi verb inflection which have been claimed to require stipulated rule ordering are the rules of *k*-prefixation and *n*-prefixation. In Potawatomi, the prefix *k*- serves to mark an indicative verb whose subject or object refers to the addressee; the prefix *n*-, by contrast, serves to mark an indicative verb whose subject or object refers to the speaker. These rules might be schematically formulated as in (4) (where the

Table 3.1 *Direct paradigm of positive nonpreterite indicative forms of the transitive animate verb* WAPUM *'see'*

OBJECT:	3SG				OBV					3PL				
SUBJECT	Pr	Stem	I	IV	Pr	Stem	I	IV	VI	Pr	Stem	I	IV	VI
1SG	*n-*	*wapUm*	*-a*		*n-*	*wapUm*	*-a*		*-Un*	*n-*	*wapUm*	*-a*		*-Uk*
2SG	*k-*	*wapUm*	*-a*		*k-*	*wapUm*	*-a*		*-Un*	*k-*	*wapUm*	*-a*		*-Uk*
3SG					*w-*	*wapUm*	*-a*		*-Un*					
1PL														
INCL:	*k-*	*wapUm*	*-a*	*-mUn*	*k-*	*wapUm*	*-a*	*-mUn*		*k-*	*wapUm*	*-a*	*-mUn*	
EXCL:	*n-*	*wapUm*	*-a*	*-mUn*	*n-*	*wapUm*	*-a*	*-mUn*		*n-*	*wapUm*	*-a*	*-mUn*	
2PL	*k-*	*wapUm*	*-a*	*-wa*	*k-*	*wapUm*	*-a*	*-wa*	*-Un*	*k-*	*wapUm*	*-a*	*-wa*	*-Uk*
3PL					*w-*	*wapUm*	*-a*	*-wa*	*-Un*					

Table 3.2 *Inverse paradigm of positive nonpreterite indicative forms of the transitive animate verb* WAPUM *'see'*

SUBJECT:	3SG				OBV					3PL				
OBJECT	Pr	Stem	I	IV	Pr	Stem	I	IV	VI	Pr	Stem	I	IV	VI
1SG	*n-*	*wapUm*	*-UkO*							*n-*	*wapUm*	*-UkO*		*-Uk*
2SG	*k-*	*wapUm*	*-UkO*							*k-*	*wapUm*	*-UkO*		*-Uk*
3SG					*w-*	*wapUm*	*-UkO*		*-Un*					
1PL														
INCL:	*k-*	*wapUm*	*-UkO*	*-nan*						*k-*	*wapUm*	*-UkO*	*-nan*	*-Uk*
EXCL:	*n-*	*wapUm*	*-UkO*	*-nan*						*n-*	*wapUm*	*-UkO*	*-nan*	*-Uk*
2PL	*k-*	*wapUm*	*-UkO*	*-wa*						*k-*	*wapUm*	*-UkO*	*-wa*	*-Uk*
3PL					*w-*	*wapUm*	*-UkO*	*-wa*	*-Un*					

Table 3.3 *'You-and-me' paradigm of positive nonpreterite indicative forms of the transitive animate verb* WAPUM *'see'*

SUBJECT	OBJECT	Pr	Stem	III	IV
1SG	2SG	*k-*	*wapUm*	*-Un*	
	2PL	*k-*	*wapUm*	*-Un*	*-Um*
1PL(EXCL)	2SG	*k-*	*wapUm*	*-Un*	*-mUn*
	2PL	*k-*	*wapUm*	*-Un*	*-mUn*
2SG	1SG	*k-*	*wapUm*		
	1PL(EXCL)	*k-*	*wapUm*	*-Uy*	*-mUn*
2PL	1SG	*k-*	*wapUm*		*-Um*
	1PL(EXCL)	*k-*	*wapUm*	*-Uy*	*-mUn*

Table 3.4. *Nonpreterite indicative forms of the animate intransitive verb* KAS·UKUMI *'start running'*

	Pr	Stem	IV	VI
1SG	*n-*	*kask·umi*		
2SG	*k-*	*kask·umi*		
3SG		*kask·umi*		
OBV		*kask·umi*		*-Un*
1PL INCL: EXCL:	 *k-* *n-*	 *kask·umi* *kask·umi*	 *-mUn* *-mUn*	
2PL	*k-*	*kask·umi*	*-Um*	
3PL		*kask·umi*		*-Uk*

feature INCL is assumed to be positively specified in the second person, in the 1pl inclusive, and nowhere else):

(4) Where α = su or ob,

a. $\mathrm{RR}_{\mathrm{pref},\{\mathrm{MOOD:indic,\ AGR}(\alpha)\mathrm{:\{INCL:yes\}}\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <k\mathrm{X}',\sigma>$

b. $\mathrm{RR}_{\mathrm{pref},\{\mathrm{MOOD:indic,\ AGR}(\alpha)\mathrm{:\{PER:1\}}\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <n\mathrm{X}',\sigma>$

Since the rules introducing *k-* and *n-* belong to the same, prefixal rule block, they enter into competition in the inflection of an indicative verb whose subject and object arguments refer both to the addressee and to the speaker;

Table 3.5 *Nonpreterite indicative forms of the transitive inanimate verb* WAPUT *'see'*

	SINGULAR OBJECT				PLURAL OBJECT				
SUBJECT	Pr	Stem	I	IV	Pr	Stem	I	IV	VI
1SG	*n-*	*wapUt*	*-a*	*-Un*	*n-*	*wapUt*	*-a*	*-Un*	*-Un*
2SG	*k-*	*wapUt*	*-a*	*-Un*	*k-*	*wapUt*	*-a*	*-Un*	*-Un*
3SG	*w-*	*wapUt*	*-a*	*-Un*	*w-*	*wapUt*	*-a*	*-Un*	*-Un*
1PL INCL:	*k-*	*wapUt*	*-a*	*-mUn*	*k-*	*wapUt*	*-a*	*-mUn*	
EXCL:	*n-*	*wapUt*	*-a*	*-mUn*	*n-*	*wapUt*	*-a*	*-mUn*	
2PL	*k-*	*wapUt*	*-a*	*-na-wa*	*k-*	*wapUt*	*-a*	*-na-wa*	*-Un*
3PL	*w-*	*wapUt*	*-a*	*-na-wa*	*w-*	*wapUt*	*-a*	*-na-wa*	*-Un*

in such instances, the rule of *k*-prefixation prevails. Thus, competition between *k*- and *n*- is resolved in favour of *k*-, not only in all forms in the 'you-and-me' paradigm in table 3.3, but also in any verb whose subject or object is 1pl inclusive (tables 3.1, 3.2, 3.4, and 3.5). The Pāṇinian approach to the resolution of rule competition affords no obvious account of the fact that the rule of *k*-prefixation overrides the rule of *n*-prefixation, since – as they are formulated in (4) – neither of these rules is narrower than the other. Thus, to account for the fact that *k*- overrides *n*- in forms involving reference to both the addressee and the speaker, Anderson (1992:165f.) simply stipulates that in the block of prefixation rules, the *k*- rule is ordered before the *n*- rule.

The prefixation rules are not the only rules of Potawatomi verb inflection that Anderson uses to motivate the rule-ordering approach to resolving rule competition. Thus, consider the rules of -*mUn* suffixation and -*Um* suffixation, which might be schematically formulated as in (5).

(5) Where α = su or ob,

a. $\mathrm{RR}_{\mathrm{IV},\{\mathrm{MOOD:indic,\ AGR}(\alpha)\mathrm{:}\{\mathrm{PER:1,\ NUM:pl}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{mUn}',\sigma\rangle$

b. $\mathrm{RR}_{\mathrm{IV},\{\mathrm{MOOD:indic,\ MR:no,\ AGR}(\alpha)\mathrm{:}\{\mathrm{PER:2,\ NUM:pl}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{Um}',\sigma\rangle$

Rule (5a) causes the slot IV suffix -*mUn* to be affixed to an indicative verb having a 1pl argument (whether this be its subject or its object); this rule accounts for -*mUn*'s appearance in the indicative mood in the direct and 'you-and-me' paradigms of transitive animate verbs (tables 3.1 and 3.3) and in the paradigms of animate intransitive and transitive inanimate verbs (tables 3.4 and 3.5). Rule (5b) causes the slot IV suffix *-Um* to be affixed to an indicative verb having a 2pl argument (subject or object), but lacking any major reference. This rule accounts for *-Um*'s appearance in the indicative mood in the 'you-and-me' paradigms of transitive animate verbs (table 3.3) and in the paradigms of animate intransitive verbs (table 3.4).

Rules (5a) and (5b) are in competition, since besides belonging to the same rule block, they are both applicable in the inflection of stems associated with (extensions of) either of the property sets in (6).

(6) a. {MOOD:indic, MR:no, AGR(su):{PER:2, NUM:pl}, AGR(ob):{PER:1, NUM:pl}}
b. {MOOD:indic, MR:no, AGR(su):{PER:1, NUM:pl}, AGR(ob):{PER:2, NUM:pl}}

The forms from table 3.3 which are associated with these two property sets are given in (7):

(7) a. *k-wapUm-Uy-mUn* 'you (pl) see us'
b. *k-wapUm-Un-mUn* 'we see you (pl)'

As these forms reveal, the *-mUn* rule (5a) overrides the *-Um* rule (5b) in the realization of the property sets in (6). The Pāṇinian approach affords no obvious account of this fact, since neither of the rules in (5) is narrower than the other. Thus, Anderson (1992:156ff.) concludes that the override of *-Um* suffixation by *-mUn* suffixation must be attributed to a linear ordering of the *-mUn* rule before the *-Um* rule.

3.3 Evidence from Georgian

A third well-known instance of alleged stipulated rule ordering comes from Georgian verb agreement. In Georgian, the expression of agreement in an inflected verb's morphology depends on the conjugation to which it belongs and on the particular combination of temporal, modal, and aspectual properties – the particular 'screeve' – which it realizes. At issue here is the default pattern of affixal agreement in table 3.6, which is exhibited by verbs in any but the fourth conjugation in screeves other than those of the so-called perfect series; the first-conjugation verb MO-ḲLAV 'kill', for example, has the future-tense paradigm in table 3.7.

I assume that most of the prefixes in table 3.6 are introduced by a single block of realization rules, and that these rules have the formulations in (8).[2]

Table 3.6 *Default subject and object agreement affixes in Georgian*

	SUBJECT AGREEMENT	DIRECT OBJECT AGREEMENT	INDIRECT OBJECT AGREEMENT
1SG	*v-*	*m-*	*m-*
2SG	none	*g-*	*g-*
3SG	*-s* or none[a]	none	*s-* ~ *h-* ~ none[b]
1PL	*v-*…$-t_1$	*gv-*	*gv-*
2PL	$-t_1$	*g-*…$(-t_2)$[c]	*g-*…$(-t_2)$[c]
3PL	*-en* or *-es*[d]	none	*s-* ~ *h-* ~ none[b]

Note:
[a] *-s* appears in the present and future tenses of first- and third-conjugation verbs and of some second-conjugation verbs; and in the conjunctive and optative moods.
[b] The alternation *s-* ~ *h-* ~ none is phonologically conditioned; see Aronson (1990:173f.), Hewitt (1996:74).
[c] $-t_2$ appears only in the presence of singular subject agreement.
[d] *-es* appears in the aorist of first- and third-conjugation verbs; *-en* (or one of its morphophonological variants) appears elsewhere.

(8)
a. $\mathrm{RR}_{\mathrm{pref},\{\mathrm{AGR(su)}:\{\mathrm{PER}:1\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle vX',\sigma\rangle$
b. $\mathrm{RR}_{\mathrm{pref},\{\mathrm{AGR(ob)}:\{\mathrm{PER}:1\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle mX',\sigma\rangle$
c. $\mathrm{RR}_{\mathrm{pref},\{\mathrm{AGR(ob)}:\{\mathrm{PER}:1,\ \mathrm{NUM}:\mathrm{pl}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle gvX',\sigma\rangle$
d. $\mathrm{RR}_{\mathrm{pref},\{\mathrm{AGR(ob)}:\{\mathrm{PER}:2\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle gX',\sigma\rangle$

In this block of rules, competition arises between the rule (8a) of *v*-prefixation realizing first-person subject agreement and the rule (8d) of *g*-prefixation realizing second-person object agreement. Rule (8d) is the overriding rule; thus, the forms in (9) meaning 'I/we will kill you' exhibit the *g*-prefix and not the *v*- prefix.

(9)

	Preverb	Prefix	Stem	Suffix	
a.	*mo-*	*g-*	*ḳlav*		'I will kill you (sg)'
b.	*mo-*	*g-*	*ḳlav*	*-t*	'I will kill you (pl)'
c.	*mo-*	*g-*	*ḳlav*	*-t*	'we will kill you (sg)'
d.	*mo-*	*g-*	*ḳlav*	*-t*	'we will kill you (pl)'

Here again, the facts seem inexplicable under the Pāṇinian approach: (8d) overrides (8a), yet neither rule is narrower than the other. Thus, to account for the observed override relation, Anderson (1992:128ff.) concludes that (8d) is simply ordered before (8a).

Table 3.7 *Future-tense paradigm of Georgian* MO-ḲLAV *'kill' (Aronson 1990: 171)*

Subject: / Object	1SG	1PL	2SG	2PL	3SG	3PL
1SG			*mo-m-ḳlav*	*mo-m-ḳlav-t*	*mo-m-ḳlav-s*	*mo-m-ḳlav-en*
2SG	*mo-g-ḳlav*	*mo-g-ḳlav-t*			*mo-g-ḳlav-s*	*mo-g-ḳlav-en*
3SG	*mo-v-ḳlav*	*mo-v-ḳlav-t*	*mo-ḳlav*	*mo-ḳlav-t*	*mo-ḳlav-s*	*mo-ḳlav-en*
1PL			*mo-gv-ḳlav*	*mo-gv-ḳlav-t*	*mo-gv-ḳlav-s*	*mo-gv-ḳlav-en*
2PL	*mo-g-ḳlav-t*	*mo-g-ḳlav-t*			*mo-g-ḳlav-t*	*mo-g-ḳlav-en*
3PL	*mo-v-ḳlav*	*mo-v-ḳlav-t*	*mo-ḳlav*	*mo-ḳlav-t*	*mo-ḳlav-s*	*mo-ḳlav-en*

3.4 Two modes of application for realization rules

The facts presented above are prima facie counterevidence to the Pāṇinian Determinism Hypothesis. Nevertheless, the Pāṇinian approach to resolving realization-rule competition remains fully viable if one assumes that realization rules apply in two different modes.

I have assumed so far that a realization rule is defined as realizing a particular property set; rule (8d), for instance, is defined as realizing the property set {AGR(ob):{PER:2}}. I now assume, however, that a realization rule may be defined as applying in either of two MODES: a rule defined as applying in UNEXPANDED mode realizes a particular property set; by contrast, a rule defined as applying in EXPANDED mode realizes EVERY WELL-FORMED EXTENSION of a particular property set. The format in (10) (=(11), section 2.5) will continue to be used for the definition of rules applying in unexpanded mode. The distinct format in (11), however, will be used for the definition of rules applying in expanded mode.

(10) Format for realization rules applying in unexpanded mode:
$RR_{n,\tau,C}(<X,\sigma>) =_{def} <Y',\sigma>$

(11) Format for realization rules applying in expanded mode:
$RR_{n,\leftarrow\tau\rightarrow,C}(<X,\sigma>) =_{def} <Y',\sigma>$

A realization rule R applying in expanded mode is a rule schema instantiated by each member of a class S_R of rules applying in unexpanded mode: where R has the definition '$RR_{n,\leftarrow\tau\rightarrow,C}(<X,\sigma>) =_{def} <Y',\sigma>$', S_R is the smallest class containing every rule R′ such that for some well-formed extension τ′ of τ, R′ has the definition '$RR_{n,\tau',C}(<X,\sigma>) =_{def} <Y',\sigma>$'. Henceforth, I refer to realization rules applying in expanded mode as EXPANSION SCHEMATA; contrastingly, rules applying in unexpanded mode are called UNEXPANDED RULES.

Once expansion schemata are countenanced, the evidence from Potawatomi and Georgian is easily reconciled with the Pāṇinian Determinism Hypothesis. Thus, consider again the competition between *k*-prefixation and *n*-prefixation in Potawatomi. If the rule of *k*-prefixation is formulated as the expansion schema in (12), then Pāṇini's principle correctly predicts that *k*-prefixation should override the unexpanded rule of *n*-prefixation: as an expansion schema, (12) is instantiated by rules such as those in (13), which, being narrower than rule (4b), override it.

(12) Where α = su or ob, $RR_{\text{pref},\leftarrow\{\text{MOOD:indic, AGR}(\alpha)\text{:\{INCL:yes\}}\}\rightarrow,V}(<X,\sigma>)$
$=_{def} <kX',\sigma>$

(13) a. $RR_{\text{pref},\{\text{MOOD:indic, AGR(su):\{INCL:yes\}, AGR(ob):\{PER:1\}}\},V}(<X,\sigma>) =_{def} <kX',\sigma>$

b. $RR_{\text{pref},\{\text{MOOD:indic, AGR(su):\{PER:1\}, AGR(ob):\{INCL:yes\}}\},V}(<X,\sigma>) =_{def} <kX',\sigma>$

c. Where $\alpha =$ su or ob, $RR_{\text{pref},\{\text{MOOD:indic, AGR}(\alpha)\text{:\{PER:1, INCL:yes\}}\},V}(<X,\sigma>) =_{def} <kX',\sigma>$

In the same way, if the Potawatomi rule of *-mUn* suffixation is defined as the expansion schema (14), Pāṇini's principle correctly predicts that it should override the unexpanded rule (5b) of *-Um* suffixation.

(14) Where $\alpha =$ su or ob, $RR_{IV,\leftarrow\{\text{MOOD:indic, AGR}(\alpha)\text{:\{PER:1, NUM:pl\}}\}\rightarrow,V}(<X,\sigma>) =_{def} <XmUn',\sigma>$

And if the Georgian rule of *g*-prefixation is formulated as the expansion schema (15), it should override the unexpanded rule (8a) of *v*-prefixation.

(15) $RR_{\text{pref},\leftarrow\{\text{AGR(ob):\{PER:2\}}\}\rightarrow,V}(<X,\sigma>) =_{def} <gX',\sigma>$

Thus, the evidence from Potawatomi and Georgian does not exclude the Pāṇinian Determinism Hypothesis.

3.5 The Pāṇinian approach is more restrictive than the rule-ordering approach

The device of allowing a rule to apply in expanded mode might, on first consideration, seem like a rather powerful one. It might seem that this device would allow any imaginable analysis based on rule ordering to be translated into an analysis compatible with the Pāṇinian Determinism Hypothesis: where rule R_1 is ordered before rule R_2 in a rule-ordering analysis, one simply assumes a Pāṇinian analysis in which R_1 applies in expanded mode. But rule ordering and expansion schemata are not actually equivalent.

As was shown in section 1.5.2, the Pāṇinian Determinism Hypothesis entails the following well-formedness condition:

(16) Pāṇinian well-formedness condition on realization-rule blocks (cf. (24), section 1.5.2):
If Q and R are realization rules belonging to the same block b, then for any expression X and any complete set σ of morphosyntactic properties appropriate to X,
either a. Q and R are not both applicable to $<X,\sigma>$;
or b. Q and R are both applicable to $<X,\sigma>$ and
either i. one is narrower than the other,
or ii. there is a third rule in block b which is applicable to $<X,\sigma>$ and is narrower than both Q and R.

This condition greatly restricts the range of analyses available (to linguists and to language learners) for complex inflectional systems: in languages whose realization rules realize single properties, (16) has the effect of requiring these rules to be organized into featurally coherent blocks; in languages whose realization rules realize larger sets of morphosyntactic properties, (16) requires members of the same block to participate in relations of comparative narrowness to the extent that they lack featural coherence. In all languages, (16) excludes the existence of any rule block containing two or more rules which are applicable to some FPSP $<X,\sigma>$ but no one of which is narrower than all the others. Because the rule-ordering approach to resolving rule competition does not impose any comparable restriction on the constitution of rule blocks, it is less restrictive than the Pāṇinian approach. To appreciate this point, consider a hypothetical example.

Suppose that ρ, σ, and τ are morphosyntactic property sets such that (i) none is an extension of either of the others, and (ii) the unification of {ρ, σ, τ} is itself a well-formed property set. Suppose, secondly, that these property sets figure in the definition of the three rules in (17), which together constitute the full membership of rule block *n*.

(17) a. $RR_{n,\rho,C}(<X,\sigma'>) =_{def} <W,\sigma'>$
b. $RR_{n,\sigma,C}(<X,\sigma'>) =_{def} <Y,\sigma'>$
c. $RR_{n,\tau,C}(<X,\sigma'>) =_{def} <Z,\sigma'>$

Finally, suppose that in cases in which they compete, the rules in (17) exhibit the override relations in (18).

(18) (17a) overrides (17b) and (17c); (17b) overrides (17c).

The override relations in (18) are easily expressible under the rule-ordering approach: one need only assume an analysis in which it is stipulated that the three rules apply in the order (17a) : (17b) : (17c). By contrast, the device of allowing a rule to apply in expanded mode does not allow the override relations in (18) to be directly expressed. If one assumes that (17a) overrides (17b) because (17a) is an expansion schema realizing extensions of ρ, then one CANNOT assume that (17b) overrides (17c) because (17b) is an expansion schema realizing extensions of σ, since this assumption would lead to overt contradiction for any extension of σ which was also an extension of ρ. Thus, the device of allowing a rule to apply in expanded mode is more restrictive than the device of rule ordering, since it is subject to the following logical requirement: where ρ, σ are distinct property sets such that the unification of {ρ,σ} is well-formed, the existence of an expansion schema $RR_{n,\leftarrow\rho\rightarrow,C}$ realizing extensions of ρ excludes the existence of a distinct expansion schema $\mathrm{RR}_{n,\leftarrow\sigma\rightarrow,\mathrm{C}}$ realizing extensions of σ. A difference therefore emerges between the empirical predictions of the rule-ordering approach and those of the Pāṇinian approach: the latter predicts that the hypothetical situation depicted in (17) and (18) should never arise, while the former does not exclude that possibility.

Interestingly, Anderson's (1992:165f.) analysis of Potawatomi prefixation takes exactly the form of (17) and (18): in addition to assuming that the rule of *k*-prefixation is ordered before the rule of *n*-prefixation, he assumes that *n*-prefixation is in turn ordered before the rule of *w*-prefixation, which he formulates as prefixing *w*- to verbs carrying properties of both object agreement and subject agreement; since it is ordered after the rules of *k*-prefixation and *n*-prefixation (cf. again (4)), *w*- prefixation applies only by default, in cases in which neither the subject nor the object refers to the speaker or to the addressee.

The *w*-prefixation facts need not, however, be taken as disconfirming the Pāṇinian approach, since there is an alternative analysis of those facts which is compatible with this approach. In particular, the rule of *w*-prefixation might be formulated as in (19).

(19) Where $\alpha = \mathrm{su}$ or ob, $\mathrm{RR}_{\mathrm{pref},\{\mathrm{MOOD:indic},\ \mathrm{MR}:\alpha,\ \mathrm{AGR}(\alpha):\{\mathrm{ANIM:yes},\ \mathrm{PER:3}\}\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <w\mathrm{X}',\sigma>$

As formulated, rule (19) competes neither with rule (4b) nor with (any instantiation of) the expansion schema (12); that is, the three rules do not, on this analysis, instantiate the hypothetical situation schematized in (17) and (18), and therefore do not disconfirm the predictions of the Pāṇinian approach.

There is, of course, no practicable way of proving that instances genuinely instantiating situation (17)/(18) never arise. I do, however, leave it as an open challenge to proponents of the rule-ordering approach to find instances of this sort; if no such instances can be cited, then in view of its higher restrictiveness, the Pāṇinian approach (incorporating the notion that some rules apply in expanded mode) must be favoured over the rule-ordering approach on metatheoretical grounds.[3]

3.6 Generalizing over expansion schemata

As they are formulated, rules (5b) and (14) accurately account for the fact that -*mUn* suffixation overrides -*Um* suffixation in Potawatomi verb inflection; but once additional evidence from Potawatomi is examined, it is clear that the override of *-Um* by *-mUn* must be seen as but one instance of a broader phenomenon.

3.6.1 *A second look at Potawatomi verb agreement*

The forms cited in tables 3.1 – 3.5 are all indicative, and indicative forms have tended to be the focus of recent theoretical discussions of Potawatomi verb morphology (cf. Anderson 1992, Halle and Marantz 1993, Steele 1995). But Potawatomi also has a conjunct mood: according to Hockett (1948:9), it 'expresses a wish . . . [and] is also used in certain types of dependent clauses; but most often it appears subordinated to a preverb /ʔe/, as the most customary formation in story telling and other hearsay narration'. Some sample paradigms of (nonpreterite) conjunct forms are given in the following tables: tables 3.8 – 3.10 show the direct, inverse, and 'you-and-me' paradigms of a transitive animate verb;[4] table 3.11 shows the paradigm of an animate intransitive verb; and table 3.12 shows the paradigm of a transitive inanimate verb. As a comparison of tables 3.11 and 3.12 reveals, the conjunct forms of a transitive inanimate verb are inflectionally parallel to those of an animate intransitive verb; I assume that this parallelism is an effect of the metarule in (20), which licenses the inference of a rule of the form '$\mathrm{RR}_{n,(\sigma \cup \{\mathrm{MR:su,\ AGR(ob):\{ANIM:no\}}\}),\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{Y}',\sigma>$' from the existence of a rule of the form '$\mathrm{RR}_{n,(\sigma \cup \{\mathrm{MR:no}\}),\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{Y}',\sigma>$'.

(20) Metarule: If $\sigma = \{\mathrm{MOOD:conj,\ AGR(su)}:\tau\}$ and *n* is any rule block, then

$$\mathrm{RR}_{n,(\sigma \cup \{\mathrm{MR:no}\}),\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{Y}',\sigma>$$
$$\downarrow$$
$$\mathrm{RR}_{n,(\sigma \cup \{\mathrm{MR:su,\ AGR(ob):\{ANIM:no\}}\}),\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{Y}',\sigma>.$$

Among the rules involved in the conjunct inflection are those in (21).

(21) a. Where α = su or ob,

$$\mathrm{RR}_{\mathrm{IV},\{\mathrm{MOOD:conj,\ MR:no,\ AGR(\alpha):\{PER:1,\ NUM:pl,\ INCL:no\}}\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}ak',\sigma>$$

b. $\mathrm{RR}_{\mathrm{IV},\{\mathrm{MOOD:conj,\ MR:no,\ AGR(su):\{PER:2,\ NUM:sg\}}\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}Un',\sigma>$

c. $\mathrm{RR}_{\mathrm{IV},\{\mathrm{MOOD:conj,\ MR:no,\ AGR(su):\{PER:2,\ NUM:pl\}}\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}ek',\sigma>$

Rule (21a), which schematically represents the two rules in (22), causes *-ak* to be suffixed to a conjunct verb having a 1pl exclusive argument but lacking any major reference; this rule accounts for *-ak*'s appearance in the conjunct mood in the 'you-and-me' paradigms of transitive animate verbs (table 3.10), in the paradigms of animate intransitive verbs (table 3.11), and, because of metarule (20), in the paradigms of transitive inanimate verbs (table 3.12).

Table 3.8 *Direct paradigm of nonpreterite conjunct forms of the transitive animate verb* MIN *'give to'*

OBJECT:	3SG				OBV				3PL		
SUBJECT	Stem	II	III	IV	Stem	III	IV	VI	Stem	III	IV
1SG	*min*		*-Uk*						*min*	*-Uk*	*-wa*
2SG	*min*		*-Ut*						*min*	*-Ut*	*-wa*
3SG					*min*	*-a*		*-Ot*			
1PL											
INCL:	*min*		*-at*						*min*	*-at*	
EXCL:	*min*		*-Uk*	*-o*					*min*	*-Uk*	*-o*
2PL	*min*	*-e*	*-Uk*						*min*	*-Uk*	*-wa*
3PL					*min*	*-a*	*-wa*	*-Ot*			

Table 3.9 *Inverse paradigm of nonpreterite conjunct forms of the transitive animate verb* MIN *'give to'*

SUBJECT:	3SG				OBV				3PL			
OBJECT	Stem	III	IV	VI	Stem	III	IV	VI	Stem	III	IV	VI
1SG	*miš*			*-Ut*					*miš*		*-wa*	*-Ut*
2SG	*min*		*-Uk*						*min*	*-Uk·*	*-wa*	
3SG					*min*	*-Uk*		*-Ot*				
1PL												
INCL:	*min*	*-Un*	*-Uk*						*min*	*-Un*	*-Uk*	
EXCL:	*miš*	*-Uy*	*-Um*	*-Ut*					*miš*	*-Uy*	*-Um*	*-Ut*
2PL	*min*	*-Un*	*-ak*						*min*	*-Un*	*-ak*	
3PL					*min*	*-Uk*	*-wa*	*-Ot*				

Table 3.10 *'You-and-me' paradigm of nonpreterite conjunct forms of the transitive animate verb* MIN *'give to'*

SUBJECT	OBJECT	Stem	III	IV
1SG	2SG	*min*	*-Un*	*-an*
	2PL	*min*	*-Un*	*-UnUko*
1PL(EXCL)	2SG	*min*	*-Un*	*-ak*
	2PL	*min*	*-Un*	*-ak*
2SG	1SG	*miš*	*-Uy*	*-Un*
	1PL(EXCL)	*miš*	*-Uy*	*-ak*
2PL	1SG	*miš*	*-Uy*	*-ek*
	1PL(EXCL)	*miš*	*-Uy*	*-ak*

Table 3.11 *Nonpreterite conjunct forms of the animate intransitive verb* PYA/E *'come'*

	Stem	III	IV	VI
1SG	*pya*	*-Uy*	*-an*	
2SG	*pya*	*-Uy*	*-Un*	
3SG	*pya*			*-Ut*
OBV	*pya*	*-nu*		*-Ot*
1PL INCL:	*pya*	*-Uy*	*-ko*	
EXCL:	*pya*	*-Uy*	*-ak*	
2PL	*pya*	*-Uy*	*-ek*	
3PL	*pya*		*-wa*	*-Ut*

(22) a. $\mathrm{RR}_{\mathrm{IV},\{\mathrm{MOOD:conj,\ MR:no,\ AGR(su)}:\{\mathrm{PER:1,\ NUM:pl,\ INCL:no}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{ak}',\sigma\rangle$

b. $\mathrm{RR}_{\mathrm{IV},\{\mathrm{MOOD:conj,\ MR:no,\ AGR(ob)}:\{\mathrm{PER:1,\ NUM:pl,\ INCL:no}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{ak}',\sigma\rangle$

Rule (21b) causes -*Un* to be suffixed to a conjunct verb having a 2sg subject but lacking any major reference (cf. tables 3.10 – 3.12); similarly, rule (21c) causes -*ek* to be suffixed to a conjunct verb having a 2pl subject but no major reference (cf. again tables 3.10 – 3.12).

Table 3.12 *Nonpreterite conjunct forms of the transitive inanimate verb* PYETO *'bring'*

	SINGULAR OBJECT				PLURAL OBJECT			
SUBJECT	Stem	III	IV	VI	Stem	III	IV	VI
1SG	*pyeto*	*-Uy*	*-an*		*pyeto*	*-Uy*	*-an*	
2SG	*pyeto*	*-Uy*	*-Un*		*pyeto*	*-Uy*	*-Un*	
3SG	*pyeto*			*-Ut*	*pyeto*			*-Ut*
1PL INCL:	*pyeto*	*-Uy*	*-ko*		*pyeto*	*-Uy*	*-ko*	
1PL EXCL:	*pyeto*	*-Uy*	*-ak*		*pyeto*	*-Uy*	*-ak*	
2PL	*pyeto*	*-Uy*	*-ek*		*pyeto*	*-Uy*	*-ek*	
3PL	*pyeto*		*-wa*	*-Ut*	*pyeto*		*-wa*	*-Ut*

Rules (21a–c) all belong to the same block. Accordingly, (21a) competes with (21b) in the realization of (extensions of) the property set in (23a) and with (21c) in the realization of (extensions of) the property set in (23b).

(23) a. {MOOD:conj, MR:no, AGR(su):{PER:2, NUM:sg}, AGR(ob):{PER:1, NUM:pl, INCL:no}}
b. {MOOD:conj, MR:no, AGR(su):{PER:2, NUM:pl}, AGR(ob):{PER:1, NUM:pl, INCL:no}}

The forms from table 3.10 which are associated with these two property sets are given in (24):

(24) a. *miš-y-ak* 'may you (sg) give to us'
b. *miš-y-ak* 'may you (pl) give to us'

As these forms show, rule (21a) overrides rules (21b,c) in the realization of the property sets in (23).

To account for these facts, one could reformulate (21a) as an expansion schema, as in (25):

(25) Where α = su or ob, $\mathrm{RR}_{\mathrm{IV},\leftarrow\{\mathrm{MOOD:conj,\ MR:no,\ AGR}(\alpha)\mathrm{:\{PER:1,\ NUM:pl,\ INCL:no\}\}}\rightarrow,\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{ak}',\sigma\rangle$

Notice, however, that when the indicative forms and the conjunct forms are compared, an unanticipated generalization emerges:

(26) Whenever a Block IV rule R realizing 1pl agreement competes with another rule, R is the overriding rule.

In and of themselves, the expansion schemata in (14) and (25) fail to capture generalization (26): the stipulation that *-mUn* suffixation applies in expanded mode and the stipulation that *-ak* suffixation applies in expanded mode together portray (26) as pure coincidence. If (26) is to be captured, some means of generalizing across expansion schemata is necessary.[5]

The necessary generalization might be plausibly assumed to take the form of an EXPANSION METARULE – a metarule deducing expansion schemata from unexpanded rules:

(27) Expansion metarule:
If τ is an extension of {AGR(α):{PER:1, NUM:pl}} (where α = su or ob), then

$$\begin{array}{l} RR_{IV,\tau,V}(<X,\sigma>) =_{def} <Y',\sigma> \\ \downarrow \\ RR_{IV,\leftarrow\tau\rightarrow,V}(<X,\sigma>) =_{def} <Y',\sigma>. \end{array}$$

According to this metarule, the existence of an unexpanded rule '$RR_{IV,\tau,V}(<X,\sigma>) =_{def} <Y',\sigma>$' entails that of the corresponding expansion schema '$RR_{IV,\leftarrow\tau\rightarrow,V}(<X,\sigma>) =_{def} <Y',\sigma>$' wherever τ is as in (27). In accordance with (27), the existence of unexpanded rules (5a) and (21a) entails that of the expansion schemata (14) and (25). Thus, (27) simultaneously captures generalization (26) and makes it possible to deduce the existence of the expansion schemata (14) and (25) (provided that the morphology of Potawatomi includes the unexpanded rules (5a) and (21a)).[6]

Metarule (27) gives rise to other expansion schemata as well. Consider, for instance, the rules in (28).

(28) a. $RR_{IV,\{MOOD:conj,\ \underline{MR:su},\ AGR(su):\{PER:1,\ NUM:pl,\ INCL:no\},\ AGR(ob):\{ANIM:yes,\ PER:3\}\},V}(<X,\sigma>) =_{def} <Xo',\sigma>$

b. $RR_{IV,\{MOOD:conj,\ \underline{MR:ob},\ AGR(su):\{ANIM:yes,\ PER:3\},\ AGR(ob):\{PER:1,\ NUM:pl,\ INCL:no\}\},V}(<X,\sigma>) =_{def} <XUm',\sigma>$

c. Where α = su or ob, $RR_{IV,\{MOOD:conj,\ AGR(\alpha):\{ANIM:yes,\ PER:3,\ NUM:pl\}\},V}(<X,\sigma>) =_{def} <Xwa',\sigma>$

Rule (28a) introduces the slot IV suffix *-o* appearing in conjunct forms having a 1pl exclusive subject and a third-person animate object (see table 3.8); rule (28b) introduces the slot IV suffix *-Um* in conjunct forms having a third-person animate subject and a 1pl exclusive object (table 3.9); and rule (28c) introduces the slot IV suffix *-wa* in conjunct forms having a 3pl animate subject or object argument (tables 3.8, 3.9, 3.11, and 3.12). As they are stated, neither (28a) nor (28b) is either more or less narrow than (28c). Metarule (27), however, introduces expansion schemata for (28a) and (28b), and Pāṇini's principle predicts that these should override (28c); as the examples in (29) show, this is exactly the desired consequence.

(29) a. *min-Uk-o* 'may we (excl) give to them'
b. *miš-Uy-Um-Ut* 'may they give to us (excl)'

As it is formulated, the expansion metarule (27), like generalization (26), relates strictly to rules in Block IV. The question naturally arises, however, of whether it should be reformulated as applying to rules in other blocks as well – perhaps even in all blocks. There is no evidence clearly militating against a broader restatement of metarule (27), and there is, in fact, evidence favouring such a restatement. Consider, for example, the following rules from Block VI:

(30) Where α = su or ob,

a. Provided that $\beta \neq \alpha$, $RR_{VI,\{MOOD:indic,\ MR:\beta,\ AGR(\alpha):\{ANIM:yes,\ PER:3,\ NUM:pl\}\},V}(<X,\sigma>) =_{def} <X\mathit{Uk}',\sigma>$

b. $RR_{VI,\{MOOD:indic,\ AGR(\alpha):\{ANIM:yes,\ PER:obv\}\},V}(<X,\sigma>) =_{def} <X\mathit{Un}',\sigma>$

c. $RR_{VI,\{AGR(ob):\{ANIM:no,\ NUM:pl\}\},V}(<X,\sigma>) =_{def} <X\mathit{Un}',\sigma>$

Rule (30a) introduces the slot VI suffix -*Uk* in indicative forms having a 3pl animate subject or object argument which is not a major reference; rule (30b) introduces the slot VI suffix -*Un* in indicative forms having an obviative animate subject or object argument; and rule (30c) introduces -*Un* in indicative forms[7] having a plural, inanimate object. As tables 3.1 and 3.5 show, none of these rules applies in the inflection of indicative forms having a 1pl subject. To account for this fact, one might postulate the Block VI rule (31):

(31) $RR_{VI,\{MOOD:indic,\ MR:su,\ AGR(su):\{PER:1,\ NUM:pl\}\},V}(<X,\sigma>) =_{def} <X',\sigma>$

This rule requires slot VI to remain empty in indicative forms having a 1pl subject. As it is formulated in (31), this rule is neither more nor less narrow than any of the three rules in (30); but if the expansion metarule (27) is generalized as in (32) (so as to embody an even stronger generalization than (26), namely (33)), then by Pāṇini's principle, the expansion schema of (31) correctly overrides the rules in (30).

(32) Expansion metarule:
If τ is an extension of {AGR(α):{PER:1, NUM:pl}} (where α = su or ob) and *n* is any rule block, then

$$RR_{n,\tau,V}(<X,\sigma>) =_{def} <Y',\sigma>$$
$$\downarrow$$
$$RR_{n,\leftarrow\tau\rightarrow,V}(<X,\sigma>) =_{def} <Y',\sigma>.$$

(33) Whenever a rule R realizing 1pl agreement competes with another rule, R is the overriding rule.

Closer inspection of the system of Georgian verb agreement reveals a generalization comparable to (33) and therefore provides additional motivation for the introduction of expansion metarules.

3.6.2 A second look at Georgian verb agreement

Following Anderson (1986:12), I assume that the suffixes listed in table 3.6 are introduced by a single block of rules. On this assumption, Georgian presents a second instance of rule competition: in the inflection of verbs with 3sg subjects and 2pl objects, *-s* suffixation competes with *-t* suffixation. The details of this competition are, however, complicated by *-t*.

Anderson (1992:131f.) assumes that all instances of *-t* in table 3.6 are instances of a single suffix, whose function is to encode plural agreement (whether this be with a subject or an object argument). On this assumption, every instance in which *-t* is absent from a verb form marked for agreement with a plural argument must be accounted for. In table 3.7, instances of this sort are of three types:

(34)
a. forms marked for agreement with a 3pl subject uniformly lack *-t*, as in *mo-g-ḳlav-en* 'they will kill you (sg)'
b. forms marked for agreement with a 1pl object lack *-t*, as in *mo-gv-ḳlav* 'you (sg) will kill us' (unless the presence of *-t* is motivated by that of a plural subject, as in *mo-gv-ḳlav-t* 'you (pl) will kill us')
c. forms marked for agreement with a 3pl object lack *-t*, as in *mo-ḳlav* 'you (sg) will kill them' (again, unless *-t* is motivated by a plural subject, as in *mo-ḳlav-t* 'you (pl) will kill them')

The absence of *-t* in instances of type (34a) is easily accounted for: in such instances, the rule of *-t* suffixation is (in accordance with Pāṇini's principle) overridden by a narrower rule belonging to the same rule block – e.g. by *-en* suffixation, in the case of *mo-g-ḳlav-en*.

In order to account for the absence of *-t* in instances of type (34b), Anderson (1992:132) invokes a different principle, according to which a rule's application is excluded by the application of a narrower rule belonging to an EARLIER rule block. If this principle is valid, then (on the otherwise unmotivated assumption that the prefixal rule block is ordered before the suffixal block) the application of *gv-* prefixation in *mo-gv-ḳlav* blocks the subsequent application of *-t* suffixation, since the former rule realizes a more specific set of morphosyntactic properties than the latter.

Anderson proposes a different explanation for the absence of *-t* in instances of type (34c). In Georgian, 3pl direct-object agreement is never formally distinguished from 3sg direct-object agreement; thus, the forms in the '3PL' row in table 3.7 are identical to those in the '3SG' row. Anderson therefore reasons (1986:13; 1992:131n.) that third-person direct objects do not participate in number agreement in Georgian – in effect, that

AGR(ob):{PER:3, NUM:pl} isn't a well-formed morphosyntactic property.

Although independent factors usually prevent -*t* from marking number agreement with 3pl arguments, Anderson points out (1986:10f.; 1992:131) that this is not always the case, citing the inversion construction as evidence. This construction is used (i) in clauses in which the verb belongs to the first or third conjugation and is inflected for a screeve belonging to the perfect series; and (ii) in clauses in which the verb belongs to the fourth conjugation. One of the marks of this construction is the special pattern of verb-agreement morphology which it exhibits: direct-object agreement is encoded by means of markings otherwise used to encode subject agreement (i.e. those listed in the first column of table 3.6), while subject agreement is encoded by means of markings otherwise used to encode indirect-object agreement (i.e. those listed in the third column of table 3.6). In the inversion construction, -*t* is used to encode number agreement with 3pl subjects, as in the perfect form in (35) (where *u*- signals version); here, according to Anderson, the default rule of -*t* suffixation applies because it is overridden neither by a more specific rule nor by the systematic absence of number agreement with third-person direct objects.

(35) *mo-u-ḳlav-t* 'they apparently killed X (sg/pl)' (Hewitt 1996:237)

There are good reasons, however, for doubting Anderson's conclusion that all instances of -*t* are (synchronically) instances of the same suffix. First, the -t_3 which expresses 3pl subject agreement in the inversion construction cannot be identified with the -t_2 expressing 2pl subject agreement in that construction. The former is quite restricted in its distribution: according to Aronson (1990:272), '[w]hen the subject is third person *plural* and the direct object is first or second person *singular* the verb takes no plural marker' in the inversion construction. Thus, in the future indicative paradigm of the fourth-conjugation verb *qvar* 'love', the -*t* suffix in (36b) can only be construed as marking direct-object number:

(36) a. *v-eqvarebi* 'X (sg/pl) will love me'
b. *v-eqvarebi-t* *'They will love me'
(instead means: 'X (sg/pl) will love us') (Hewitt 1996:197)

But in an inversion construction with a 2pl subject and a 1sg object, -t_2 marks number agreement with the subject, as in (37).

(37) *g-eqvarebi-t* 'you (pl) will love me'
(also: 'you (sg/pl) will love us') (Hewitt 1996:197)

In view of this distributional distinction, the -t_3 in (35) and the -t_2 in (37) must be regarded as homophonous but not identical; that is, the -t_2 which encodes number agreement with 2pl noninverted objects and 2pl inverted subjects is not the same as the -t_3 which encodes number agreement with a 3pl inverted subject.[8]

Moreover, the principle which Anderson invokes to account for the absence of -*t* in instances of type (34b) (the principle that a rule's application is excluded by the application of a narrower rule belonging to an earlier rule block) cannot be maintained in the face of massive counterevidence. In Swahili verb morphology, for example, the application of the negative past-tense rule of *ku*-prefixation does not exclude the subsequent application of the negative rule of *ha*-prefixation in *ha-tu-ku-taka* 'we did not want'; in Potawatomi, the application of the Block III rule of -*a* suffixation (which realizes conjunct mood, third-person animate subject agreement, and obviative animate object agreement) does not exclude the subsequent application of the Block VI rule of -*Ot* suffixation (which realizes conjunct mood and obviative animate agreement) in *min-a-wa-Ot* 'may they (anim) give to X (obv)'; and so on. Thus, the failure of -t_2 to appear in forms marked for 1pl object agreement cannot be attributed to the rule of *gv*-prefixation, but must instead be seen as an inherent fact about -t_2 itself – namely, that the noninverted object or inverted subject whose number is encoded by -t_2 must be second person.

But what of the -t_1 which encodes number agreement with noninverted subjects and with inverted direct objects? Given that the argument encoded by the rule of -t_1 suffixation may be first or second person and that the application of this rule can be assumed to be overridden by more specific rules in the presence of a 3pl noninverted subject, this rule can be assumed to be insensitive to properties of person. On that assumption, -t_1 must be distinguished from -t_2, since the latter is inherently restricted to the second person.

If -t_1, -t_2, and -t_3 are synchronically distinguished in this way, then the suffixes in table 3.6 can be assumed to be introduced by the realization-rule block in (38):

(38) a. Where α = {TNS:present}, {TNS:future}, {MOOD:conjunctive}, or {MOOD:optative},
$\mathrm{RR}_{\text{suff},\{\text{SCREEVE}:\alpha,\ \text{AGR(su)}:\{\text{PER:3, NUM:sg}\}\},\text{V}}(<X,\sigma>) =_{\text{def}} <X\mathit{s}',\sigma>$

b. $\mathrm{RR}_{\text{suff},\{\text{AGR(su)}:\{\text{PER:3, NUM:pl}\}\},\text{V}}(<X,\sigma>) =_{\text{def}} <X\mathit{en}',\sigma>$

c. $\mathrm{RR}_{\text{suff},\{\text{SCREEVE}:\{\text{TNS:aorist}\},\ \text{AGR(su)}:\{\text{PER:3, NUM:pl}\}\},\text{V}}(<X,\sigma>) =_{\text{def}} <X\mathit{es}',\sigma>$

d. $\mathrm{RR}_{\text{suff},\{\text{AGR(su)}:\{\text{NUM:pl}\}\},\text{V}}(<X,\sigma>) =_{\text{def}} <X\mathit{t}',\sigma>$

e. $\mathrm{RR}_{\text{suff},\{\text{AGR(su)}:\{\text{NUM:sg}\},\ \text{AGR(ob)}:\{\text{PER:2, NUM:pl}\}\},\text{V}}(<X,\sigma>) =_{\text{def}} <X\mathit{t}',\sigma>$[9]

These rules present a second instance of rule competition in Georgian – that of rule (38a) with rule (38e). As table 3.7 shows, this competition is resolved in favour of (38e): *mo-g-ḳlav-t* 's/he will kill you (pl)' has the suffix *-t* but not the suffix *-s*.

This fact, together with the earlier observation that second-person object prefixation wins over first-person subject prefixation, affords a broader generalization:

(39) Whenever a rule R realizing second-person object agreement competes with another rule, R is the overriding rule.

This generalization cannot be expressed by individually stipulated expansion schemata; it can, however, be expressed by means of the following expansion metarule.

(40) Expansion metarule:
If τ is an extension of {AGR(ob):{PER:2}}, then

$$\begin{array}{l} RR_{n,\tau,V}(\langle X,\sigma\rangle) =_{def} \langle Y',\sigma\rangle \\ \downarrow \\ RR_{n,\leftarrow\tau\rightarrow,V}(\langle X,\sigma\rangle) =_{def} \langle Y',\sigma\rangle. \end{array}$$

Metarule (40) captures generalization (39) by inducing the existence of the expansion schemata (15) and (41) from the unexpanded rules (8d) and (38e).

(41) $RR_{suff,\leftarrow\{AGR(su):\{NUM:sg\},\ AGR(ob):\{PER:2,\ NUM:pl\}\}\rightarrow,V}(\langle X,\sigma\rangle) =_{def} \langle Xt',\sigma\rangle$

3.7 Expansion metarules are not always reducible to argument hierarchies

An expansion metarule has the effect of according special priority to the inflectional realization of a particular set of morphosyntactic properties (regardless of how this set of properties is realized in any specific instance); one might ask, however, whether this special priority should instead be seen as the effect of a hierarchical ranking among arguments.

Consider again the Potawatomi metarule in (32). This metarule causes the inflectional realization of 1pl agreement to override that of second-person agreement: thus, competition between (5a) and (5b) is resolved in favour of (5a)'s expansion schema, and competition between (21a) and (21b) (or (21c)) is resolved in favour of (21a)'s expansion schema. Suppose, though, that the arguments of a Potawatomi verb were ranked hierarchically as in (42); one might then seemingly abandon metarule (32) in favour of a general requirement that where $x > y$ in the hierarchy, the expression of agreement with argument x overrides the expression of agreement with argument y. Is it in general possible to dispense with expansion metarules by appealing to argument hierarchies in this fashion?

(42) 1pl argument > . . . second-person argument . . .

As the Potawatomi evidence itself reveals, it is not. Consider, for instance, the prefixal rule block and the suffixal block filling slot IV: both blocks contain rules capable of expressing agreement with a 1pl exclusive subject (namely the rules of *n*-prefixation and *-mUn* suffixation), and both contain rules capable of expressing agreement with a 2pl object (namely the rules of *k*-prefixation and *-Um* suffixation). If rule competition is genuinely regulated by the argument hierarchy in (42), the former pair of rules should prevail over the latter pair in the inflection of the form meaning 'we see you (pl)'. This prediction, however, is wrong. The form in question is *k-wapUm-Un-mUn*: the fact that *-mUn* suffixation overrides *-Um* suffixation in Block IV conforms to the requirements of hierarchy (42), but the fact that *k*-prefixation overrides *n*-prefixation in the prefixal block runs counter to these same requirements. By contrast, if hierarchy (42) is rejected in favour of the expansion metarule (32), then the paradox evaporates. On the one hand, (32) correctly entails the appearance of the slot IV suffix *-mUn* in *k-wapUm-Un-mUn*. On the other hand, (32) doesn't introduce an expansion schema for the rule of *n*-prefixation (i.e. rule (4b)), since this rule fails to realize an extension of {AGR(α):{PER:1, NUM:pl}}; accordingly, the expansion schema for *k*- prefixation (rule (12)) prevails. This evidence shows that expansion metarules are not uniformly reducible to argument hierarchies.

In view of the foregoing considerations, I conclude that the Pāṇinian Determinism Hypothesis is both a viable and a desirable assumption; the validation of this hypothesis supports the broader assumption pursued here that in the definition of a language's inflectional morphology, rule interactions are regulated by a universally invariant set of principles. Though I have focussed on specific details of the Georgian and Potawatomi systems of verb inflection, I see no obstacle to developing complete analyses of these systems in a manner consistent with this hypothesis. In the following Appendix, I present a more detailed analysis of Potawatomi verb inflection; in this analysis, the members of each rule block are unordered, and each block conforms to the well-formedness condition (16).

Appendix: Analysis of a fragment of Potawatomi verb morphology

What follows is a PFM analysis of the verb morphology exemplified by the Potawatomi paradigms in tables 3.1 – 3.5 and 3.8 – 3.12 above; that is, an analysis of the positive, nonpreterite forms of transitive animate ([+TA]), animate intransitive ([+AI]), and transitive inanimate ([+TI]) verbs in the indicative and conjunct moods. For the purposes of this fragment of Potawatomi morphology, I assume the following set of morphosyntactic properties:

(A.1) Morphosyntactic features and values

FEATURE	PERMISSIBLE VALUES
MOOD	indic, conj
MR	su, ob, no
ANIM	yes, no
PER	1, 2, 3, obv
NUM	sg, pl
INCL	yes, no
AGR(su)	(sets of morphosyntactic properties)
AGR(ob)	(sets of morphosyntactic properties)

A verb's property set consists of feature–value pairings drawn from (A.1); well-formed property sets for verbs conform to the following property cooccurrence restrictions.

(A.2) Property cooccurrence restrictions
A set σ of morphosyntactic properties for an expression of category V is in conformity with the property cooccurrence restrictions of Potawatomi only if:

a. Where F is PER, NUM, INCL, or ANIM, σ is not an extension of {F:α} (for any permissible value α of F).
b. If σ is an extension of {AGR(α):τ} (where α = su or ob), then
   i. for any property F:v such that τ is an extension of {F:v}, F is either PER, NUM, INCL, or ANIM, and v is a permissible value for F;
   ii. if τ is an extension of {PER:1} or {PER:2}, then it is an extension of {ANIM:yes};
   iii. if τ is an extension of {PER:2}, then it is an extension of {INCL:yes};
   iv. if τ is an extension of {PER:1, INCL:yes}, then it is an extension of {NUM:pl};
   v. if τ is an extension of {PER:3}, {PER:obv}, or {PER:1, NUM:sg}, then it is an extension of {INCL:no}; and
   vi. if τ is an extension of {PER:obv}, then it is an extension of neither {NUM:sg} nor {NUM:pl}.

c. If σ is an extension of {AGR(α):τ_1, AGR(β):τ_2} (where {α,β} = {su,ob}), τ_1 is an extension of {PER:1}, and τ_2 is an extension of {PER:2}, then τ_1 is an extension of {INCL:no}.
d. If σ is an extension of {AGR(α):τ_1, AGR(β):τ_2} (where {α,β} = {su,ob}), τ_1 and τ_2 are both extensions of {ANIM:yes}, and τ_1 is an extension of {PER:3}, then τ_2 is not an extension of {PER:3}.
e. If σ is an extension of {MOOD:α, MR:β, AGR(β):{PER:γ}, AGR(δ):{PER:obv}} (where {β,δ} = {su,ob}), γ = 3 unless α = indic and β = su.
f. If σ is an extension of {AGR(α):τ, AGR(β):{PER:obv}} (where {α,β} = {su,ob}), then τ is an extension of {ANIM:yes}.
g. If σ is an extension of {AGR(su):τ_1, AGR(ob):τ_2}, then σ is an extension of {MR:su} iff $\tau_1 >> \tau_2$ and σ is an extension of {MR:ob} iff $\tau_2 >> \tau_1$.
h. If (i) σ is an extension of {AGR(su):τ_1, AGR(ob):τ_2} but neither $\tau_1 >> \tau_2$ nor $\tau_2 >> \tau_1$, or
(ii) σ is an extension of {AGR(su):τ_1} but not of {AGR(ob):τ_2},
then σ is an extension of {MR:no}.

The >> relation referred to in the property cooccurrence restrictions (A.2g) and (A.2h) is defined as in (A.3), which formalizes the hierarchy of person and animacy given as (2) in section 3.2.

(A.3) Definition of the >> relation: $\tau_1 >> \tau_2$ iff
either a. τ_1 and τ_2 are both extensions of {ANIM:yes} and
either i. τ_1 is an extension of either {PER:1} or {PER:2} and τ_2 is an extension of either {PER:3} or {PER:obv}
or ii. τ_1 is an extension of {PER:3} and τ_2 is an extension of {PER:obv}
or b. τ_1 is an extension of {ANIM:yes} and τ_2 is an extension of {ANIM:no}.

A verb's conjugation class determines the range of morphosyntactic properties available to it. In particular: where α is an extension of {ANIM:yes}, AGR(ob):α is only available to verbs belonging to the [+TA] class; where α is an extension of {ANIM:no}, AGR(ob):α is only available to verbs belonging to the [+TI] class; there is no value α for which AGR(ob):α is available to verbs belonging to the [+AI] class; and where α is an extension of {ANIM:no}, AGR(su):α is unavailable to any verb belonging to the [+TA], the [+AI], or the [+TI] class.

The realization rules necessary in this fragment of Potawatomi morphology are those in (A.4)–(A.10). For clarity, these formulations include certain morphosyntactic properties whose presence is deducible from the property cooccurrence restrictions in (A.2); properties which are redundant in this way are indicated by underlining.

(A.4) Prefixal block:

Where $\alpha = \text{su}$ or ob,

a. $$RR_{\text{pref},\{\text{MOOD:indic, MR:}\alpha\text{, AGR}(\alpha)\text{:}\{\underline{\text{ANIM:yes}}\text{, PER:3}\}\},V}(<X,\sigma>) =_{\text{def}} <wX',\sigma>$$

b. $$RR_{\text{pref},\{\text{MOOD:indic, AGR}(\alpha)\text{:}\{\text{PER:1}\}\},V}(<X,\sigma>) =_{\text{def}} <nX',\sigma>$$

c. $$RR_{\text{pref},\leftarrow\{\text{MOOD:indic, AGR}(\alpha)\text{:}\{\text{INCL:yes}\}\}\rightarrow,V}(<X,\sigma>) =_{\text{def}} <kX',\sigma>$$

(A.5) Block I

a. $$RR_{\text{I},\{\text{MOOD:indic, MR:su}\},V}(<X,\sigma>) =_{\text{def}} <Xa',\sigma>$$

b. $$RR_{\text{I},\{\text{MOOD:indic, MR:ob}\},V}(<X,\sigma>) =_{\text{def}} <XUkO',\sigma>$$

(A.6) Block II

$$RR_{\text{II},\{\text{MOOD:conj, }\underline{\text{MR:su}}\text{, AGR(su):}\{\text{PER:2, NUM:pl}\}\text{, AGR(ob):}\{\text{ANIM:yes, PER:3, NUM:sg}\}\},V}(<X,\sigma>) =_{\text{def}} <Xe',\sigma>$$

(A.7) Block III

a. Where $<\alpha,\beta> = <\text{indic,no}>$ or $<\text{conj,ob}>$,

$$RR_{\text{III},\{\text{MOOD:}\alpha\text{, MR:}\beta\text{, AGR(ob):}\{\text{PER:1, NUM:pl, INCL:no}\}\},V}(<X,\sigma>) =_{\text{def}} <XUy',\sigma>$$

b. $$RR_{\text{III},\{\text{MOOD:conj, }\underline{\text{MR:su}}\text{, AGR(su):}\{\underline{\text{ANIM:yes}}\text{, PER:3}\}\text{, AGR(ob):}\{\text{ANIM:yes, PER:obv}\}\},V}(<X,\sigma>) =_{\text{def}} <Xa',\sigma>$$

c. $$RR_{\text{III},\{\text{MOOD:conj, MR:su, AGR(su):}\{\text{PER:1, NUM:pl, INCL:yes}\}\text{, AGR(ob):}\{\text{ANIM:yes}\}\},V}(<X,\sigma>) =_{\text{def}} <Xat',\sigma>$$

d. $$RR_{\text{III},\{\text{MOOD:conj, }\underline{\text{MR:su}}\text{, AGR(su):}\{\text{PER:2, NUM:sg}\}\text{, AGR(ob):}\{\text{ANIM:yes, PER:3}\}\},V}(<X,\sigma>) =_{\text{def}} <XUt',\sigma>$$

e. $$RR_{\text{III},\{\text{MOOD:conj, }\underline{\text{MR:ob}}\text{, AGR(su):}\{\text{ANIM:yes, PER:3, NUM:pl}\}\text{, AGR(ob):}\{\text{PER:2, NUM:sg}\}\},V}(<X,\sigma>) =_{\text{def}} <XUk\cdot',\sigma>$$

f. $$RR_{\text{III},\{\text{MOOD:conj, MR:ob, AGR(ob):}\{\text{NUM:pl, INCL:yes}\}\},V}(<X,\sigma>) =_{\text{def}} <XUn',\sigma>$$

g. $$RR_{\text{III},\{\text{MOOD:conj, MR:no, AGR(su):}\{\text{ANIM:yes, PER:3}\}\},V}(<X,\sigma>) =_{\text{def}} <X',\sigma>$$

h. $$RR_{\text{III},\{\text{MOOD:conj, MR:no, AGR(su):}\{\text{ANIM:yes, PER:obv}\}\},V}(<X,\sigma>) =_{\text{def}} <Xnu',\sigma>$$

i. $$RR_{\text{III},\{\text{MOOD:conj, MR:no, AGR(su):}\{\text{ANIM:yes}\}\},V}(<X,\sigma>) =_{\text{def}} <XUy',\sigma>$$

j. $$RR_{\text{III},\{\text{MOOD:conj, AGR(ob):}\{\text{ANIM:yes, PER:3}\}\},V}(<X,\sigma>) =_{\text{def}} <XUk',\sigma>$$

k. $$RR_{\text{III},\leftarrow\{\text{MR:no, AGR(ob):}\{\text{PER:2}\}\}\rightarrow,V}(<X,\sigma>) =_{\text{def}} <XUn',\sigma>$$

(A.8) Block IV:

Where $\{\alpha,\beta\} = \{\text{su,ob}\}$,

a. $$RR_{\text{IV},\{\text{MOOD:indic, }\underline{\text{MR:su}}\text{, AGR(su):}\{\text{ANIM:yes, NUM:sg}\}\text{, AGR(ob):}\{\text{ANIM:no}\}\},V}(<X,\sigma>) =_{\text{def}} <XUn',\sigma>$$

b. $$RR_{\text{IV},\{\text{MOOD:indic, MR:ob, AGR(ob):}\{\text{PER:1, NUM:pl}\}\},[+\text{TA}]}(<X,\sigma>) =_{\text{def}} <Xnan',\sigma>$$

c. $$RR_{\text{IV},\{\text{MOOD:indic, MR:no, AGR}(\alpha)\text{:}\{\text{PER:2, NUM:pl}\}\},V}(<X,\sigma>) =_{\text{def}} <XUm',\sigma>$$

d. $$RR_{\text{IV},\{\text{MOOD:indic, AGR}(\alpha)\text{:}\{\text{PER:1, NUM:pl}\}\},V}(<X,\sigma>) =_{\text{def}} <XmUn',\sigma>$$

e. $\mathrm{RR}_{\mathrm{IV},\{\text{MOOD:conj, }\underline{\text{MR:}\alpha}\text{, AGR}(\alpha)\text{:}\{\text{PER:1, NUM:pl, INCL:yes}\}\text{, AGR}(\beta)\text{:}\{\text{ANIM:yes, PER:3, NUM:pl}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle Y,\sigma\rangle$,
where $\mathrm{Nar}_{\mathrm{IV}}(\langle X,\sigma/\{\mathrm{AGR}(\beta)\text{:}\{\text{NUM:sg}\}\}\rangle) = \langle Y,\sigma/\{\mathrm{AGR}(\beta)\text{:}\{\text{NUM:sg}\}\}\rangle$

f. $\mathrm{RR}_{\mathrm{IV},\{\text{MOOD:conj, }\underline{\text{MR:su}}\text{, AGR(su):}\{\text{PER:1, NUM:pl, INCL:no}\}\text{, AGR(ob):}\{\text{ANIM:yes, PER:3}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{o}',\sigma\rangle$

g. $\mathrm{RR}_{\mathrm{IV},\{\text{MOOD:conj, }\underline{\text{MR:ob}}\text{, AGR(su):}\{\text{ANIM:yes, PER:3, NUM:sg}\}\text{, AGR(ob):}\{\text{INCL:yes}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{Uk}',\sigma\rangle$

h. $\mathrm{RR}_{\mathrm{IV},\{\text{MOOD:conj, }\underline{\text{MR:ob}}\text{, AGR(su):}\{\text{ANIM:yes, PER:3}\}\text{, AGR(ob):}\{\text{PER:1, NUM:pl, INCL:no}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{Um}',\sigma\rangle$

i. $\mathrm{RR}_{\mathrm{IV},\leftarrow\{\text{MOOD:conj, }\underline{\text{MR:ob}}\text{, AGR(su):}\{\text{ANIM:yes, PER:3}\}\text{, AGR(ob):}\{\text{PER:2, NUM:pl, }\underline{\text{INCL:yes}}\}\}\rightarrow,\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{ak}',\sigma\rangle$

j. $\mathrm{RR}_{\mathrm{IV},\{\text{MOOD:conj, MR:no, AGR}(\alpha)\text{:}\{\text{PER:1, NUM:pl, INCL:no}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{ak}',\sigma\rangle$

k. $\mathrm{RR}_{\mathrm{IV},\{\text{MOOD:conj, }\underline{\text{MR:no}}\text{, AGR(su):}\{\text{PER:1, NUM:sg}\}\text{, AGR(ob):}\{\text{PER:2, NUM:pl}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{UnUko}',\sigma\rangle$

l. $\mathrm{RR}_{\mathrm{IV},\{\text{MOOD:conj, MR:no, AGR(su):}\{\text{PER:1, NUM:sg}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{an}',\sigma\rangle$

m. $\mathrm{RR}_{\mathrm{IV},\{\text{MOOD:conj, MR:no, AGR(su):}\{\text{PER:1, }\underline{\text{NUM:pl}}\text{, INCL:yes}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{ko}',\sigma\rangle$

n. $\mathrm{RR}_{\mathrm{IV},\{\text{MOOD:conj, MR:no, AGR(su):}\{\text{PER:2, NUM:sg}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{Un}',\sigma\rangle$

o. $\mathrm{RR}_{\mathrm{IV},\{\text{MOOD:conj, MR:no, AGR(su):}\{\text{PER:2, NUM:pl}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{ek}',\sigma\rangle$

p. $\mathrm{RR}_{\mathrm{IV},\{\text{MOOD:conj, AGR}(\alpha)\text{:}\{\text{ANIM:yes, PER:3, NUM:pl}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{wa}',\sigma\rangle$

q. $\mathrm{RR}_{\mathrm{IV},\{\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \mathrm{Nar}_{\mathrm{IVb}}(\mathrm{Nar}_{\mathrm{IVa}}(\langle X,\sigma\rangle))$

(A.9) Blocks IVa and IVb

a. $\mathrm{RR}_{\mathrm{IVa},\{\text{MOOD:indic, }\underline{\text{MR:su}}\text{, AGR(su):}\{\text{ANIM:yes, NUM:pl}\}\text{, AGR(ob):}\{\text{ANIM:no}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{na}',\sigma\rangle$

b. Where α = su or ob,
$\mathrm{RR}_{\mathrm{IVb},\{\text{MOOD:indic, MR:}\alpha\text{, AGR}(\alpha)\text{:}\{\underline{\text{ANIM:yes}}\text{, NUM:pl}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{wa}',\sigma\rangle$

(A.10) Block VI: Where α = su or ob,

a. Provided that $\beta \neq \alpha$, $\mathrm{RR}_{\mathrm{VI},\{\text{MOOD:indic, MR:}\beta\text{, AGR}(\alpha)\text{:}\{\text{ANIM:yes, PER:3, NUM:pl}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{Uk}',\sigma\rangle$

b. $\mathrm{RR}_{\mathrm{VI},\{\text{MOOD:indic, MR:su, AGR(su):}\{\text{PER:1, NUM:pl}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X',\sigma\rangle$

c. $\mathrm{RR}_{\mathrm{VI},\{\text{MOOD:indic, AGR}(\alpha)\text{:}\{\text{ANIM:yes, PER:obv}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{Un}',\sigma\rangle$

d. $\mathrm{RR}_{\mathrm{VI},\{\text{MOOD:conj, }\underline{\text{MR:ob}}\text{, AGR(su):}\{\text{ANIM:yes, PER:3}\}\text{, AGR(ob):}\{\text{PER:1, INCL:no}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{Ut}',\sigma\rangle$

e. $\mathrm{RR}_{\mathrm{VI},\{\text{MOOD:conj, MR:no, AGR(su):}\{\text{ANIM:yes, PER:3}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{Ut}',\sigma\rangle$

f. $\mathrm{RR}_{\mathrm{VI},\{\text{MOOD:conj, AGR}(\alpha)\text{:}\{\text{ANIM:yes, PER:obv}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{Ot}',\sigma\rangle$

g. $\mathrm{RR}_{\mathrm{VI},\{\text{AGR(ob):}\{\text{ANIM:no, NUM:pl}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{Un}',\sigma\rangle$

There is one prefixal block, comprising the rules in (A.4). The suffixal blocks are numbered I, II, III, IV, and VI, to correspond with the five suffix positions labelled in tables 3.1 – 3.5 and 3.8 – 3.12. (There is also a suffix position V situated between positions IV and VI; this is occupied by the preterite suffix, which is not included in this present fragment. I assume that the rule introducing this suffix occupies a separate block intermediate between Blocks IV and VI.)

In the default case covered by rule (A.8q), suffix position IV is filled by two ancillary blocks, IVa and IVb; thus, since none of the other rules in (A.8) is applicable in the inflection of the form *w-wapUt-a-na-wa-Un* 'they see them (inanim)', rules (A.9a) and (A.9b) fill slot IV together, the former rule furnishing the suffix *-na*, the latter, the suffix *-wa*. This analysis in effect treats the suffixation rules in (A.8) as portmanteau rules, each of which simultaneously fills the adjacent slots IVa and IVb; a more thorough discussion of portmanteau realization rules is presented in section 5.2.

Block IV includes a rule of referral, namely (A.8e), whose effect is to cause conjunct forms having a 1pl inclusive major reference and a 3pl animate argument to inflect (in slot IV) as if the latter argument were singular; thus, *min-at* 'may we (incl) give to them' and *min-Un-Uk* 'may they give to us (incl)' are syncretized with *min-at* 'may we (incl) give to her/him' and *min-Un-Uk* 'may s/he give to us (incl)'. By Pāṇini's principle, (A.8e) overrides (A.8p), which would otherwise introduce *-wa* into the first pair of forms. A thorough discussion of inflectional syncretism is presented in chapter 7.

The metarules relevant to this fragment of Potawatomi are (A.11) and (A.12). The expansion metarule (A.11) introduces an expansion schema for every rule defined as realizing 1pl agreement; the rules that are expanded by this metarule are (A.7a), (A.7c), (A.8d), (A.8f), (A.8h), (A.8j), (A.8m), and (A.10b). Metarule (A.12) causes every rule defined as realizing an instantiation of {MOOD:conj, MR:no, AGR(su):τ} to have a twin rule realizing the corresponding instantiation of {MOOD:conj, MR:su, AGR(su):τ, AGR(ob):{ANIM:no}}; the rules that are subject to this metarule are (A.7g), (A.7h), (A.7i), (A.8j), (A.8l), (A.8m), (A.8n), (A.8o), and (A.10e).

(A.11) Expansion metarule:
If τ is an extension of {AGR(α):{PER:1, NUM:pl}} (where α = su or ob) and *n* is any rule block, then

$$\begin{array}{l} \mathrm{RR}_{n,\tau,\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{Y}',\sigma> \\ \quad\downarrow \\ \mathrm{RR}_{n,\leftarrow\tau\rightarrow,\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{Y}',\sigma>. \end{array}$$

(A.12) Metarule:
If σ = {MOOD:conj, AGR(su):τ} and *n* is any rule block, then

$$\begin{array}{l} \mathrm{RR}_{n,(\sigma\,\cup\,\{\mathrm{MR:no}\}),\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{Y}',\sigma> \\ \quad\downarrow \end{array}$$

$$\mathrm{RR}_{n,(\sigma \cup \{\mathrm{MR:su,\ AGR(ob)\!:\!\{ANIM:no\}}\}),\mathrm{V}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{Y}',\sigma>.$$

The morphophonological rules for this fragment of Potawatomi are those in (A.13).

(A.13) Morphophonological rules
Where $\mathrm{RR}_{n,\sigma,\mathrm{V}}(<\mathrm{X},\sigma>) = <\mathrm{Y}',\sigma>$
a. If Y can be syllabified as U $[_\sigma$ W $\mathrm{V_a}$] $[_\sigma$ $\mathrm{C_a}$ $\mathrm{V_b}$] Z (where $\mathrm{V_a}$ is a strong vowel and $\mathrm{V_b}$ a weak vowel), then $\mathrm{Y}' = \mathrm{UWV_aC_aZ}'$.
b. If Y can be syllabified as R $[_\sigma$ S $\mathrm{V_a}$ T] $[_\sigma$ U $\mathrm{V_b}$ W] Z (where $\mathrm{V_a}$ is a strong vowel and $\mathrm{V_b}$ a weak vowel), then $\mathrm{Y}' = \mathrm{RSV_aTUV_cWZ}'$, where $\mathrm{V_c}$ is the strong counterpart of $\mathrm{V_b}$.
c. If Y = WGGZ and G is a glide, then Y′ = WʔGZ′.
d. If $\mathrm{Y} = \mathrm{WV_aV_bZ}$, then $\mathrm{Y}' = \mathrm{WV_aZ}'$.

These rules presume Hockett's (1948:1ff.) morphophonological distinction between STRONG VOWELS (*i e a o u*) and WEAK VOWELS (*O* and *U*, which are phonologically unrealized in one set of contexts and realized as their strong counterparts *o* and *u* in another). Moreover, I assume that a Potawatomi expression X is syllabifiable only if the segments of X can be grouped into syllables each of which has an onset and none of which has a coda of more than one consonant. Because (A.13b) is applicable whenever (A.13a) is (while the reverse is not true), the application of (A.13a) always overrides that of (A.13b).

The morphophonological rules in (A.13) are associated with specific realization rules by the morphological metageneralizations in (A.14).

(A.14) Morphological metageneralizations:
a. For any rule R, c,d $\in \phi_\mathrm{R}$.
b. For any rule R in Block VI, a,b $\in \phi_\mathrm{R}$.

The following partial definition of the Potawatomi paradigm function accounts for all forms in tables 3.1 – 3.5 and 3.8 – 3.12:

(A.15) Partial definition of the Potawatomi paradigm function:
$\mathrm{PF}(<\mathrm{X},\sigma>) =_{\mathrm{def}}$
$\mathrm{Nar_{pref}}(\mathrm{Nar_{VI}}(\mathrm{Nar_{V}}(\mathrm{Nar_{IV}}(\mathrm{Nar_{III}}(\mathrm{Nar_{II}}(\mathrm{Nar_{I}}(<\mathrm{X},\sigma>)))))))$

Thus, where σ is as in (A.16a), PF(<*wapUm*,σ>) is evaluated as in (A.16b); where σ is as in (A.17a), PF(<*wapUm*,σ>) is evaluated as in (A.17b); and so on.

(A.16) a. σ = {MOOD:indic, MR:ob, AGR(su):{ANIM:yes, PER:obv, INCL:no}, AGR(ob):{ANIM:yes, PER:3, NUM:sg, INCL:no}}
b. PF(<*wapUm*,σ>)
$= \mathrm{Nar_{pref}}(\mathrm{Nar_{VI}}(\mathrm{Nar_{V}}(\mathrm{Nar_{IV}}(\mathrm{Nar_{III}}(\mathrm{Nar_{II}}(\mathrm{Nar_{I}}(<\textit{wapUm},\sigma>)))))))$

$$= RR_{[A.4a]}(RR_{[A.10c]}(RR_{V,\{\},U}(RR_{IVb,\{\},U}(RR_{IVa,\{\},U}(RR_{III,\{\},U}(RR_{II,\{\},U}(RR_{[A.5b]}(\langle \textit{wapUm},\sigma\rangle))))))))$$
$$= \langle \textit{ʔwapmukon},\sigma\rangle$$

(A.17) a. $\sigma = \{$MOOD:indic, MR:ob, AGR(su):$\{$ANIM:yes, PER:3, NUM:pl, INCL:no$\}$, AGR(ob):$\{$ANIM:yes, PER:1, NUM:pl, INCL:yes$\}\}$

b. PF(<*wapUm*,σ>)

$$= Nar_{pref}(Nar_{VI}(Nar_{V}(Nar_{IV}(Nar_{III}(Nar_{II}(Nar_{I}(\langle \textit{wapUm},\sigma\rangle)))))))$$
$$= RR_{[A.4c]}(RR_{[A.10a]}(RR_{V,\{\},U}(RR_{[A.8b]}(RR_{III,\{\},U}(RR_{II,\{\},U}(RR_{[A.5b]}(\langle \textit{wapUm},\sigma\rangle)))))))$$
$$= \langle \textit{kwapmuknanuk},\sigma\rangle$$

This analysis of Potawatomi verb inflection differs in many respects from the analysis proposed by Anderson (1992: chapter 6). First and foremost, this analysis – unlike Anderson's – is compatible with the Pāṇinian Determinism Hypothesis: when the effects of metarules (A.11) and (A.12) are taken into account, each of the rule blocks in (A.4)–(A.10) satisfies the Pāṇinian well-formedness condition (16); accordingly, stipulated orderings among members of the same rule block play no role in this analysis. Because it embodies a more restrictive conception of rule competition (as demonstrated in section 3.5), the present analysis must be preferred on theoretical grounds, all else being equal. There are, however, additional reasons for preferring this analysis.

One notable feature of Anderson's analysis is his use of the same rules to spell out nominal and verbal inflections. Consider, for example, the personal prefixes *k*-, *n*-, and *w*-: besides joining with verbs to encode a subject or object argument, these prefixes also join with nouns to encode a possessor, e.g. *n-čiman* 'my canoe', *k-čiman* 'your canoe', *w-čiman* 'her/his canoe'. Anderson (1992:165f.) therefore formulates the rules of *k*-, *n*-, and *w*-prefixation as applying both to verbs and to nouns. Here and elsewhere, however, Anderson's formulations fail to take account of the fact that where the same affix appears in both verbal and nominal contexts, it realizes a richer set of morphosyntactic properties in the former than in the latter; thus, in verbal contexts, the prefixes *k*-, *n*-, and *w*- express not only agreement information, but also modal information, appearing in the indicative mood but not in the conjunct mood. The formulations proposed in (A.4) do account for the extra modal information encoded by the personal prefixes in verbal contexts; given the rules in (A.4), the corresponding rules of nominal prefixation might, in the present analysis, be deduced by means of the metarule in (A.18) (where 'POSS' is a feature of possessor agreement).

(A.18) Metarule:
If σ is an extension of $\{AGR(\alpha){:}\tau\}$ (where α = su or ob), then

$$RR_{pref,\sigma,V}(<X,\sigma>) =_{def} <Y',\sigma>$$
$$\downarrow$$
$$RR_{pref,\{POSS:\tau\},N}(<X,\sigma>) =_{def} <Y',\sigma>.$$

Similar remarks hold for other apparent correspondences between verbal and nominal inflection in Potawatomi.

Another point of contrast between Anderson's analysis and the present analysis is in their treatment of inverse forms. Anderson conceives of a verb's agreement properties as having a layered organization, such that verbs ordinarily 'have agreement with their Direct Objects recorded in an inner(most) layer of Morphosyntactic Representation, while Subject agreement is recorded in an outer(most) layer' (1992: 146). On this view, rules realizing a verb's agreement properties may be sensitive to the layers which those properties occupy: thus, the rule of *-wa* suffixation in Anderson's analysis realizes the property 'plural', but only when it occupies a word's outer layer of agreement properties (as when it expresses plural subject agreement in such direct forms as *k-wapUm-a-wa* 'you (pl) see her/him'). To account for the fact that the subject-agreement morphology of a [+TA] verb's direct forms sometimes matches the object-agreement morphology of its inverse forms, Anderson postulates (p.172) a rule of layer reversal, which applies to inverse forms prior to the application of any realization rule. Once layer reversal has taken place, *-wa* suffixation may still apply to encode the presence of the property 'plural' in the outer layer of a verb's agreement properties; in doing so, however, it now expresses plural OBJECT agreement, as in inverse forms such as *k-wapUm-UkO-wa* 's/he sees you (pl)'. The device of allowing inflectional rules to manipulate a word's agreement properties in this way is, of course, an extremely powerful one (Spencer 1991:469f.; Carstairs-McCarthy 1992:201f.); another virtue of the analysis presented here is that it does not resort to this device. Instead, the major-reference feature MR is used to generalize over subject agreement in direct forms and object agreement in inverse forms: Anderson's rule of *-wa* suffixation, for example, is here formulated (in (A.9b)) as expressing agreement with a plural major reference (whether this be a direct form's subject or an inverse form's object).

4 *Headedness*

4.1 Introduction

In the Bulgarian analysis developed in chapter 2, the individual realization rules function as parts of the definition of a single overarching paradigm function. In this chapter, I present an extended argument motivating the postulation of paradigm functions in morphological theory; in particular, I show that an adequate theory of inflectional head marking necessitates their postulation.[1]

The usual expectation is that a word's inflectional markings will be linearly outside of any derivational or compounded formatives which that word contains. Nevertheless, there is a large and systematic class of counterexamples to this generalization. For instance, Sanskrit has a set of preverbs (which generally also serve independently as adverbs or adpositions) which can be combined with a verb to form a new, compound verb: thus, the verb root *pat*- 'fly' combines with the preverb *ni* 'down' to produce the compound verb root *ni-pat*- 'fly down'; as this example suggests, the preverb usually has the semantic effect of an adverb (though in many instances the compound has an idiosyncratic meaning not directly deducible from the meanings of its parts, e.g. *pra* 'forward, forth' + *labh*- 'to seize' → *pra-labh*- 'to deceive'). When a compound verb root inflects, the inflection is realized on the root heading the compound. This is particularly evident in those tenses that require the preterite prefix *a*- (the so-called 'augment'). Thus, in the 3sg imperfect active form of *ni-pat*-, the inflectional marking is linearly inside of the compounded formative *ni*: *ny-a-patat*. (Parallel examples are given in table 4.1.) Similarly, third-conjugation verbs form their present-tense stem by means of initial reduplication, and in the present-tense stem of a compound verb belonging to the third conjugation, the reduplication is invariably realized on the root, inside of the preverb; thus, the 3sg present indicative active form of the third-conjugation compound verb *pari-dhā*- 'put around' is *pari-da-dhāti*.

Table 4.1 *Some inflected forms of five compound verb roots in Sanskrit*

Verb root	Compound verb root	3sg Present indicative	3sg Imperfect
gam- 'to go'	*vi-gam-* 'to go away'	*vi-gacchati*	*vy-a-gacchat*
car- 'to act'	*abhi-car-* 'to charm'	*abhi-carati*	*abhy-a-carat*
nī- 'to lead'	*pari-ṇī-* 'to marry'	*pari-ṇayati*	*pary-a-ṇayat*
labh- 'to seize'	*pra-labh-* 'to deceive'	*pra-labhate*	*pra-a-labhata (prālabhata)*
śī- 'to recline'	*saṃ-śī-* 'to be doubtful'	*saṃ-śete*	*sam-a-śeta*

This is not a peculiarity of Sanskrit; similar examples can be found in a wide range of languages, e.g. Breton *tok-sivi* 'strawberry hull' (literally, 'hat-strawberries'), plural *tokoù-sivi* (cf. *tok* 'hat', plural *tokoù*); English *mother-in-law*, plural *mothers-in-law* (cf. *mother*, plural *mothers*); English *un-happy*, comparative *un-happier* (cf. *happy*, comparative *happier*); English *hafta*, 3sg present indicative *hasta* (Pullum 1997); German *einsehen* 'examine', past participle *eingesehen* (cf. *sehen* 'see', past participle *gesehen*); Russian *mýt'-sja* 'wash oneself', 1pl present *móem-sja* (cf. *mýt'* 'wash', 1pl present *móem*); Southern Barasano *wi-aka* 'little house', plural *wiri-aka* (cf. *wi* 'house', plural *wiri*); and so on. What ties these examples together is that they all embody the tendency in (1); that is, they exhibit HEAD MARKING.

(1) Headed roots inflect on their heads.

In this chapter I investigate the details of this tendency. Specifically, I will be concerned with two main questions:

(2) a. Do all headed roots exhibit head marking in their inflection?
b. If not, what is it that determines whether a given headed root will do this?

In addressing these questions, I shall assert the following four claims about head marking:

(3) a. Not all headed roots exhibit head marking.
b. Purely morphological properties do not percolate from the head of a root to the root as a whole.
c. Coderivative Uniformity Generalization:
Headed roots arising through the application of the same category-preserving rule are alike in exhibiting or in failing to exhibit head marking.
d. Paradigm Uniformity Generalization:
Roots that exhibit head marking do so categorically, throughout their paradigm of inflected forms.

Ultimately, I argue that PFM provides the most adequate account of the generalizations in (3); in particular, I conclude that the need to capture these generalizations provides strong motivation for the postulation of paradigm functions in morphological theory.

My discussion proceeds as follows. In section 4.2, the assumed notion of morphological headedness is elucidated. In section 4.3, the details of the four generalizations in (3) and their implications for learnability are discussed. In the sections which follow, two conceptions of head marking are evaluated: according to the Head Operation Hypothesis (section 4.4), head marking is a stipulated property of individual realization rules; in PFM, by contrast, head marking is seen as the effect of a universal constraint on the relation between the root of an inflectional paradigm and the words constituting that paradigm (section 4.5). I argue that only the latter conception of head marking affords an adequate account of generalizations (3a,c,d). In section 4.6, I examine several apparent counterexamples to generalization (3d) but conclude that none genuinely disconfirms it. In section 4.7, the special problems posed by the inflection of headed derivatives of the 'word-to-stem' type are recapitulated, though discussion of these problems is deferred until section 6.5.2. In section 4.8, my main conclusions about headedness are summarized.

4.2 Headed morphological expressions

As I have argued elsewhere (Stump 1991, 1993a,d), the only expressions that need to be considered headed in a realizational theory of morphology are those arising through the application of a category-preserving rule of derivation or compounding. The property which distinguishes rules of this sort is that of TRANSPARENCY. Suppose that a morphological rule M applies to a base *b* to yield a derivative or compound form *d*; following Stump (1993a), M will be said to be transparent with respect to the morphosyntactic property *P* if M allows *P* to persist from *b* to *d*. Each of the diminutivizing rules in (4a) is transparent in this sense.

(4) a. Some transparent rules of diminutivization:
  i. the Russian rule forming pejorative diminutives in -*iška*
  ii. the Southern Barasano rule forming diminutives in -*aka*
  iii. the Breton rule forming diminutives in -*ig*
 b. A nontransparent rule of diminutivization: the English rule forming diminutives in -*let*

The -*iška* rule (4ai) is transparent with respect to properties of gender: like its base *xvastún* 'braggart', the pejorative diminutive *xvastuníška* 'contemptible little braggart' is masculine, but like its base *kvartíra* 'apartment', the pejorative diminutive *kvartíriška* 'squalid little apartment' is feminine. The -*aka* rule (4aii) is transparent with respect to the major syntactic category of its base, applying to nouns to yield nouns (*wi* 'house', *wiaka* 'little house'), to adverbs to yield adverbs (*kẽdaro* 'well', *kẽdaroaka* 'slowly'), and to quantifiers to yield quantifiers (*bõhoro* 'few', *bõhoroaka* 'few'); see Jones and Jones (1991). The -*ig* rule (4aiii) exhibits similar properties: *bag* 'boat (feminine)', *bagig* 'little boat (feminine)'; *ti* 'house (masculine)', *tiïg* 'little house (masculine)'; *bihan* 'small', *bihanig* 'a little (too) small'; *bremañ* 'now', *bremaïg* 'presently'; and so on (see Hemon 1976). Unlike the rules in (4a), the *-let* rule (4b) is not clearly transparent: although *pig* and *piglet* are both nouns, it is not necessary to assume that *piglet* owes its nominal status to *pig*; because diminutives in *-let* are always nouns, one can instead simply assume that the *-let* rule assigns nominal status to its derivatives. But given that *-iška* derivatives aren't always masculine, that *-aka* derivatives aren't always adverbial, and that *-ig* derivatives aren't always adjectival, none of the masculine gender of *xvastuníška*, the adverbial status of *kẽdaroaka*, or the adjectival status of *bihanig* can be assumed to have been assigned by the relevant rule of diminutivization; rather, these properties must have been allowed to persist from the corresponding base forms. A rule will be said to be CATEGORY PRESERVING if it must be assumed to be transparent with respect to some morphosyntactic property; a rule which needn't be assumed to be transparent with respect to any morphosyntactic property is instead CATEGORY CHANGING. Thus, the rules in (4a) are category preserving, while (4b) is category changing. The head relation can now be defined as follows: *b* is the HEAD of a morphological expression *d* if and only if *d* arises from *b* through the application of a category-preserving rule. By this definition, diminutives in *-iška*, *-aka*, and *-ig* are headed by their derivational bases, while diminutives in *-let* are simply unheaded.

This definition does not exclude the possibility that a category-preserving rule might prevent certain properties from persisting from a base *b* to a derivative or compound form *d* headed by *b*; indeed, some category-preserving rules do in fact prevent certain properties from persisting in this way (Stump 1991:697ff.). First, *b* and *d* may belong to distinct morphological classes. Consider, for instance, the Yiddish forms in table 4.2 (from Bochner (1984:415) and Perlmutter (1988:90)). Each of the singular bases in the table belongs to the class of nouns forming their plural with *-im* (a Hebrew/Aramaic loan), but in the corresponding plural diminutive forms, the external plural affix is *-ex* rather than *-im*; thus, although the rule which introduces the diminutive suffix *-l* is transparent with respect to properties of number (and is therefore category preserving), it doesn't allow morphological class membership to persist from base to derivative.

A category-preserving rule may also cause the syntactic subcategorization properties of a base *b* to differ from those of a derivative or compound form *d* which it heads. When this happens, however, it is not because the rule imposes an entirely new set of subcategorization properties on *d*, but

Table 4.2 *Yiddish diminutive nouns of Hebrew/Aramaic origin and their bases*

	SINGULAR BASE	SINGULAR DIMINUTIVE	PLURAL BASE	PLURAL DIMINUTIVE
'bridegroom'	*xosn*	*xosndl*	*xasanim*	*xasanimlex*
'(religious) book'	*seyfer*	*seyferl*	*sforim*	*sforimlex*
'sin'	*xet*	*xetl*	*xatoim*	*xatoimlex*
'smart person'	*xoxem*	*xoxeml*	*xaxomim*	*xaxomimlex*
'Chasid'	*xosid*	*xosidl*	*xasidim*	*xasidimlex*

Table 4.3 *KṚ compounds and BHŪ compounds in Sanskrit*

BASE	KṚ COMPOUND
ADJECTIVAL:	
badhira- 'deaf'	*badhirī-kṛ-* 'deafen'
bhadra- 'beautiful'	*bhadrā-kṛ-* 'shave'
śukla- 'white'	*śuklī-kṛ-* 'whiten'
NOMINAL:	
bhasman- 'ashes'	*bhasmā-kṛ-* 'reduce to ashes'
vāja- 'strength'	*vājī-kṛ-* 'strengthen'
yūtha- 'herd'	*yūthī-kṛ-* 'make into a herd'
BASE	BHU COMPOUND
ADJECTIVAL:	
śukla- 'white'	*śuklī-bhū-* 'become white'
kṛṣṇa- 'black'	*kṛṣṇī-bhū-* 'become black'
yuvan- 'young'	*yuvī-bhū-* 'become young'
NOMINAL:	
bhasman- 'ashes'	*bhasmā-bhū-* 'become ashes'
mitra- 'friend'	*mitrī-bhū-* 'become a friend'
suvarṇa- 'gold'	*suvarṇī-bhū-* 'become gold'

because in forming *d*, it (partially or wholly) satisfies *b*'s subcategorization requirements. In later varieties of Sanskrit, for example, nominal and adjectival roots can be combined with forms of the verbs KṚ 'make, do' and BHU 'become' to make compound verbs, as in table 4.3 (cf. Whitney (1889:402)); those based on KṚ generally have a factitive interpretation, while those based on BHU have an inchoative interpretation. This compounding rule is transparent with respect to all morphosyntactic properties (for instance, the properties of agreement, tense, mood, and voice all persist from *karoti* 'makes' to *badhirī-karoti* 'deafens' and from *bhavati* 'becomes' to *śuklī-bhavati* 'becomes white') and is therefore category preserving; nevertheless, the subcategorization requirements of a compound introduced by this rule are not identical to those of its head, since the nominal/adjectival member of the compound serves as an argument of the verbal member, and in this way satisfies (part or all of) its subcategorization restriction.

A category-preserving rule may also prevent certain morphosyntactic properties from persisting from a base to a derivative or compound form which it heads (though, by definition, it cannot prevent all such properties from persisting). Consider, for example, the diminutivizing rule of *-chen* suffixation in German. This rule is transparent with respect to properties of number (as evidenced by forms such as *Kleiderchen* 'little clothes', *Blätterchen* 'little leaves', *Bücherchen* 'little books', *Dingerchen* 'little things'; Bauer 1983:26, citing Ettinger 1974:60) and is therefore category preserving; nevertheless, it imposes neuter gender on its derivatives, overriding the gender of the base noun (e.g. *die Hand* 'the hand (feminine)', but *das Händchen* 'the little hand (neut)').

The idea that a category-preserving rule might impose a morphosyntactic property is initially somewhat troubling, since there are seemingly some category-changing rules whose effects are likewise limited to the imposition of morphosyntactic properties. For instance, the French suffix *-esse* changes the gender specification of a masculine noun with which it joins (e.g. *abbé* (masculine), *abbesse* (feminine)), but otherwise seemingly leaves the noun's morphological, morphosyntactic, and subcategorization properties unchanged. Nevertheless, the German diminutive suffix *-chen* differs from the French suffix *-esse*. When *-chen* joins with a nominal base, it allows at least one of its morphosyntactic properties to persist to the corresponding derivative: *Kinderchen* 'little children' is plural precisely because *Kinder* 'children' is plural. On the other hand, there is no evidence against the assumption that *-esse* suppresses all of the morphosyntactic properties of the base with which it joins. For instance, although there is at least one morphosyntactic property which *abbé* and *abbesse* have in common (namely the property 'singular'), there is no reason to assume that this property persists from *abbé* to *abbesse*; on the contrary, singular number is associated with *abbesse* in precisely the same way as it is associated with underived singular nouns in French. The fundamental difference between category-preserving rules of derivation/compounding and category-changing rules is that only the former must be seen as allowing one or more morphosyntactic properties to persist from a base to the derivative or compound to which it gives rise.

Although a category-preserving rule may give rise to a derivative or compound form which differs from its head with respect to its morphological class membership, its subcategorization properties, or some of its morphosyntactic properties, it is a general characteristic of category-preserving rules that they produce derivatives or compounds whose major syntactic category matches that of their base; that is, a sufficient (though not a necessary) property of category-changing rules is that of producing derivatives belonging to a major syntactic category distinct from that of the corresponding base. Given this fact, the foregoing conception of headedness entails that derivatives whose bases belong to a different syntactic category cannot possibly exhibit head marking because they are by definition unheaded. This entailment is correct: where *d* derives from *b* and belongs to a major syntactic category distinct from that of *b*, the inflection of *d* is never effected through the inflection of *b*, even if *d* and *b* can in principle carry the same morphosyntactic properties; the adverb *quickly*, for example, does not have **quickerly* as its comparative form, nor does the German adjective *freundlich* 'friendly' have **freundelich* as its nominative plural form (Stump 1991:699).

4.3 Four generalizations about head marking

In this section, I discuss the evidence favouring the four generalizations in (3), their scope, and some implications for the learnability of inflectional morphology.

4.3.1 Not all headed roots exhibit head marking

Given the notion of 'head' proposed in section 4.2, the question of whether all headed roots exhibit head marking can now be addressed. The answer is apparently no. Consider again the diminutive forms *wiaka* and *xvastuníška*, each of which is headed by its nominal base. Of the two, only *wiaka* exhibits head marking: when inflected for plural number, the inflection appears on the head noun *wi*: *wiriaka* (cf. *wi* 'house', plural *wiri*).[2] When *xvastuníška* inflects, by contrast, the inflection appears externally rather than on the head noun *xvastún*; for instance, the genitive singular form of *xvastuníška* is *xvastuníški* (cf. *xvastuná* 'braggart (genitive singular)'). Still other headed roots follow yet a third pattern of inflection, in which the inflected form is marked both externally and on its head: when pluralized, the Breton headed diminutive *bagig* 'little boat' shows two inflectional exponents, one on the head noun, the other external – *bag-où-ig-où* [boat-PLURAL-DIMINUTIVE-PLURAL]. Thus, headed roots fall into three subclasses – the head-marking (HM) subclass exemplified by *wiaka*, the external-marking (EM) subclass exemplified by *xvastuníška*, and the double-marking (2M) subclass exemplified by *bagig*.

These are subclasses of headed roots; thus, not all roots which exhibit 'external' inflection belong to the EM subclass, since many roots fail to exhibit head marking precisely because they aren't headed. Consider, for example, the class of English verbs that includes *moonlight*, *moonshine*, and *grandstand*, which inflect as weak verbs (*moonlighted*, *moonshined*, *grandstanded*) despite the fact that *stand* and – for many speakers – *light* and *shine* inflect as strong verbs (*stood*, *lit*, *shone*). Despite their 'external' inflection, these do not belong to the EM subclass. The verb *moonlight* is not a compound of the noun *moon* with the verb *light*, but instead arises by conversion from the nominal compound *moonlight* (whose meaning is, metaphorically at least, a part of the meaning of the verb); in the same way, the verbs *moonshine* and *grandstand* arise by conversion from the nominal compounds *moonshine* and *grandstand*, respectively. Conversion is a category-changing process, so on the assumption that only category-preserving processes produce headed expressions, the verbs *moonlight*, *moonshine*, and *grandstand* are unheaded.

In view of the validity of generalization (3a), an important criterion of adequacy for any theory of head marking is its success in delimiting the three subclasses of headed roots. That is, given any headed root, a theory of head marking should furnish some means of determining whether that root is one which inflects on its head, one which inflects externally, or one which ends up doubly inflected.

4.3.2 Head marking vs. the percolation of purely morphological properties

Consider now generalization (3b), which might be restated in more detailed terms as in (5):

(5) Purely morphological properties (i.e. specifications of morphological class membership) do not persist from the head of a root to the root as a

whole; thus, when a headed root systematically exhibits the inflectional markings proper to the morphological class of its head, it does so as an effect of head marking.

Consider an example. In Latin, verb roots can be compounded with preverbs in much the same way as in Sanskrit. Latin compound verb roots exhibit the properties in (6).

(6) a. Compounds of a given verb root systematically exhibit the inflectional markings proper to the conjugation of the root itself; thus, compounds of *dūcere* 'lead' (e.g. *addūcere* 'lead to', *indūcere* 'lead in', *redūcere* 'lead back') exhibit the inflectional markings typical of the third conjugation, to which *dūcere* belongs.

b. Any irregularities in the inflection of a given verb root generally show up in the inflection of that root's compounds: for instance, just as *ferre* 'carry' exhibits a suppletive stem *tul-* in the perfect (1sg perfect indicative active *tulī*), so do its compounds, e.g. *cōnferre* 'bring together', 1sg perfect indicative active *contulī*; *offerre* 'offer', 1sg perfect indicative active *obtulī*; *prōferre* 'bring forward', 1sg perfect indicative active *prōtulī*.

There are two alternative ways in which one might explain these facts. On the one hand, one could say that whatever purely morphological property causes a verb root to inflect in a particular way percolates from that root to any compound which it heads; for instance, one might say that the specification 'third conjugation' percolates from *dūcere* to *addūcere*, causing it to inflect in exactly the same fashion as its head.[3] Alternatively, one could regard the facts in (6) as a manifestation of head marking – that is, one could assume that if a compound verb root and its head exhibit the same inflectional peculiarities, this is precisely because the inflection of the compound is effected through the inflection of the head; for instance, one might say that *addūcere* inflects through the inflection of its head *dūcere* and therefore inevitably preserves whatever inflectional peculiarities exist in *dūcere*'s paradigm.

Because preverbs and inflectional markings appear on opposite sides of the root heading a Latin compound verb, there is no obvious way to choose between these two alternative accounts of the facts in (6). In other languages, however, the choice between the PERCOLATION APPROACH and the HEAD-MARKING APPROACH is a clearer one. Sanskrit compound verbs, for example, exhibit properties parallel to those in (6); in Sanskrit, however, there is at least one prefixal verb inflection, namely the augment *a-*, and the fact that it is always positioned internally relative to a preverb decisively favours the head-marking approach over the percolation approach.

The question therefore arises whether the percolation approach is ever necessary to account for facts such as those in (6). The answer, I shall argue, is no – that is, I shall argue that if a headed root systematically exhibits the inflectional markings appropriate to the morphological class of its head, this is necessarily the consequence of head marking rather than percolation. This is the fundamental content of generalization (5).

The only certain way to test generalization (5) is to examine headed roots which cannot be assumed to exhibit head marking: if such roots systematically exhibit the inflectional markings appropriate to the morphological class of their heads, then percolation is the only available explanation for this fact, and (5) is therefore disconfirmed; but if such roots do not systematically exhibit the inflectional markings appropriate to the morphological class of their heads, then there is no clear counterevidence to (5), whose adoption would therefore be favoured by Occam's Razor.

A class of headed roots which fail to exhibit head marking has already been encountered: the EM subclass of section 4.3.1. When members of this subclass inflect, they do not systematically exhibit the inflectional markings proper to the morphological class membership of their head. Although the Russian noun *xvastún* 'braggart' belongs to the first declension, its pejorative diminutive *xvastuníška* inflects as a second-declension noun; contrast the genitive singular forms *xvastuníški* and *xvastuná* cited above. Or consider Breton -*ad*, a productive suffix whose rough equivalent in English is the suffix -*ful* in *handful*. Because the -*ad* rule is transparent with respect to properties of gender (*dorn* 'hand (masc)', *dornad* 'handful (masc)'; *poezell* 'bushel (fem)', *poezellad* 'bushelful, contents of a bushel (fem)'), it is category-preserving; -*ad* derivatives are therefore headed by their nominal base. When an -*ad* derivative is inflected for plural number, the plural suffix -*où* is positioned externally rather than on the head – *dornadoù*, *poezelladoù*; in other words, -*ad* derivatives belong to the EM subclass of headed roots. Like Russian pejorative diminutives in -*iška*, -*ad* derivatives do not systematically exhibit the inflectional markings proper to the morphological class membership of their head; for instance, although the Breton noun *ti* 'house' takes -*ez* as its plural suffix, its -*ad* derivative *tiad* 'houseful' instead takes -*où* as its plural suffix (*tiadoù*, **tiadez*). These examples are, to my knowledge, absolutely typical; I know of no case in which a headed root which cannot be assumed to exhibit head marking must nevertheless be assumed to inherit its morphological class membership from its head. In view of this evidence, I adopt (5) as a universally valid generalization about headed roots.[4]

Diachronic evidence confirms the validity of (5). On the head-marking approach, a root X headed by Y does not share Y's purely morphological properties; the inflectional parallelism between X and Y is instead simply a consequence of the fact that X inflects through the inflection of Y. On the percolation approach, by contrast, X does share Y's purely morphological properties, and this fact ensures their inflectional parallelism. The head-marking approach entails that if X should come to be viewed by speakers as unheaded, then it should automatically cease to exhibit any systematic inflectional parallelism to Y; the percolation approach, by contrast, entails that X should continue to inflect like Y even when speakers no longer perceive X as headed. Of the two entailments, the former is the correct one. Consider, for example, the verb *behave*. According to the *OED*, *behave* (in the sense 'to have or bear oneself in a specified way') arose as a derivative of *have* at the beginning of the Early Modern English period. At first, its inflection systematically paralleled that of *have* (as e.g. in (7)); that is, it was a headed root, typically of deverbal derivatives in *be-* (most of which inflect as headed roots to the present day – cf. *become/became*, *befall/befell*, *behold/beheld*, *bespeak/bespoke*).

(7) Yet in all her trybulacions she behad her so paciently.
(ante 1520, *The myroure of oure Ladye*, 241)

Through time, however, *behave* came to be perceived as unheaded; indeed, there is clear evidence that *behave* was disassociated from *have* quite early on. In Early Modern English, the stem *have* had both a 'strong' alternant [hɛːv] appearing in stressed positions (as in the exact rhyme (8) cited by Barber 1976:320f.) and a 'weak' alternant [hæv] restricted to unstressed positions.

(8) Furnish and deck my soul, that thou mayst *have*
A better lodging, then a rack, or *grave*
(1633, George Herbert, 'Christmas')

Over a certain period, the weak stem-alternant was generalized to stressed positions as well, replacing the strong stem-alternant throughout the paradigm of *have*.[5] The fact that this generalization of the weak stem-alternant was not simultaneously manifested in the paradigm of *behave* (whose present-day pronunciation stems from that of the strong stem-alternant) suggests that by that period, *have* was no longer perceived as the head of *behave*. The head-marking approach predicts that at this point, *behave* should have ceased to exhibit any systematic inflectional parallelism to *have*. This prediction is correct: by the end of the Early Modern English period, *behave* had come to exhibit the default inflection of an ordinary weak verb, as in (9).

(9) He was some Years a Captain, and behaved himself with great Galantry in several Engagements.
(1711, Sir Richard Steele, *The Spectator* No.2 ¶4)

In order to account for this development under the percolation approach, one must instead make the implausible assumption that when *behave* ceased to be viewed as headed, it simultaneously and coincidentally switched from one conjugation class to another. Thus, the diachronic development of *behave* provides additional evidence in favour of (5).

4.3.3 *The uniformity of head marking among coderivatives*

To facilitate discussion of generalization (3c), it will be useful to introduce a special piece of terminology: let any two expressions be termed CODERIVATIVES if they arise through the application of the same rule of derivation or compounding. Thus, *ni-pat-* 'fly down' and *pra-labh-* 'deceive' are coderivatives, since they both arise through the application of the Sanskrit rule of verbal compounding; *xvastuníška* 'contemptible little braggart' and *kvartíriška* 'squalid little apartment' are coderivatives, since they both arise through the application of the Russian rule of *-iška* suffixation; and so on. Generalization (3c) can then be stated as a property of coderivatives, as in (10):

(10) Coderivative Uniformity Generalization (CUG):
Where X and Y are headed coderivatives, either X and Y both exhibit head marking or neither does.

This generalization holds true even if X and Y are inflected by means of distinct rules. Consider, for instance, the Breton expressions *tok-sivi* 'strawberry hull' and *kazh-koad* 'squirrel' (literally, 'cat-wood'), which both arise through the application of the category-preserving rule of left-headed compounding: these both exhibit head marking in their inflection even though they are pluralized by means of distinct rules – *tokoù-sivi* (with *-où* suffixation), but *kizhier-koad* (with umlaut-inducing *-ier* suffixation). Similarly, consider the Southern Barasano diminutives *wiaka* 'little house' and *ohoaka* 'little bananas', which both arise through the application of the category-preserving rule of *-aka* suffixation (to the collective noun *oho* 'bananas', in the latter instance): these both exhibit head marking in their inflection even though they are inflected by means of distinct rules realizing distinct properties; *wiriaka* 'little houses' involves the pluralizing rule of *-ri* suffixation while *ohoroaka* 'little banana' involves the singularizing rule of *-ro* suffixation. The Russian pejorative diminutives *xvastuníška* 'contemptible little braggart' and *kvartíriška* 'squalid little apartment', which both arise through the application of the category-preserving rule of *-iška* suffixation, are alike in failing to exhibit head marking; and so on.

Apparent exceptions to the CUG are occasionally encountered, but these generally involve forms comparable to *behave* (section 4.3.2) – forms which, through time, have lost their status as headed roots. The Breton noun *potouarn* 'cooking pot', for instance, arose historically as a left-headed compound from *pod* 'pot' and *houarn* 'iron'; but unlike ordinary left-headed compounds, *potouarn* inflects externally rather than on its head (*potouarnioù* 'cooking pots'). The explanation, of course, is that *potouarn* has ceased to be viewed as a compound, reductive phonological processes (including a regressive vowel assimilation yielding *poutouarn* in some dialects; Trépos 1957:107) having sufficiently obscured its historical origin as *pod-houarn*. Thus, the CUG is not counterexemplified by the *potouarnioù*/*tokoù-sivi* contrast any more than by the *behaved*/*befell* contrast.

In theoretical terms, the CUG imposes a specific requirement on the principles invoked to delimit the three subclasses of headed roots identified in section 4.3.1: whatever these principles might be, if they place X in the HM subclass, they must likewise place X's coderivatives in the HM subclass.

4.3.4 The uniformity of head marking within an inflectional paradigm

The CUG relates to the uniformity of head marking among headed coderivatives. It is important to recognize, however, that head marking also exhibits a kind of uniformity within the inflectional paradigm of any one headed derivative, in accordance with (3d), the Paradigm Uniformity Generalization (PUG). According to the PUG, head marking is an all-or-none phenomenon: if a root ever exhibits head marking in its inflectional paradigm, it always does.

Evidence favouring this generalization can be found both in the inflection of individual words and in the inflectional patterns exhibited by entire paradigms. At the level of individual words, the PUG is supported by the following fact: given a headed root X associated with a set σ of morphosyntactic properties, if any exponent of σ in the inflection of X is realized by head marking, then every such exponent is. In Sanskrit, verb roots in the third conjugation form their present-tense stem by means of a reduplicative prefix; for instance, the third-conjugation root *dhā-* 'put' has *dadhā-* as its present-tense stem. Because the imperfect is formed from the present-tense stem, both the augment and the reduplicative prefix show up in imperfect forms, e.g. 3sg imperfect active *adadhāt* 's/he put'. Now, when a third-conjugation verb root is compounded with a preverb and the result is inflected for the imperfect tense, both the augment and the reduplicative prefix appear on the head; for instance, the 3sg imperfect active form of *pari-dhā-* 'put around' is *paryadadhāt*. What one does not find – in Sanskrit or anywhere else, to my knowledge – is the situation in which one inflectional exponent appears on the head of a root while the other appears externally; that is, while one can imagine a Sanskrit-like language in which imperfect forms of *pari-dhā-* would exhibit an internal reduplicative prefix but an external augment (as e.g. in **aparidadhāt*), it is not clear that any real language actually exhibits this kind of pattern.

In the foregoing example, the incidence of head marking is transparently revealed by the linear ordering of the two prefixal inflections with respect to the preverb. But once generalization (5) is accepted, other kinds of evidence can then be seen to confirm the PUG. Consider the fact that a compound verb systematically exhibits the suffixal inflections proper to the morphological class of its head: for instance, the compound *ni-pat-* 'fly down' forms its present-tense stem *ni-pat-a-* by means of the *-a* suffix appropriate to the first conjugation, to which its head *pat-* 'fly' belongs. According to (5), this fact about suffixal morphology must be attributed to head marking. Consequently, the PUG receives additional confirmation from the absolute typicalness of forms such as 3sg imperfect active *ny-a-pat-a-t* 's/he flew down' (in which the augment is positioned on the head and the stem-forming suffix is appropriate to the conjugation class to which the head belongs) and from the nonexistence of forms such as **a-ni-pat-a-t* (in which the stem-forming suffix is appropriate to the head's conjugation class while the augment is externally positioned) and **ny-a-pat-no-t* (in which the augment is positioned on the head while the stem-forming suffix is inappropriate to the head's conjugation class).

At the level of entire paradigms, the PUG is further supported by the fact that if a root exhibits head marking in any cell of its inflectional paradigm, it will do so in every cell in which it is overtly inflected. For instance, the compound verb root *ni-pat-* exhibits head marking everywhere that it is possible for it to do so: thus, note the position of the augment in 3sg imperfect active *ny-a-patat*, that of the reduplicative prefix in 3sg perfect active *ni-pa-pāta*, and that of both the augment and the reduplicative prefix in 3sg aorist active *ny-a-pa-ptat*. While one can imagine a Sanskrit-like language in which *ni-pat-* would exhibit head marking in the imperfect but not the perfect, no language known to me actually exhibits this sort of variation within its inflectional paradigm.

Given this evidence, I adopt the PUG as a universally valid generalization. There are some apparent counterexamples to this generalization – instances in which a paradigm seems to exhibit non-uniform head marking; in section 4.6, however, I shall argue that all such counterexamples are merely apparent. In particular, I shall argue that apparent counterexamples are of three types: instances in which a paradigm actually does exhibit uniform head marking but appears not to for independent reasons; instances in which the members of a paradigm exhibiting uniform head marking give rise to extraparadigmatic forms incapable of exhibiting head marking; and instances in which a paradigm which seems to exhibit nonuniform head marking actually involves an unheaded root exhibiting no head marking at all.

In view of the validity of the PUG, a final criterion of adequacy for theories of head marking can now be identified: a theory which entails the PUG is more adequate than one which does not.

4.3.5 The implications of the CUG and the PUG for the learnability of inflectional morphology

It is logical that the CUG and the PUG should exist as theorems of universal grammar, since their effect is to make morphological systems more learnable. It is clear that a language's category-preserving rules of derivation and compounding vastly expand its stock of inflectable lexemes, and that the phenomenon of head marking simplifies the task of learning the inflectional properties of this expanded set of lexemes, enabling language learners to deduce the inflected form of a headed derivative from the corresponding inflected form of its head. Consider, particularly, the special problems posed by languages with rich inflection. If the principles of universal grammar did not entail the PUG, then the incidence of head marking in one cell of a lexeme's paradigm would not necessarily allow language learners to deduce the incidence of head marking in other cells of that paradigm. But if the PUG is a theorem of universal grammar, then the incidence of head marking in a single cell of a derivative lexeme's paradigm generally allows language learners to deduce every other form in the paradigm from the inflectional properties of the derivative's head. If the principles of universal grammar entail the PUG but not the CUG, then the incidence of head marking in one lexeme's paradigm reveals nothing about the incidence of head marking in the paradigm of that lexeme's coderivatives; but if both the PUG and the CUG are theorems of universal grammar, then the incidence of head marking in a single cell of a derivative lexeme's paradigm generally helps language learners to deduce every form in every cell of every coderivative's paradigm. If the PUG and the CUG can be maintained, as I believe they can, then they reflect extraordinarily strong constraints on the inflection of headed roots.[6]

4.4 The Head Operation Hypothesis

As noted in section 4.3, any adequate theoretical approach to the phenomenon of head marking must do at least two things: first, it must delimit the HM, EM, and 2M subclasses, and do so in a way that entails the CUG; second, it must predict the PUG. In this section and the one which follows, I shall evaluate two alternative theories of head marking according to these two criteria.

Hoeksema 1984 and others (e.g. Zwicky 1987b, Aronoff 1988, Anderson 1992, Rainer 1993) have pursued the hypothesis that some realization rules are HEAD OPERATIONS, whose application to an expression results in some kind of marking on that expression's head. Under this hypothesis (the HEAD OPERATION HYPOTHESIS (HOH)), head marking is formalized as a property of individual realization rules; for instance, the fact that the augment *a-* appears on the verb root *pat-* in preterite forms of Sanskrit *ni-pat-* 'fly down' is accounted for by stipulating that the Sanskrit rule of *a*-prefixation is a head operation. Accordingly, the distinction between the HM and EM subclasses of headed roots is seen as a distinction between those roots that inflect by means of head operations and those that inflect by other means. (For the present purposes, I shall refer to realization rules that aren't head operations as SIMPLE OPERATIONS.) For instance, the inflectional difference between the Southern Barasano diminutive *wiaka* 'little house' and the Russian diminutive *xvastuníška* 'contemptible little braggart' is seen as a difference in the kinds of realization rules to which they are subject: the rule of *-ri* suffixation by which *wiaka* is pluralized is a head operation, whose effect is to convert *wiaka* to *wiriaka*; by contrast, the rule of *-i* suffixation giving rise to the genitive singular form *xvastuníški* is a simple operation rather than a head operation.

In itself, this approach to the delimitation of the HM and EM subclasses does not entail the CUG; that is, given any two headed roots X and Y which inflect by means of distinct sets of rules, the HOH carries no implication that they will either both exhibit head marking or both fail to do so, even if X and Y are coderivatives. To the extent that such uniformity exists among the derivatives produced by a given category-preserving rule, the HOH portrays this as coincidence. One might attempt to remedy this difficulty by introducing a well-formedness condition on sets of headed coderivatives – one stipulating that if any member of such a set inflects by means of a head operation, then all members of that set must do likewise (even where the inflectional operations involved are distinct; cf. *tokoù-sivi*/*kizhier-koad*, *wiriaka*/*ohoroaka*, section 4.3.3). But even if this condition is adopted, the need to delimit the three subclasses of headed roots presents intractable problems for the HOH.

According to the assumptions underlying the HOH, a realization rule either is a head operation or is not; either it marks the head of every expression to which it applies or it applies 'externally', blindly marking the relevant expressions as wholes. The HOH therefore predicts that no realization rule will effect head marking in some instances but external marking in others. This prediction is not borne out, however (Stump 1991:692ff.). In Breton, nominal compounds are headed by their left-hand member, and they inflect for number on their head. For instance, the compound *tok-sivi* 'strawberry hull' (literally, 'hat-strawberries') has *tokoù-sivi* as its plural form; cf. *tok*/*tokoù*, 'hat'/'hats'. On the assumptions underlying the HOH, this fact must be taken as evidence that the realization rule introducing the plural suffix *-où* is a head operation; it then follows that *-où* should never be positioned at the periphery of a headed noun. Yet, there are at least two classes of headed nouns in whose plurals the suffix *-où* is positioned peripherally. As noted in section 4.3.2 above, Breton *-ad* derivatives exhibit external inflection: *ti* 'house', plural *tiez*, but *tiad* 'houseful', plural *tiadoù*/**tiezad*. Similarly, Breton has a productive suffix *-vezh* used to form nouns of duration. The *-vezh* rule is category preserving (*miz* 'month (masc)', *mizvezh* 'month's duration (masc)'; *noz* 'night (fem)', *nozvezh* 'night's duration (fem)') and therefore produces headed derivatives; yet, the plural suffix *-où* is positioned externally rather than on the head of a *-vezh* derivative (*mizvezhioù*, *nozvezhioù*). These facts are fundamentally incompatible with the HOH: they demonstrate that the difference between those roots that exhibit head marking and those that do not cannot, in general, be reduced to a difference between head operations and simple operations.

The existence of the 2M subclass of headed roots is also inherently problematic for the HOH. Recall the example of Breton nominal diminutives in -*ig*: when these pluralize, they are marked with two plural affixes, one of which is positioned on the head noun, the other of which is positioned peripherally (section 4.3.1); the fact that the same affix may appear in both positions (as in *bag-où-ig-où* 'little boats') is not reconcilable with the HOH.

From this evidence, it is clear that the HOH does not furnish a satisfactory delimitation of the HM, EM, and 2M subclasses of headed roots; the notion that they are distinguished by the kinds of realization rules to which they are subject cannot be maintained.

In itself, the HOH does not predict the PUG. According to the assumptions underlying the HOH, there is no reason to expect that the forms in a complex inflectional paradigm should either all exhibit or all fail to exhibit head marking; indeed, since head marking is, on this view, a stipulated property of individual rules of inflection, the HOH actually leads one to expect that the forms in a paradigm might vary according to whether they exhibit head marking. Thus, to the extent that the PUG holds, it is portrayed as pure coincidence under the HOH. To remedy this difficulty, one would have to assume a kind of well-formedness condition on paradigms requiring that the forms in a paradigm either all arise by head operations or all arise by simple operations.

Once well-formedness conditions of this sort are resorted to, the question naturally arises whether one could account for the CUG and the PUG purely by means of such conditions, without even assuming the existence of head operations. In the following section, I argue that this is in fact the case; in particular, I argue for a paradigm-based theory of head marking in which the CUG and the PUG follow from the Head-Application Principle (itself a kind of well-formedness condition on paradigms) and in which the notion of head operations is dispensed with entirely.

4.5 Head marking in PFM

As the evidence presented in the preceding section has shown, the HOH does not afford a satisfactory delimitation of the HM, EM, and 2M subclasses, nor can it predict the PUG without supplementary conditions. In this section, I discuss an alternative, paradigm-based theory of head marking; unlike the HOH, the paradigm-based theory satisfies both of the assumed criteria of adequacy.

The paradigm-based approach to head marking is integral to the network of assumptions constituting PFM. In this approach, there are no head operations; that is, all realization rules are simple operations (in the sense of section 4.4). Head marking is not a property of individual realization rules, but is the effect of a universal constraint on the relation between the root of an inflectional paradigm and the words constituting that paradigm; this constraint is the HEAD-APPLICATION PRINCIPLE. In informal terms, the effect of this constraint is to enforce the regularity in (11).

(11) Where root Y is headed by root Z (and is a member of the HM subclass), each word in Y's inflectional paradigm is headed by the corresponding word in Z's inflectional paradigm.

Thus, on the assumption that Sanskrit *ni-pat-* is headed by *pat-* (and is a member of the HM subclass), the Head-Application Principle correctly requires that the 3sg imperfect active member of the paradigm of *ni-pat-* (i.e. *nyapatat*) be headed by the corresponding member of the paradigm of *pat-* (i.e. by *apatat*).

The definition of the Head-Application Principle presupposes a particular conception of the boundaries separating the three subclasses of headed roots. According to the view of headedness discussed in section 4.2, every headed morphological expression Y is the result of applying a category-preserving rule M to a morphological expression Z: Y = M(Z). Suppose, now, that the inflection of Y is effected by a realization rule R. What is it that determines whether this inflection appears on Y as a whole or on its head Z? According to the HOH, this is determined by the formulation of R: if R is stated as a head operation, Z receives the inflectional marking, and if not, Y does; thus, the inflectional difference between Southern Barasano *wiriaka* and Russian *xvastuníški* is attributed to a difference between two realization rules, the first of which is a head operation and the second of which isn't. In the paradigm-based theory, however, this assumption is rejected in favour of the assumption that in all cases, M is what determines whether the inflection of Y is realized through head marking, external marking, or double marking – that whether a headed root exhibits head marking, external marking, or double marking is strictly determined by the category-preserving rule which generates that root. On this view, category-preserving rules are of three types: those that consistently give rise to members of the HM subclass of headed roots, those that consistently give rise to members of the EM subclass, and those that consistently give rise to members of the 2M subclass. Thus, the distinct patterns of inflection exhibited by Southern Barasano *wiriaka*, Russian *xvastuníški*, and Breton *bagoùigoù* are assumed to follow from differences among the rules of *-aka* suffixation (whose derivatives all belong to the HM subclass), *-iška* suffixation (whose derivatives all belong to the EM subclass), and *-ig* suffixation (whose derivatives all belong to the 2M subclass).

In delimiting the three subclasses of headed roots in this way, the paradigm-based approach in effect elevates the CUG to the status of a theoretical principle. According to the CUG, there is a class of category-preserving rules whose derivatives all belong to the HM subclass and jointly constitute its full membership. Under the paradigm-based approach, this observational correlation holds true by definition: certain category-preserving rules are formulated so as to ASSIGN their derivatives to the HM subclass, and together, these rules constitute an exhaustive definition of the HM subclass's membership. In the same way, distinct sets of category-preserving rules define the memberships of the EM and 2M subclasses. This way of delimiting the HM, EM, and 2M subclasses avoids the difficulties encountered by the HOH in section 4.4. For instance, the fact that the Breton plural inflection *-où* appears on the head of *tokoù-sivi*, at the periphery of *tiadoù*, and both on the head and at the periphery of *bagoùigoù* is unproblematic: one need only say that the rule of nominal compounding produces derivatives in the HM subclass, that the rule of *-ad* suffixation produces derivatives in the EM subclass, and that the rule of *-ig* suffixation produces derivatives in the 2M subclass.

It is not clear that the subclass (HM, EM, or 2M) to which a given category-preserving rule assigns its derivatives can be deduced from any independent property of that rule; that is, the subclass to which a rule of this sort assigns its derivatives must seemingly just be stipulated as part of that rule's formulation. A stipulation of this sort amounts to a restriction on the range and domain of the rule in question. Thus, a category-preserving rule which assigns its derivatives to the EM subclass (e.g. the Russian rule forming pejorative diminutives in *-iška*) will be termed a ROOT-TO-ROOT rule, one which assigns its derivatives to the HM subclass (e.g. the Southern Barasano rule forming diminutives in *-aka*) will be called a WORD-TO-WORD rule, and one which assigns its derivatives to the 2M subclass (e.g. the Breton rule forming diminutives in *-ig*) will be called a WORD-TO-STEM rule.

The logic behind this terminology should be carefully noted. A root is any morphological expression lacking overt inflectional marking; a word is any morphological expression which may function as an independent syntactic constituent. Given these definitions, it is possible for an expression to qualify as both a root and a word (e.g. *dog*, *walk*, *yellow*), but this overlap is only partial; Latin *amīc-* 'friend', for example, is a root but not a word, and its nominative singular form *amīcus* is a NONRADICAL WORD (i.e. a word but not a root). A root-to-root rule has nonradical words in neither its range nor its domain: it always applies to the root of a base lexeme to yield the root of a derivative lexeme. A word-to-word rule, by contrast, does have nonradical words in its range and domain; in particular, it applies to the root of a base lexeme to yield the root of a derivative lexeme, but may also apply to a nonradical word in the paradigm of the base lexeme to yield a nonradical word in the paradigm of the derivative lexeme. The Southern Barasano *-aka* rule is word-to-word; it may, for example, apply to a noun carrying an overt plural inflection to yield the corresponding plural diminutive (*wi-ri* 'house-s', *wi-ri-aka* 'little houses'). The Russian *-iška* rule, however, is root-to-root: it never applies to nonradical words, but always applies to a root to yield a root. The Breton *-ig* rule cannot be legitimately classified as either root-to-root or word-to-word: on the one hand, it cannot be root-to-root because it applies freely to inflected plurals; on the other hand, it cannot be word-to-word because the expression resulting from its application to an inflected plural cannot function as an independent syntactic constituent. For instance, the *-ig* rule may apply to the inflected plural *bag-où* 'boat-s'; the resulting diminutive form *bag-où-ig-*, however, does not qualify as a word, but must itself receive additional marking for plural number (*bag-où-ig-où* 'little boats'). The intermediate expression *bag-où-ig-* belongs to the class of stems: stems aren't necessarily roots, because they may carry overt inflectional markings, but they are likewise not necessarily words, because they need not function as independent syntactic constituents. Accordingly, the *-ig* rule must be classified as a word-to-stem rule, whose application to the root of a base lexeme yields the root of a derivative lexeme (*bag* 'boat', *bagig* 'little boat') but whose application to a nonradical word in the paradigm of the base lexeme yields the stem for the corresponding member of the paradigm of the derivative lexeme (*bagoù*, *bagoùig-*).

With this three-way terminological distinction among category-preserving rules, one can draw the analogous distinction among ROOT-TO-ROOT DERIVATIVES, WORD-TO-WORD DERIVATIVES, and WORD-TO-STEM DERIVATIVES. Root-to-root derivatives are roots arising from other roots through the application of a root-to-root rule (hence members of the EM subclass). Word-to-word derivatives are expressions arising through the application of a word-to-word rule: a word-to-word derivative and its base are either both roots or both nonradical words; roots which are word-to-word derivatives constitute the membership of the HM subclass. Word-to-stem derivatives are expressions arising through the application of a word-to-stem rule: a word-to-stem derivative and its base are both roots or are a stem and a nonradical word, respectively; roots which are word-to-stem derivatives constitute the membership of the 2M subclass.

Given this conception of the boundaries separating the three subclasses of headed roots, the formal properties of the Head-Application Principle can now be considered. Where PF is a language's paradigm function and <Y,σ> is a root pairing in that language, the evaluation of PF(<Y,σ>) is directly determined by the language-specific definition of PF in any instance in which Y is not a word-to-word derivative. On the other hand, if Y is a word-to-word derivative, the evaluation of PF(<Y,σ>) is instead determined by the Head-Application Principle, a universal principle. Suppose that Y is a root arising from root Z through the application of a word-to-word rule M (i.e. that Y is a word-to-word derivative headed by Z): for any set σ of morphosyntactic properties associated with some cell in Y's paradigm, the Head-Application Principle requires the expression occupying the σ-cell in Y's paradigm to be the result of applying M to the expression occupying the σ-cell in Z's paradigm. Thus, the Head-Application Principle is defined as in (12) (cf. Stump 1991, 1993a).

(12) Head-Application Principle (HAP):
If M is a word-to-word rule and Y, Z are roots such that for some (possibly empty) sequence <S>, Y = M(Z,S), then where PF(<Z,σ>) = <W,σ>, PF(<Y,σ>) = <M(W,S),σ>.

A couple of examples will help illustrate. Suppose first that M is the Sanskrit compounding rule which applies to the root *pat*- 'fly' and the preverb *ni* to yield *nipat*- 'fly down', that σ is the set of morphosyntactic properties associated with the 3sg imperfect active cell in the paradigm of a Sanskrit verb, and that PF(<*pat*,σ>) = <*apatat*,σ>: by the HAP, PF(<*nipat*,σ>) = <*nyapatat*,σ>, where *nyapatat* is the result of using M to compound *apatat* with *ni*. Suppose now that M is the Southern Barasano rule of -*aka* suffixation, which applies to *wi* 'house' to yield its diminutive *wiaka*, and that PF(<*wi*,{NUM:pl}>) = <*wiri*,{NUM:pl}>: by the HAP, PF(<*wiaka*,{NUM:pl}>) = <*wiriaka*,{NUM:pl}>, where *wiriaka* is the result of applying M to *wiri*.

As it is defined, the HAP only regulates the evaluation of PF(<Y,σ>) if Y is a word-to-word derivative (a member of the HM subclass); it plays no role in the evaluation of a paradigm function applying to a root pairing having a root-to-root derivative as its first member. Thus, when the Breton paradigm function PF applies to the root pairing <*tok-sivi*,{NUM:pl}>, it is evaluated in accordance with the HAP because *tok-sivi* is a word-to-word derivative; but when this paradigm function applies to <*tiad*,{NUM:pl}>, where *tiad* is a root-to-root derivative, the HAP is inapplicable – the evaluation of PF is in this case entirely determined by the language-specific definition of PF supplied by the grammar of Breton. The HAP likewise plays no role in the evaluation of a paradigm function applying to a root pairing whose first member is a word-to-stem derivative such as *bagig*.

Because any coderivative of a word-to-word derivative is itself necessarily a word-to-word derivative, the HAP regulates the inflection of a headed root if and only if it likewise regulates the inflection of all of that root's coderivatives; that is, the paradigm-based approach to head marking entails the CUG, as noted earlier. Moreover, if the HAP determines the evaluation of PF(<X,σ>) for some choice of σ, then it does so for every choice of σ for which PF(<X,σ>) is defined; that is, the HAP entails the PUG. Thus, the paradigm-based theory of head marking embodied by the HAP satisfies both of the criteria of adequacy identified in section 4.3, successfully delimiting the membership of the three subclasses of headed morphological expressions and entailing both the CUG and the PUG. In view of this fact, the paradigm-based theory must be preferred to the HOH.

4.6 Some apparent counterexamples to the PUG

In this section, I examine some apparent counterexamples to the PUG – paradigms which seemingly exhibit head marking in some of their cells but not others. I argue that none of this evidence genuinely disconfirms the PUG. In particular, I argue that apparent counterexamples to the PUG are of three sorts: those involving a paradigm which exhibits uniform head marking but in which independent factors tend to obscure this uniformity; those involving a paradigm which exhibits uniform head marking but gives rise to extraparadigmatic forms incapable of exhibiting head marking; and those involving roots which are not genuinely headed and therefore exhibit head marking nowhere in their paradigm.

4.6.1 Conjunct forms

In Sanskrit, there are two affixes used in the formation of gerunds: -*tvā* and -*ya*. The suffix -*tvā* joins with uncompounded verb roots; for instance, the simple root *nī*- 'lead' has *nītvā* as its gerund. By contrast, the suffix *-ya* appears with compounded verb roots; for instance, the compound root *pari-ṇī*- 'marry' (literally 'lead around') has *pariṇīya* and not **pariṇītvā* as its gerund. (Cf. Whitney (1889:355f.).) In the form *pariṇīya*, the root *pariṇī*- seems not to exhibit head marking. Yet, because *pariṇī*- exhibits head marking elsewhere in its paradigm (e.g. 3sg imperfect active *pary-a-ṇayat*), it cannot simply be viewed as a root-to-root derivative comparable to *xvastuníška* (section 4.5), nor can it be assumed to have become headless through a gradual historical disassociation from *nī*- (comparable to the disassociation of *behave* from *have*, section 4.3.2). Thus, the apparent lack of head marking in *pariṇīya* seems genuinely problematic: to all appearances, *pariṇī*- is a headed root which exhibits head marking in some of the cells in its paradigm but fails to do so in its gerund cell; that is, it seems to counterexemplify the PUG. I shall argue, however, that the apparent lack of head marking in *pariṇīya* is merely apparent – that the contrast between Sanskrit gerunds in -*tvā* and -*ya* is instead the reflection of a more general phenomenon whose existence is in no way incompatible with the PUG.

A dramatic instance of this same phenomenon is furnished by Old Irish. In Old Irish, the verb *ber*- 'carry' has *bermai* as its 1pl present indicative form, but when it is compounded with a preverb, its 1pl present indicative form is instead -*beram*: *do-beram* 'we bring', *as-beram* 'we say', and so on; other forms in the paradigm of *ber*- are similarly distinct from their counterparts in the paradigms of *ber*-'s various compounds. In effect, an Old Irish verb exhibits two distinct sets of inflections: a set of ABSOLUTE inflections used when the verb is not compounded with a preverb, and a set of CONJUNCT inflections used when it is compounded. The partial paradigm of *berid* 'carries' in table 4.4 illustrates.

How is this seeming lack of head marking in the paradigm of *do-ber*- to be accounted for? One might, at first, be tempted to assume that *do-ber*- is simply a root-to-root derivative comparable to *xvastuníška*. Or one might try to argue that the lack of inflectional parallelism between *do-beram* and *bermai* is a sign that *do-ber*- has become disassociated from its erstwhile head *ber*- (just as *behave* became disassociated from *have*). But *xvastuníška* and *behave* both differ in a significant way from *do-beram*: both fall into inflectional patterns that are well-established among uncompounded forms – in the case of *xvastuníška*, the Russian second declension; in the case of *behave*, the English weak conjugation. By contrast, the inflectional pattern exhibited by *do-ber*- has no parallel in the morphology of uncompounded roots in Old Irish. Thus, while the rules by which *xvastuníška* and *behave*

Table 4.4 *Present indicative and future-tense forms of Old Irish* BERID *'carries' (Strachan 1949:35, 58)*

		ABSOLUTE INFLECTION	CONJUNCT INFLECTION
PRESENT INDICATIVE:	1SG	*biru*	*-biur*
	2SG	*biri*	*-bir*
	3SG	*berid, berith*	*-beir*
	1PL	*bermai*	*-beram*
	2PL	*beirthe*	*-berid*
	3PL	*berait*	*-berat*
FUTURE:	1SG	*béra*	*-bér*
	2SG	*bérae*	*-bérae*
	3SG	*béraid*	*-béra*
	1PL	*bérmai*	*-béram*
	2PL	*bérthae*	*-béraid*
	3PL	*bérait*	*-bérat*

are inflected are blind to the fact that these are (synchronically or diachronically) derivative forms, the rules by which *do-ber-* is inflected are in some way sensitive to its status as a compound verb root. Given, then, that *do-ber-* is unlike either *xvastuníška* or *behave*, its apparent failure to exhibit head marking remains to be accounted for.

Logically, there are at least two ways of looking at Old Irish verb inflection. On the one hand, one might assume a special set of realization rules whose application is restricted to compound roots (e.g. a rule of *-am* suffixation applying to *do-ber-* to yield *do-beram*); on this approach, the inflection of forms such as *do-beram* does not – cannot – involve head marking. On the other hand, one might assume that simple verb roots such as *ber-* literally do have two parallel paradigms, one absolute and one conjunct: by default, members of a verb's absolute paradigm are chosen over the corresponding members of its conjunct paradigm for use in syntactic combinations, but the morphological rule of compound verb formation is defined in such a way that its output for a given verbal argument is a function of that argument's conjunct form. On this latter approach, the inflection of compound forms such as *do-beram* DOES involve head marking: just as the compound root *do-ber-* arises from the root *ber-* through the application of a category-preserving rule, so each word in *do-ber-*'s paradigm arises from the corresponding word in *ber-*'s paradigm

Table 4.5 *Present indicative and future-tense forms of Old Irish* TÉIT *'goes' (Strachan 1949:89ff.)*

		ABSOLUTE	CONJUNCT
PRESENT INDICATIVE:	1SG	*tíagu*	*-tíag*
	2SG	*tégi*	*-téig*
	3SG	*téit*	*-tét*
	1PL	*tíagmai*	*-tíagam*
	2PL		*-téit*
	3PL	*tíagait*	*-tíagat*
FUTURE:	1SG	*rega*	*-rig, -reg*
	2SG	*regae*	*-regae*
	3SG	*regaid*	*-riga, -rega*
	1PL	*rigmi, regmai*	*-regam*
	2PL	*regthae* [?]	*-regaid*
	3PL	*regait*	*-regat*

through the application of that same rule. One way of deciding between these two approaches to Old Irish verb inflection is to look for independent evidence of head marking in the inflection of compound forms such as *do-beram*. If there is no such evidence, then one can maintain the former approach; if there is such evidence, then one must instead adopt the latter approach.

The latter approach turns out to be the right one. Suppose that a root X exhibits suppletive alternations within its inflectional paradigm and that X is the head of a derivative root Y; if the suppletive alternations in X's paradigm are preserved in Y's paradigm, then (given generalization (5), section 4.3.2) that is sufficient evidence of head marking in the inflection of Y. For instance, the fact that the *go/went* alternation is preserved in the inflection of *undergo* (past *underwent*) is sufficient evidence that *undergo* inflects through head marking. In view of this fact, consider now the partial paradigm of Old Irish *téit* 'goes' in table 4.5. As table 4.5 shows, the absolute paradigm of the verb *téit* 'goes' exhibits the suppletive stem form *tég-* (or its morphophonemic alternant *tíag-*; Thurneysen 1946:36) in the first- and second-persons singular and the first- and third-persons plural of the present indicative (Thurneysen 1946:376, 472); it further exhibits the suppletive stem form *reg-/rig-* in the future (Thurneysen 1946:406, 473). What is significant is that this pattern of suppletive alternation is preserved in the conjunct paradigm of *téit*: in view of this fact, compound verb forms such as *do-regam* 'we will come' (root *do-tét-*) must be assumed to inflect through head marking.

Further evidence confirms the need to assume head marking in the inflection of Irish compound verb forms. Old Irish verbs can be grouped into several distinct conjugation classes according to the inflection of their absolute forms. If the conjugation class of a derivative root Y systematically matches that of its head, then by generalization (5), that is sufficient evidence of head marking in the inflection of Y. It is significant, therefore, that the distinctness of the various Old Irish conjugation classes is preserved among conjunct forms: thus, just as the absolute paradigms in table 4.6 justify the assignment of *berid* 'carries', *benaid* 'strikes', and *léicid* 'leaves' to three distinct conjugation classes, so do the corresponding conjunct paradigms. In other words, the inflection of a compound root is sensitive to the conjugation class of its head; given generalization (5), this can only be understood as entailing that compound roots inflect by head marking.

One must conclude that Old Irish morphology supplies two alternative paradigms – one absolute and the other conjunct – for one and the same verbal lexeme, and that when the morphological rule of compound verb formation applies to an inflected verb, that verb necessarily assumes its conjunct form; on this assumption, the apparent lack of head marking in the inflection of *do-ber-* is no more than apparent.

This understanding of the Old Irish facts sheds new light on the Sanskrit gerunds considered earlier: just as *-beram* is the conjunct form of absolute *bermai* in Old Irish, *-nīya* can be viewed as the conjunct form of absolute *nītvā* in Sanskrit; just as Old Irish *do-beram* inflects by head marking, so then does Sanskrit *pariṇīya*. Once they are seen in this light, Sanskrit gerunds are fully compatible with the PUG.

Many apparent counterexamples to the PUG can be seen as involving absolute/conjunct alternations of this sort. (See Stump (1995a:267ff.) for discussion of two additional instances, those of French *contredisez* and Latin *perficitur*.) Cases that can be viewed in this way cannot be claimed to disconfirm the PUG; to make this point clearly, it will be helpful to consider a more precise elucidation of the proposed approach to alternations of this sort. In the following section, a formal approach to absolute/conjunct alternations is developed and exemplified with an analysis of Sanskrit gerunds, and the means of extending this approach to Irish verbal inflection are discussed.

Table 4.6 *Present indicative forms of Old Irish* BERID *'carries',* BENAID *'strikes',* LÉICID *'leaves' (Strachan 1949: 35ff.)*

	BERID 'carries'		BENAID 'strikes'		LÉICID 'leaves'	
	ABSOLUTE	CONJUNCT	ABSOLUTE	CONJUNCT	ABSOLUTE	CONJUNCT
1SG	*biru*	*-biur*	*benaim*	*-benaim*	*léiciu, léicim*	*-léiciu, -léicim*
2SG	*biri*	*-bir*	*benai*	*-benai*	*léici*	*-léici*
3SG						
ACTIVE	*berid, berith*	*-beir*	*benaid*	*-ben*	*léicid*	*-léici*
PASSIVE	*berair*	*-berar*	*benair*	*-benar*	*léicthir*	*-léicther*
1PL	*bermai*	*-beram*	*benmai*	*-benam*	*léicmi*	*-léicem*
2PL	*beirthe*	*-berid*	*bentae*	*-benaid*	*léicthe*	*-léicid*
3PL						
ACTIVE	*berait*	*-berat*	*benait*	*-benat*	*léicit*	*-léicet*
PASSIVE	*bertair*	*-bertar*	*bentair*	*-bentar*	*léictir, lécitir*	*-léicter, -lécetar*

4.6.2 *A formal approach to absolute/conjunct alternations in PFM*

Suppose that X and Y are paired absolute and conjunct forms in some language. I assume that the formal expression of this relationship between X and Y is a function ALT such that ALT(X) = Y; the definition of ALT therefore varies from one language to another. When a category-preserving rule of compounding applies to an expression Z, the corresponding output is a function of ALT(Z) if this is defined (and is otherwise simply a function of Z).

In Sanskrit, *nītvā* and *-nīya* are paired absolute and conjunct forms. The absolute form *nītvā* arises from the root *nī-* by means of the realization rule (13):

(13) $\mathrm{RR}_{1,\{\mathrm{VFORM:gerund}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\textit{tvā},\sigma\rangle$

Given (13), the function ALT is defined as in (14):

(14) Where $\mathrm{RR}_{1,\{\mathrm{VFORM:gerund}\},\mathrm{V}}(\langle X,\sigma\rangle) = \langle X\textit{tvā},\sigma\rangle$, $\mathrm{ALT}(X\textit{tvā}) =_{\mathrm{def}} X\textit{ya}$;
ALT is otherwise undefined.

According to (14), every gerund in *-tvā* is an absolute form having a conjunct form in *-ya*; thus, ALT(*nītvā*) = *nīya*. The category-preserving rule combining verbs with preverbs is defined as in (15); the abbreviatory notation '$Y^{(A)}$' in (15) represents ALT(Y) if this is defined and is otherwise simply Y.

(15) Word-to-word rule:
Where X is a preposition and Y is a verb, $\mathrm{DR}_{\mathrm{compound}}(Y,X) =_{\mathrm{def}} XY^{(A)}$

In accordance with (15), the result of compounding the verb root *nī-* with the preverb *pari* is the compound verb root *pariṇī-*, and the result of compounding the gerund *nītvā* with *pari* is the gerund *pariṇīya*.

Given these assumptions, the Sanskrit paradigm function can be partially defined as in (16).

(16) Where $\sigma = \{\mathrm{VFORM:gerund}\}$ and X is a verb root (but not a word-to-word derivative), $\mathrm{PF}(\langle X,\sigma\rangle) =_{\mathrm{def}} \mathrm{Nar}_1(\langle X,\sigma\rangle)$.

In accordance with (16), $\mathrm{PF}(\langle \textit{nī},\{\mathrm{VFORM:gerund}\}\rangle)$ is evaluated as in (17).

(17) $\mathrm{PF}(\langle \textit{nī},\{\mathrm{VFORM:gerund}\}\rangle)$
$= \mathrm{Nar}_1(\langle \textit{nī},\{\mathrm{VFORM:gerund}\}\rangle)$ [by (16)]
$= \mathrm{RR}_{1,\{\mathrm{VFORM:gerund}\},\mathrm{V}}(\langle \textit{nī},\{\mathrm{VFORM:gerund}\}\rangle)$ [by Nar_n notation]
$= \langle \textit{nītvā},\{\mathrm{VFORM:gerund}\}\rangle$ [by (13)]

On the other hand, PF(<*pariṇī*,{VFORM:gerund}>) is evaluated in accordance with the HAP; nevertheless, the formulation of the compounding rule (15) guarantees that *nī*- will assume its conjunct form -*nīya*, as in (18). Because the gerund of the compound root *pariṇī*- conforms to the HAP on this analysis, it is in full conformity with the PUG.

(18) PF(<*pariṇī*,{VFORM:gerund}>)
= <$\mathrm{DR}_{\mathrm{compound}}$(*nītvā*,*pari*),{VFORM:gerund}> [by the HAP, (17)]
= <*pari*Y,{VFORM:gerund}>, where Y = ALT(*nītvā*) [by (15)]
= <*pariṇīya*,{VFORM:gerund}> [by (14)]

This approach to absolute/conjunct alternations can be straightforwardly extended to more complex cases such as that of Old Irish verb inflection. In Old Irish, the definition of the ALT function must be more elaborate: to account for the fact that *bermai*/-*beram* 'we carry' and *bérmai*/-*béram* 'we will carry' are absolute/conjunct pairs, one clause in the definition of ALT must specify that a 1pl absolute form in -*mai* has an -*am*-suffixed form as its conjunct alternant; to account for the fact that *berait*/-*berat* 'they carry' and *bérait*/-*bérat* 'they will carry' are absolute/conjunct pairs, a different clause in the definition of ALT must specify that a 3pl absolute form in -*ait* has an -*at*-suffixed form as its conjunct alternant; and so on. On the other hand, the Old Irish category-preserving morphological rule compounding verbs with preverbs can be assumed to be identical in all relevant respects to the Sanskrit rule (15). On these assumptions, the paradigm function supplying *bermai* as the 1pl present indicative form of *ber*- 'carry' will, in accordance with the HAP, supply *do*-*beram* as the 1pl present indicative form of the compound verb root *do*-*ber*- 'bring'.

4.6.3 Promiscuous inflections

The inflectional difference between *mother*-*in*-*law's* or *passer*-*by's* and *mothers*-*in*-*law*, *passers*-*by* might be taken as evidence against the PUG: while the plural forms exhibit head marking, the possessive forms do not. What makes this example special is the special status of the possessive suffix -*'s* in English morphosyntax. While the distribution of the plural suffix -*s* can be characterized in purely lexical terms (it appears on nouns specified for plural number), that of the possessive suffix must instead be characterized in syntactic terms: it appears on the last word of a possessive noun phrase.

This distributional peculiarity has led some to describe the possessive suffix as an element which, though prosodically dependent, is syntactically independent – that is, as a clitic; nevertheless, Zwicky (1987a) shows that the patterns of haplology exhibited by the possessive suffix make it necessary to assume that it is spelled out by a realizational rule fully comparable to the rule spelling out the plural suffix. On this view, the difference in syntactic distribution between the possessive suffix and the plural suffix follows from the kinds of morphosyntactic properties they realize. Properties of number such as that realized by the plural suffix are HEAD PROPERTIES, whose distribution in the syntactic domain is regulated by the Head Feature Convention (Gazdar et al. 1985:94ff.); thus, a noun phrase shares its specification for plural number with its head, whose inflection realizes that specification. On the other hand, the possessive property realized by the suffix -*'s* is an EDGE PROPERTY (specifically, a right-edge property), whose distribution in the syntactic domain is regulated by the Edge Feature Principle (Lapointe 1990, Miller 1991, Halpern 1992); thus, a possessive noun phrase triggers a specification for possessive marking on its last word, whose inflection realizes that specification.

Edge properties belong to a broader class of PROMISCUOUS PROPERTIES whose common characteristic is their relative indifference to the category of the expression on which they are morphologically realized. Edge properties are, of course, promiscuous by their very nature; the rule which suffixes -*'s*, for example, applies indiscriminately to any word that may appear in NP-final position. But not all promiscuous properties are edge properties. In Bulgarian, for example, definiteness is a promiscuous property but not an edge property: it is generally realized as a suffix on the head of the first constituent of a definite noun phrase, whatever the category of that constituent might be. Like -*'s*, the Bulgarian definite article has sometimes been portrayed as a clitic, but as in the case of -*'s*, there are compelling reasons to regard it as an inflection (Halpern 1992:193ff.).

Because Bulgarian definiteness is not an edge property, its syntactic distribution is not strictly determined by the Edge Feature Principle; but neither is it strictly determined by the Head Feature Convention, which is blind to the linear ordering of constituents (and is therefore incapable of routing a noun phrase's specification for definiteness to whichever of its constituents happens to be phrase-initial). As this example suggests, promiscuous properties are unlike ordinary head properties in that their syntactic distribution may be determined by principles making some essential reference to relations of linear precedence.

Notwithstanding this important difference between promiscuous properties and ordinary head properties in the domain of syntax, there is no logical necessity that the two should differ in any systematic way in their morphological realization; a priori, a theory in which promiscuous properties and head properties are distinguished in the syntactic component is perfectly compatible with the hypothesis that a single, undifferentiated mass of realization rules is responsible for the morphological realization of all morphosyntactic properties, promiscuous or otherwise. There is good evidence, however, that this hypothesis (the Undifferentiated Mass of Rules Hypothesis (UMoR Hypothesis)) must be rejected: the morphological manifestations of promiscuous properties differ systematically from those of head properties in at least two ways:

(19) a. Rules realizing head properties may apply to bound forms, while rules realizing promiscuous properties always apply to forms which are otherwise free. For instance, the rule forming plurals in -*s* applies to the bound alternant *wive-* of *wife*, the rule forming past-tense forms in -*ed* applies to the bound alternant *tol-* of *tell*, the rule forming comparative adjectives in -*er* applies to the bound alternant *bett-* of *good*, and so on; but the rule which suffixes -*'s* never applies to any bound form in any category.

b. In the inflection of a given form, the realization of head properties precedes that of promiscuous properties. This is most obviously the case when the exponents are uniformly suffixal (or, in principle, uniformly prefixal): in such cases, a promiscuous property's exponents are always external to those of a head property, e.g. *The oxen's harnesses came loose*, *The person who shouted's hat fell off*. More generally, rules realizing promiscuous properties only apply to forms whose head properties have already been fully realized.

In view of these two differences, the UMoR Hypothesis is too simplistic. Instead, the two differences suggest a richer hypothesis, according to which a language's realization rules fall into two discrete groups: on the one hand, rules realizing head properties define a lexeme's inflectional paradigm; on the other hand, rules realizing promiscuous properties apply to the cells in a lexeme's inflectional paradigm to define that lexeme's inventory of promiscuously inflected forms. In English, for instance, the rules realizing head properties assign the roots *ox* and *tall* the inflectional paradigms in (20); only then does the rule of -*'s* suffixation realize the promiscuous property 'possessive' by projecting the paradigms in (20) onto the corresponding inventories of possessive forms in (21).

(20) a. <*ox*,{NUM:sg}>
<*oxen*,{NUM:pl}>

b. <*tall*,{DEG:pos}>
<*taller*,{DEG:compar}>
<*tallest*,{DEG:superl}>

(21) a. <*ox's*,{NUM:sg}>, possessive
<*oxen's*,{NUM:pl}>, possessive

b. <*tall's*,{DEG:pos}>, possessive
<*taller's*,{DEG:compar}>, possessive
<*tallest's*,{DEG:superl}>, possessive

This richer hypothesis – the Differentiated Inflection (DI) Hypothesis – accounts for difference (19a): because the members of an inflectional paradigm are always words, the possibility that a rule realizing a promiscuous property might ever apply to a bound form is necessarily excluded; on the other hand, nothing excludes the possibility that the root to which a rule realizing a head property applies might be a bound form. It also accounts for difference (19b): rules realizing head properties necessarily precede rules realizing promiscuous properties, since the latter apply to the paradigms defined by the former. Thus, while the external positioning of the possessive suffix in doubly inflected forms such as *oxen's* or *shouted's* and the ungrammaticality of the singular possessive **wive's* must both be attributed to language-specific stipulations under the UMoR Hypothesis, the DI Hypothesis makes both facts a necessary consequence of the architecture of the morphological component.

Under the DI Hypothesis, rules realizing promiscuous properties are assumed to engender forms which are extraparadigmatic; that is, although the inventory of promiscuously inflected forms in (22b) is projected from the inflectional paradigm in (22a), it is not a part of that paradigm.

(22) a. <*mother-in-law*,{NUM:sg}>
<*mothers-in-law*,{NUM:pl}>

b. <*mother-in-law's*,{NUM:sg}>, possessive
<*mothers-in-law's*,{NUM:pl}>, possessive

Thus, if the DI Hypothesis is assumed, *mothers-in-law* and *mother-in-law's* are not members of the same paradigm, and therefore do not counterexemplify the PUG.

In the context of the paradigm-based approach to head marking proposed in section 4.5, the DI Hypothesis has the following entailment:

(23) Unlike rules realizing head properties, rules realizing promiscuous properties never participate in (morphological) head marking.

The reason for this entailment should be clear: because head marking is an effect of the HAP (a principle for the evaluation of paradigm functions) and because promiscuously inflected forms are extraparadigmatic (i.e. are not within the range of a language's paradigm function), the morphological realization of head properties should be able to exhibit head marking but that of promiscuous properties should not. (This is not, of course, the tautology that it might first appear to be, since – as noted above – the definitive difference between head properties and promiscuous properties is a difference in syntactic distribution which in no way necessitates any difference in morphological realization.) The fact that this entailment is correct therefore tends to confirm both the DI Hypothesis and the paradigm-based approach to head marking.

I should note before proceeding that the DI Hypothesis is motivated by considerations quite apart from those in (19) and (23). For instance, where a lexeme's inflectional paradigm includes a word X whose inflection realizes some set of head properties, the form of X may be a morphologically unanalysable portmanteau; but where X is a promiscuously inflected form of some word, the form of X is never a morphologically unanalysable portmanteau. Thus, while the expected combination of *bad* with *-er* (which realizes a head property) is supplanted by the portmanteau form *worse*, there is no word in any category whose expected NP-final combination with *-'s* (which realizes an edge property) is similarly supplanted. Though I will not propose an explicit account of these facts here, they provide further confirmation of a fundamental difference between the realization of head properties and that of promiscuous properties in the organization of a language's morphology.[7]

4.6.4 Spurious heads

Another class of apparent counterexamples to the PUG involves roots which, on closer inspection, turn out not to be headed; roots of this sort cannot counterexemplify the PUG because they exhibit head marking nowhere in their paradigm.

Anderson (1992:303) asserts that

> inflectional material may be realized by a rule that operates not on the entire form, but rather on the head of a composite. On the other hand, some rules inflect the whole (outermost) word regardless of its composite status. Furthermore, this difference is a parameter in the formulation of particular rules, and not a uniform feature within an entire language. Examples are provided from Alabama by Chiu (1987) of rules within the same grammatical domain (agreement inflection in Verbs, whose stems Chiu shows to be generally composite in structure) that differ as to whether their Structural Change applies to the entire composite base or only to its head stem.

Table 4.7 *Present-tense paradigms of two Alabama verbs (Chiu 1987:23f.)*

		CHIFIPKA 'to poke (once)'	HOFNA 'to smell'
SINGULAR:	1ST	chifipka-*li*	hofna-*li*
	2ND	chifip-*is*-ka	ho-*chi*-fna
	3RD	chifipka	hofna
PLURAL:	1ST	chifip-*il*-ka	ho-*li*-fna
	2ND	chifip-*as*-ka	ho-*hachi*-fna
	3RD	*ho*-chifipka	*ho*-hofna

Closer scrutiny of Chiu's examples, however, reveals that they do not actually counterexemplify the PUG. What is at issue are paradigms such as those in table 4.7. In both of these paradigms, the 1sg and 3pl inflections are affixed to the verb as a whole. By contrast, the 2sg, 1pl, and 2pl affixes are positioned internally: Chiu argues that *chifipka* and *hofna* belong to a class of verb stems whose morphological structure includes a designated constituent or 'point of reference' to which an internally positioned affix attaches. Thus, in the paradigm of *chifipka*, the 2sg, 1pl, and 2pl inflections are prefixed to the internal point of reference -*ka*; in the paradigm of *hofna*, they are prefixed to the point of reference -*fna*. As Chiu shows, this analysis has some historical motivation: -*ka* derives historically from a syntactically independent auxiliary verb in pre-Proto-Muskogean (Haas 1977); when this auxiliary was subsequently reanalysed as a verbal suffix, its prefixal inflections were simultaneously reanalysed as internally positioned affixes. (On the other hand, there is no independent evidence that -*fna* descends historically from an independent auxiliary verb.) The key point, in any event, is that in the synchronic analysis of Alabama, the internal positioning of the 2sg, 1pl, and 2pl affixes CANNOT be regarded as instances of head marking: because neither -*ka* nor -*fna* is itself the root of its own verbal paradigm in Alabama, neither *chifipka* nor *hofna* is even headed. That is, even if -*ka* and -*fna* function as morphological points of reference in the operation of structure-sensitive rules of infixation (or rules of 'morphemic circumscription' such as those proposed by Hammond (1992) and Hyman and Mchombo (1992)), they don't qualify as roots heading *chifipka* and *hofna* as the notion 'head' is understood here.

It is not clear, however, that infixation is even involved here. Haas (1946) argues that -*ka* has the status of an inflectional suffix (specifically, a

Table 4.8 *Present-tense paradigms of two more Alabama verbs (Chiu 1987:23, 25)*

		HAALO 'to hear'	BITLI 'to dance'
SINGULAR:	1ST	haalo-*li*	bitli-*li*
	2ND	*is*-haalo	bit-*chi*
	3RD	haalo	bitli
PLURAL:	1ST	*il*-haalo	bit-*hili*
	2ND	*has*-haalo	bit-*hachi*
	3RD	*ho*-haalo	*ho*-bitli

mediopassive suffix) in Proto-Muskogean. Suppose that *-ka* and *-fna* are likewise analysed as inflectional suffixes in Alabama – specifically, as conjugation-class markers: members of the *-ka* class take the agreement suffixes *-is* (2sg), *-(h)il* (1pl), and *-(h)as* (2pl) while members of the *-fna* class take the agreement suffixes *-chi* (2sg), *-(hi)li* (1pl), and *-hachi* (2pl); cf. table 4.7. On this view, *chifip-il-ka* 'we poke' does not involve the attachment of a 1pl subject-agreement prefix *il-* to a point of reference *-ka*, but simply involves the successive attachment of the 1pl subject-agreement suffix *-il* and the conjugation-class suffix *-ka*. The fact that the 1sg subject-agreement suffix *-li* comes after the conjugation-class suffixes (*chifip-ka-li* 'I poke', *ho-fna-li* 'I smell') can simply be attributed to the existence of three affix position classes: the innermost position class includes the 2sg, 1pl, and 2pl agreement suffixes, the intermediate class includes the conjugation-class suffixes *-ka* and *-fna*, and the outermost class includes the 1sg subject-agreement suffix.

This is a much simpler analysis, but it does encounter one difficulty. In the conjugation of certain verbs, the 2sg, 1pl, and 2pl subject-agreement affixes appear not as suffixes but as prefixes; an example is the verb *haalo* 'to hear' in table 4.8. Chiu regards such forms as lacking a point of reference; this view has the apparent advantage of allowing the 2sg, 1pl, and 2pl subject-agreement affixes to be regarded as uniformly prefixal, attaching to a verb's point of reference when it has one and otherwise attaching to the verb as a whole. Further evidence, however, shows that the 2sg, 1pl, and 2pl subject-agreement affixes cannot be uniformly prefixal: in the conjugation of *bitli* 'to dance', for example, they are suffixal; cf. table 4.8. In order to reconcile the conjugation of *bitli* with the assumption that the 2sg, 1pl, and 2pl subject-agreement affixes are uniformly prefixal, Chiu proposes that *-li* (like *-ka*, the reflex of a pre-Proto-Muskogean auxiliary verb) is *bitli*'s point of reference and that the 2sg, 1pl, and 2pl subject-agreement affixes are prefixed to this point of reference, which is then deleted by a later rule. A more satisfying assumption is that *-li* is a conjugation-class suffix belonging to the same position class as the 2sg, 1pl, and 2pl subject-agreement affixes and is therefore excluded when they appear in the inflection of a *-li* class verb. As for the 2sg, 1pl, and 2pl subject-agreement affixes, they can be assumed to constitute an AMBIFIXAL position class, i.e. one including both prefixal and suffixal members; position classes of this sort are not unusual (Stump 1993c).

I conclude from these considerations that the Alabama evidence is irrelevant to evaluating the PUG, since the forms at issue aren't even headed. (See Stump (1995a:279ff.) for discussion of another, comparable case, that of the Old Icelandic indefinite proform *huerge* 'whichever'.)

In concluding this section, I emphasize that the possibility of postulating absolute/conjunct alternations and promiscuous inflections and the recognition that claims of headedness are sometimes spurious do not bleach the PUG of its content; one can easily conceive of phenomena that would unquestionably counterexemplify this generalization. Consider an example. As was seen in section 4.3.4, imperfect verb forms in Sanskrit generally exhibit a preterite prefix – the augment *a-* (e.g. *pat-* 'fly', 3sg imperfect active *apatat*) – and third-conjugation verbs form their present-tense stem by means of a reduplicative prefix (e.g. *dhā-* 'put', present-tense stem *dadhā-*); because a verb's imperfect forms arise from its present-tense stem, both the augment and the reduplicative prefix appear in a third-conjugation verb's imperfect forms (e.g. 3sg imperfect active *adadhāt*). Imagine again a language which is like Sanskrit except that in the inflection of a headed third-conjugation verb root X, the reduplicative prefix appears on X's head while the augment appears on X as a whole (so that in the paradigm of *pari-dhā-* 'put around', this pseudo-Sanskrit has **aparidadhāt* in place of the authentic form *paryadadhāt*). Evidence of this sort would genuinely disconfirm the PUG. First, it could not be viewed as the effect of an absolute/conjunct alternation, since the realization rules used in the inflection of a simple root (such as *dhā-*) would be exactly those used in the inflection of the corresponding compound roots (e.g. *pari-dhā-*); moreover, the postulation of an absolute/conjunct alternation is in principle incapable of reconciling the PUG with the coincidence of head marking and external marking within the same paradigm. Second, evidence of the pseudo-Sanskrit sort could not be viewed as an effect of promiscuous inflection, since the preterite property realized by the augment in Sanskrit (and by assumption, in pseudo-Sanskrit) is syntactically a head property – that is, it is associated with the head of a verb phrase (and not, for example, with one of its peripheries). Finally, evidence of the pseudo-Sanskrit sort could not be dismissed as involving the inflection of a root which isn't genuinely headed: *dhā* is itself the root of a lexeme, and the rule which combines members of this lexeme's paradigm with the preverb *pari-* is category preserving. In short, one can conceive of evidence which would genuinely disconfirm the PUG (hence also the HAP); but unless and until such evidence is found in the real world, the PUG, like the CUG, must be seen as a valid universal generalization about the structure of inflectional paradigms. As such, these generalizations strongly motivate the assumption that head marking is regulated by the HAP.

4.7 The problem of word-to-stem derivatives

One issue which has not yet been fully resolved is the inflection of such word-to-stem derivatives as Breton *bagig* 'little boat' (plural *bagoùigoù*). The issue is not an insignificant one, since doubly inflecting forms closely comparable to *bag-où-ig-où* show up in a number of languages, e.g. Yiddish *xasan-im-l-ex* 'little bridegrooms' (Bochner 1984, Perlmutter 1988), English *ten little toe-s-ie-s* (name of a nursery game), Kikuyu *tũ-mĩ-rũũthi* 'little lions' (Stump 1993d,e), Pengo *huṛt-ik-n-ik* 'they (feminine) have seen' (Bybee 1985:40f.; Haspelmath 1993), and so on. What distinguishes word-to-stem rules, I claim, is that besides applying to the root of a base lexeme (e.g. *bag-*) to yield the root of a derivative lexeme (e.g. *bagig-*), they may also apply to a nonradical word in the paradigm of the base lexeme (e.g. *bagoù*) to yield a stem of the derivative lexeme (e.g. *bagoùig-*). Before this claim can be developed fully, a carefully articulated theory of stems is necessary. I shall therefore defer the analysis of word-to-stem derivatives until section 6.5.2, where it will figure in a broader discussion of stem alternations in PFM.

4.8 Conclusions

What has emerged in this chapter is the following picture. Headed roots – those arising through the application of a category-preserving rule of derivation or compounding – may exhibit head marking, external marking, or double marking; the particular kind of inflectional marking a headed root exhibits is strictly determined by the category-preserving rule through whose application it arises. Category-preserving rules can therefore be sorted into three classes: those which give rise to headed roots which inflect by head marking (= word-to-word rules), those which give rise to headed roots which inflect by external marking (= root-to-root rules), and those which give rise to headed roots which inflect by double marking (= word-to-stem rules); thus, if any headed root exhibits head marking, so do its coderivatives (= the CUG). If any member of a headed root's inflectional paradigm exhibits head marking, every member does (= the PUG).

There are no genuine counterexamples to the PUG. Apparent counterexamples are of three types: paradigms which in fact exhibit uniform head marking but in which this uniformity is obscured by an absolute/conjunct alternation; 'paradigms' which in fact consist of an inflectional paradigm exhibiting uniform head marking and an extraparadigmatic inventory of promiscuously inflected forms uniformly failing to exhibit head marking; and paradigms which seem to exhibit sporadic head marking but in fact involve unheaded roots that (by definition) never exhibit head marking.

The Head Operation Hypothesis does not afford a satisfactory account of the CUG and the PUG. The assumptions of PFM, by contrast, do; in particular, the CUG and the PUG are both entailed by the HAP, a universal principle for the evaluation of paradigm functions applying to word-to-word derivatives. The evidence discussed here therefore constitutes a strong argument in favour of postulating paradigm functions in morphological theory, since the HAP presupposes their existence. (A second, independent argument for the postulation of paradigm functions is developed in the chapter which follows.) Moreover, the validity of the HAP provides further support for the general assumption that in the inflectional domain, a language's rule interactions are regulated by a universally invariant set of principles.

Unlike the principles underlying the Head Operation Hypothesis, those underlying the paradigm-based approach to head marking make it possible to envision a highly restrictive theory of realization rules. For instance, in accounting for the head marking phenomena discussed above, the paradigm-based approach never needs to resort to realization rules that aren't in conformity with the following hypothesis:

(24) A realization rule applicable to a complex expression X cannot be defined so as to operate on a proper morphological subpart of X.

According to (24), realization rules are highly restricted in their capabilities: if a realization rule applying to X positions an affix internally to X, the location of the affix cannot be characterized in terms of X's morphological structure (but must instead be characterized in strictly prosodic terms – cf. Anderson 1992:206ff.). By excluding in principle the possibility of referring to morphological 'points of reference' in accounting for the word-internal positioning of inflectional affixes, hypothesis (24) excludes the very existence both of head operations and of 'nonhead operations' such as the following rule proposed by Anderson (1992:296f.) to account for the appearance of the semantically empty formatives *-en* and *-s* on the nonhead members of German compounds such as *Schwanengesang* and *Freiheitskämpfer*:[8]

(25) $[_N [_N X][_N Y]] \rightarrow [_N [_N X \left\{ \begin{array}{c} \text{-en-} \\ \text{-s-} \end{array} \right\}][_N Y]]$

One might object that because it causes the inflection of a headed root to be realized on its head, the HAP is as incompatible with (24) as head operations are. But the HAP regulates the evaluation of paradigm functions, not that of realization rules, and unlike realization rules, paradigm functions do not themselves effect morphological operations such as affixation; instead, they simply establish a relation between a root pairing $<X,\sigma>$ and the σ-cell of X's inflectional paradigm, where the word occupying that cell is itself, in all cases, independently defined by realization rules conforming to (24). For example, the Sanskrit paradigm function establishes the relation 'is the 3sg imperfect active form of' between *ny-a-patat* and the compound root *ni-pat-* 'fly down'. Nevertheless, there is no realization rule which positions the augment *a-* internally to the preverb *ni-* in the evaluation of PF(<*nipat*,{'3sg imperfect active'}>); indeed, *nipat-* isn't even a stage in the definition of *nyapatat* by the language's realization rules, since *nyapatat* arises through the combination of *ni* 'down' with *apatat* 's/he flew'. The connection between *nipat-* and *nyapatat* is purely and simply that they belong to the paradigm of the same lexeme; the paradigm function does nothing more than express this fact.

As it is formulated in (12), the HAP presumes that if a word-to-word rule is applicable to the root of a lexeme L, then it is likewise applicable to every member of L's paradigm; for this reason, the HAP logically excludes the existence of word-to-word rules of certain imaginable types. In order to make this point precisely, it is important to differentiate between two types of morphosyntactic features. On the one hand, a morphosyntactic feature may be identically specified in every cell of a given lexeme's paradigm; features of this sort can be termed L(EXEME)-FEATURES because they serve to specify a lexeme's invariant morphosyntactic properties. On the other hand, a morphosyntactic feature may exhibit different specifications in different cells of the same inflectional paradigm; features of this sort can be termed W(ORD)-FEATURES because they serve to specify the morphosyntactic properties of individual words within a paradigm. (Thus, in French, features of gender are L-features for nouns and W-features for adjectives, while features of number are W-features for both nouns and adjectives.) The applicability of a category-preserving rule M to an expression X may be sensitive to X's L-feature specifications, but the HAP presupposes that the application of M will never be sensitive to X's W-feature specifications. This presupposition is, to my knowledge, completely correct. For instance, the Sanskrit rule which forms compounds through the addition of a preverb is sensitive to the syntactic category of the expression to which it applies; it compounds preverbs with verbs but not, for example, with nouns. Thus, the application of this rule is sensitive to an expression's specification for the major syntactic category feature – an L-feature. By contrast, it is not sensitive to whether the verb to which it applies is specified 'imperfect tense' or 'aorist tense', since tense is a W-feature. This is not, apparently, a contingent fact about the Sanskrit rule of verbal compounding, but reflects a general property of category-preserving rules.

5 *Rule blocks*

5.1 Introduction

In chapter 4, I argued that the postulation of paradigm functions is necessitated by two fundamental generalizations about the inflection of headed expressions, namely the Coderivative Uniformity Generalization and the Paradigm Uniformity Generalization; in particular, I demonstrated that the HAP – a principle for the evaluation of paradigm functions applying to headed roots – affords a better account of both generalizations than the Head Operation Hypothesis does. In this chapter, I present a second, independent argument for the postulation of paradigm functions; as I show, paradigm functions make it possible to provide a satisfactory account of the full range of observable interactions among realization-rule blocks in the world's languages.

This chapter also presents independent motivation for the postulation of rules of referral. In the Bulgarian analysis developed in chapter 2, a rule of referral was proposed to account for an instance of systematic syncretism in Bulgarian verb inflection; indeed, syncretism is the single phenomenon for which Zwicky (1985a) originally proposed the introduction of rules of referral into morphological theory. In this chapter, however, I argue that the introduction of this rule type is additionally motivated by phenomena having nothing to do with syncretism in the strict sense.

The fundamental question at issue in this chapter is: How are a language's blocks of realization rules organized? Anderson (1992) pursues the FIXED LINEAR ORDERING HYPOTHESIS (FLOH) in (1):

(1) Fixed Linear Ordering Hypothesis: A language's blocks of realization rules are arranged in a fixed linear sequence reflected by the sequence in which the rules themselves apply.

This hypothesis is consistent with the analysis of Bulgarian verb morphology developed in chapter 2. In that analysis, the sequence of rule blocks in terms of which the Bulgarian paradigm function is defined is invariant: in all instances, the paradigm function's evaluation implies the definitional sequence **A – B – C – D** (with Block **A** having narrowest scope and Block **D** having widest). The question arises, however, whether this is a contingent fact about Bulgarian, or a necessary characteristic of human language in general.

In addressing this question, it is particularly enlightening to examine inflectional systems which make heavy use of affixation: in systems of this sort, the position classes into which the inflectional affixes can be sorted often reveal the organization and interaction of rule blocks with complete transparency. I therefore focus my attention in this chapter on some special characteristics of position-class morphology and their implications for understanding the organization of realization-rule blocks.

In sections 5.2–5.4, I discuss three position-class phenomena (namely the incidence of portmanteau, parallel, and reversible position classes) which imply interactions among realization-rule blocks which are not compatible with the FLOH; these phenomena reveal the possibility of nontrivial dependencies between a word's morphosyntactic properties and the number, identity, and definitional sequence of rule blocks responsible for spelling out its inflectional morphology.[1] As I show, paradigm functions make it possible to account for such dependencies without difficulty. In section 5.5, I consider Noyer's (1992) proposal to dispense with rule blocks entirely, in favour of a principle of feature discharge; I argue that this proposal is not a viable one. My conclusions concerning the organization and interaction of realization-rule blocks are summarized in section 5.6.

5.2 Portmanteau rule blocks

In languages with rich affixal inflection, one sometimes encounters PORTMANTEAU position classes: each of the affixes belonging to a class of this sort simultaneously occupies two or more adjacent affix positions, excluding all other affixes that might otherwise occupy any of these positions. Swahili provides a particularly clear example of a portmanteau position class. Swahili verb inflection involves a number of prefixal position classes, some of which are exemplified in table 5.1, which lists the positive and negative past-tense and future-tense forms of TAKA 'want'. In these forms, position III is occupied by tense prefixes such as the past-tense prefix *li-*, its negative counterpart *ku-*, and the future-tense prefix *ta-*; position IV is occupied by subject-agreement prefixes; and position V is occupied by the negative prefix *ha-*. There is, however, a complication: in place of the

Table 5.1 *Partial inflectional paradigm of Swahili* TAKA *'want' (Ashton 1944:70ff.)*

a. Past tense

	POSITIVE			NEGATIVE			
	IV	III	Stem	V	IV	III	Stem
1SG	*ni-*	*li-*	*taka*	*si-*		*ku-*	*taka*
2SG	*u-*	*li-*	*taka*	*ha-*	*u-*	*ku-*	*taka* (→ *hukutaka*)
3SG (CLASS 1)	*a-*	*li-*	*taka*	*ha-*	*a-*	*ku-*	*taka* (→ *hakutaka*)
1PL	*tu-*	*li-*	*taka*	*ha-*	*tu-*	*ku-*	*taka*
2PL	*m-*	*li-*	*taka*	*ha-*	*m-*	*ku-*	*taka*
3PL (CLASS 2)	*wa-*	*li-*	*taka*	*ha-*	*wa-*	*ku-*	*taka*

b. Future tense

	POSITIVE			NEGATIVE			
	IV	III	Stem	V	IV	III	Stem
1SG	*ni-*	*ta-*	*taka*	*si-*		*ta-*	*taka*
2SG	*u-*	*ta-*	*taka*	*ha-*	*u-*	*ta-*	*taka* (→ *hutataka*)
3SG (CLASS 1)	*a-*	*ta-*	*taka*	*ha-*	*a-*	*ta-*	*taka* (→ *hatataka*)
1PL	*tu-*	*ta-*	*taka*	*ha-*	*tu-*	*ta-*	*taka*
2PL	*m-*	*ta-*	*taka*	*ha-*	*m-*	*ta-*	*taka*
3PL (CLASS 2)	*wa-*	*ta-*	*taka*	*ha-*	*wa-*	*ta-*	*taka*

expected combination of the negative prefix *ha-* and the 1sg subject-agreement prefix *ni-*, one finds a single prefix *si-*; *si-* is unusual in that its appearance excludes that of both a competing position V prefix and a competing position IV prefix. The prefix *si-* is, in other words, a member (in fact, the sole member) of a portmanteau position class which is simultaneously associated with positions V and IV.

I interpret the incidence of a portmanteau position class as evidence of a PORTMANTEAU RULE BLOCK: a rule block which stands in a paradigmatic opposition to two (or more) other rule blocks. This interpretation is inherently incompatible with the FLOH, according to which the possibility of paradigmatic oppositions among rule blocks is logically excluded. The assumptions of PFM, by contrast, do not exclude the possibility that a paradigm function might be evaluated by means of rule blocks participating in paradigmatic oppositions.

For concreteness, consider how the idea of a portmanteau rule block might be developed in the context of an explicit analysis of Swahili verb morphology. I assume that the morphosyntactic properties of Swahili include pairings of the features in (2) with the corresponding permissible values. In (2), I assume that gender is a set-valued feature in Swahili (as generally in languages with noun-class systems); for instance, GEN:{1,2} is the property of a noun requiring class 1 agreement in the singular and class 2 agreement in the plural. Swahili has fifteen noun classes, traditionally numbered 1 to 11 and 15 to 18.

(2)

FEATURE	PERMISSIBLE VALUES
PER	1, 2, 3
NUM	sg, pl
GEN	(a set τ of up to two integers such that if $n \in \tau$, then $1 \leq n \leq 11$ or $15 \leq n \leq 18$)
POL	pos, neg
TNS	past, future
AGR(su)	(a set τ such that for some choice of permissible values α, β, γ, {PER:α, NUM:β, GEN:γ} is an extension of τ)

Suppose now that all of the prefixes other than *si-* in table 5.1 are introduced by the realization rules in (3).

(3) a. Block III:

i. $\mathrm{RR}_{\mathrm{III},\{\mathrm{TNS:past}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle \mathit{li}X',\sigma\rangle$

ii. $\mathrm{RR}_{\mathrm{III},\{\mathrm{POL:neg,\ TNS:past}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle \mathit{ku}X',\sigma\rangle$

iii. $\mathrm{RR}_{\mathrm{III},\{\mathrm{TNS:fut}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle \mathit{ta}X',\sigma\rangle$

b. Block IV:

i. $\mathrm{RR}_{\mathrm{IV},\{\mathrm{AGR(su)}:\{\mathrm{PER:1,\ NUM:sg}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle \mathit{ni}X',\sigma\rangle$

ii. $RR_{IV,\{AGR(su):\{PER:2,\ NUM:sg\}\},V}(<X,\sigma>) =_{def} <uX',\sigma>$
iii. $RR_{IV,\{AGR(su):\{PER:3,\ NUM:sg,\ GEN:\{1,2\}\}\},V}(<X,\sigma>) =_{def} <aX',\sigma>$
iv. $RR_{IV,\{AGR(su):\{PER:1,\ NUM:pl\}\},V}(<X,\sigma>) =_{def} <tuX',\sigma>$
v. $RR_{IV,\{AGR(su):\{PER:2,\ NUM:pl\}\},V}(<X,\sigma>) =_{def} <mX',\sigma>$
vi. $RR_{IV,\{AGR(su):\{PER:3,\ NUM:pl,\ GEN:\{1,2\}\}\},V}(<X,\sigma>) =_{def} <waX',\sigma>$

c. Block V: $RR_{V,\{POL:neg\},V}(<X,\sigma>) =_{def} <haX',\sigma>$

The rules in (3) make it possible to analyse all of the forms in table 5.1 but those involving *si*- (i.e. *sikutaka* 'I didn't want' and *sitataka* 'I won't want').

The rule of *si*- prefixation competes with both the Block IV rule of *ni*-prefixation and the Block V rule of *ha*- prefixation, and therefore doesn't strictly belong to any of the three rule blocks in (3): rather, the portmanteau rule block to which it belongs is one which stands in paradigmatic opposition both to Block IV and to Block V. I shall use the notation [*n*,*m*] to represent a portmanteau rule block paradigmatically opposed to Blocks *m* and *n*; accordingly, the portmanteau rule block to which the Swahili rule of *si*-prefixation belongs is Block [V,IV]; this rule may be formulated as in (4).

(4) $RR_{[V,IV],\{POL:neg,\ AGR(su):\{PER:1,\ NUM:sg\}\},V}(<X,\sigma>) =_{def} <siX',\sigma>$

I assume that universally, the least narrow rule in a portmanteau rule block is a rule of referral, as specified by the FUNCTION COMPOSITION DEFAULT (FCD) in (5); this principle causes the realization of some set σ of morphosyntactic properties by a portmanteau rule block [*n*,*m*] to default to the successive realization of σ by Blocks *m* and *n*.[2]

(5) Function Composition Default:
$RR_{[n,m],\{\},U}(<X,\sigma>) =_{def} Nar_n(Nar_m(<X,\sigma>))$.

Although the FCD takes the form of a rule of referral (i.e. a rule referring the morphological expression of a particular set of morphosyntactic properties to some other realization rule(s)), it is markedly different in function from the rule of referral proposed for the inflection of Bulgarian verbs in chapter 2. The latter rule (like the rules of referral proposed by Zwicky (1985a)) is formulated so as to capture a generalization about syncretism: it refers the morphological expression of a particular set σ of morphosyntactic properties to some other realization rule realizing some distinct set σ′ of morphosyntactic properties. But the assumed format for realization rules (given as (11) in section 2.5) makes it possible for rules of referral to do other things as well. In particular, it allows rules of referral to refer the realization of a particular set σ of morphosyntactic properties to rules which are situated in other blocks but which likewise realize σ. The universal rule of referral postulated in (5) does exactly that: it refers the realization of σ in Block [*n*,*m*] to rules in Blocks *m* and *n* which likewise realize σ.

It should be carefully noted that as (5) is defined, it requires that the definition of the IFD given as (25) in section 2.7 be revised so as to apply only to rule blocks which aren't of the portmanteau type, as in (6).

(6) Identity Function Default (final formulation):
Where $n \neq [p,o]$, $\mathrm{RR}_{n,\{\},\mathrm{U}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X},\sigma>$.

If Swahili verb paradigms were no more extensive than the partial paradigm in table 5.1, then in view of the FCD, the Swahili paradigm function could be partially defined as in (7).[3]

(7) Where $\sigma = \{\mathrm{AGR(su)}{:}\alpha,\ \mathrm{TNS}{:}\beta,\ \mathrm{POL}{:}\gamma\}$, $\mathrm{PF}(<\mathrm{X},\sigma>)$
$=_{\mathrm{def}} \mathrm{Nar}_{[\mathrm{V,IV}]}(\mathrm{Nar}_{\mathrm{III}}(<\mathrm{X},\sigma>))$

Thus, suppose that σ is the morphosyntactic property set in (8a); in that case, PF(<*taka*,σ>) is evaluated as in (8b–g). In line (8c), the lack of any other applicable rule in Block [V,IV] causes $\mathrm{Nar}_{[\mathrm{V,IV}]}$(<*kutaka*,σ>) to be evaluated by means of the FCD; the resulting form <*hatukutaka*,σ> therefore exhibits separate prefixes in positions IV and V.

(8)
a. $\sigma = \{\mathrm{POL{:}neg},\ \mathrm{AGR(su)}{:}\{\mathrm{PER}{:}1,\ \mathrm{NUM{:}pl}\},\ \mathrm{TNS{:}past}\}$
b. $\mathrm{PF}(<\mathit{taka},\sigma>)$
$= \mathrm{Nar}_{[\mathrm{V,IV}]}(\mathrm{Nar}_{\mathrm{III}}(<\mathit{taka},\sigma>))$ [by (7)]
c. $= \mathrm{RR}_{[\mathrm{V,IV}],\{\},\mathrm{U}}(\mathrm{RR}_{(3\mathrm{aii})}(<\mathit{taka},\sigma>))$ [by Nar_n notation]
d. $= \mathrm{RR}_{[\mathrm{V,IV}],\{\},\mathrm{U}}(<\mathit{kutaka},\sigma>)$ [by (3aii)]
e. $= \mathrm{Nar}_{\mathrm{V}}(\mathrm{Nar}_{\mathrm{IV}}(<\mathit{kutaka},\sigma>))$ [by the FCD]
f. $= \mathrm{RR}_{(3\mathrm{c})}(\mathrm{RR}_{(3\mathrm{biv})}(<\mathit{kutaka},\sigma>))$ [by Nar_n notation]
g. $= <\mathit{hatukutaka},\sigma>$ [by (3c), (3biv)]

But suppose now that σ′ is the property set in (9a); in that case, PF(<*taka*,σ′>) is evaluated as in (9b–d). In line (9c), rule (4) is applicable to <*kutaka*,σ′>, and therefore overrides the FCD; accordingly, the resulting form *sikutaka* exhibits a single prefix spanning positions IV and V.

(9)
a. $\sigma' = \{\mathrm{POL{:}neg},\ \mathrm{AGR(su)}{:}\{\mathrm{PER}{:}1,\ \mathrm{NUM{:}sg}\},\ \mathrm{TNS{:}past}\}$
b. $\mathrm{PF}(<\mathit{taka},\sigma'>)$
$= \mathrm{Nar}_{[\mathrm{V,IV}]}(\mathrm{Nar}_{\mathrm{III}}(<\mathit{taka},\sigma'>))$ [by (7)]
c. $= \mathrm{RR}_{(4)}(\mathrm{RR}_{(3\mathrm{aii})}(<\mathit{taka},\sigma'>))$ [by Nar_n notation]
d. $= <\mathit{sikutaka},\sigma'>$ [by (4), (3aii)]

As these examples show, the FCD allows the evaluation of a paradigm function to depend on paradigmatically opposed rule blocks: the simplified Swahili paradigm function in (7), for example, is evaluated by means of

Block [V,IV] in (9) but by means of the blocks to which [V,IV] is paradigmatically opposed – Blocks IV and V – in (8). This example also shows that the principles of PFM do not require that the definition of a language's paradigm function make direct reference to every block of realization rules in that language: while the definition of the Swahili paradigm function makes reference to the portmanteau block [V,IV], it makes no direct reference to blocks V and IV; it is only by virtue of the FCD that the latter two blocks sometimes enter into the evaluation of this paradigm function.

5.3 Parallel rule blocks

Another phenomenon which arises in languages with rich affixal inflection is that of PARALLEL position classes – classes which, though associated with distinct affix positions, overlap partially or totally in their membership. Traditional Lingala provides a clear example of parallel position classes. Lingala verbs exhibit five inflectional affix positions (Dzokanga 1979:232); positions 1–3 are prefixal, and positions 4 and 5, suffixal. Position 1 is occupied by subject-agreement prefixes; position 2 is occupied by the prefix *ko-*, which marks infinitives but is also used in the formation of certain tenses (including the present continuative, the second habitual present, and the more-remote future); position 3 is occupied by object-agreement prefixes, including the reflexive prefix *mí-*; position 4 is occupied by the suffix *-ak*, which appears in present habitual forms and in the historical and most-remote past tenses; and position 5 is occupied by a suffixal vowel (*-i* in the recent and historical past and most-remote future, and elsewhere *-a*, which, by vowel harmony, assimilates to the quality of a preceding open mid vowel). The examples in table 5.2 illustrate. Note that certain tenses are distinguished by their tonology: all past-tense forms, for example, have final high tone; present continuative forms, by contrast, have low-high tone on their initial syllable.

The subject-agreement prefixes found in position 1 and the object-agreement prefixes found in position 3 are listed in table 5.3: inspection of this table reveals that in Lingala, the subject-agreement prefix encoding a particular set of properties is most often identical to the object-agreement prefix encoding those same properties; indeed, only four subject-agreement prefixes (those bracketed in table 5.3) differ from their object-encoding counterparts. Thus, the prefixes occupying position 1 and those occupying position 3 constitute parallel position classes.

Given this fact, it would be highly redundant to have one set of rules

Table 5.2 *Position-class analysis of some Lingala verb forms*

AFFIX POSITION						GLOSS
1	2	3	(root)	4	5	
na-	*ko-*		*sál*	*-ak*	*-a*	'I always work' (2nd habitual present)
ba-		*m-*	*bet*	*-ak*	*-í*	'they hit me' (historical past)
na-	*ko-*	*mí-*	*sukol*	*-ak*	*-a*	'I often wash myself' (2nd habitual present)
to-	*ko-*		*kɛnd*		*-ɛ*	'we are leaving' (present continuative)

Table 5.3 *Subject- and object-agreement prefixes in Lingala (Dzokanga 1979:232, 235, 240)*

PERSON		SUBJECT		OBJECT	
		SG	PL	SG	PL
1st		[*na-*]	[*to-*]	*n-/m-*	*lo-*
2nd		[*o-*]	*bo-*	*ko-*	*bo-*
3rd:	CLASSES				
	1 – 2	[*a-*]	*ba-*	*mo-*	*ba-*
	1a – 2	[*a-*]	*ba-*	*mo-*	*ba-*
	3 – 4	*mo-*	*mi-*	*mo-*	*mi-*
	5 – 6	*li-*	*ma-*	*li-*	*ma-*
	7 – 8	*e-*	*bi-*	*e-*	*bi-*
	9 – 10	*e-*	*i-*	*e-*	*i-*
	9a – 10a	*e-*	*i-*	*e-* (*li-*)	*i-*
	11 – 10	*lo-*	*i-*	*lo-*	*i-*
	11 – 6	*lo-*	*ma-*	*lo-*	*ma-*
	14 – 6	*bo-*	*ma-*	*bo-*	*ma-*
	15	*e-*			

introducing the subject-agreement prefixes in table 5.3 and a separate set of rules introducing the object-agreement prefixes. A superior alternative is to assume that if a subject-agreement prefix and an object-agreement prefix have the same form and encode the same agreement properties, then they are introduced by the same rule (and are therefore the same prefix). Thus, I propose that Lingala has a block Agr of rules which express verb agreement but do so without distinguishing subject agreement from object agreement; one can then say that in the default case, the rules in Agr are used in position 1 to express subject agreement, but that these same rules are used in position 3 to express object agreement. This solution to the problem of parallel position classes is incompatible with the FLOH, since it entails that the definitional sequence of Block Agr isn't fixed with respect to other blocks. The assumptions of PFM, by contrast, do not exclude the possibility that the same rule block might enter into a paradigm function's evaluation in more than one way. For instance, the Lingala facts can be accounted for without redundancy through the postulation of rules of referral: one need only assume that the block of rules realizing subject agreement in position 1 and the block of rules realizing object agreement in position 3 contain default rules referring the realization of agreement to Block Agr.

Thus, suppose that the morphosyntactic properties of Lingala include pairings of the features in (10) with the corresponding permissible values.

(10)

FEATURE	PERMISSIBLE VALUES
PER	1, 2, 3
NUM	sg, pl
GEN	(a set τ of up to two members such that if $n \in \tau$, then either (i) n is an integer such that $1 \leq n \leq 11$ or $14 \leq n \leq 15$, or (ii) $n =$ 1a, 9a, or 10a)
REFL	no, yes
PAST	recent, historical, more-remote, most-remote
PRES	continuative, habitual-i, habitual-ii
FUT	immediate, most-remote
TNS	(a set τ such that for some choice of permissible values α, β, γ, {PAST:α} or {PRES:β} or {FUT:γ} is an extension of τ)
AGR(su)	(a set τ such that for some choice of permissible values α, β, γ, {PER:α, NUM:β, GEN:γ} is an extension of τ)
AGR(ob)	(a set τ such that for some choice of permissible values $\alpha, \beta, \gamma, \delta$, {PER:$\alpha$, NUM:$\beta$, GEN:$\gamma$, REFL:$\delta$} is an extension of τ)

In that case, an analysis of Lingala verb inflection can be developed along the following lines. Block I comprises the rules of exponence in (11a) and the rule of referral in (11b). The rules of exponence in (11a) introduce the four 'exceptional' subject-agreement prefixes, i.e. those that aren't identical to their object-encoding counterparts; by default, the rule of referral in (11b) causes the realization of a verb's subject-agreement properties in position 1 to be determined by the rules in Block Agr.

(11) Block I rules:

a. Rules of exponence:

i. $RR_{1,\{AGR(su):\{PER:1,\ NUM:sg\}\},V}(<X,\sigma>) \quad =_{def} <\textit{na}X',\sigma>$
ii. $RR_{1,\{AGR(su):\{PER:1,\ NUM:pl\}\},V}(<X,\sigma>) \quad =_{def} <\textit{to}X',\sigma>$
iii. $RR_{1,\{AGR(su):\{PER:2,\ NUM:sg\}\},V}(<X,\sigma>) \quad =_{def} <\textit{o}X',\sigma>$
iv. $RR_{1,\{AGR(su):\{NUM:sg,\ GEN:\{1\}\}\},V}(<X,\sigma>) \quad =_{def} <\textit{a}X',\sigma>$

b. Rule of referral:
Where σ is a complete extension of {AGR(su):τ},
$RR_{1,\{\},V}(<X,\sigma>) =_{def} <Y,\sigma>$, where $Nar_{Agr}(<X,\tau>) = <Y,\tau>$

Block 3 comprises the rules of exponence in (12a) and the rule of referral in (12b). The rules of exponence in (12a) introduce the 'exceptional' object-agreement prefixes as well as the reflexive prefix *mí*-; by default, the rule of referral in (12b) causes the realization of a verb's object-agreement properties in position 3 to be determined by the rules in Block Agr.

(12) Block 3 rules:

a. Rules of exponence:
i. $RR_{3,\{AGR(ob):\{PER:1,\ NUM:sg\}\},V}(<X,\sigma>) \quad =_{def} <\textit{n}X',\sigma>$
ii. $RR_{3,\{AGR(ob):\{PER:1,\ NUM:pl\}\},V}(<X,\sigma>) \quad =_{def} <\textit{lo}X',\sigma>$
iii. $RR_{3,\{AGR(ob):\{PER:2,\ NUM:sg\}\},V}(<X,\sigma>) \quad =_{def} <\textit{ko}X',\sigma>$
iv. $RR_{3,\{AGR(ob):\{NUM:sg,\ GEN:\{1\}\}\},V}(<X,\sigma>) \quad =_{def} <\textit{mo}X',\sigma>$
v. $RR_{3,\leftarrow\{AGR(ob):\{REFL:yes\}\}\rightarrow,V}(<X,\sigma>) \quad =_{def} <\textit{mí}X',\sigma>$

b. Rule of referral:
Where σ is a complete extension of {AGR(ob):τ},
$RR_{3,\{\},V}(<X,\sigma>) =_{def} <Y,\sigma>$, where $Nar_{Agr}(<X,\tau>) = <Y,\tau>$

Block Agr comprises the rules of exponence in (13); these introduce the unexceptional agreement prefixes, i.e. those that are used indiscriminately as marks of subject agreement (in position 1) or as marks of object agreement (in position 3).

(13) Block Agr rules:

a. $RR_{Agr,\{PER:2,\ NUM:pl\},V}(<X,\sigma>) \quad =_{def} <\textit{bo}X',\sigma>$
b. $RR_{Agr,\{NUM:pl,\ GEN:\{2\}\},V}(<X,\sigma>) \quad =_{def} <\textit{ba}X',\sigma>$
c. $RR_{Agr,\{NUM:sg,\ GEN:\{3\}\},V}(<X,\sigma>) \quad =_{def} <\textit{mo}X',\sigma>$
d. $RR_{Agr,\{NUM:pl,\ GEN:\{4\}\},V}(<X,\sigma>) \quad =_{def} <\textit{mi}X',\sigma>$
e. $RR_{Agr,\{NUM:sg,\ GEN:\{5\}\},V}(<X,\sigma>) \quad =_{def} <\textit{li}X',\sigma>$
f. $RR_{Agr,\{NUM:pl,\ GEN:\{6\}\},V}(<X,\sigma>) \quad =_{def} <\textit{ma}X',\sigma>$
g. $RR_{Agr,\{NUM:sg,\ GEN:\{7\}\},V}(<X,\sigma>) \quad =_{def} <\textit{e}X',\sigma>$
h. $RR_{Agr,\{NUM:pl,\ GEN:\{8\}\},V}(<X,\sigma>) \quad =_{def} <\textit{bi}X',\sigma>$
i. $RR_{Agr,\{NUM:sg,\ GEN:\{9\}\},V}(<X,\sigma>) \quad =_{def} <\textit{e}X',\sigma>$
j. $RR_{Agr,\{NUM:pl,\ GEN:\{10\}\},V}(<X,\sigma>) \quad =_{def} <\textit{i}X',\sigma>$
k. $RR_{Agr,\{NUM:sg,\ GEN:\{11\}\},V}(<X,\sigma>) \quad =_{def} <\textit{lo}X',\sigma>$
l. $RR_{Agr,\{NUM:sg,\ GEN:\{14\}\},V}(<X,\sigma>) \quad =_{def} <\textit{bo}X',\sigma>$

The workings of this analysis can be exemplified by the verb forms *ambetakí* 'he hit me' and *bababetakí* 'they hit them' in (14) and (15).

(14) *Polo* *a-n-bet-akí* (→ *ambetakí*).
Paul AGR(su):CL.1-AGR(ob):1SG-hit-HISTORICAL.PAST
Paul hit me.

(15) *Ba-sodá* *ba-ba-bet-akí*.
CL.2-soldier AGR(su):CL.2-AGR(ob):CL.2-hit-HISTORICAL.PAST
The soldiers hit them.

Suppose (i) that the Lingala paradigm function is partially defined as in (16), where Blocks 1 to 5 correspond to the affix positions 1–5 exemplified in table 5.2; (ii) that $<\mathit{ambetakí},\sigma>$ 'he hit me' is the value of $\mathrm{PF}(<\mathit{bet},\sigma>)$, where σ is the set of morphosyntactic properties in (17); (iii) that the rules in Blocks 4 and 5 relevant to the evaluation of $\mathrm{Nar}_5(\mathrm{Nar}_4(<\mathit{bet},\sigma>))$ are as in (18); and (iv) that by the IFD, $\mathrm{Nar}_2(<X,\sigma>) = <X,\sigma>$.

(16) Where $\sigma = \{\mathrm{TNS}{:}\alpha,\ \mathrm{AGR(su)}{:}\beta,\ \mathrm{AGR(ob)}{:}\gamma\}$, $\mathrm{PF}(<X,\sigma>)$
$=_{\mathrm{def}} \mathrm{Nar}_1(\mathrm{Nar}_2(\mathrm{Nar}_3(\mathrm{Nar}_5(\mathrm{Nar}_4(<X,\sigma>)))))$.

(17) {TNS:{PAST:historical}, AGR(su):{PER:3, NUM:sg, GEN:{1,2}}, AGR(ob):{PER:1, NUM:sg, GEN:{}, REFL:no}}

(18) a. Where α = {PRES:habitual-*n*} or α = {PAST:β} and β = historical or most-remote,
$\mathrm{RR}_{4,\{\mathrm{TNS}:\alpha\},\mathrm{V}}(<X,\sigma>) =_{\mathrm{def}} <X\mathit{ak}',\sigma>$
b. Where α = {FUT:most-remote} or α = {PAST:β} and β = recent or historical,
$\mathrm{RR}_{5,\{\mathrm{TNS}:\alpha\},\mathrm{V}}(<X,\sigma>) =_{\mathrm{def}} <X\mathit{í}',\sigma>$

The evaluation of $\mathrm{PF}(<\mathit{bet},\sigma>)$ then proceeds as in (19).

(19) $\mathrm{PF}(<\mathit{bet},\sigma>)$
$= \mathrm{Nar}_1(\mathrm{Nar}_3(\mathrm{Nar}_5(\mathrm{Nar}_4(<\mathit{bet},\sigma>))))$ [by (16), Nar_n notation, and the IFD]
$= \mathrm{RR}_{(11aiv)}(\mathrm{RR}_{(12ai)}(\mathrm{RR}_{(18b)}(\mathrm{RR}_{(18a)}(<\mathit{bet},\sigma>))))$ [by Nar_n notation]
$= <\mathit{ambetakí},\sigma>$ [by (11aiv), (12ai), (18a,b)]

Here, the exceptional subject-agreement prefix *a-* is supplied by the Block 1 rule (11aiv), and the exceptional object-agreement prefix *n-* is supplied by the Block 3 rule (12ai); I assume that the latter rule is associated with a morphophonological rule causing *n* to assimilate to *b* as *m*.

Suppose, now, (i) that *bababetakí* 'they hit them' is the value of $\mathrm{PF}(<\mathit{bet},\sigma'>)$, where σ′ is the set of morphosyntactic properties in (20); (ii) that the rules in Blocks 4 and 5 relevant to the evaluation of $\mathrm{Nar}_5(\mathrm{Nar}_4(<\mathit{bet},\sigma'>))$ are as in (18); and (iii) that by the IFD, $\mathrm{Nar}_2(<X,\sigma'>) = <X,\sigma'>$. The evaluation of $\mathrm{PF}(<\mathit{bet},\sigma'>)$ then proceeds as in (21).

(20) {TNS:{PAST:historical}, AGR(su):{PER:3, NUM:pl, GEN:{1,2}}, AGR(ob):{PER:3, NUM:pl, GEN:{1,2}, REFL:no}}

(21) $\mathrm{PF}(<\textit{bet},\sigma'>)$
$= \mathrm{Nar}_1(\mathrm{Nar}_3(\mathrm{Nar}_5(\mathrm{Nar}_4(<\textit{bet},\sigma'>))))$ [by (16), Nar_n notation, and the IFD]
$= \mathrm{RR}_{(11b)}(\mathrm{RR}_{(12b)}(\mathrm{RR}_{(18b)}(\mathrm{RR}_{(18a)}(<\textit{bet},\sigma'>))))$ [by Nar_n notation]
$= \mathrm{RR}_{(11b)}(\mathrm{RR}_{(12b)}(<\textit{betakí},\sigma'>))$ [by (18a,b)]
$= \mathrm{RR}_{(11b)}(<\textit{babetakí},\sigma'>)$ [by (12b), (22a)]
$= <\textit{bababetakí},\sigma'>$ [by (11b), (22b)]

(22) Where τ = {PER:3, NUM:pl, GEN:{1,2}},
a. $\mathrm{Nar}_{\mathrm{Agr}}(<\textit{betakí},\tau>) = <\textit{babetakí},\tau>$ [by Nar_n notation, (13b)]
b. $\mathrm{Nar}_{\mathrm{Agr}}(<\textit{babetakí},\tau>) = <\textit{bababetakí},\tau>$ [by Nar_n notation, (13b)]

Because the rules of referral in (11b) and (12b) both enter into the evaluation of $\mathrm{PF}(<\textit{bet},\sigma'>)$, the Block Agr rule (13b) supplies both instances of the agreement prefix *ba-* in *bababetakí*.

As this example shows, rules of referral such as (11b) and (12b) make it possible for a single block of rules to participate in a paradigm function's evaluation in more than one way, and hence to fill more than one affix position in the same word. This example also shows that the principles of PFM allow a realization rule's range and domain to include FPSPs whose property sets are not complete: in (22), for instance, the property set τ, though presumably well-formed, is not complete.

5.4 Reversible rule blocks

A third phenomenon arising in languages with rich affixal inflection is that of REVERSIBLE position classes – classes whose relative position varies according to the set of morphosyntactic properties being realized. Fula provides an example of this phenomenon.[4] Fula has an unusually extensive system of tenses (Arnott 1970:179ff.); at issue here are the relative tenses (relative past and relative future).[5] In the relative tenses, agreement with a personal subject is marked by the affixes in table 5.4, and agreement with a personal object, by the affixes in table 5.5.[6] The subject-agreement affixes are introduced by one block (Block III), and the object-agreement suffixes are introduced by another (Block IV).

In the inflection of most forms in the relative tenses, the application of a Block IV rule presupposes the application of a Block III rule; thus, in forms in which subject agreement is realized suffixally, an object-agreement suffix is generally peripheral to the subject-agreement suffix, as in examples

Table 5.4 *Personal subject-agreement affixes in the Fula relative tenses (Arnott 1970:194ff.)*

	PREFIX	SUFFIX
1SG		*-mi*
2SG		*-aa, -ɗaa*
3SG (CLASS 1)	*'o-*	
1PL	*min-*	
2PL:		
INCL		*-en, -ɗen*
EXCL		*-on, -ɗon*
3PL (CLASS 2)	*ɓe-*	

Note: the suffixes *-aa*, *-en*, and *-on* are used in the relative future active; their alternants *-ɗaa*, *-ɗen*, and *-ɗon* are used elsewhere in the relative tenses.

Table 5.5 *Personal object-agreement affixes in Fula (Arnott 1970:211ff.)*

1SG	*-yam*
2SG	*-maa*
3SG (CLASS 1)	*-mo(o)*
1PL	*-min*
2PL:	
INCL	*-'en*
EXCL	*-'on*
3PL (CLASS 2)	*-ɓe*

(23d–h). Nevertheless, there are two instances in which subject agreement is realized peripherally to object agreement in the relative tenses, namely those instances in which a 1sg subject coincides with a 2sg or 3sg (class 1) object, as in (23i,j); here, the application of a Block III rule presupposes the application of a Block IV rule.

(23) Some relative past tense active forms of Fula *wall-* 'help' (Arnott 1970: Appendix 15)

a.	*'o-wall-i-ɓe'* he:CL.1-help-REL.PAST.ACT-them:CL.2 'he helped them'	*'o-wall-u-noo-ɓe'* he:CL.1-help-REL.PAST.ACT-PRET-them:CL.2 'he had helped them'
b.	*'o-wall-i-mo'* he:CL.1-help-REL.PAST.ACT-him:CL.1 'he helped him'	*'o-wall-u-noo-mo'* he:CL.1-help-REL.PAST.ACT-PRET-him:CL.1 'he had helped him'

c. *'o-wall-u-(no-)maa'*
he:CL.1-help-REL.PAST.ACT-(PRET-)you:SG
'he (had) helped you (sg)'

d. *mball-u-(no-)ɗaa-ɓe'*
help-REL.PAST.ACT-(PRET-)you:SG-them:CL.2
'you (sg) (had) helped them'

e. *mball-u-(no-)ɗaa-mo'*
help-REL.PAST.ACT-(PRET-)you:SG-him:CL.1
'you (sg) (had) helped him'

f. *mball-u-(noo-)ɗon-ɓe'*
help-REL.PAST.ACT-(PRET-)you:PL-them:CL.2
'you (pl) (had) helped them'

g. *mball-u-(noo-)ɗon-mo'*
help-REL.PAST.ACT-(PRET-)you:PL-him:CL.1
'you (pl) (had) helped him'

h. *mball-u-(noo-)mi-ɓe'*
help-REL.PAST.ACT-(PRET-)I-them:CL.2
'I (had) helped them'

i. *mball-u-(no-)moo-mi'*
help-REL.PAST.ACT-(PRET-)him:CL.1-I
'I (had) helped him'

j. *mball-u-(no-)maa-mi'*
help-REL.PAST.ACT-(PRET-)you:SG-I
'I (had) helped you (sg)'

Thus, while the suffixes -*mo*(*o*) 'him' and -*mi* 'I' participate in a subject-agreement:object-agreement pattern in forms such as *mball-u-ɗon-mo'* 'you (pl) helped him' and *mball-u-mi-ɓe'* 'I helped them', they instead participate in an object-agreement:subject-agreement pattern in the form *mball-u-moo-mi'* 'I helped him'.

Reversible position classes are inevitably problematic for the FLOH. According to this hypothesis, a rule's membership in a particular block simply fixes its definitional sequence with respect to members of other rule blocks; this sequence cannot vary according to the set of morphosyntactic properties being realized. The incidence of reversible position classes, however, shows that a rule's membership in a particular rule block is neither a necessary nor a sufficient correlate of its definitional sequence with respect to rules in other blocks; membership and sequence must, in principle, be able to be specified separately. The assumptions of PFM make this possible: in the evaluation of a paradigm function, a portmanteau rule of referral can be used to assign the same blocks a different definitional sequence according to the set of properties being realized. Thus, consider again the Fula facts.

I assume that the morphosyntactic properties of Fula include pairings of the features in (24) with the corresponding permissible values.

(24)

FEATURE	PERMISSIBLE VALUES
PER	1, 2, 3
NUM	sg, pl
INCL	yes, no
GEN	(a set τ of up to two integers such that if $n \in \tau$, then $1 \leq n \leq 25$)
TNS	relative past
VCE	active, middle, passive
PRET	yes, no
AGR(su)	(a set τ such that for some choice of permissible values $\alpha, \beta, \gamma, \delta$, {PER:$\alpha$, NUM:$\beta$, INCL:$\gamma$, GEN:$\delta$} is an extension of τ)
AGR(ob)	(a set τ such that for some choice of permissible values $\alpha, \beta, \gamma, \delta$, {PER:$\alpha$, NUM:$\beta$, INCL:$\gamma$, GEN:$\delta$} is an extension of τ)

In addition, I assume that the associated property cooccurrence restrictions entail that any well-formed set σ of morphosyntactic properties (i) has a well-formed extension of the form {TNS:α, VCE:β, PRET:γ, AGR(su):{PER:δ, NUM:ε, INCL:ζ, GEN:η}, AGR(ob):{PER:θ, NUM:ι, INCL:κ, GEN:λ}}, where α, β, γ, δ, ε, ζ, η, θ, ι, κ, and λ are all permissible values; and (ii) satisfies the restriction in (25).

(25) If σ is an extension of {AGR(α):{PER:β, GEN:γ}} (where $\beta = 1$ or 2), then $\gamma = \{1,2\}$.

This restriction associates the first and second persons with GEN:{1,2}, the default for nouns with personal reference.

The inflectional affixes used in relative past-tense verb forms are furnished by the realization rules in (26). The Block I rules in (26a) supply suffixes distinguishing the voice of relative past-tense verb forms; the Block II rule (26b) supplies the preterite suffix *-noo*; the Block III rules in (26c) furnish the subject-agreement affixes (which include both prefixes and suffixes); and the Block IV rules in (26d) introduce the object-agreement suffixes.

(26) a. Block I

i. $\mathrm{RR}_{\mathrm{I},\{\mathrm{AGR(su)}:\{\mathrm{PER}:\alpha,\ \mathrm{NUM}:\beta\},\ \mathrm{TNS:relative\ past},\ \mathrm{VCE:active}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{i}',\sigma\rangle$, where $\alpha = 3$ or $\langle\alpha,\beta\rangle = \langle 1,\mathrm{pl}\rangle$

ii. $\mathrm{RR}_{\mathrm{I},\{\mathrm{TNS:relative\ past},\ \mathrm{VCE:active}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{U}',\sigma\rangle$

iii. $\mathrm{RR}_{\mathrm{I},\{\mathrm{TNS:relative\ past},\ \mathrm{VCE:middle}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{ii}',\sigma\rangle$

iv. $\mathrm{RR}_{\mathrm{I},\{\mathrm{TNS:relative\ past},\ \mathrm{VCE:passive}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{aa}',\sigma\rangle$

b. Block II

$\mathrm{RR}_{\mathrm{II},\{\mathrm{PRET:yes}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{noo}',\sigma\rangle$

c. Block III

i. $\mathrm{RR}_{\mathrm{III},\{\mathrm{AGR(su)}:\{\mathrm{PER}:1,\ \mathrm{NUM:sg}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{mi}',\sigma\rangle$

ii. $\mathrm{RR}_{\mathrm{III},\{\mathrm{AGR(su)}:\{\mathrm{PER}:2,\ \mathrm{NUM:sg}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\textit{ɗaa}',\sigma\rangle$

iii. $\mathrm{RR}_{\mathrm{III},\{\mathrm{AGR(su)}:\{\mathrm{PER}:3,\ \mathrm{NUM:sg},\ \mathrm{GEN}:\{1\}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle \textit{'o}X',\sigma\rangle$

iv. $\mathrm{RR}_{\mathrm{III},\{\mathrm{AGR(su)}:\{\mathrm{PER}:1,\ \mathrm{NUM:pl}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle \mathit{min}X',\sigma\rangle$

v. $\mathrm{RR}_{\mathrm{III},\{\mathrm{AGR(su)}:\{\mathrm{PER}:2,\ \mathrm{NUM:pl},\ \mathrm{INCL:yes}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\textit{ɗen}',\sigma\rangle$

vi. $\mathrm{RR}_{\mathrm{III},\{\mathrm{AGR(su)}:\{\mathrm{PER}:2,\ \mathrm{NUM:pl},\ \mathrm{INCL:no}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\textit{ɗon}',\sigma\rangle$

vii. $\mathrm{RR}_{\mathrm{III},\{\mathrm{AGR(su)}:\{\mathrm{PER}:3,\ \mathrm{NUM:pl},\ \mathrm{GEN}:\{2\}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle \textit{ɓe}X',\sigma\rangle$

d. Block IV

i. $\mathrm{RR}_{\mathrm{IV},\{\mathrm{AGR(ob)}:\{\mathrm{PER}:1,\ \mathrm{NUM:sg}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{yam}',\sigma\rangle$

ii. $\mathrm{RR}_{\mathrm{IV},\{\mathrm{AGR(ob)}:\{\mathrm{PER}:2,\ \mathrm{NUM:sg}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{maa}',\sigma\rangle$

iii. $\mathrm{RR}_{\mathrm{IV},\{\mathrm{AGR(ob)}:\{\mathrm{PER}:3,\ \mathrm{NUM:sg},\ \mathrm{GEN}:\{1\}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{mo}',\sigma\rangle$

iv. $\mathrm{RR}_{\mathrm{IV},\{\mathrm{AGR(ob)}:\{\mathrm{PER}:1,\ \mathrm{NUM:pl}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\mathit{min}',\sigma\rangle$

v. $\mathrm{RR}_{\mathrm{IV},\{\mathrm{AGR(ob)}:\{\mathrm{PER}:2,\ \mathrm{NUM:pl},\ \mathrm{INCL:yes}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\textit{'en}',\sigma\rangle$

vi. $\mathrm{RR}_{\mathrm{IV},\{\mathrm{AGR(ob)}:\{\mathrm{PER}:2,\ \mathrm{NUM:pl},\ \mathrm{INCL:no}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\textit{'on}',\sigma\rangle$

vii. $\mathrm{RR}_{\mathrm{IV},\{\mathrm{AGR(ob)}:\{\mathrm{PER}:3,\ \mathrm{NUM:pl},\ \mathrm{GEN}:\{2\}\}\},\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle X\textit{ɓe}',\sigma\rangle$

A set of morphological metageneralizations associates each of these rules with a set of morphophonological rules. I will not formulate these here, but shall assume that there is an appropriate formulation that accounts for the following alternations:

(a) Verb roots which (like *wall-* 'help') exhibit initial consonant gradation appear in the F-grade in the presence of a singular agreement prefix (e.g. *wall-* in (23a–c)) and in the N-grade elsewhere (e.g. *mball-* in (23d–j)). (See Arnott (1970:42ff.;187, 204f.) for details concerning the Fula system of initial consonant gradation.)

(b) The default relative past active suffix, which Arnott represents morphophonologically as *-U*, appears as *-u* with 'Type 1' roots (as in (23d–j)), has no phonological expression with 'Type 2' roots, and appears as an optional *-u* with 'Type 3' roots. (See Arnott (1970: 187f.) for the properties distinguishing these three classes of roots.)

(c) The relative past active suffix *-i* (used only in the first-person plural and in the third persons, as in (23a–c)), the relative past middle suffix *-ii*, the relative past passive suffix *-aa*, and the preterite suffix *-noo* have the respective short alternants *-U*, *-i*, *-a*, and *-no* (where *-U* participates in the alternation described in (b)). These short alternants appear when a long-vowelled suffix follows (as in *’o-wall-u-noo-ɓe’* ‘he had helped them’, *’o-wall-u-maa’* ‘he helped you (sg)’ in (23a,c) and in preterite forms such as *mball-u-no-maa-mi’* ‘I had helped you (sg)’ in (23j)). (See Arnott (1970: 219f.;224ff.) for details.)

(d) The 3sg class 1 object-agreement suffix *-mo* has the long alternant *-moo* in 1sg verb forms (as in (23i)). (See Arnott (1970: 211ff.) for details.)

(e) The incidence of final glottality (represented by ’ in (23)) is predictable: all relative past-tense forms exhibit final glottality unless they end with a first- or second-person object-agreement suffix other than *-maa* or with the nonconcording third-person singular object suffix *-ɗum*. (See Arnott (1970: 231ff.) for details.)

According to the partial definition of the Fula paradigm function in (27), the application of an object-agreement rule from Block IV ordinarily presupposes the application of a subject-agreement rule from Block III.

(27) Where $\sigma = \{\mathrm{AGR(su)}{:}\alpha, \mathrm{TNS}{:}\beta, \mathrm{VCE}{:}\gamma, \mathrm{PRET}{:}\delta, \mathrm{AGR(ob)}{:}\varepsilon\}$,
$\mathrm{PF}(<X,\sigma>) =_{\mathrm{def}} \mathrm{Nar}_{[\mathrm{IV,III}]}(\mathrm{Nar}_{\mathrm{II}}(\mathrm{Nar}_{\mathrm{I}}(<X,\sigma>)))$.

The definitional sequence of Blocks III and IV is, however, reversed by the portmanteau rule of referral in (28), the sole stipulated member of the portmanteau rule block [IV,III]:

(28) $\mathrm{RR}_{[\mathrm{IV,III}],\{\mathrm{AGR(su)}:\{\mathrm{PER}:1,\ \mathrm{NUM}:\mathrm{sg}\},\ \mathrm{TNS}:\mathrm{relative\ past},\ \mathrm{AGR(ob)}:\{\mathrm{NUM}:\mathrm{sg},\ \mathrm{GEN}:\{1\}\}\},\mathrm{V}}(<X,\sigma>) =_{\mathrm{def}} \mathrm{Nar}_{\mathrm{III}}(\mathrm{Nar}_{\mathrm{IV}}(<X,\sigma>))$

Thus, suppose that σ is the set of morphosyntactic properties in (29); in that case, $\mathrm{PF}(<\mathit{wall},\sigma>)$ is evaluated as in (30). In line (30b), the absence of any more specific rule in the portmanteau block [IV,III] guarantees that $\mathrm{Nar}_{[\mathrm{IV,III}]}(<\mathit{wall\text{-}U},\sigma>)$ is evaluated in accordance with the FCD, as $\mathrm{Nar}_{\mathrm{IV}}(\mathrm{Nar}_{\mathrm{III}}(<\mathit{wall\text{-}U},\sigma>))$; thus, the marking of object agreement (by the rule (26dvii) of *-ɓe* suffixation) is peripheral to that of subject agreement (by the rule (26ci) of *-mi* suffixation) in the resulting form *mball-u-mi-ɓe’*.

(29) {TNS:relative past, VCE:active, PRET:no, AGR(su):{PER:1, NUM:sg, GEN:{1}}, AGR(ob):{PER:3, NUM:pl, GEN:{2}}}

(30) PF(<*wall*,σ>)

a. $= \text{Nar}_{[\text{IV},\text{III}]}(\text{Nar}_{\text{II}}(\text{Nar}_{\text{I}}(<\textit{wall},\sigma>)))$ [by (27)]

b. $= \text{Nar}_{\text{IV}}(\text{Nar}_{\text{III}}(\text{Nar}_{\text{II}}(\text{Nar}_{\text{I}}(<\textit{wall},\sigma>))))$ [by Nar_n notation, FCD]

c. $= \text{RR}_{(26\text{dvii})}(\text{RR}_{(26\text{ci})}(\text{RR}_{\text{II},\{\},\text{U}}(\text{RR}_{(26\text{aii})}(<\textit{wall},\sigma>))))$ [by Nar_n notation]

d. = <*mball-u-mi-ɓe'*,σ>

[by (26dvii), (26ci), (26aii), and the IFD, assuming the appropriate morphophonology]

Suppose now that σ′ is the set of morphosyntactic properties in (31); in that case, PF(<*wall*,σ′>) is evaluated as in (32). In line (32c), $\text{Nar}_{[\text{IV},\text{III}]}$(<*wall-U*,σ′>) is evaluated as $\text{RR}_{(28)}$(<*wall-U*, σ′>), hence – in line (d) – as $\text{Nar}_{\text{III}}(\text{Nar}_{\text{IV}}$(<*wall-U*,σ′>)); thus, the marking of subject agreement (by the rule (26ci) of *-mi* suffixation) is peripheral to that of object agreement (by the rule (26dii) of *-maa* suffixation) in the resulting form *mball-u-maa-mi'*.

(31) {TNS:relative past, VCE:active, PRET:no, AGR(su):{PER:1, NUM:sg, GEN:{1}}, AGR(ob):{PER:2, NUM:sg, GEN:{1}}},

(32) PF(<*wall*,σ′>)

a. $= \text{Nar}_{[\text{IV},\text{III}]}(\text{Nar}_{\text{II}}(\text{Nar}_{\text{I}}(<\textit{wall},\sigma'>)))$ [by (27)]

b. $= \text{RR}_{(28)}(\text{RR}_{\text{II},\{\},\text{U}}(\text{RR}_{(26\text{aii})}(<\textit{wall},\sigma'>)))$ [by Nar_n notation]

c. $= \text{Nar}_{\text{III}}(\text{Nar}_{\text{IV}}(\text{RR}_{\text{II},\{\},\text{U}}(\text{RR}_{(26\text{aii})}(<\textit{wall},\sigma'>))))$ [by (28)]

d. $= \text{RR}_{(26\text{ci})}(\text{RR}_{(26\text{dii})}(\text{RR}_{\text{II},\{\},\text{U}}(\text{RR}_{(26\text{aii})}(<\textit{wall},\sigma'>))))$

[by Nar_n notation]

e. = <*mball-u-maa-mi'*,σ′>

[by (26ci), (26dii), (26aii), and the IFD, assuming the appropriate morphophonology]

As these examples show, a rule's membership in a particular block and its definitional sequence relative to rules in other blocks are in principle distinguished in PFM; in particular, portmanteau rules of referral such as (28) make it possible for the definitional sequence of the rule blocks in terms of which a paradigm function is evaluated to vary according to the morphosyntactic property set being realized.

A proponent of the FLOH might contest the need to separate block membership from definitional sequence by arguing that reversible position classes can always be avoided by postulating a sufficiently large number of position classes. In the Fula case, for instance, one might argue that the rules of subject and object agreement aren't actually organized into two reversible blocks, but are instead situated in four nonreversible blocks. That is, one might argue that the agreement rules are grouped as follows: Block IIIa contains all subject-agreement rules but the 1sg rule of *-mi* suffixation, which instead belongs to Block IIIb; Block IVa contains two

Table 5.6 *A position-class analysis for Fula that is consistent with the FLOH*

Block I stem	IIIa	IVa	IIIb	IVb	Gloss
mball-u	*-ɗon*			*-ɓe*	'you (pl.) helped them'
mball-u	*-ɗon*	*-mo(o)*			'you (pl.) helped him'
mball-u			*-mi*	*-ɓe*	'I helped them'
mball-u		*-mo(o)*	*-mi*		'I helped him'

object-agreement rules – the 2sg rule of *-maa* suffixation, and the 3sg (class 1) rule of *-mo(o)* suffixation – while Block IVb contains all other object-agreement rules. On this view, the four blocks of agreement rules are nonreversible: they always apply in the sequence IIIa – IVa – IIIb – IVb, as in table 5.6.

This counterargument has little to recommend it, however. In the analysis represented in table 5.6, the affixation rules in Blocks IIIa and IIIb apply in complementary circumstances, as do those in Blocks IVa and IVb; this analysis therefore portrays as pure coincidence the fact that Blocks IIIa, IVa, IIIb, and IVb never supply more than two affixes in the inflection of any given word. Moreover, it isn't clear that this sort of analysis would be as learnable as the analysis proposed in (26)–(28). Two types of factors might be assumed to favour the postulation of multiple rule blocks by language learners: first, if as many as *n* realization rules are observed to apply within a single word, at least *n* distinct rule blocks must be postulated; and second, as many rule blocks must be postulated as are necessary to ensure conformity to the Pāṇinian well-formedness condition on rule blocks (given as (16) in section 3.5). Beyond these requirements, however, it is natural to assume that language learners postulate as few additional rule blocks as they can. The analysis proposed in (26)–(28) satisfies this preference principle in an optimal way; the analysis in table 5.6 does not.

5.5 Rule blocks or feature discharge?

In PFM, it is assumed that a language's realization rules are organized into blocks, and that except in cases involving parallel position classes, the inflection of a given word involves at most one rule of exponence from each block. A corollary of this assumption is that however many distinct inflectional markings a word carries in some language, that language must have at least that many rule blocks. Consider, for example, the Tamazight Berber

Table 5.7 *Completive paradigm of Tamazight Berber* DAWA *'cure' (Noyer 1992:132)*

		SINGULAR	PLURAL
1		*dawa-γ*	*n-dawa*
2	MASC	*t-dawa-d*	*t-dawa-m*
	FEM	*t-dawa-d*	*t-dawa-n-t*
3	MASC	*i-dawa*	*dawa-n*
	FEM	*t-dawa*	*dawa-n-t*

verb paradigm in table 5.7. As this paradigm shows, a Berber verb may carry as many as three different affixes expressing subject agreement; under the assumptions of PFM, this is a sign that at least three distinct rule blocks are applicable in the inflection of Berber verbs for subject agreement.

Noyer (1992), however, proposes a very different theory of the organization of realization rules. His theory is like PFM to the extent that it is inferential and realizational – that is, realization rules are assumed to apply to a word to express specific sets of morphosyntactic properties with which that word is associated. Nevertheless, there are key differences between Noyer's theory and PFM. These differences can be appreciated by considering Noyer's (1992:133) analysis of the Tamazight Berber paradigm in table 5.7; this analysis is given in (33).

(33)

Rule of affixation	is a primary exponent of	is a secondary exponent of	bleeds
a. *n-*	{PER:1, NUM:pl}		(b), (h)
b. *-γ*	{PER:1}		
c. *t-*	{PER:2}		
d. *-m*	{NUM:pl, GEN:masc}	{PER:2}	(h)
e. *i-*	{NUM:sg, GEN:masc}		
f. *t-*	{NUM:sg, GEN:fem}		(i)
g. *-d*	{NUM:sg}	{PER:2}	
h. *-n*	{NUM:pl}		
i. *-t*	{GEN:fem}		

This analysis comprises nine realization rules which may apply to a verb's stem to express particular sets of morphosyntactic properties. What should be immediately noticed is that in Noyer's approach, the different realization rules are not organized into distinct blocks; they instead, as it were, simply constitute a single block of ordered rules. The interaction of these rules is regulated by a principle of FEATURE DISCHARGE.[7] The application of any given rule – such as any of (a) to (i) in (33) – discharges the set of morphosyntactic properties associated with that rule; once a set of properties is discharged in this way, it is not available for realization by any subsequent rule. So, for example, rule (33d) realizes plural number and masculine gender and discharges those features, in such a way that no subsequent rule in the list can be a primary exponent of either of those properties in the inflection of the same word. Thus, the application of rule (33d) bleeds rule (33h) (which would otherwise realize plural number). Rules (33d) and (33h) are both rules of suffixation, but Noyer draws particular attention to the fact that his approach to inflection also induces instances of 'discontinuous bleeding' – bleeding of a rule of suffixation by a rule of prefixation, or vice versa. For example, rule (33a), which prefixes *n*- to realize first person and plural number, discharges both of those features, and therefore bleeds both rule (33b) (which would otherwise suffix -γ to realize first person) and rule (33h) (which would otherwise suffix -*n* to realize plural number). In the same way, rule (33f) (which prefixes *t*- to realize singular number and feminine gender) excludes the subsequent application of rule (33i) (which would otherwise suffix -*t* in feminine forms).

On its own, the principle of feature discharge would seem to be incompatible with the phenomenon of extended exponence (section 1.2); a second assumption, however, reconciles it with this phenomenon. Noyer assumes (pp.68ff.) that besides being the primary exponent of some set of morphosyntactic properties, a realization rule may also be the SECONDARY EXPONENT of some set of properties. Rule (33d), for example, besides being a primary exponent of plural number and masculine gender, is also a secondary exponent of second person. This means that any time rule (33d) applies, that rule not only discharges the properties of plural number and masculine gender: it also presupposes the prior discharge of the property of second person by some earlier rule. So rule (33d) requires rule (33c) to have applied beforehand. In the same way, rule (33g) requires rule (33c) to have applied beforehand as well.

The ordering of the rules in (33) is critical for their proper interaction in determining the paradigm of forms in table 5.7. Noyer emphasizes that the ordering of rules in this system is not simply a matter of bald stipulation, but in fact follows from general principles. In particular, he appeals to the SPELL-OUT ORDERING HYPOTHESIS (Noyer 1992:93):

(34) If a given input can undergo two different spell-out rules the following principles order the rules in the unmarked instance, where one of two situations will obtain.
   a. Pāṇini's principle: If one rule's structural description is contained in the other's, the rule with the more specific structural description applies first.
   b. Feature Hierarchy Principle: If the structural descriptions are disjoint or overlapping, then the rule referring to the hierarchically higher feature applies first.

In accordance with Pāṇini's principle (34a), rule (33a) applies before rules (33b) and (33h), rule (33f) applies before rules (33g) and (33i), and so on. In accordance with (34b), rules realizing highly ranked morphosyntactic properties precede rules realizing less highly ranked properties; the ranking to which Noyer refers in developing this idea is that in (35), which he argues is motivated on independent grounds.

(35) 1st person > 2nd person > plural > feminine

Those rule orderings in (33) which are not determined by Pāṇini's principle are, in general, predicted by this Feature Hierarchy Principle: for instance, the ordering of (33c) before (33h) follows from the fact that second person outranks plural number in hierarchy (35); the ordering of (33h) before (33i) follows from the fact that plural outranks feminine; and so on. In the few cases in which neither Pāṇini's principle nor the Feature Hierarchy Principle determines the ordering of two rules, the ordering is either intrinsic (as in the case of rules (33c) and (33g), where the application of the latter rule presupposes the discharge of the property 'second person' by the former rule) or immaterial (as in the case of rules (33e) and (33i), which are never applicable in the realization of the same set of morphosyntactic properties).

These assumptions allow Noyer to say that the rules in (33) apply as a single block rather than as three distinct blocks in the inflection of Berber verbs for subject agreement. One important assumption that Noyer has to make in order to get this analysis to come out right is that there is no gender distinction in the second-person singular. Notice that the 2sg forms in table 5.7 are in fact identical, and Noyer assumes that this is not simply an accident, but is a reflection of the fact that there simply is no gender distinction in the second-person singular of Berber verbs – that the property sets {PER:2, NUM:sg, GEN:fem} and {PER:2, NUM:sg, GEN:masc} are ill formed in Berber. Notice why he has to make this assumption. If he instead assumed that there is in fact a gender distinction in the second-person singular, the rules in (33) would wrongly end up expressing it: on the one hand, the 2sg feminine form would wrongly evince the application of both *t*-prefixation rules ((33c) and (33f)), the latter of which – by discharging the properties 'singular' and 'feminine' – would block the subsequent application of rule (33g); on the other hand, the 2sg masculine form would wrongly evince the application of rules (33c) and (33e), the latter of which – by discharging the properties 'singular' and 'masculine' – would block the subsequent application of rule (33g). It is therefore critical to Noyer's analysis that the property sets {PER:2, NUM:sg, GEN:fem} and {PER:2, NUM:sg, GEN:masc} be excluded.

The key features of this analysis are, again, the absence of any organization of rules into distinct rule blocks, the principle of feature discharge (together with that of secondary exponence), and the notion that rule ordering is determined by universal principles.

I'd like to argue that, theoretically, Noyer's analysis of Berber subject agreement does not embody a viable approach to inflectional morphology. Before doing so, however, I must mention two facts about Berber morphology which are at apparent odds with the details of Noyer's analysis. First, his assumption that gender is not a distinctive property in the second-person singular in Berber verbs is questionable. Typologically, a system which distinguished gender in the second-person plural but not in the second-person singular would be quite unusual. And in Berber, in fact, gender is formally distinguished in 2sg pronominal-object suffixes for verbs and prepositions, in possessive suffixes for nouns, and in the system of free pronouns (Bentolila 1981:74f.); it is only with respect to subject agreement that the gender distinction fails to receive formal expression. This suggests that the identity of the 2sg forms in table 5.7 is simply an accident of the rule system – a consequence of the fact that 2sg subject agreement is expressed by rules which happen not to be sensitive to gender.

A second point of detail relates to Noyer's analysis of the suffix -*n*, introduced by rule (33h) in his system. He treats the suffix -*n* as a general marker of the plural, one which is overridden in two cases: it is bled by the rule (33d) of -*m* suffixation, and it is discontinuously bled by the rule (33a) of *n*-prefixation in the first-person plural. Other dialects of Berber, however, suggest a different analysis. If the Tamazight Berber paradigm in table 5.7 is compared with the Kabyle Berber paradigm in table 5.8, one critical difference emerges: the suffix -*n* only shows up in the third-person plural in Kabyle Berber; in the second-person plural, the suffix -*m* shows up both in the masculine and in the feminine. This suggests that Tamazight Berber has

Table 5.8 *Completive paradigm of Kabyle Berber* WALI *'see' (Hamouma n.d.:79; Chaker 1983:112)*

		SINGULAR	PLURAL
1		*wala-γ*	*n-wala*
2	MASC	*t-wala-ḍ*	*t-wala-m*
	FEM	*t-wala-ḍ*	*t-wala-m-t*
3	MASC	*i-wala*	*wala-n*
	FEM	*t-wala*	*wala-n-t*

the same sort of system, with the one difference that in the second-person plural feminine, suffixal *-m* assimilates to the place of articulation of the following *-t* – that the appearance of *-n* rather than *-m* is, in this case, simply a matter of (morpho)phonology rather than of morphology. And indeed, there is independent evidence for just such a (morpho)phonological rule in Tamazight Berber. In Berber, feminine nominals can be derived from masculine nominals through the circumfixation of *t-* ... *-t*; thus, *amQan* 'big (masc)' gives rise to *t-amQan-t* 'big (fem)'. If a masculine nominal ends in *m*, the circumfixation of *t-* ... *-t* invariably induces the assimilation of *m* as *n*; thus, *asMam* 'bitter (masc)' gives rise to *t-asMan-t* 'bitter (fem)' (Bentolila 1981:25).[8] This supports the possibility that the paradigms in tables 5.7 and 5.8 are in fact alike, but that this similarity is obscured by the tendency of *-m* to assimilate to *-t* in Tamazight (and not in Kabyle). If this is so, then one needn't assume that *-n* suffixation is discontinuously bled by *n-* prefixation in Berber; rather, one can instead simply assume that the two affixes express contrasting properties of person.

Neither of these empirical points is an argument against Noyer's theoretical assumptions: it's perfectly possible to modify his rule system in such a way as to take account of these empirical points without abandoning his theoretical ground plan. One imaginable reworking of his analysis would be as in (36).

(36)

Rule of affixation	is a primary exponent of	is a secondary exponent of	bleeds
a. *n-*	{PER:1, NUM:pl}		(b)
b. *-γ*	{PER:1}		
c. *t-*	{PER:2}		
d. *-n*	{PER:3, NUM:pl}		
e. *i-*	{PER:3, NUM:sg, GEN:masc}		(f)

f.	*t-*	{PER:3, NUM:sg}	
g.	*-m*	{NUM:pl}	{PER:2}
h.	*-d*	{NUM:sg}	{PER:2}
i.	*-t*	{GEN:fem}	{NUM:pl}

Nevertheless, there are good theoretical grounds for rejecting any such analysis. The principal objection to Noyer's theory flows from the related notions of feature discharge and secondary exponence. In Noyer's theory, the notion of secondary exponence is necessary to reconcile the principle of feature discharge with the widely observed phenomenon of extended exponence. The notion of secondary exponence, however, is a paradoxical one: in particular, there are frequent instances in which an inflection must, on Noyer's assumptions, be a primary exponent of some morphosyntactic property set in one class of cases but has to be a secondary exponent (and not a primary exponent) of that property set in some other class of cases. A familiar example of this can be found in Swahili.

Thus, consider again the partial inflectional paradigm of the Swahili verb TAKA 'want' given above in table 5.1. Recall that in the past tense, there is a special negative past-tense prefix *ku-*, which contrasts with the positive past-tense prefix *li-* (e.g. *tu-li-taka* 'we wanted', but *ha-tu-ku-taka* 'we didn't want'); on the other hand, no corresponding contrast is found among the future-tense forms, where *ta-* is invariably the expression of future tense in both positive and negative forms (e.g. *tu-ta-taka* 'we will want', *ha-tu-ta-taka* 'we won't want'). The problem which this paradigm fragment poses for Noyer's theory relates to the negative prefix *ha-*. Under Noyer's assumptions, should *ha-* be characterized as a primary or a secondary exponent of negative polarity? Neither answer is consistently satisfactory. In future-tense forms, *ha-* must seemingly be regarded as a primary exponent of negative polarity, because there is no other exponent of negative polarity in negative future-tense forms. That is, to account for the plural future-tense forms in table 5.1, one must seemingly assume a rule system such as (37).

(37)		Rule of affixation	is a primary exponent of
	a.	*ta-*	{TNS:fut}
	b.	*tu-*	{AGR(su):{PER:1, NUM:pl}}
	c.	*m-*	{AGR(su):{PER:2, NUM:pl}}
	d.	*wa-*	{AGR(su):{PER:3, NUM:pl}}
	e.	*ha-*	{POL:neg}

This rule system, however, cannot be extended to cover negative past-tense forms. In order for *ku-* to appear in negative forms but never in positive forms, *ku*- must be assumed to be a primary exponent of negative polarity; but if it is, then by the time that the *ha*- rule has a chance to apply in the inflection of a negative past-tense verb form, the property 'negative' will already have been discharged, and will simply not be available for discharge by the *ha*- rule. Thus, *ha*- cannot be regarded as a primary exponent of negative polarity; the only possibility will be for *ha*- to realize negative polarity as a secondary exponent, as in (38).

(38)

	Rule of affixation	is a primary exponent of	is a secondary exponent of
a.	*ku*-	{TNS:past, POL:neg}	
b.	*tu*-	{AGR(su):{PER:1, NUM:pl}}	
c.	*m*-	{AGR(su):{PER:2, NUM:pl}}	
d.	*wa*-	{AGR(su):{PER:3, NUM:pl}}	
e.	*ha*-	∅	{POL:neg}

But since the property 'negative' isn't discharged prior to *ha*- prefixation in negative future-tense forms, *ha*- cannot be a secondary exponent of negative polarity in the future tense. Paradoxically, one and the same affix – the *ha*- prefix – seemingly has to function as a primary exponent of negation in one set of forms, but has to function as a secondary exponent of negation in another set of forms. Similar paradoxes can be found in other languages.

Such facts raise the question of whether the alleged distinction between primary and secondary exponents can be empirically motivated. I believe that it cannot. The only principle that I am aware of whose formulation presupposes a distinction between primary and secondary exponents is the Peripherality Constraint (which Noyer argues (p.103) to be derivable from his assumptions): Carstairs (1987:193) formulates this constraint as a ban on pure outward sensitivity, a notion whose definition (Carstairs 1987:147ff.) makes explicit reference to the primary/secondary distinction. But the validity of the Peripherality Constraint is itself highly questionable; in Bulgarian, for example, it is disconfirmed by the absence of the aorist and preterite suffixes from 3sg aorist forms (cf. section 2.2), as I have shown elsewhere (Stump 1997:229ff.). The claim that a given morphological marking is a secondary exponent of some property *p* is, as far as I can tell, not different from the claim that that marking is 'subcategorized' for stems marked for property *p*; but as I have shown elsewhere (Stump 1992, 1993c, cf. section 1.3), the syntactic device of subcategorization is poorly suited to expressing distributional generalizations in the domain of inflectional morphology.

Thus, the approach to the organization of realization rules that Noyer proposes is fundamentally flawed, relying on an empirically unmotivated and ultimately paradoxical distinction between primary and secondary exponents. In section 5.2 above, I have proposed a different kind of analysis for the Swahili forms in table 5.1; similarly, I would propose the PFM analysis in (39) for the Tamazight Berber paradigm in table 5.7. In these analyses, the notions of feature discharge and secondary exponence are abandoned,[9] and the realization rules are organized into disjunctive blocks. The rules within each block are unordered; the choice of one rule over another is, without exception, determined by Pāṇini's principle.

(39)

$$
\begin{array}{lll}
\textbf{Block A} & \mathrm{RR}_{\mathrm{A},\{\mathrm{AGR(su)}:\{\mathrm{PER:2}\}\},\mathrm{V}}(\langle \mathrm{X},\sigma\rangle) & =_{\mathrm{def}} \langle t\mathrm{X}',\sigma\rangle \\
 & \mathrm{RR}_{\mathrm{A},\{\mathrm{AGR(su)}:\{\mathrm{PER:3,\ NUM:sg,\ GEN:masc}\}\},\mathrm{V}}(\langle \mathrm{X},\sigma\rangle) & =_{\mathrm{def}} \langle i\mathrm{X}',\sigma\rangle \\
 & \mathrm{RR}_{\mathrm{A},\{\mathrm{AGR(su)}:\{\mathrm{PER:3,\ NUM:sg}\}\},\mathrm{V}}(\langle \mathrm{X},\sigma\rangle) & =_{\mathrm{def}} \langle t\mathrm{X}',\sigma\rangle \\
 & \mathrm{RR}_{\mathrm{A},\{\mathrm{AGR(su)}:\{\mathrm{PER:1,\ NUM:pl}\}\},\mathrm{V}}(\langle \mathrm{X},\sigma\rangle) & =_{\mathrm{def}} \langle n\mathrm{X}',\sigma\rangle \\
\textbf{Block B} & \mathrm{RR}_{\mathrm{B},\{\mathrm{AGR(su)}:\{\mathrm{PER:1,\ NUM:sg}\}\},\mathrm{V}}(\langle \mathrm{X},\sigma\rangle) & =_{\mathrm{def}} \langle \mathrm{X}\gamma',\sigma\rangle \\
 & \mathrm{RR}_{\mathrm{B},\{\mathrm{AGR(su)}:\{\mathrm{PER:2,\ NUM:pl}\}\},\mathrm{V}}(\langle \mathrm{X},\sigma\rangle) & =_{\mathrm{def}} \langle \mathrm{X}m',\sigma\rangle \\
 & \mathrm{RR}_{\mathrm{B},\{\mathrm{AGR(su)}:\{\mathrm{PER:2}\}\},\mathrm{V}}(\langle \mathrm{X},\sigma\rangle) & =_{\mathrm{def}} \langle \mathrm{X}d',\sigma\rangle \\
 & \mathrm{RR}_{\mathrm{B},\{\mathrm{AGR(su)}:\{\mathrm{PER:3,\ NUM:pl}\}\},\mathrm{V}}(\langle \mathrm{X},\sigma\rangle) & =_{\mathrm{def}} \langle \mathrm{X}n',\sigma\rangle \\
\textbf{Block C} & \mathrm{RR}_{\mathrm{C},\{\mathrm{AGR(su)}:\{\mathrm{NUM:pl,\ GEN:fem}\}\},\mathrm{V}}(\langle \mathrm{X},\sigma\rangle) & =_{\mathrm{def}} \langle \mathrm{X}t',\sigma\rangle
\end{array}
$$

Noyer raises one possible objection to this sort of analysis: 'From the point of view of learning the forms of the system, one must assume on [a Word-and-Paradigm analysis] that one must learn both the rule *and* the block it occurs in . . . In contrast, the analysis I have given in [(33)] requires only that each affix be learned associated with its feature content' (1992:137f.). The strength of this objection rests on the assumption that a rule's assignment to a particular block is a matter of blunt stipulation. But rule systems such as those in (3) and (39) adhere to a number of transparent organizational principles; for instance, the grouping of rules in (39) is the ONLY grouping of these rules that conforms to the categorical principles in (40) and optimally satisfies the preference principles in (41).

(40) Two categorical principles for the organization of realization rules into blocks

a. If *n* distinct rules of exponence apply in the inflection of some word, then those rules are situated in *n* distinct blocks.

b. All rule blocks satisfy the Pāṇinian well-formedness condition on rule blocks (given in (16), section 3.5).

(41) Three preference principles for the organization of realization rules into blocks

c. The number of rule blocks is preferably minimized.

d. If a set of affixation rules is organized into two or more blocks, rules of prefixation are preferably situated in separate blocks from rules of suffixation.

e. If a set of realization rules is organized into two or more blocks, each block preferably realizes the minimum possible number of morphosyntactic features.

If these principles (or perhaps some more inclusive set of principles) can be shown to determine the organization of rules into blocks in all cases, then Noyer's objection evaporates. Moreover, Noyer apparently underestimates the difficulties which the notion of secondary exponence would present for language learners. In particular, how does a language learner determine the properties of which a rule is a primary exponent and those of which it is a secondary exponent? Consider again the analysis of Tamazight Berber subject-agreement inflections in (36); in this analysis, the suffixes -*m* and -*d* are treated as secondary exponents of second person. But one could seemingly just as well assume that they are primary exponents of second person, as in the alternative to (36) in (42).

(42)

Rule of affixation	is a primary exponent of	is a secondary exponent of	bleeds
a. *n*-	{PER:1, NUM:pl}		(b)
b. -*γ*	{PER:1}		
c. -*m*	{PER:2, NUM:pl}		(d)
d. -*d*	{PER:2}		
e. -*n*	{PER:3, NUM:pl}		
f. *i*-	{PER:3, NUM:sg, GEN:masc}		(g)
g. *t*-	{PER:3, NUM:sg}		
h. -*t*	{GEN:fem}	{NUM:pl}	
i. *t*-	∅	{PER:2}	

What are the principles that determine the choice between the analyses in (36) and (42)? The question is not a trivial one, since – as this example shows – the ordering of rules in Noyer's theory depends as much on the primary and secondary exponence relations in which they participate as on the Feature Hierarchy Principle. In view of these considerations, it is difficult to have any confidence in Noyer's claim that the feature-discharge analysis is more learnable than an analysis involving rule blocks.

It is true, of course, that unlike a feature-discharge analysis, a rule-block analysis must specify the relative ordering of rule blocks in the definition of an overarching paradigm function. But this specification needn't always be a matter of stipulation; instead, by invoking an analogue of Noyer's Feature Hierarchy Principle, it may be possible to derive this specification from a universal default.

Recall that in Noyer's approach, the ordering of realization rules is determined first by Pāṇini's principle, and second by the principle that rules realizing higher-ranking morphosyntactic properties take priority over rules realizing lower-ranking properties. In PFM, Pāṇini's principle is restricted in its application to the choice among rules within a rule block, but something like the Feature Hierarchy Principle might well be invoked to account for the relative ordering of entire blocks. Not all ordering relations among rule blocks can be accounted for in this way: there are instances in which the same categories are realized in one order in one language but in the opposite order in some other language (e.g. Latin *amā-ba-m* 'love-IMPF-1SG' but Welsh Romany *kamá-v-as* 'love-1SG-IMPF'), and within one and the same language, there are cases in which properties are realized in different orderings in different contexts (as in the case of Fula reversible rule blocks discussed above). But following Noyer, one might want to assume that there is at least a kind of unmarked case to which languages will tend to adhere even if they fail to do so exceptionlessly. Let MaxP be a function which applies to a rule block B to yield the highest-ranked property realized by any rule in B. The effects of Noyer's Feature Hierarchy Principle might then be mimicked by the default principle in (43).

(43) Let B_1, B_2 be distinct rule blocks and let R_1, R_2 be distinct rules such that $R_1 \in B_1$ and $R_2 \in B_2$: in that case, if $\mathrm{MaxP}(B_1) > \mathrm{MaxP}(B_2)$, then in the absence of any contrary indication, the application of R_2 presupposes that of R_1 in any form arising through the application of both R_1 and R_2.

This has the effect of causing Block C to follow Blocks A and B in the Tamazight analysis (39), because the highest-ranked property realized by the rule in Block C is that of plural number, whereas the highest-ranked property realized in Blocks A and B is that of first person. So we might want to say that the ordering of Block C after Blocks A and B is an effect of a default principle; on the other hand, the relative ordering of Blocks A and B seems to be pretty much immaterial – both orderings work, and neither ordering is preferred by principle (43). Again, this default principle of block ordering would have to be assumed to be overridden in a good many cases. (The notion that morphosyntactic properties or features are in some sense hierarchically organized arises in other contexts; in section 7.6, for example, I examine the possibility that the incidence of syncretism in natural language is restricted by feature hierarchies.)

5.6 Conclusions

Inflectional 'templates' are frequently invoked as a way of accounting for language-particular restrictions on the cooccurrence of affixes in systems of position-class morphology. Few current theories of inflectional morphology, however, are precise about the formal status of such 'templates'; the template metaphor is therefore a particularly unfortunate one, since it prejudices the issue in favour of the unexamined assumption that templates are simply positive output constraints on morphological structure. Paradigm functions (such as those proposed above for fragments of Swahili, Lingala, and Fula verb morphology) give precise theoretical content to the notion of template. Paradigm functions are not positive output constraints; rather, they are the highest-order rules for the inflectional realization of a language's morphosyntactic properties.

This conception of inflectional templates is strongly motivated by the special peculiarities of position-class morphology discussed above. The assumptions of PFM allow rule blocks standing in paradigmatic opposition to compete in the evaluation of a paradigm function; they allow a single rule block to participate in the evaluation of a paradigm function in more than one way; and they allow variation in the definitional sequence of rule blocks involved in the evaluation of a given paradigm function. Consequently, PFM affords a straightforward account of portmanteau position classes, parallel position classes, and reversible position classes – i.e. for the dependencies which may exist between a word's morphosyntactic properties and the number, identity, and sequence of the realization-rule blocks which spell out its inflectional morphology. The assumption that a word's inflectional form is determined through the evaluation of a paradigm function applying to a root pairing is essential to this account, whose adequacy therefore constitutes a second argument for the postulation of paradigm functions; logically, this argument is completely independent of the first such argument, developed in chapter 4.

Rules of referral are essential to the proposed account of portmanteau, parallel, and reversible position classes: the FCD (a universal rule of referral instantiated in every portmanteau rule block) mediates the competition between portmanteau rule blocks and the blocks to which they are paradigmatically opposed; default rules of referral such as (11b) and (12b) allow the same block of rules to enter into a paradigm function's evaluation more than once; and portmanteau rules of referral such as (28) determine the definitional sequence of the rule blocks involved in a paradigm function's evaluation. None of these rules of referral describes a syncretism in the strict sense: that is, none refers the realization of some set σ of morphosyntactic properties to a rule which realizes a complete property set distinct from σ; instead, each refers the realization of σ to one or more rules realizing σ (or some of the properties constituting σ) in one or more other blocks.

An important consequence of the view that inflectional templates are nothing other than paradigm functions is that all inflectional paradigms are 'templatic', since all inflectional paradigms involve paradigm functions. This consequence may seem questionable to those who assume that inflection is templatic in some languages but not in others (as e.g. Carstairs-McCarthy (1992:210ff.) seems to assume). This is, however, an assumption that has never been justified empirically; indeed, the criteria that are standardly used to distinguish templatic morphology from 'layered' morphology (Simpson and Withgott 1986) confirm the view that all inflection (and perhaps also some derivation) is templatic (Stump 1997).

Finally, I have argued that Noyer's notion of feature discharge is not a satisfactory alternative to the postulation of rule blocks, since it depends on an empirically unmotivated and ultimately paradoxical distinction between primary and secondary exponents.

6 *Stem alternations*

6.1 Introduction

A single lexeme may exhibit a variety of distinct stems within its inflectional paradigm. When it does, the question naturally arises why one stem is chosen over another in a particular cell of that paradigm. One might try to attribute the choice of one stem over another to a semantic difference between the two stems, or to an inherent difference in morphosyntactic feature content, or to some phonological exigency forcing the choice. But in a good many cases, such attempts are vain; that is, it frequently happens that the distributional difference between two stems follows neither from any systematic difference in meaning or morphosyntactic feature content, nor from ordinary phonological considerations. In view of the widespread incidence of such cases, one must simply assume that a lexeme's stems often carry indices whose sole function is to distinguish their mode of interaction with realization rules (and, more broadly, with rules of derivation and compounding). In the terminology of Aronoff (1994:25), the category of stems distinguished by an index of this sort is MORPHOMIC: it has no role in the grammar beyond the autonomous workings of the morphological component.[1]

For concreteness, consider an example from Sanskrit. In Sanskrit, adjectives inflect for agreement with the case, number, and gender of the noun they modify; for instance, the masculine and neuter forms of the possessive adjective BHAGAVANT 'fortunate' are as in tables 6.1 and 6.2 (Whitney 1889: section 453). BHAGAVANT belongs to the class of C-STEM NOMINALS, a large and varied class of declinable lexemes which includes (i) masculine and neuter nouns whose stems end in consonants, and (ii) adjectives whose masculine and neuter stems end in consonants; more specifically, BHAGAVANT belongs to the subclass of MULTIPLE-C-STEM nominals, whose paradigms exhibit a distinctive pattern of stem alternation (Whitney 1889: section 311). Members of this subclass have both a STRONG stem and

Table 6.1 *Masculine forms of the Sanskrit possessive adjective* BHAGAVANT *'fortunate' (Strong stem* bhágavant-*; Weak stem* bhágavat-*)*

	SINGULAR	DUAL	PLURAL	
NOM	*bhágavān*	*bhágavant-āu*	*bhágavant-as*	based on the Strong stem
ACC	*bhágavant-am*	*bhágavant-āu*	*bhágavat-as*	based on the Weak stem
INSTR	*bhágavat-ā*	*bhágavad-bhyām*	*bhágavad-bhis*	
DAT	*bhágavat-e*	*bhágavad-bhyām*	*bhágavad-bhyas*	
ABL	*bhágavat-as*	*bhágavad-bhyām*	*bhágavad-bhyas*	
GEN	*bhágavat-as*	*bhágavat-os*	*bhágavat-ām*	
LOC	*bhágavat-i*	*bhágavat-os*	*bhágavat-su*	

Table 6.2 *Neuter forms of the Sanskrit possessive adjective* BHAGAVANT *'fortunate' (Strong stem* bhágavant-*; Weak stem* bhágavat-*)*

	SINGULAR	DUAL	PLURAL	
NOM/ACC	*bhágavat*	*bhágavat-ī*	*bhágavant-i*	based on the Strong stem
INSTR	*bhágavat-ā*	*bhágavad-bhyām*	*bhágavad-bhis*	based on the Weak stem
		[etc. as in table 6.1]		

a WEAK stem: in masculine paradigms, the Strong stem appears in the nominative and accusative of the singular and dual as well as in the nominative plural, while in neuter paradigms, the Strong stem only appears in a single, syncretic form, that of the nominative and accusative plural.[2] In tables 6.1 and 6.2, the Strong stem is *bhágavant*- (which, by regular processes of sandhi, loses its final *t* in the nominative singular – Whitney 1889: section 150) and the Weak stem is *bhágavat*- (which regular sandhi processes cause to appear as *bhágavad*- in the instrumental, dative, and ablative of the dual and plural – Whitney 1889: sections 111 and 157); thus, the double lines cutting across the paradigms in these tables separate those cells in which the Strong stem appears from those in which the distinct Weak stem appears. It should additionally be noted that BHAGAVANT belongs to a large subclass of C-stem nominals (which I shall call the class of stem-lengthening nominals) whose members exhibit stem-final lengthening in the masculine nominative singular; thus, BHAGAVANT's Strong stem is lengthened to *bhágavānt*-, the Strong stem of BALIN 'strong' is lengthened to *balī́n*-, and so on.

Because there is no invariant piece of meaning nor any invariant set of morphosyntactic properties that always accompanies the Strong stem *bhágavant*- and never accompanies the Weak stem *bhágavat*-, it is clear that the distributional difference between the two stems cannot be plausibly attributed to a semantic difference or an inherent difference in morphosyntactic feature content. Moreover, the phonology of Sanskrit does not suffice to determine the choice between the two stems of BHAGAVANT; indeed, both combine with a suffix of the form -*as* (cf. the masculine nominative plural and genitive singular forms). One must instead assume that the two stems are indexed as members of distinct morphomic categories – i.e. the categories 'Strong' and 'Weak' – and that in the inflection of BHAGAVANT, the choice between the two stems is effected by rules that are sensitive to this difference in indexing.

Once this perspective is adopted, an important question arises, namely: how are indices assigned to a lexeme's stems? On first consideration, the question might appear to be a trivial one: if a lexeme's stems are all listed in the lexicon, why not simply assume that a stem's index is listed right along with it? But the problem of stem indexing cannot be so facilely dismissed. If idiosyncrasy or unpredictability is taken to be the common property of lexically listed elements, then not all stems can be assumed to be lexically listed: as Aronoff (1994:41ff.) has emphasized, a stem's phonological form and grammatical properties – including what I am calling its index – are often straightforwardly predictable from other facts about the lexeme which that stem represents; that is, a stem's index can often be determined by rule.

The question thus becomes: in those cases in which a stem's index is not simply supplied by blunt lexical stipulation, what sort of rule predicts it? A natural hypothesis is that stem formation and stem indexing go hand-in-hand – that a rule predicting the form of a stem Y from that of a distinct stem X also predicts the index carried by Y from that carried by X. For instance, one might envision a rule such as (1).

(1) Stem-formation rule:
A possessive adjective has a Strong stem in -*vant* iff it has a Weak stem in -*vat*.

This rule portrays the contrast in form and the contrast in indexing between BHAGAVANT's Strong and Weak stems as simply different sides of the same coin.

But stem formation and stem indexing don't always go hand-in-hand; the rule predicting the form of a stem and the rule supplying the indexing relevant to the choice of that same stem must in some cases be distinguished. Three logically distinguishable sets of rules are therefore at issue here: rules which choose among differently indexed stems, rules which predict the form of one stem from that of a distinct stem, and rules which assign stems the indices to which the stem-choosing rules are sensitive. The conclusion for which I argue in sections 6.2 and 6.3 is that although the latter two sets of rules may overlap (that is, although a single rule might predict both the form of a stem and the index relevant to its choice by a stem-choosing rule), they must in principle be distinguished in an adequate morphological theory, since a stem's form and the index mediating its choice must in some instances be predicted separately.

In section 6.2, I clarify my assumptions about the stem-choosing rules: drawing upon unpublished work by Arnold Zwicky, I argue that stem choice is effected by at least two distinct kinds of rules – stem-selection rules (a kind of realization rule) and morphological metageneralizations. In section 6.3, I present evidence from Sanskrit that the indices to which rules of stem choice are sensitive cannot always be assumed to be assigned by rules of stem formation; I lay out the details of a formal theory of stem indexing capable of accommodating these facts and, drawing upon the Sanskrit evidence, demonstrate its superiority over imaginable alternatives. The proposed theory of stem formation, stem indexing, and stem choice is summarized in section 6.4. In section 6.5, I show how the proposed theory can be applied in the analysis of a variety of phenomena, including the inflection of word-to-stem derivatives and portmanteau stems.

6.2 Stem-selection rules and morphological metageneralizations

As a prerequisite to considering the means by which a lexeme's stems are indexed, it is necessary to consider the nature of the rules whose sensitivity to this indexing determines the choice of stem for each word in a lexeme's inflectional paradigm. In this section, I shall argue that at least two different sorts of rules serve to determine stem choice in this way; the discussion here owes a considerable debt to unpublished work by Arnold Zwicky.

6.2.1 Paradigmatic and syntagmatic determinants of stem choice

The central insight on which the following discussion rests is the observation that both paradigmatic and syntagmatic factors enter into determinations of stem choice. To see this, consider the masculine and neuter paradigms of the Sanskrit perfect active participle TASTHIVANS 'having stood' in tables 6.3 and 6.4 (Whitney 1889: section 461).[3] TASTHIVANS is a multiple-C-stem nominal; that is, its masculine and neuter paradigms, like those of BHAGAVANT in tables 6.1 and 6.2, exhibit a distinction between Strong and Weak stems. Unlike BHAGAVANT, however, TASTHIVANS also belongs to what I will call the WEAKEST CLASS, whose defining property is that its members have paradigms in which the Weak stem itself exhibits two alternants; in the paradigm of TASTHIVANS, for example, the Weak stem has the alternants *tasthivát-* and *tasthúṣ-*. These Weak stem alternants are traditionally referred to as the MIDDLE STEM and the WEAKEST STEM, respectively. The alternation between the Strong stem and the Weak stems differs strikingly from the alternation between the Middle stem and the Weakest stem. On the one hand, the choice between the Strong stem and the Weak stems is determined paradigmatically, by the morphosyntactic feature content of the case form for which the stem is being chosen: when inflected for masculine agreement, TASTHIVANS exhibits its Strong stem in the nominative of all three numbers and in the accusative singular and dual; when inflected for neuter agreement, it instead exhibits its Strong form in the nominative/accusative plural only. By contrast, the choice between the Middle and Weakest stems is determined syntagmatically, by the phonological context created by the inflectional suffix: the Weakest stem *tasthúṣ-* is

Table 6.3 *Masculine forms of the Sanskrit perfect active participle* TASTHIVANS *'having stood'* (*Strong stem* tasthivā́ṃs-*;* *Middle stem* tasthivát-*;* *Weakest stem* tasthúṣ-)

	SINGULAR	DUAL	PLURAL	
NOM	*tasthivā́n*	*tasthivā́ṃs-āu*	*tasthivā́ṃs-as*	based on the Strong stem
ACC	*tasthivā́ṃs-am*	*tasthivā́ṃs-āu*	*tasthúṣ-as*	based on the Middle and Weakest stems
INSTR	*tasthúṣ-ā*	*tasthivád-bhyām*	*tasthivád-bhis*	
DAT	*tasthúṣ-e*	*tasthivád-bhyām*	*tasthivád-bhyas*	
ABL	*tasthúṣ-as*	*tasthivád-bhyām*	*tasthivád-bhyas*	
GEN	*tasthúṣ-as*	*tasthúṣ-os*	*tasthúṣ-ām*	
LOC	*tasthúṣ-i*	*tasthúṣ-os*	*tasthivát-su*	

Table 6.4 *Neuter forms of the Sanskrit perfect active participle* TASTHIVANS *'having stood'* (*Strong stem* tasthivā́ṃs-*;* *Middle stem* tasthivát-*;* *Weakest stem* tasthúṣ-)

	SINGULAR	DUAL	PLURAL	
NOM/ACC	*tasthivát*	*tasthúṣ-ī*	*tasthivā́ṃs-i*	based on the Strong stem
INSTR	*tasthúṣ-ā*	*tasthivád-bhyām*	*tasthivád-bhis*	based on the Middle and Weakest stems
[etc. as in table 6.3]				

used when the suffix begins with a vowel, and the Middle stem *tasthivát-* is used otherwise (i.e. when the suffix begins with a consonant or when – as in the nominative/accusative singular of the neuter – there is no suffix).[4] That is, the alternation of *tasthivát-* and *tasthúṣ-* is an instance of the phenomenon of 'phonologically conditioned suppletion' discussed by Carstairs (1988, 1990).

6.2.2 Stem choice by means of stem-selection rules

Given that choices among stems may be regulated by both paradigmatic and syntagmatic factors, consider now the question of what sorts of rules actually effect these choices. The most obvious possibility is that rules which carry out independent morphological operations of inflection, derivation, and compounding are formulated so as to operate on a particular member of a given lexeme's array of indexed stems. Thus, in Sanskrit, the realization rule of *-am* suffixation used in the inflection of masculine accusative singulars might be formulated so as to operate on a multiple-C-stem nominal's Strong stem, as in (2).

(2) Realization rule:
$\mathrm{RR}_{1,\{\text{GEN:masc, CASE:acc, NUM:sg}\},[\text{Nominal}]}(\langle X,\sigma\rangle) =_{\text{def}} \langle Y\textit{am},\sigma\rangle$, where Y is X's Strong stem.

It is clear, however, that stem choice cannot always be accomplished in this way. In particular, it is clear that in at least some cases, there must be STEM-SELECTION RULES which directly associate a particular stem with a particular set of morphosyntactic properties independently of any morphological operation.[5]

Three sorts of phenomena lead to this conclusion. Two of these are exemplified by the partial paradigm of the Breton verb SKRIVAÑ 'write' in table 6.5. Note preliminarily that among the forms listed, five distinct stems can be discerned: the *e*-stem *skrive-* appears in all imperfect forms as well as in third-person imperative forms and in two present indicative forms (the second person singular and the impersonal); the *o*-stem *skrivo-* appears in three future-tense forms (the third-person singular, the second-person plural, and the impersonal) and in two present indicative forms (the first- and third-persons plural); the *i*-stem *skrivi-* appears in the remaining future-tense forms and in the 2pl present indicative form; the *a*-stem *skriva-* is restricted to the 1pl present indicative; and the radical stem *skriv* appears in the 3sg present indicative and the 2sg imperative (besides serving as the basis for the other four stems).

Table 6.5 *Partial inflectional paradigm of Breton* SKRIVAÑ *'write'*

	PRESENT INDICATIVE	IMPERFECT	FUTURE	IMPERATIVE
1SG	*skriv-a-n*	*skriv-e-n*	*skriv-i-n*	—
2SG	*skriv-e-z*	*skriv-e-s*	*skriv-i*	*skriv*
3SG	*skriv*	*skriv-e*	*skriv-o*	*skriv-e-t*
1PL	*skriv-o-m*	*skriv-e-m*	*skriv-i-m*	*skriv-o-m* (= PRES INDIC)
2PL	*skriv-i-t*	*skriv-e-c'h*	*skriv-o-t*	*skriv-i-t* (= PRES INDIC)
3PL	*skriv-o-nt*	*skriv-e-nt*	*skriv-i-nt*	*skriv-e-nt*
IMPERSONAL	*skriv-e-r*	*skriv-e-d*	*skriv-o-r*	—

Now, consider first the fact that in many languages, there are inflectional paradigms one or more of whose cells are occupied by a bare stem. For instance, in the future-tense paradigm of a Breton regular verb, the 2sg form is the bare *i*-stem and the 3sg form is the bare *o*-stem; cf. table 6.5. Neither the choice of the *i*-stem in the 2sg future nor that of the *o*-stem in the 3sg future can be attributed to any independent realization rule, since none applies in either instance. Instead, these choices must be effected by stem-selection rules directly associating particular stems with particular sets of morphosyntactic properties. These rules might, of course, stand in a default/override relationship; for instance, one rule might select the *i*-stem as the default future-tense stem but be overridden by a more specific rule selecting the *o*-stem in particular future-tense forms, including the third person singular but not the second person singular.

Consider next the fact that a single realization rule may be compatible with more than one stem. For instance, the Breton rule of *-m* suffixation used in the inflection of 1pl verb forms combines freely with the *o*-stem, the *e*-stem, and the *i*-stem: *skrivom* 'we write', *skrivem* 'we wrote', *skrivim* 'we will write'. Clearly the rule of *-m* suffixation doesn't choose among the stems of SKRIVAÑ; rather, this choice must be effected by independent means. In particular, I assume that three distinct stem-selection rules are at work here, and that the application of one or another of these is a precondition for the application of the *-m* suffixation rule.

A final sort of evidence motivating the postulation of stem-selection rules is the fact that in the inflection of a lexeme for a given set of morphosyntactic properties, the choice of stem must in some cases logically precede the application of any other rule or rules realizing that set of properties. An example of this sort is furnished by the Bulgarian verbs in table 6.6. In the partial paradigms in this table, the irregular verb JA(D) 'eat' exhibits the two stems *jad-* and (in the 1sg present) *ja-*. The stem *jad-* belongs to the nontruncating consonantal ([−T,+C]) conjugation. Its inflection is therefore like that of the regular [−T,+C] verb KRAD 'steal' and unlike that of DÁVA 'give', a regular member of the nontruncating vocalic ([−T, −C]) conjugation: *jadém* 'we are eating', *kradém* 'we are stealing', but *dávame* 'we are giving'. The stem *ja-*, by contrast, belongs to the [−T, −C] conjugation, and therefore parallels the inflection of DÁVA rather than that of KRAD: *jám* 'I am eating', *dávam* 'I am giving', but *kradǝ́* 'I am stealing'. Here, the realization rule forming 1sg present-tense verbs through the suffixation of *-m* can hardly be claimed to determine the choice of *ja-* over *jad-*; on the contrary, it is the independent fact that *ja-* is used in the 1sg present tense that

Table 6.6 *Present and aorist forms of three imperfective verbs in Bulgarian*

		JA(D) 'eat'	KRAD 'steal'	DÁVA 'give'
PRESENT	1SG	*já-m*	*krad-ə́*	*dáva-m*
	2SG	*jad-é-š*	*krad-é-š*	*dáva-š*
	3SG	*jad-é*	*krad-é*	*dáva*
	1PL	*jad-é-m*	*krad-é-m*	*dáva-me*
	2PL	*jad-é-te*	*krad-é-te*	*dáva-te*
	3PL	*jad-ə́t*	*krad-ə́t*	*dáva-t*
AORIST	1SG	*jád-o-x*	*krád-o-x*	*dáva-x, davá-x*
	2SG	*jád-e*	*krád-e*	*dáva, davá*
	3SG	*jád-e*	*krád-e*	*dáva, davá*
	1PL	*jád-o-x-me*	*krád-o-x-me*	*dáva-x-me, davá-x-me*
	2PL	*jád-o-x-te*	*krád-o-x-te*	*dáva-x-te, davá-x-te*
	3PL	*jád-o-x-a*	*krád-o-x-a*	*dáva-x-a, davá-x-a*

determines the choice of *-m* suffixation over *-ə* suffixation in the inflection of *jám* 'I am eating'. This independent fact is, I assume, expressed by a stem-selection rule.

How might stem-selection rules be used to account for the alternation between a Sanskrit multiple-C-stem nominal's Strong stem and its Middle stem? Here and throughout, 'Middle stem' will be used not only to refer to the nonprevocalic Weak stem in the paradigms of nominals belonging to the Weakest class (e.g. to *tasthivát-* in the paradigm of TASTHIVANS), but also to refer to the invariant Weak stem in the paradigms of multiple-C-stem nominals not belonging to the Weakest class (e.g. to *bhágavat-* in the paradigm of BHAGAVANT); thus, every multiple-C-stem nominal is assumed to have a Middle stem, even if it doesn't have a distinct Weakest stem.

I assume that a language's stem-selection rules constitute a block of realization rules whose application to a root pairing <X,σ> (where X is the root of some lexeme L) yields <Y,σ>, where Y is one of L's stems. In order to account for the alternation of Strong and Middle stems in the masculine and neuter paradigms of BHAGAVANT and TASTHIVANS, I assume the stem-selection rules in (3); these rules presuppose the property cooccurrence restriction in (4), according to which nominative and accusative are the 'direct' cases.

(3) Stem-selection rules:

a. $\mathrm{RR}_{0,\{\mathrm{GEN:masc,\ DIR:yes}\},[\mathrm{C\text{-}stem\ nominal}]}(<X,\sigma>) =_{def} <Y,\sigma>$, where Y is X's Strong stem

b. $\mathrm{RR}_{0,\{\mathrm{GEN:masc,\ DIR:yes,\ CASE:acc,\ NUM:pl}\},[\mathrm{C\text{-}stem\ nominal}]}(<X,\sigma>) =_{def} <Y,\sigma>$, where Y is X's Middle stem

c. $\mathrm{RR}_{0,\{\mathrm{GEN:neut,\ DIR:yes,\ NUM:pl}\},[\mathrm{C\text{-}stem\ nominal}]}(<X,\sigma>) =_{def} <Y,\sigma>$, where Y is X's Strong stem

d. $\mathrm{RR}_{0,\{\},[\mathrm{C\text{-}stem\ nominal}]}(<X,\sigma>) =_{def} <Y,\sigma>$, where Y is X's Middle stem

(4) A set σ of morphosyntactic properties for a nominal is in conformity with the property cooccurrence restrictions of Sanskrit only if: σ is an extension of {DIR:yes} iff σ is an extension of either {CASE:nom} or {CASE:acc}.

Rules (3a,c) guarantee that a C-stem nominal's Strong stem will appear in those cells of its paradigm that are associated with the property sets listed in (5); by Pāṇini's principle, rule (3b) overrides rule (3a), guaranteeing that a C-stem nominal's Middle stem will appear in the masculine accusative plural cell of its paradigm; and rule (3d) causes a C-stem nominal's Middle stem to appear elsewhere by default. Note that if choice of stem is regarded as one kind of inflectional exponent, then by virtue of their form, the stem-selection rules in (3) can simply be regarded as rules of exponence of a particular sort.

(5) {GEN:masc, CASE:nom, NUM:sg} {GEN:neut, CASE:nom, NUM:pl}
{GEN:masc, CASE:acc, NUM:sg} {GEN:neut, CASE:acc, NUM:pl}
{GEN:masc, CASE:nom, NUM:du}
{GEN:masc, CASE:acc, NUM:du}
{GEN:masc, CASE:nom, NUM:pl}

Above, the possibility was raised that the Sanskrit rule of *-am* suffixation used in the inflection of masculine accusative singular forms might be stated so as to operate on a lexeme's Strong stem, as in (2); the stem-selection rule in (3a), however, now allows the choice of stem to be determined independently of the application of the rule of *-am* suffixation, whose formulation can now be simplified accordingly.[6]

6.2.3 Stem choice by means of morphological metageneralizations

The entire business of stem choice cannot, however, be turned over to stem-selection rules. Stem-selection rules directly associate a particular stem with a particular set of morphosyntactic properties; they are therefore suited for choosing among paradigmatic stem alternants, but not for choosing among syntagmatic stem alternants. Consider again the masculine and neuter paradigms of Sanskrit TASTHIVANS in tables 6.3 and 6.4. The choice between the Weak stem alternants *tasthivát-* and *tasthúṣ-* cannot be effected by a stem-selection rule, because the distributional difference between the two stems is conditioned by their phonological context: *tasthúṣ-* appears prevocalically, and *tasthivát-* elsewhere. Because the phonological context which determines the choice between *tasthivát-* and *tasthúṣ-* is created by the realization rules which introduce case suffixes, this choice cannot be effected independently of the application of those rules.

On the face of it, this fact seems to present a problem. The realization rules which introduce vowel-initial case suffixes should cause *tasthúṣ-* to be chosen over *tasthivát-*, and the reverse should be true of the realization rules which introduce consonant-initial suffixes. But does this mean that each rule introducing a vowel-initial suffix must include a stipulation requiring the Weakest stem and that each rule introducing a consonant-initial suffix must include a stipulation requiring the Middle stem? If so, then the overarching distributional generalization concerning *tasthivát-* and *tasthúṣ-* (and other, similar, pairs) is missed.

Zwicky (personal communication, 1993) has suggested that this sort of distributional generalization might be captured by means of MORPHOLOGICAL METAGENERALIZATIONS – rules whose function is to express redundancies across whole classes of realization rules. As was seen in chapter 2, the use of metageneralizations makes it possible to account for morphophonological alternations without postulating morphologically conditioned phonological rules, a discrete morphophonological component, or a level-ordered phonology; the use of metageneralizations to effect choices among a lexeme's stems is, however, a distinct idea, since alternating stems are not simple morphophonological variants of a single basic form. Consider how this idea might be applied in the analysis of the Middle/Weakest alternation.

I assume that the stems chosen by the Block 0 stem-selection rules in (3) are themselves subject to a second block of realization rules, in accordance with the partial definition (6) of the Sanskrit paradigm function:

(6) Where $\sigma = \{\text{GEN:}\alpha, \text{CASE:}\beta, \text{NUM:}\gamma\}$ and X is the root of a nominal lexeme (but is not a word-to-word derivative),
$\text{PF}(<X,\sigma>) =_{\text{def}} \text{Nar}_1(\text{Nar}_0(<X,\sigma>))$.

Suppose that Block 1 includes the rules of exponence in (7a–r); suppose, in addition, that Blocks 0 and 1 both contain instantiations of the schematic rules of referral in (7s,t).

(7) Realization rules:

a. $RR_{1,\{\text{CASE:nom, NUM:sg}\},[\text{Nominal}]}(<X,\sigma>) =_{\text{def}} <X\textit{s}',\sigma>$

b. $RR_{1,\{\text{CASE:acc, NUM:sg}\},[\text{Nominal}]}(<X,\sigma>) =_{\text{def}} <X\textit{am}',\sigma>$

c. $RR_{1,\{\text{GEN:neut, DIR:yes, NUM:sg}\},[\text{Nominal}]}(<X,\sigma>) =_{\text{def}} <X',\sigma>$

d. $RR_{1,\{\text{CASE:instr, NUM:sg}\},[\text{Nominal}]}(<X,\sigma>) =_{\text{def}} <X\textit{ā}',\sigma>$

e. $RR_{1,\{\text{CASE:dat, NUM:sg}\},[\text{Nominal}]}(<X,\sigma>) =_{\text{def}} <X\textit{e}',\sigma>$

f. $RR_{1,\{\text{CASE:gen, NUM:sg}\},[\text{Nominal}]}(<X,\sigma>) =_{\text{def}} <X\textit{as}',\sigma>$

g. $RR_{1,\{\text{CASE:loc, NUM:sg}\},[\text{Nominal}]}(<X,\sigma>) =_{\text{def}} <X\textit{i}',\sigma>$

h. $RR_{1,\{\text{DIR:yes, NUM:du}\},[\text{Nominal}]}(<X,\sigma>) =_{\text{def}} <X\textit{āu}',\sigma>$

i. $RR_{1,\{\text{GEN:neut, DIR:yes, NUM:du}\},[\text{Nominal}]}(<X,\sigma>) =_{\text{def}} <X\textit{ī}',\sigma>$

j. Where α = instr or dat,
$RR_{1,\{\text{CASE:}\alpha\text{, NUM:du}\},[\text{Nominal}]}(<X,\sigma>) =_{\text{def}} <X\textit{bhyām}',\sigma>$

k. Where α = gen or loc,
$RR_{1,\{\text{CASE:}\alpha\text{, NUM:du}\},[\text{Nominal}]}(<X,\sigma>) =_{\text{def}} <X\textit{os}',\sigma>$

l. $RR_{1,\{\text{CASE:nom, NUM:pl}\},[\text{Nominal}]}(<X,\sigma>) =_{\text{def}} <X\textit{as}',\sigma>$

m. $RR_{1,\{\text{CASE:acc, NUM:pl}\},[\text{Nominal}]}(<X,\sigma>) =_{\text{def}} <X\textit{as}',\sigma>$

n. $RR_{1,\{\text{GEN:neut, DIR:yes, NUM:pl}\},[\text{Nominal}]}(<X,\sigma>) =_{\text{def}} <X\textit{i}',\sigma>$

o. $RR_{1,\{\text{CASE:instr, NUM:pl}\},[\text{Nominal}]}(<X,\sigma>) =_{\text{def}} <X\textit{bhis}',\sigma>$

p. $RR_{1,\{\text{CASE:dat, NUM:pl}\},[\text{Nominal}]}(<X,\sigma>) =_{\text{def}} <X\textit{bhyas}',\sigma>$

q. $RR_{1,\{\text{CASE:gen, NUM:pl}\},[\text{Nominal}]}(<X,\sigma>) =_{\text{def}} <X\textit{ām}',\sigma>$

r. $RR_{1,\{\text{CASE:loc, NUM:pl}\},[\text{Nominal}]}(<X,\sigma>) =_{\text{def}} <X\textit{su}',\sigma>$

s. For any rule block *n*, $RR_{n,\{\text{CASE:abl}\},[\text{Nominal}]}(<X,\sigma>)$
$=_{\text{def}} <Y,\sigma>$,
where $Nar_n(<X,\sigma/\{\text{CASE:dat}\}>) = <Y,\sigma/\{\text{CASE:dat}\}>$.

t. For any rule block *n*, $RR_{n,\{\text{CASE:abl, NUM:sg}\},[\text{Nominal}]}(<X,\sigma>)$
$=_{\text{def}} <Y,\sigma>$,
where $Nar_n(<X,\sigma/\{\text{CASE:gen}\}>) = <Y,\sigma/\{\text{CASE:gen}\}>$.

The evaluation of the Block I rules in (7) is regulated by a set of morphological metageneralizations; following Zwicky's suggestion, this set might be assumed to include the metageneralization in (8), according to which the stem substitution in (9) is a concomitant of any Block I rule.

(8) Morphological metageneralization:
Where R is in Block I, $(9) \in \phi_R$.

(9) Where $RR_{n,\tau,C}(<X,\sigma>) = <Y',\sigma>$,
if X is a Middle stem, Z is the corresponding Weakest stem, and Y is X[vowel]W, then $<Y',\sigma> = RR_{n,\tau,C}(<Z,\sigma>)$.

Metageneralization (8) accounts for the syntagmatic alternation of the Middle and Weakest stems in the masculine and neuter paradigms of TASTHIVANS. For instance, the application of rule (7d) to the Middle stem *tasthivát*- introduces the suffix -*ā* while metageneralization (8) concomitantly causes the Weakest stem *tasthúṣ*- to be substituted for *tasthivát-*, yielding the instrumental singular form *tasthúṣ-ā*. By contrast, the application of (7d) to the Middle stem *bhágavat-* simply yields *bhágavat-ā*; since there is no Weakest stem corresponding to *bhágavat-*, the stem substitution in (9) is here inapplicable. Similarly, (9) is irrelevant to the evaluation of rule (7r), since the suffix it introduces isn't vowel-initial; accordingly, the result of applying (7r) to the Middle stem *tasthivát-* is simply *tasthivát-su*.

As metageneralization (8) is formulated, it associates the stem substitution in (9) with the Block I rules in (7); it doesn't associate this substitution with all morphological rules in the language that create prevocalic environments. This is right: as the prior member of a compound, a multiple-C-stem nominal always assumes the form of its Middle stem (Whitney 1889: section 1249), even in prevocalic position.[7]

Besides accounting for syntagmatic alternations among indexed stems, morphological metageneralizations naturally also account for regularities in the application of ordinary morphophonological rules, as argued in section 2.6. By metageneralization (10), for example, any Block I rule realizing the properties 'nominative' and 'singular' has the morphophonological rule (11) as a concomitant. Metageneralization (10) encompasses both rule (7a) and rule (12); the latter rule is restricted to a class of stem-truncating nominals, and realizes the property set 'nominative singular' through the subtraction of a stem-final resonant consonant R.[8] Because BALIN 'strong' is both a stem-lengthening nominal and stem-truncating nominal, its masculine nominative singular form *balī́* exhibits the effects of both (11) and (12). BHAGAVANT and TASTHIVANS, by contrast, are stem-lengthening but not stem-truncating. Their masculine nominative singular forms therefore arise through the application of the default nominative singular rule (7a); the resulting forms (*bhágavān*, *tasthivā́n*) accordingly exhibit the effects of (11), although automatic principles of sandhi prevent both the *-s* suffix introduced by (7a) and the stem-final obstruents from surfacing in these forms (Whitney 1889: sections 150 and 307). When (7a) applies to a nominal which isn't stem lengthening, such as AGNI 'fire' (nom sg *agní-s*), operation (11) is simply inapplicable.

(10) Morphological metageneralization:
Where R is in Block I, (11) $\in \phi_R$ iff R realizes some extension of {CASE:nom, NUM:sg}.

(11) Where $RR_{n,\tau,C}(<X,\sigma>) = <Y',\sigma>$:
If L-index(X) is a stem-lengthening nominal and Z is the result of lengthening X's stem-final syllable, then $<Y',\sigma> = RR_{n,\tau,C}(<Z,\sigma>)$.

(12) Realization rule:
$RR_{1,\{\text{CASE:nom, NUM:sg}\},[\text{Stem-truncating nominal}]}(\langle XR,\sigma\rangle) =_{def} \langle X',\sigma\rangle$

In summary, I have shown in this section there are two distinct mechanisms of stem choice: paradigmatic stem alternations are regulated by stem-selection rules (a type of rule of exponence), while syntagmatic stem alternations are regulated by morphological metageneralizations.

6.3 Stem formation and stem indexing

Given these assumptions about stem choice, the problem of capturing regularities in the formation and indexing of stems can now be broached. Consider first the matter of stem formation.

6.3.1 Stem-formation rules

For every lexeme in a language, there is an associated STEM INVENTORY containing all of the stems realizing that lexeme; the stem inventory of the Sanskrit adjective BHAGAVANT includes *bhágavant*- and *bhágavat*-, that of TASTHIVANS includes *tasthivā́ns*-, *tasthivát*-, and *tasthúṣ*-, and so on. I assume that phonological regularities among members of the same stem inventory are captured by a class of STEM-FORMATION RULES, whose job is to express generalizations of the type ‘if such-and-such member of lexeme L’s stem inventory has the phonological form X, then such-and-such other member of L’s inventory has the phonological form Y’. For instance, a perfect active participle’s three stems conform to the regularity expressed by the stem-formation rule in (13):

(13) Stem-formation rule:
Where L is a perfect active participle, properties (a) and (b) imply each other and both imply (c):
a. L’s Strong stem is X*ivā́ns*-
b. L’s Middle stem is X*ivát*-
c. L’s Weakest stem is X*úṣ*-

This rule correctly accounts for the fact that a perfect active participle has a Strong stem in -*ivā́ns* if and only if it has a Middle stem in -*ivát* and that if the Strong and Middle stems have these forms, then the participle has a Weakest stem -*úṣ*.[9]

I emphasize here that because the labels ‘Strong’, ‘Middle’, and ‘Weak’ do not name morphosyntactic properties (but instead simply name morphomic stem categories), the rule in (13) is of a separate subtype from rules of exponence and rules of referral; unlike them, (13) doesn't serve to express sets of morphosyntactic properties. Thus, I assume that inflectional rules are of two different subtypes: those of the realizational subtype (comprising rules of exponence and rules of referral) and those of the morphomic subtype, which express generalizations about the form and indexing of stems belonging to morphomic categories but make no direct reference to morphosyntactic properties.

Rule (13) allows the form/index pairing of one member of a stem inventory to be predicted from the distinct form/index pairing of another member of that inventory; thus, (13) establishes a direct correlation between differences in indexing and differences in form. The question that I wish to address here is whether this is a necessary property of stem-formation rules or merely a contingent property of some such rules. A priori, the simplest hypothesis is that all stem-formation rules have exactly the character of (13); in the following sections, however, I shall argue for the INDEXING AUTONOMY HYPOTHESIS in (14).

(14) Indexing Autonomy Hypothesis (IAH):
The determination of a stem's index is in principle independent of the determination of its form.

The precise content of this hypothesis should be carefully noted. The claim is not simply that stems carrying the same index needn't arise by means of the same rule of stem formation; the claim is instead that stem pairs exhibiting an identical contrast in formation needn't exhibit an identical contrast in indexing. In Maiden's (1992:308) words, '[t]he phonological substance of alternation is independent of the alternation itself'.

In this section, I show that this claim is justified in an especially clear way by the Sanskrit system of vowel gradation, a pattern of stem alternation which recurs widely in the morphology of the language; in particular, I shall show that in the stem inventories of nominals participating in the system of vowel gradation, differences in vowel grade do not coincide with differences in indexing. Discussion will proceed as follows. In section 6.3.2, I examine the characteristics of the Sanskrit system of vowel gradation. In section 6.3.3, I show that in the stem inventories of gradational nominals (i.e. those nominals participating in the system of vowel gradation), differences in vowel grade do not coincide with differences in indexing. In section 6.3.4, I argue that if the rule of stem formation for gradational nominals is formulated in terms of vowel grades, then (given the conclusions of section 6.3.3) the indexing of a gradational nominal's stems must be predicted separately

Table 6.7 *Vṛddhi-, Guṇa-, and Zero-grade stems of the masculine noun* PAD *'foot'*

VṚDDHI GRADE (*ā*-vocalism)	GUṆA GRADE (*a*-vocalism)	ZERO GRADE (∅-vocalism)
pād- (e.g. acc sg <u>*pā́d*</u>*-am*)	*pad-* (e.g. dat sg <u>*pad*</u>*-é*)	*pd-* (e.g. *upa-*<u>*bd*</u>*-á-*'trampling under foot')

Table 6.8 *Vṛddhi-, Guṇa-, and Zero-grade stems of the feminine noun* SVASAR *'sister'*

VṚDDHI GRADE	GUṆA GRADE	ZERO GRADE
svásār- (e.g. acc sg <u>*svásār*</u>*-am*)	*svásar-* (e.g. loc sg <u>*svásar*</u>*-i*)	*svásṛ-* (e.g. instr pl <u>*svásṛ*</u>*-bhis*)

from their form; I therefore postulate a class of stem-indexing rules. In section 6.3.5, I examine an imaginable alternative to the postulation of stem-indexing rules, that of assuming that stem choice is determined by purely prosodic criteria; as I show, this alternative is not ultimately viable.

6.3.2 Vowel gradation in Sanskrit declensional stems

Consider again the masculine paradigm of BHAGAVANT in table 6.1. The formal difference between the Strong stem *bhágavant-* and the Middle stem *bhágavat-* reflects a pattern of vowel gradation which permeates the morphology of the language. In what follows, a lexeme will be called a GRADATIONAL lexeme if and only if its stems participate in this pattern of vowel gradation.

In Sanskrit, a stem may exhibit any of three vowel grades: in the most abstract terms, the final syllable of a stem in the VṚDDHI GRADE contains a long *ā*; the final syllable of a GUṆA-GRADE stem instead contains a short *a*; and a stem in the ZERO GRADE has no corresponding *a*-vocalism. Thus, the noun PAD 'foot' has the three distinct grade forms in table 6.7. If the alternating vowel is followed by a resonant R, this becomes the nucleus of the stem-final syllable in the Zero grade; thus, because the alternating vowel in the Vṛddhi- and Guṇa-grade stems of SVASAR 'sister' is followed by *r*, the corresponding Zero-grade stem has a syllabic *r*, as in table 6.8.

In view of these facts, the phonological regularities exhibited by a gradational nominal's stems might be captured by means of the stem-formation rule in (15).[10]

(15) Stem-formation rule:[11]
For any gradational nominal L, each of (a)–(c) implies the other two:
a. The Vṛddhi-grade stem of L has the form X*ā*(R)C_0
b. The Guṇa-grade stem of L has the form X*a*(R)C_0
c. The Zero-grade stem of L has the form X(R̥)C_0

The regularity of this pattern of gradation is obscured by two phonological phenomena. First, there is an automatic process of resyllabification by which the resonant R in (15c) loses its syllabicity in prevocalic contexts, becoming the onset of the following syllable; thus, SVASAR's Zero-grade stem *svásṛ-* appears prevocalically as *svásr-*, e.g. dat sg *svásr-e*. The second complication concerns stems in which the resonant R is a nasal. According to (15), the Guṇa-grade stem *bhágavant-* 'fortunate' has a Zero-grade counterpart whose final syllable contains a syllabic *n* and no *a*-vocalism. At the phonetic level, however, the distinction between a syllabic nasal and short *a* is absolutely neutralized in Sanskrit; thus, BHAGAVANT's Zero-grade stem *bhágavn̥t-* is phonetically realized as *bhágavat-*. These phenomena cause the Zero-grade stem *rā́jn̥-* of the noun RAJAN 'king' to have two phonetic realizations: in prevocalic contexts, resyllabification yields *rā́jñ-*[12] (e.g. dat sg *rā́jñ-e*); elsewhere, *n̥/a* neutralization yields *rā́ja-* (e.g. loc pl *rā́ja-su*).

To see how BHAGAVANT fits into this system of vowel gradation, consider again the paradigms in tables 6.1 and 6.2: in these paradigms, the Strong stem is the Guṇa-grade stem and the Middle stem is the Zero-grade stem. This same pattern is generally exhibited by possessive adjectives in -*vant* and -*mant* and by some *n*-stem nouns. In view of this fact, one might attempt to reformulate the stem-formation rule in (15) in such a way that it, like (13), would establish a direct correlation between differences in indexing and differences in form, labelling Guṇa-grade stems as Strong and Zero-grade stems as Middle. But no such reformulation can in fact be maintained, because distinctions in indexing are not generally congruent with the distinctions in vowel grade.

6.3.3 The incongruence of vowel grade distinctions with indexing distinctions

A range of factors makes it impossible to equate the Strong/Middle distinction with the Guṇa/Zero distinction; a sampling of these (summarized in table 6.9) will be discussed here.

TABLE 6.9 *Strong, Middle, and Weakest stems of some multiple-C-stem nominals*

		STRONG STEM	MIDDLE STEM	WEAKEST STEM
A.	BHAGAVANT 'fortunate'	Guṇa-grade stem (*bhágavant-*)	Zero-grade stem (*bhágavn̥t-*)	[none]
	PAŚUMANT 'possessing cattle'	Guṇa-grade stem (*paśumánt-*)	Zero-grade stem (*paśumn̥ ́t-*)	[none]
B.	RAJAN 'king'	Vr̥ddhi-grade stem (*rā́jān-*)	Zero-grade stem (*rā́jn̥-*)	[none]
	ŚREYANS 'better'	Vr̥ddhi-grade stem (*śréyāns-*)	Zero-grade stem (*śréyn̥s-*)	[none]
C.	UDAÑC 'turned upwards'	Guṇa-grade stem (*údañc-*)	Zero-grade stem (*údn̥ ̃c-*)	suppletive stem (*údīc-*)
	AHAN 'day'	Vr̥ddhi-grade stem (*áhān-*)	suppletive stem (*áhas-*)	Zero-grade stem (*áhn-*)
	TASTHIVANS 'having stood'	Vr̥ddhi-grade stem (*tasthivā́ns-*)	stem in *-ivat* (*tasthivát-*)	stem in *-uṣ* (*tasthúṣ-*)
D.	BALIN 'strong'	stem in *-in* (*balín-*)	stem in *-i* (*balí-*)	stem in *-in* (*balín-*)

While the Strong stem of a possessive adjective such as BHAGAVANT or PAŚUMANT 'possessing cattle' is its Guṇa-grade stem, as in table 6.9(A), there are other gradational nominals whose Strong stems are in the Vṛddhi grade. This is true, for example, of most *n*-stem nominals and of comparative adjectives in *-yāṃs*; the examples in table 6.9(B) illustrate.

Furthermore, possessive adjectives such as BHAGAVANT do not exhibit distinct Middle and Weakest stems; but if a gradational nominal does have distinct Middle and Weakest stems, then at most one of these – and not always the same one – is that nominal's Zero-grade stem. Thus, consider the examples in table 6.9(C). In the declension of the directional adjective UDAÑC 'turned upwards', the Middle stem is the Zero-grade counterpart of the Strong, Guṇa-grade stem, while the Weakest stem is simply suppletive. By contrast, in the declension of the neuter noun AHAN 'day', the Weakest stem is the Zero-grade counterpart of the Strong, Vṛddhi-grade stem, while the Middle stem is simply suppletive. Finally, perfect active participles (such as TASTHIVANS) must be regarded as gradational nominals because of the way they form their masculine vocative singular (see below) – yet, neither the Middle stem nor the Weakest stem in a perfect active participle's inventory is the expected Zero-grade counterpart of its Strong stem.

While all gradational C-stem nominals are multiple-C-stem nominals, not all multiple-C-stem nominals are gradational. Some nominals which are nongradational (i.e. whose stems do not participate in the pattern of vowel gradation in (15)) nevertheless exhibit a distinction between Strong and Middle stems and between Middle and Weakest stems. This is true, for example, of adjectival derivatives in *-in*; thus, in the paradigm of BALIN 'strong', the Strong and Weakest stems are both *balín-*, while the Middle stem is *balí-*, as in table 6.9(D).

A final instance of incongruence between vowel grade and morphomic indexing emerges in the morphology of the vocative case. Vocatives are unaccented (though in sentence-initial position, a vocative noun phrase is accented at its left periphery; see section 1.4). Segmentally, the vocative case is always syncretized with the nominative in both the dual and the plural; in the singular, the situation is somewhat more complicated. Among C-stem nominals, the vocative singular form is always a bare stem: in most cases, this is simply the Strong stem, as in table 6.10(A); but among C-stem nominals having a Strong stem in the Vṛddhi grade, there is a subclass whose masculine vocative singular instead takes the form of the Guṇa-grade stem, as in table 6.10(B).

TABLE 6.10 *Masculine vocative singular stems in the paradigms of some multiple-C-stem nominals*

	MASC VOC SG STEM	GUṆA-GRADE STEM	STRONG STEM
A. The masc voc sg stem = the Strong stem			
TIRYAÑC 'going aside'	*tiryañc-*	*tiryáñc-*	*tiryáñc-*
ADANT 'eating'	*adant-*	*adánt-*	*adánt-*
BHAGAVANT 'fortunate'	*bhagavant-*	*bhágavant-*	*bhágavant-*
BALIN 'strong'	*balin-*	[none; BALIN is nongradational]	*balín-*
DVIṢ 'enemy'	*dviṣ-*	[none; DVIṢ is nongradational]	*dvíṣ-*
B. The masc voc sg stem = the Guṇa-grade stem ≠ the Strong (Vṛddhi-grade) stem			
RAJAN 'king'	*rājan-*	*rā́jan-*	*rā́jān-*
TASTHIVANS 'having stood'	*tasthivans-*	*tasthiváns-*	*tasthivā́ns-*

6.3.4 *The Indexing Autonomy Hypothesis*

Because distinctions in indexing are not congruent with distinctions in vowel grade, a stem's index and its vowel grade cannot simply be predicted in parallel; that is, because sameness of vowel grade is neither necessary nor sufficient for sameness of indexing, the stem-formation rule in (15) – unlike the one in (13) – cannot be seen as establishing a direct correlation between differences in form and differences in indexing.

These facts favor the IAH (14), according to which the determination of a stem's index is in principle independent of the determination of its form. This hypothesis does not exclude the possibility that a stem-formation rule might (like (13)) establish a direct correlation between form and indexing; instead, it simply entails that the establishment of such a correlation is not a necessary property of stem-formation rules – that in some cases, a stem's index might be determined separately from its form.

Once this hypothesis is adopted, the following sort of analysis can be envisioned for gradational C-stem nominals in Sanskrit. On the one hand, the phonological regularities among members of a gradational C-stem nominal's stem inventory are captured by the stem-formation rule in (15), which makes no reference to indexing; on the other hand, the distribution of the members of that inventory is determined by rules of stem choice (specifically, by the stem-selection rules in (3) and the morphological metageneralization in (8)) which make no reference to vowel grade. Bridging the gap between the two sorts of rule is a class of STEM-INDEXING RULES whose function is to assign indices to a gradational nominal's stems; the existence of rules of the latter sort is the essential content of the IAH.

Under these assumptions, a formal analysis of Sanskrit declensional morphology might incorporate the stem-indexing rules in (16). Consider now how these rules make it possible to span the incongruities between stem indexing and stem formation noted earlier.

(16) Stem-indexing rules:
Where L is a gradational nominal,
a. by default, L's Strong stem is its Guṇa-grade stem.
b. by default, L's Middle stem is its Zero-grade stem.
c. if L belongs to the Weakest class,
then by default, L's Weakest stem is its Zero-grade stem.
d. if L ∈ {*n*-stem nominals, perfect active participles, comparative adjectives in -*yāṃs*, MAHANT, ...},
then L's Strong stem is its Vṛddhi-grade stem.

Under the proposed conception of stem formation and stem indexing, the possessive adjective BHAGAVANT represents the simplest type of gradational C-stem nominal. Suppose that BHAGAVANT's Guṇa-grade stem is listed lexically, as in table 6.11(A): the stem-formation rule (15) then determines the form of BHAGAVANT's Zero-grade stem; the stem-indexing rule (16a) entails that its Strong stem is its Guṇa-grade stem; and the stem-indexing rule (16b) entails that its Middle stem is its Zero-grade stem.

The fact that some gradational C-stem nominals have Strong stems in the Vṛddhi grade rather than the Guṇa grade is accounted for by the stem-indexing rule (16d), which overrides the default rule in (16a). Thus, if RAJAN's Guṇa-grade stem is listed lexically, as in table 6.11(B), then the stem-formation rule (15) determines the form of its Vṛddhi-grade stem, and by (16d), this is identified as the Strong stem.

Because BHAGAVANT and RAJAN do not belong to the Weakest class, neither has a Weakest stem. As noted earlier, those nominals that do belong to the Weakest class are heterogeneous: for some (such as UDAÑC) the Middle stem is the Zero-grade counterpart of the Strong stem; for others (such as AHAN), the Weakest stem is the Zero-grade counterpart of the Strong stem; and for still others (such as TASTHIVANS), neither the Middle nor the Weakest stem is the Zero-grade counterpart of the Strong stem. Under the proposed approach, this heterogeneousness is accounted for as follows. Suppose first that the lexical listing for UDAÑC specifies both its Guṇa-grade stem and its suppletive Weakest stem, as in table 6.11(C): rule (15) then determines the form of UDAÑC's Zero-grade stem, and (16b) entails that this is the Middle stem; on the other hand, the Weakest stem stipulated in the lexicon overrides the default Weakest stem supplied by rule (16c). Suppose next that the lexical listing for AHAN specifies both its Guṇa-grade stem and its suppletive Middle stem, as in table 6.11(D): rule (15) then determines the form of the Zero-grade stem, and rule (16c) entails that this is the Weakest stem; on the other hand, the Middle stem stipulated in the lexicon overrides the default Middle stem supplied by (16b). Suppose finally that the lexical listing for TASTHIVANS specifies its Guṇa-grade stem, as in table 6.11(E): (15) then determines the form of its Vṛddhi-grade stem, which (16d) identifies as the Strong stem; in virtue of this latter fact, the stem-formation rule (13) overrides the default stem-indexing rules (16b,c) in determining the forms of TASTHIVANS' Middle and Weakest stems.

As these examples show, the default indexings supplied by rules (16a–c) may be overridden in three ways: by a more specific stem-indexing rule (as

Table 6.11 *Lexically stipulated stems for various C-stem nominals and the vowel gradation and morphomic indexing they entail*

	Lexical stipulations	Predicted vowel gradation	Predicted morphomic indexing
A.	BHAGAVANT 'fortunate': Guṇa-grade stem: *bhágavant-*	by (15), Zero-grade stem: *bhágavn̥t-*	by (16a), Strong stem: *bhágavant-*; by (16b), Middle stem: *bhágavn̥t-*
B.	RAJAN 'king': Guṇa-grade stem: *rā́jan-*	by (15), Vr̥ddhi-grade stem: *rā́jān-* by (15), Zero-grade stem: *rā́jn̥-*	by (16d), Strong stem: *rā́jān-* by (16b), Middle stem: *rā́jn̥-*
C.	UDAÑC 'turned upwards': Guṇa-grade stem: *údañc-* Weakest stem: *údīc-*	by (15), Zero-grade stem: *údñ̥c-*	by (16a), Strong stem: *údañc-* by (16b), Middle stem: *údñ̥c-*
D.	AHAN 'day': Guṇa-grade stem: *áhan-* Middle stem: *áhas-*	by (15), Vr̥ddhi-grade stem: *áhān-* by (15), Zero-grade stem: *áhn̥-*	by (16d), Strong stem: *áhān-* by (16c), Weakest stem: *áhn̥-*
E.	TASTHIVANS 'having stood': Guṇa-grade stem: *tasthiváns-*	by (15), Vr̥ddhi-grade stem: *tasthivā́ns-*	by (16d), Strong stem: *tasthivā́ns-* by (13), Middle stem: *tasthivát-* by (13), Weakest stem: *tasthúṣ-*
F.	SUMANAS 'favourably minded': Middle stem: *sumánas-*	[nongradational]	by (17), Strong stem: *sumánas-*
G.	BALIN 'strong': Weakest stem: *balín-*	[nongradational]	by (18), Strong stem: *balín-* by (18), Middle stem: *balí-*

in the case of RAJAN's Strong stem), by a lexical stipulation (as in the cases of UDAÑC's Weakest stem and AHAN's Middle stem), or by a stem-formation rule defined for a narrower class of nominals (as in the case of TASTHIVANS's Middle and Weakest stems).

The morphomic indices of nongradational C-stem nominals are, of course, determined by rules distinct from those in (16). Most such nominals are subject to the default stem-formation rule in (17).

(17) Stem-formation rule:
Where L is nongradational, L's Strong stem is identical to its Middle stem.

Thus, suppose that the lexical listing for the nongradational adjective SUMANAS 'favourably minded' specifies the form of its Middle stem, as in table 6.11(F); it then follows from (17) that its Strong stem takes the same form.

The default stem-formation rule in (17) is sometimes overridden by a more specific rule. Recall that nongradational nominals may exhibit a distinction between Middle and Weakest stems, as most prominently in the case of adjectival derivatives in -*in*, such as BALIN. Derivatives of this sort are subject to the stem-formation rule in (18).

(18) Stem-formation rule:
If L's Weakest stem is X*in*, then its Middle stem is X*i* and its Strong stem is identical to its Weakest stem.

Thus, suppose that the lexical listing for BALIN specifies the form of its Weakest stem: (18) then determines the form of the corresponding Middle and Strong stems, as in table 6.11(G); rule (17) is thus overridden.

All of the rules of stem choice proposed so far – the stem-selection rules in (3) and the morphological metageneralization (8) – are sensitive to the chosen stem's morphomic index. None of what I have proposed, however, excludes the possibility that a rule of stem choice might instead be directly sensitive to a stem's vowel grade (or to some other aspect of its form). Indeed, at least one such rule seems to be well motivated by the evidence considered here. Recall that in Sanskrit, the vocative is generally syncretized with the nominative; I assume that this fact can be captured by means of an appropriately formulated rule of referral.[13] Nevertheless, there is a subclass of gradational nominals – call it 'Class 6.10(B)' – in whose paradigms the masculine vocative singular stem is distinct from the stem appearing in the nominative; because the special masculine vocative singular stem is invariably in the Guṇa grade, it would be redundant to mark it with a special morphomic index – that is, economy dictates the postulation of a stem-selection rule such as (19), in which the Guṇa-grade stem is explicitly singled out for use in the masculine vocative singular.[14]

(19) Stem-selection rule:
$RR_{0,\{GEN:masc,\ CASE:voc,\ NUM:sg\},[Class\ 6.10(B)]}(<X,\sigma>) =_{def} <Y,\sigma>$, where Y is X's (unaccented) Guṇa-grade stem.

6.3.5 *Against a prosodic approach to stem choice*

As the foregoing examples suggest, adopting the IAH makes it possible to account for the full range of incongruities between vowel gradation and morphomic indexing. Two imaginable alternatives to the postulation of the stem-indexing rules in (16) can be rejected out of hand. Consider first the possibility of formulating rules of stem choice for gradational C-stem nominals directly in terms of their vowel grade, without reference to morphomic indices such as 'Strong', 'Middle', and 'Weakest'. This approach is not a viable one, because it doesn't afford any account of similarities in distribution among stems that are formally different: that is, a stem exhibiting a particular vowel grade (e.g. the Guṇa-grade stem of BHAGAVANT) may have some distributional parallelism to a stem exhibiting a different vowel grade (e.g. the Vṛddhi-grade stem of RAJAN) or to a stem which doesn't participate in the pattern of vowel gradation in (15) (e.g. the *-in* stem of BALIN); if rules of stem choice for gradational C-stem nominals are stated directly in terms of vowel grades, then such parallelisms are inevitably portrayed as coincidental.

Consider also the possibility of stating stem-formation rules without reference to the three degrees of vowel grade, i.e. the possibility of requiring that stem-formation rules establish a direct correlation between the form of a gradational C-stem nominal's stems and their indexing. This possibility must be rejected because there are stems which are alike in their formation but whose indexing is heterogeneous. For instance, the formal relationship between the Strong and Middle stems of RAJAN is the same as the formal relationship between the Strong and Weakest stems of AHAN: in a position where the former stem has *ā*-vocalism, the latter has nothing. If references to vowel grade were excluded, this parallelism would have to be portrayed as an accident; that is, whatever stem-formation rule linked the Strong and Middle forms of RAJAN would have to duplicate the formal effects of the stem-formation rule linking the Strong and Weakest stems of AHAN.

Nevertheless, there is at least one way in which one might try to dispense with the stem-indexing rules in (16) and hence with the IAH as a whole: one might try to argue that the rules of stem choice for gradational C-stem nominals are directly formulated in terms of the prosodic properties of a nominal's stems, without reference to morphomic indices.

Consider first the fact that in the paradigms of the overwhelming majority of gradational nominals, the Guṇa-grade stem never appears as a Middle or Weakest stem: when this regularity is overridden, it is apparently overridden for prosodic reasons. Thus, in a small number of cases in which a gradational nominal's Strong stem is in the Vṛddhi grade, the corresponding Middle or Weakest stem appears in the Guṇa grade because use of the Zero-grade stem would give rise to unpronounceable syllable structures. In the paradigm of the masculine noun PAD 'foot', for example, the Strong stem is the Vṛddhi-grade stem *pā́d-*, while the Middle stem is the corresponding (unaccented) Guṇa-grade stem *pad-*; a Middle stem in the Zero grade would in this instance yield prosodically anomalous case forms such as **pd-ā́*.[15] Similarly, in the paradigm of the masculine noun ATMAN 'soul, self', the Strong stem is the Vṛddhi-grade stem *ātmā́n-*, the Middle stem is the Zero-grade stem *ātmn̥-* (phonetically *ātmá-*), and the Weakest stem is the Guṇa-grade stem *ātmán-*; if the Weakest stem were the Zero-grade stem *ātmn-*, it would yield prosodic anomalies such as **ātmn-ā́*.

That prosodic considerations regulate stem choice in such instances seems indisputable. These facts do, however, raise the question of whether prosodic criteria might not suffice to determine stem choice in all other instances as well. That is, they suggest a way of dispensing with the stem-indexing rules in (16) (and hence with the IAH), namely to assume that each nominal lexeme L has an inventory of unindexed inflectional stems and that the choice among these stems is made by direct reference to their prosodic properties. (For a given nominal lexeme L, the full membership of L's stem inventory could be specified by direct lexical stipulation or predicted by rule or both.) This approach would employ stem-selection rules and morphological metageneralizations which might be informally stated as in (20) and (21).

(20) Stem-selection rules:
Given a multiple-C-stem nominal L,
a. in L's paradigm, the cells listed in (5) are occupied by forms based on the stem of L that is prosodically the heaviest;
b. in the remaining cells, stem choice is determined by the metageneralizations in (21).

(21) Morphological metageneralizations:

Where X and Y are those stems of L that are prosodically the lightest,

a. the choice between (i) using X prevocalically and Y elsewhere and (ii) using Y prevocalically and X elsewhere is determined by which of the two choices yields optimal syllable structures (i.e. structures in which onsets are maximized and in which codas and onsetless syllables are minimized);
b. if the choice between X and Y is not determined by criterion (21a), then the lighter of the two stems is used prevocalically and the heavier elsewhere.

The stem-selection rules in (20) make no reference to the morphomic index 'Strong', but instead simply select the heaviest available stem; similarly, the morphological metageneralizations in (21) make no reference to the indices 'Middle' and 'Weakest', but simply choose among two alternative stems according to which choice yields the best syllable structure (or, by default, according to prosodic weight). In this way, morphomic indices (and a fortiori, the stem-indexing rules in (16)) are dispensed with.

On first consideration, this seems like a workable alternative to the use of morphomic indices. For instance, given that the participle TASTHIVANS 'having stood' has the four stems in (22a), the stem-selection rules in (20) and the metageneralizations in (21) correctly determine which of these is the Strong stem and, in the Weak cases, which is to be used prevocalically and which elsewhere. Similarly, given that the adjectives ATMAN 'soul, self' and BALIN 'strong' have the stems in (22b,c), the rules in (20) and (21) again make the right predictions. Notwithstanding these encouraging facts, the prosodic approach cannot, ultimately, be maintained, for a variety of reasons.

(22) a. TASTHIVANS 'having stood' has four stems: *tasthivā́ns-*, *tasthiváns-*, *tasthivát-*, and *tasthúṣ-*.
By (20a), *tasthivā́ns-* is the Strong stem;
by (21b), *tasthúṣ-* is the Weakest (prevocalic) stem and *tasthivát-*, the Middle (elsewhere) stem.

b. ATMAN 'soul, self' has three stems: *ātmā́n-*, *ātmán-*, and *ātmṇ́-*.
By (20a), *ātmā́n-* is the Strong stem;
by (21a), *ātmán-* is the Weakest (prevocalic) stem and *ātmṇ́-*, the Middle (elsewhere) stem.

c. BALIN 'strong' has two stems: *balín-* and *balí-*.
By (20a), *balín-* is the Strong stem;
by (21a), *balín-* is the Weakest (prevocalic) stem and *balí-*, the Middle (elsewhere) stem.

First, a nominal lexeme's Strong stem is not always distinguished by the criterion in (20a). An example is the directional adjective UDAÑC 'turned upwards': by the traditional principles of Sanskrit prosody, its Strong stem *údañc-* and its Weakest stem *údīc-* are equally heavy.

Second, there are nominal lexemes whose Middle and Weakest stems are distinguished by neither of the criteria in (21a,b). Thus, consider again the adjective UDAÑC: on the one hand, syllable structure is no better optimized by using UDAÑC's Weakest stem *údīc-* prevocalically and the Middle stem *údac-* elsewhere than it would be by using *údac-* prevocalically and *údīc-* elsewhere; on the other hand, the Middle stem *údac-* is not prosodically heavier than the Weakest stem *údīc-* (indeed, it's lighter).

Third, there are instances in which the criterion in (21a) makes exactly the wrong predictions. For example, because the noun AHAN 'day' has the Middle stem *áhas-* and the Weakest stem *áhn̥-*, neither its locative plural form *áhas-su* (phonetically *áhaḥ-su*) nor its dative singular form *áhn-e* (where *n̥* automatically loses its syllabicity) is optimal in its syllable structure; both have codas in the penultimate syllable. On the other hand, if *áhn̥-* were used preconsonantally and *áhas-* prevocalically, both forms would have optimal syllable structures: neither the dative singular form **áhas-e* nor the locative plural form **áhn̥-su* (phonetically **áha-su*) would have any codas at all. Thus, from the perspective of criterion (21a), the Middle and Weakest stems of AHAN are exactly the opposite of what they should be.

The faultiness of the metageneralizations in (21) is particularly evident in their implications for the distribution of Guṇa-grade stems. Given, for example, that the noun RAJAN has three stems (the Vr̥ddhi-grade stem *rā́jān-*, the Guṇa-grade stem *rā́jan-*, and the Zero-grade stem *rā́jn̥-*), metageneralization (21a) prescribes the choice of the Guṇa-grade stem over the Zero-grade stem in prevocalic contexts in the Weak cases, since the Guṇa-grade stem does a better job of minimizing codas: in the dative singular, for example, (21a) favours the unattested, codaless form **rā́jan-e* over the actual form *rā́jñ-e*, whose first syllable has a coda. But this is the wrong choice: the Zero-grade stem is used in all of the Weak cases in RAJAN's paradigm, and the Guṇa-grade stem is restricted to the vocative singular.

More generally, the prosodic approach fails to capture the aforementioned generalization about the distribution of Guṇa-grade stems in the paradigms of gradational lexemes, namely that *in the paradigms of the overwhelming majority of gradational nominals, the Guṇa-grade stem never serves as a Middle or Weakest stem*. Nothing about the rules in (20) and (21) entails this consequence. In the morphomic indexing approach, by contrast, this generalization follows from the default stem-indexing rules (16b,c); the few exceptions to this generalization – such as the fact that

ATMAN's Guṇa-grade stem is its Weakest stem and the fact that PAD's Guṇa-grade stem is its Middle stem – can be accommodated by allowing a Zero-grade stem to be supplanted by its Guṇa-grade counterpart if prosodic anomaly would otherwise ensue. Thus, the prosodic approach and the morphomic indexing approach differ strikingly in their treatment of the *n*-stem nouns RAJAN and ATMAN. In the prosodic approach, ATMAN is portrayed as unexceptional – its Guṇa-grade stem appears in the Weakest cases, exactly as (21a) prescribes; RAJAN, by contrast, is portrayed as exceptional – something special has to be said about it to prevent its Guṇa-grade stem from appearing in the Weakest cases. In the morphomic indexing approach, RAJAN is unexceptional – its Guṇa-grade stem appears in the vocative singular and nowhere else, in accordance with the stem-indexing rules in (16) and the stem-selection rule in (19); ATMAN, by contrast, is exceptional – prosodic considerations override the default stem-indexing rule (16c), requiring the appearance of its Guṇa-grade stem in the Weakest cases. Of the two approaches, only the latter is easily reconciled with the extremely high level of conformity to the generalization that Guṇa-grade stems do not serve as Middle or Weakest stems.

Finally, the prosodic approach to stem choice fails to capture generalizations about default/override relations among competing stem forms. Why, for example, is TASTHIVANS' regular Zero-grade stem **tasthivṇ́s-* absent from the stem inventory in (22a)? In the prosodic approach, there is no obvious sense in which the regular Zero-grade stem is excluded from (22a) by the suppletive stems *tasthivát-* and *tasthúṣ-*. In the morphomic indexing approach, by contrast, the explanation is obvious: because the suppletive stems carry the indices 'Middle' and 'Weakest', the assignment of any index to the regular Zero-grade stem by the default stem-indexing rules in (16b,c) is overridden.

I conclude from the foregoing considerations that Sanskrit declensional stem choice is not, in general, determined by prosodic exigencies. This is not to say, however, that syllable structure isn't usually optimized in a nominal's inflected forms; but it isn't the principles of stem choice that are responsible for this – rather, the optimization of syllable structure is effected by principles of automatic phonology: in traditional terms, by rules of sandhi. Consider an example. Because syllabic resonant consonants lose their syllabicity in prevocalic contexts, the Zero-grade stems of the nouns in table 6.12 appear prevocalically as in row (a) but elsewhere as in row (b). This sandhi alternation tends to maximize onsets (as in the genitive/locative dual forms *svásr-os*, *gáty-os*, *rā́jñ-os*) and to minimize codas (as in the locative

Table 6.12 *Zero-grade stem alternants of three Sanskrit nouns*

	SVASAR 'sister'	GATI 'gait'	RAJAN 'king'
a. PREVOCALICALLY	*svásr-*	*gáty-*	*rā́jñ-*
b. ELSEWHERE	*svásṛ-*	*gáti-*	*rā́jṇ-* (phonetically *rā́ja-*)

plural forms *svásṛ-ṣu*, *gáti-ṣu*, *rā́jṇ-su* – phonetically *rā́ja-su*). Similarly, there is a principle of sandhi requiring that stem-final *as* appear as *o* before voiced consonants (Whitney 1889: section 175); because of this phonological principle, the combination of the instrumental plural suffix *-bhis* with AHAN's Middle stem *áhas-* yields *áho-bhis*, in which the stem itself is codaless. As these examples suggest, the need to optimize syllable structure does not determine stem choice; rather, stem choice determines the particular sandhi processes by which syllable structure is optimized. The fact that Weakest stems always end in nonsyllabic sounds while Middle stems frequently end in syllabic sounds is, in general, the consequence – not the cause – of the appearance of Weakest stems in prevocalic contexts and the appearance of Middle stems in preconsonantal contexts.

6.4 Summary of the proposed theory of stem alternations

The central conclusion to be drawn from the foregoing discussion is that the IAH (14) is valid – that the morphomic categorization of a lexeme's stems is not always simply effected by the stem-formation rules determining their form. In arguing for this conclusion, I have proposed that Sanskrit declensional stem alternations are regulated by a richly variegated system of rule-types, whose essential properties I recapitulate here.

(i) A STEM-FORMATION RULE allows the phonological form of a stem to be deduced from that of some other stem of the same lexeme. The stem-formation rule which allows the phonological form of stem_1 to be deduced from that of stem_2 in some instances allows the index of stem_1 to be deduced from that of stem_2; this isn't always the case, however.

(ii) If a stem's index isn't explicitly assigned by lexical stipulation or by the stem-formation rule which determines its form, its index is assigned by a STEM-INDEXING RULE. Together, a language's rules of stem formation and stem indexing constitute its MORPHOMIC rules.

(iii) A STEM-SELECTION RULE associates a particular stem with a particular set of morphosyntactic properties. In some instances, the stem in question is identified by its morphomic index; in others, by its formation.

In accordance with earlier assumptions (sections 2.4 – 2.7):

(iv) A REALIZATION RULE applies to a stem paired with a set σ of morphosyntactic properties to realize a particular subset of σ, either by directly stipulating that subset's exponence or by referring its realization to some other rule. Stem-selection rules are a particular kind of rule of exponence; a language's realization rules and its morphomic rules together constitute its INFLECTIONAL RULES.

(v) A MORPHOLOGICAL METAGENERALIZATION expresses a redundancy in the evaluation of two or more realization rules – in some instances, this redundancy is a shared morphophonological concomitant, while in others, it is a syntagmatic principle of stem choice.

(vi) A PARADIGM FUNCTION applies to a root pairing <X,σ> to yield the σ-cell in the inflectional paradigm associated with X. The value of a paradigm function is defined in terms of more specific realization rules.

In the proposed analysis of Sanskrit, these kinds of rules are instantiated as in (23).

(23)
- A. Paradigm function: (6)
- B. Inflectional rules
  - 1. Realization rules
    - a. Rules of exponence: (7a–r), (12)
      (including stem-selection rules: (3), (19))
    - b. Rules of referral: (7s,t)
  - 2. Morphomic rules
    - a. Rules of stem formation: (13), (15), (17), (18)
    - b. Rules of stem indexing: (16)
- C. Morphological metageneralizations: (8), (10)

These provide an optimal analysis of stem formation, stem indexing, stem choice, and inflectional marking for a substantial fragment of Sanskrit declensional morphology, encompassing the regular masculine[16] and neuter inflection of most subclasses of C-stem nominals,[17] including directional adjectives in *-añc* (e.g. UDAÑC), derivatives in *-an* (e.g. AHAN, RAJAN), present and future active participles (e.g. ADANT 'eating'), derivatives in *-in* (e.g. BALIN), perfect active participles (e.g. TASTHIVANS), possessive adjectives in *-vant* and *-mant* (e.g. BHAGAVANT, PAŚUMANT), and derived nonalternating C-stems (e.g. SUMANAS).

Though my discussion has focussed on details of Sanskrit declensional morphology, evidence favouring the IAH is in fact widespread: comparable examples can be easily multiplied. In Spanish, for instance, verbs in one conjugation have a default stem carrying the theme vowel *-a* and a present subjunctive stem carrying the theme vowel *-e* (e.g. HABLAR 'speak': default stem *habla-*, subjunctive stem *hable-*), while verbs in another conjugation instead have a default stem in *-e* and a present subjunctive stem in *-a* (e.g. COMER 'eat': default stem *come-*, subjunctive stem *coma-*); see Matthews (1991:198ff.). Thus, verb stems which are alike in their formation (e.g. *habla-* and *coma-*) may carry distinct indices, and verbs stems which are alike in their indexing (e.g. *habla-* and *come-*) may be distinct in their formation. Similarly, one subclass of neuter nouns in Russian exhibits stem stress in singular case forms but end stress in plural case forms (e.g. nom sg *dél-o* 'matter', nom pl *del-á*), while another subclass of neuter nouns exhibits end stress in singular case forms and stem stress in plural case forms (e.g. nom sg *okn-ó* 'window', nom pl *ókn-a*); thus, neuter noun stems which are alike in their formation (e.g. *dél-* and *ókn-*) may carry distinct indices, and neuter noun stems which are alike in their indexing (e.g. *dél-* and *okn-*) may be distinct in their formation.

The IAH is reminiscent of Robert Beard's Separation Hypothesis, according to which inflectional or derivational modifications of a lexeme's meaning or morphosyntactic properties are effected by abstract rules operating independently of the morphological rules by means of which those modifications receive concrete expression. As evidence in favour of the Separation Hypothesis, Beard (1988:31ff.; 1995:6) cites the phenomenon of 'morphological asymmetry' (so named by Karcevskij 1929): on the one hand, the same derivational function may be expressed by distinct morphological rules (as the function 'subjective nominalization' is expressed by *-ee* suffixation in *escapee*, by *-er* suffixation in *driver*, by *-ant* suffixation in *occupant*, etc.); on the other hand, the same morphological rule may express distinct derivational functions (as the rule of *-ant* suffixation expresses the function 'subjective nominalization' in *occupant*, the function 'objective nominalization' in *rehabilitant*, the function 'qualitative adjectivization' in *dominant*, and so on). The Sanskrit declensional stem alternations discussed here exhibit a similar asymmetry: while stems carrying the same index may be distinct in their formation, stems exhibiting the same formation may carry distinct indices. Thus, the IAH might be seen as one entailment of a suitably general formalization of Beard's hypothesis; that is, if the Separation Hypothesis entails the separation of a language's inflectional and derivational subsystems from its concrete morphology, it should likewise entail the separation of morphomic categorization from stem formation.

6.5 Some applications of the theory

The theory of stem alternations developed in sections 6.1 – 6.4 affords seamless analyses of a number of phenomena: it directly accommodates instances in which specific stems are invariably associated with specific property sets and therefore do not require morphomic indices (section 6.5.1); it makes it possible to delineate the inflectional properties of word-to-stem derivatives in an exact way (section 6.5.2); and it furnishes an account of portmanteau stems which doesn't rely on the widely invoked but ultimately untenable assumption that inflectional rules obey an anti-redundancy principle (section 6.5.3).

6.5.1 Stems without morphomic indices

In Sanskrit, it is not possible to associate each stem of a nominal lexeme with a single, invariant set of morphosyntactic properties; this is one of the facts about Sanskrit that favours the introduction of the morphomic indices 'Strong', 'Middle', and 'Weakest'. Nevertheless, one does find instances in which the members of a lexeme's stem inventory can each be associated with a single, invariant property set. In instances of this sort, morphomic indices are otiose; that is, the relation between a stem's form and its distribution can be given a single, direct statement without the mediation of a rule of stem indexing.

Consider a case in point. In Breton, many nouns have a single stem, used in all inflectional contexts; the noun POTR 'boy', for example, exhibits the stem *potr-* both in the singular (*potr*) and in the plural (*potr-ed*). Nevertheless, a large number of Breton nouns have two stems, one used in the singular and the other in the plural. Often in such instances, one of the stems arises from the other by means of an independently motivated rule of derivation. For example, there is a rule of *-ez* suffixation serving to derive feminine nouns with feminine reference from nouns and sometimes adjectives (Hemon 1975:28f., 47, 66): *kaz* 'cat' → *kazez* 'female cat'; *bleiz* 'wolf'

→ *bleizez* 'she-wolf'; *miliner* 'miller' → *milinerez* 'miller's wife'; *paour* 'poor' → *paourez* 'poor woman'. In addition, there is a class of feminine nouns with feminine reference (call it 'Class Z') whose singular and plural stems are related by the rule of *-ez* suffixation (Hemon 1975:32): *c'hoar* 'sister', plural *c'hoarez-ed*; *itron* 'lady', plural *itronez-ed*; *moereb* 'aunt', plural *moerebez-ed*. Because the singular stem *c'hoar-* and its plural counterpart *c'hoarez-* can each be associated with a single invariant property set (the former with {} and the latter with {NUM:pl}), it is not necessary to resort to morphomic indices to account for their formal and distributional differences.

To see this, suppose that the derivational rule of *-ez* suffixation is formulated as in (24):

(24) Where X is a nominal,
$\mathrm{DR}_{\mathrm{fem}}(\mathrm{X}) =_{\mathrm{def}} \mathrm{X}\textit{ez}$; L-index(X*ez*) ∈ GEN:fem.

The semantics of Breton requires nouns arising by means of (24) to be referentially feminine. Suppose in addition that the inflectional rule of *-ed* suffixation (the default rule for plurals of animate nouns) is formulated as in (25), and that the Breton paradigm function is partially defined as in (26):

(25) $\mathrm{RR}_{1,\{\mathrm{NUM:pl}\},[+\mathrm{Animate}]}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}\textit{ed},\sigma>$

(26) Where X is the root of a nominal lexeme (but is not a word-to-word derivative),
$\mathrm{PF}(<\mathrm{X},\{\mathrm{NUM}:\alpha\}>) =_{\mathrm{def}} \mathrm{Nar}_1(\mathrm{Nar}_0(<\mathrm{X},\{\mathrm{NUM}:\alpha\}>))$

Together with the IFD, (25) and (26) guarantee that $\mathrm{PF}(<\textit{potr},\{\mathrm{NUM:pl}\}>) = <\textit{potred},\{\mathrm{NUM:pl}\}>$, and so on. On these assumptions, the formal and distributional differences between *c'hoar-* and *c'hoarez-* can be accounted for by the stem-selection rule in (27), which puts (24) to use as a stem-formation rule.

(27) $\mathrm{RR}_{0,\{\mathrm{NUM:pl}\},[\mathrm{Class\ Z}]}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{DR}_{\mathrm{fem}}(\mathrm{X}),\sigma>$

Though it makes no reference to morphomic indices, this rule yields the desired consequences: together, (26) and (27) guarantee that $\mathrm{PF}(<\textit{c'hoar},\{\mathrm{NUM:pl}\}>) = <\textit{c'hoarezed},\{\mathrm{NUM:pl}\}>$, that $\mathrm{PF}(<\textit{itron},\{\mathrm{NUM:pl}\}>) = <\textit{itronezed},\{\mathrm{NUM:pl}\}>$, and so on.

6.5.2 On the inflection of word-to-stem derivatives

In the inflection of *c'hoarezed*, *itronezed*, etc., an independently motivated rule of derivation is pressed into service as a rule of stem formation. As common a phenomenon as this is, one might well ask whether other sorts of morphological rules are likewise made to serve the purposes of stem formation. The answer, I believe, is yes; in particular, there are instances in which independently motivated rules of inflectional exponence apparently serve in the formation of inflectional stems for particular lexemes.

A case in point is that of word-to-stem derivatives. In section 4.7, it was observed that many languages have classes of headed lexemes whose inflected forms seemingly exhibit both head marking and peripheral marking. In Breton, for example, diminutives are formed by means of a category-preserving derivational rule of *-ig* suffixation: *bag* 'boat (fem)' → *bagig* 'little boat (fem)'; *ti* 'house (masc)' → *tiïg* 'little house (masc)'; *bihan* 'small' → *bihanig* 'a little (too) small'. When a diminutive noun X*ig* is pluralized, it shows two exponents of plural number – one on its head X and the other at its periphery; thus, the plural of *bagig* 'little boat' is *bagoùigoù*, with two instances of the default plural suffix *-où*. The theory of stems developed in sections 6.1–6.4 now affords a precise account of this phenomenon.

At the heart of this account is the claim that when a category-preserving derivational rule of the word-to-stem type applies to the root of a base lexeme, it determines not merely the root of the corresponding headed derivative but an array of distinct stems for that derivative; for example, the application of the diminutivizing rule of *-ig* suffixation to the root *bag-* of the lexeme BAG 'boat' determines not only the root *bagig-* of the diminutive derivative BAGIG 'little boat', but two stems as well: the singular stem (identical to the root *bagig-*) and the plural stem *bagoùig-*.

What allows a word-to-stem rule to determine multiple stems is the universal metarule (28); the stem-selection rules induced by this metarule cause the realization rules to which a root X is subject to serve as stem-formation rules for any word-to-stem derivative of X.

(28) Universal metarule for word-to-stem derivatives:
If X,Y are roots and M is a word-to-stem rule such that $M(X) = Y$, then for each set σ of morphosyntactic properties such that $\mathrm{PF}(\langle X,\sigma\rangle)$ is defined, if $\mathrm{PF}(\langle X,\sigma\rangle) = \langle Z,\sigma'\rangle$, then $\mathrm{RR}_{0,\sigma,\{\text{L-index}(Y)\}}(\langle Y,\sigma''\rangle) =_{\text{def}} \langle M(Z),\sigma''\rangle$.

According to (28), a word-to-stem rule's inflectable derivatives regularly exhibit double marking in their inflection. Consider, for illustration, the case of BAGIG 'little boat': the word-to-stem rule introducing the root of this lexeme is (29).

(29) Breton diminutive suffixation (a word-to-stem rule):

$\mathrm{DR}_{\text{dimin}}(X) =_{\text{def}} X\textit{ig}$

The root *bagig* arises through the application of (29) to the root of the noun BAG 'boat', which has two cells in its paradigm: a singular cell and a plural cell. In accordance with the partial definition (26) of the Breton paradigm function and the default pluralization rule (30), $\mathrm{PF}(<\textit{bag},\{\mathrm{NUM{:}sg}\}>) = <\textit{bag},\{\mathrm{NUM{:}sg}\}>$ and $\mathrm{PF}(<\textit{bag},\{\mathrm{NUM{:}pl}\}>) = <\textit{bagoù},\{\mathrm{NUM{:}pl}\}>$.

(30) $\mathrm{RR}_{1,\{\mathrm{NUM:pl}\},\mathrm{N}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}\textit{où},\sigma>$

Metarule (28) therefore entails the existence of the two stem-selection rules in (31); both rules are as narrow as they can possibly be, since each is restricted to a class of lexemes having BAGIG as its only member.

(31) a. $\mathrm{RR}_{0,\{\mathrm{NUM:sg}\},\{\textsc{bagig}\}}(<\textit{bagig},\sigma>) =_{\mathrm{def}} <\mathrm{DR}_{\mathrm{dimin}}(\textit{bag}),\sigma>$
[since *bag*, *bagig* are roots,
$\mathrm{DR}_{\mathrm{dimin}}$ is a word-to-stem rule such that $\mathrm{DR}_{\mathrm{dimin}}(\textit{bag}) = \textit{bagig}$,
and $\mathrm{PF}(<\textit{bag},\{\mathrm{NUM{:}sg}\}>) = <\textit{bag},\{\mathrm{NUM{:}sg}\}>$]

b. $\mathrm{RR}_{0,\{\mathrm{NUM:pl}\},\{\textsc{bagig}\}}(<\textit{bagig},\sigma>) =_{\mathrm{def}} <\mathrm{DR}_{\mathrm{dimin}}(\textit{bagoù}),\sigma>$
[since *bag*, *bagig* are roots,
$\mathrm{DR}_{\mathrm{dimin}}$ is a word-to-stem rule such that $\mathrm{DR}_{\mathrm{dimin}}(\textit{bag}) = \textit{bagig}$,
and $\mathrm{PF}(<\textit{bag},\{\mathrm{NUM{:}pl}\}>) = <\textit{bagoù},\{\mathrm{NUM{:}pl}\}>$]

By virtue of these rules, $\mathrm{PF}(<\textit{bagig},\{\mathrm{NUM{:}sg}\}>) = <\textit{bagig},\{\mathrm{NUM{:}sg}\}>$ and $\mathrm{PF}(<\textit{bagig},\{\mathrm{NUM{:}pl}\}>) = <\textit{bagoùigoù},\{\mathrm{NUM{:}pl}\}>$; the proof of the latter equation is given in (32).

(32) $\mathrm{PF}(<\textit{bagig},\{\mathrm{NUM{:}pl}\}>)$

a. $= \mathrm{Nar}_1(\mathrm{Nar}_0(<\textit{bagig},\{\mathrm{NUM{:}pl}\}>))$ [by (26)]

b. $= \mathrm{RR}_{1,\{\mathrm{NUM:pl}\},\mathrm{N}}(\mathrm{RR}_{0,\{\mathrm{NUM:pl}\},\{\textsc{bagig}\}}(<\textit{bagig},\sigma>))$ [by Nar_n notation]

c. $= \mathrm{RR}_{1,\{\mathrm{NUM:pl}\},\mathrm{N}}(<\mathrm{DR}_{\mathrm{dimin}}(\textit{bagoù}),\sigma>)$ [by (31b)]

d. $= \mathrm{RR}_{1,\{\mathrm{NUM:pl}\},\mathrm{N}}(<\textit{bagoùig},\sigma>)$ [by (29)]

e. $= <\textit{bagoùigoù},\sigma>$ [by (30)]

This analysis reveals what I take to be the defining property of word-to-stem rules: these are simply category-preserving rules which give rise to derivatives whose stems are determined by the metarule (28).[18]

Kikuyu diminutives present a somewhat more complex instantiation of metarule (28). In Kikuyu, nouns belonging to gender 3/4 take the class 3 prefix *mũ-* in the singular and the class 4 prefix *mĩ* – in the plural: *-rũũthi* 'lion', sg *mũ-rũũthi*, pl *mĩ-rũũthi*. Diminutivization in Kikuyu amounts to a shift in gender – specifically, a shift to gender 12/13. The diminutive derivative of a class 3/4 noun shows double marking for number and gender: in the singular, it has the class 12 prefix *ka-* followed by the class 3 prefix *mũ-* (*ka-mũ-rũũthi* 'little lion'), and in the plural, it has the class 13 prefix *tũ-* followed by the class 4 prefix *mĩ-* (*tũ-mĩ-rũũthi* 'little lions'); thus, the rule which diminutivizes nouns in gender 3/4 is fully comparable to the rule forming *-ig* diminutives in Breton. Suppose, now, that the Kikuyu rules of noun class inflection include the four rules in (33ai), that the rule of diminutive conversion for gender 3/4 nouns is the word-to-stem rule in (33aii), and that the Kikuyu paradigm function has the partial definition in (33b).

(33) a. Morphological rules:
i. Noun class prefixation (realization rules):
$RR_{1,\{GEN:3/4,\ NUM:sg\},N}(<X,\sigma>) =_{def} <\textit{mũ}X,\sigma>$
$RR_{1,\{GEN:3/4,\ NUM:pl\},N}(<X,\sigma>) =_{def} <\textit{mĩ}X,\sigma>$
$RR_{1,\{GEN:12/13,\ NUM:sg\},N}(<X,\sigma>) =_{def} <\textit{ka}X,\sigma>$
$RR_{1,\{GEN:12/13,\ NUM:pl\},N}(<X,\sigma>) =_{def} <\textit{tũ}X,\sigma>$
ii. Diminutive conversion (a word-to-stem rule):
If L-index(X) $\in$ GEN:3/4, then $DR_{dimin}(X) =_{def} Y$, where Y is identical in form to X but L-index(Y) $\in$ GEN:12/13.
b. Partial definition of the Kikuyu paradigm function:
Where X is a nominal lexeme and L-index(X) $\in$ GEN:α,
$PF(<X,\{NUM:\beta\}>) =_{def} Nar_1(Nar_0(<X,\{GEN:\alpha,\ NUM:\beta\}>))$

Metarule (28) then entails the existence of the two stem-selection rules in (34), where, for clarity, I use a subscript 'DIM' to indicate the gender 12/13 lexeme RŨŨTHI and its forms, and a subscript 'BASE' to indicate the gender 3/4 lexeme RŨŨTHI and its forms.

(34) a. $RR_{0,\{NUM:sg\},\{\text{RŨŨTHI}_{DIM}\}}(<\textit{rũũthi}_{DIM},\sigma>) =_{def} <DR_{dimin}(\textit{mũrũũthi}_{BASE}),\sigma>$
[since $\textit{rũũthi}_{BASE}$, $\textit{rũũthi}_{DIM}$ are roots,
DR_{dimin} is a word-to-stem rule such that $DR_{dimin}(\textit{rũũthi}_{BASE}) = \textit{rũũthi}_{DIM}$,
and $PF(<\textit{rũũthi}_{BASE},\{NUM:sg\}>) = <\textit{mũrũũthi}_{BASE},\{GEN:3/4,\ NUM:sg\}>$]
b. $RR_{0,\{NUM:pl\},\{\text{RŨŨTHI}_{DIM}\}}(<\textit{rũũthi}_{DIM},\sigma>) =_{def} <DR_{dimin}(\textit{mĩrũũthi}_{BASE}),\sigma>$
[since $\textit{rũũthi}_{BASE}$, $\textit{rũũthi}_{DIM}$ are roots,
DR_{dimin} is a word-to-stem rule such that $DR_{dimin}(\textit{rũũthi}_{BASE}) = \textit{rũũthi}_{DIM}$,
and $PF(<\textit{rũũthi}_{BASE},\{NUM:pl\}>) = <\textit{mĩrũũthi}_{BASE},\{GEN:3/4,\ NUM:pl\}>$]

By virtue of these rules, $PF(<\textit{rũũthi}_{DIM},\{NUM:sg\}>) = <\textit{kamũrũũthi}, \{GEN:12/13,\ NUM:sg\}>$ and $PF(<\textit{rũũthi}_{DIM},\{NUM:pl\}>) = <\textit{tũmĩrũũthi}, \{GEN:12/13,\ NUM:pl\}>$; (35) is the proof of the latter equation.[19]

(35) Where $\text{RŨŨTHI}_{DIM} \in$ GEN:12/13 and $\text{RŨŨTHI}_{BASE} \in$ GEN:3/4,
$PF(<\textit{rũũthi}_{DIM},\{NUM:pl\}>)$
a. $= Nar_1(Nar_0(<\textit{rũũthi}_{DIM},\{GEN:12/13,\ NUM:pl\}>))$ [by (33b)]
b. $= RR_{1,\{GEN:12/13,NUM:pl\},N}(RR_{0,\{NUM:pl\},\{\text{RŨŨTHI}_{DIM}\}}(<\textit{rũũthi}_{DIM},\{GEN:12/13,\ NUM:pl\}>))$ [by Nar_n notation]

c. $=RR_{1,\{GEN:12/13,\ NUM:pl\},N}(<DR_{dimin}(\textit{mĩrũũthi}_{BASE}),\{GEN:12/13,\ NUM:pl\}>)$ [by (34b)]

e. $=RR_{1,\{GEN:12/13,\ NUM:pl\},N}(<\textit{mĩrũũthi}_{DIM},\{GEN:12/13,\ NUM:pl\}>)$ [by (33aii)]

f. $=<$*tũmĩrũũthi*,{GEN:12/13, NUM:pl}$>$ [by (33ai)]

The approach to the inflection of word-to-stem derivatives exemplified here provides additional motivation for the postulation of paradigm functions in morphological theory, since the formulation of the universal metarule (28) makes essential reference to a paradigm function, in much the same way as the formulation of the HAP ((12), section 4.5) does.

The proposed approach to the inflection of word-to-stem derivatives has specific implications for the analysis of morphological change. Haspelmath (1993) documents a diachronic process of inflection externalization in which (a) forms having a derivational marking which is external to an inflectional marking develop into (b) doubly inflected forms (in which the derivational marking is sandwiched between two inflectional markings) and ultimately into (c) forms in which the derivational marking is internal to the inflectional marking. These diachronic developments might be schematically represented as in (36):

(36) a. root – inflectional affix – derivational affix
b. root – inflectional affix – derivational affix – inflectional affix
c. root – derivational affix – inflectional affix

The proposed approach to the inflection of word-to-stem derivatives allows these diachronic tendencies to be characterized more precisely. At stage (36a), the derivational affix is the mark left by a category-preserving rule of the word-to-word type; the derivative therefore exhibits head inflection, in accordance with the HAP. At stage (36b), a reanalysis has taken place: the interposed inflectional affix has been reinterpreted as a stem formative. The derivational affix is correspondingly reinterpreted as the mark of a word-to-stem rule (i.e. a category-preserving rule subject to metarule (28)); this latter reanalysis accounts for the appearance of an inflectional affix as a stem formative, but also requires a peripheral inflectional marking. At stage (36c), a simplification has taken place: the derivational affix has now been reinterpreted as the mark of a root-to-root rule; no longer the mark of a word-to-stem rule, it is now unaccompanied by the diversity of stem alternants engendered by metarule (28).

6.5.3 Portmanteau stem-selection rules

It frequently happens that a default affix encoding a particular set of morphosyntactic properties fails to combine with a stem which itself already encodes those same properties; to account for this fact, it has been widely claimed that there is a universal principle which blocks redundant affixation. Ultimately, however, no such principle can be validly maintained, since one also commonly encounters instances in which redundant affixation DOES occur. As I show in this section, the assumptions of PFM afford a straightforward resolution of this paradox.

Consider a concrete case from English. The lexeme BAD has the suppletive comparative stem *worse*, to which the default comparative suffix *-er* does not attach. One might attribute the absence of *-er* from the comparative form of BAD to an anti-redundancy principle requiring that if some form X is lexically listed as carrying a set τ of morphosyntactic properties, then that fact alone prevents X from undergoing any rule whose application realizes some set of which τ is an extension. On this view, the fact that the suppletive stem *worse* is lexically specified as {DEGREE:comparative} prevents it from undergoing *-er* suffixation, since the latter rule realizes the same property. The claim would be, in effect, that certain kinds of extended exponence are universally prohibited: in the case at hand, for example, the comparative degree has exactly one exponent in each of *taller* and *worse* and the purported principle blocks forms (such as **worser*) in which it would have more than one exponent; similarly, the purported principle might be invoked to account for the fact that the regular past-tense suffix *-ed* doesn't join with *was* and *were*, the fact that the regular plural suffix *-s* doesn't join with *men*, and so on.

The assumption that extended exponence is restricted by an anti-redundancy principle of this sort is a widely held one, and various ways of formulating this principle have been proposed, e.g. by Kiparsky (1982:136f.), Marantz (1984:128), and Anderson (1992:134). Nevertheless, there is considerable evidence suggesting that extended exponence is not in fact inhibited by any such anti-redundancy principle, so that some other explanation is needed for the absence of *-er* in the comparative form of BAD, the absence of a past-tense suffix in past-tense forms of BE, and so on. For instance, GOOD has the suppletive comparative stem *bett-*, with which the comparative suffix does join; BE has the suppletive 3sg present indicative stem *i-*, with which the 3sg present indicative suffix *-s* joins; and so on.[20] Thus, a paradox arises; how can a theory of inflection get *better* and *worse* at the same time?

The assumptions of PFM afford a straightforward resolution of this paradox, and do so without resorting to any sort of anti-redundancy principle. In section 5.2, I argued for the existence of portmanteau rule blocks; here, I argue that the *better/worse* paradox can be resolved through the use of a portmanteau block of stem-selection rules.

Thus, consider the case of *worse*. I assume that the default realization rules for English comparative adjectives are as in (37), and that the English paradigm function has the partial definition in (38).

(37) a. $\mathrm{RR}_{0,\{\},\mathrm{A}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{Y},\sigma>$, where Y is X's bare stem
b. $\mathrm{RR}_{\mathrm{I},\{\mathrm{DEG:compar}\},\mathrm{A}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}er',\sigma>$
[defined only if X meets certain prosodic conditions, which ordinarily entail that X has fewer than three syllables]

(38) Where X is the root of an adjectival lexeme (and is not a word-to-word derivative),
$\mathrm{PF}(<\mathrm{X},\sigma>) =_{\mathrm{def}} \mathrm{Nar}_{[\mathrm{I},0]}(<\mathrm{X},\sigma>)$.

On the assumption that *tall* is lexically listed as the bare stem of the lexeme TALL, (38) yields *taller* as the corresponding comparative form, as in (39). Here, the FCD causes $\mathrm{Nar}_{[\mathrm{I},0]}(<tall,\{\mathrm{DEG:compar}\}>)$ to be evaluated as $\mathrm{Nar}_{\mathrm{I}}(\mathrm{Nar}_0(<tall,\{\mathrm{DEG:compar}\}>))$.

(39) $\mathrm{PF}(<tall,\{\mathrm{DEG:compar}\}>)$
$= \mathrm{Nar}_{[\mathrm{I},0]}(<tall,\{\mathrm{DEG:compar}\}>)$ [by (38)]
$= \mathrm{Nar}_{\mathrm{I}}(\mathrm{Nar}_0(<tall,\{\mathrm{DEG:compar}\}>))$ [by the FCD]
$= \mathrm{RR}_{\mathrm{I},\{\mathrm{DEG:compar}\},\mathrm{A}}(\mathrm{RR}_{0,\{\},\mathrm{A}}(<tall,\{\mathrm{DEG:compar}\}>))$ [by Nar_n notation]
$= <taller,\{\mathrm{DEG:compar}\}>$ [by (37a,b)]

Suppose, however, that the inflection of BAD is regulated by the portmanteau stem-selection rule (40), according to which BAD has the portmanteau stem alternant *worse* in the comparative. On this assumption, (38) supplies *worse* as the comparative form of BAD, as in (41). Here, the FCD is overridden by (40), in accordance with Pāṇini's principle.

(40) Stem-selection rule:
$\mathrm{RR}_{[\mathrm{I},0],\{\mathrm{DEG:compar}\},\{\mathrm{BAD}\}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <worse,\sigma>$

(41) $\mathrm{PF}(<bad,\{\mathrm{DEG:compar}\}>)$
$= \mathrm{Nar}_{[\mathrm{I},0]}(<bad,\{\mathrm{DEG:compar}\}>)$ [by (38)]
$= \mathrm{RR}_{[\mathrm{I},0],\{\mathrm{DEG:compar}\},\{\mathrm{BAD}\}}(<bad,\{\mathrm{DEG:compar}\}>)$ [by Nar_n notation]
$= <worse,\{\mathrm{DEG:compar}\}>$ [by (40)]

On this analysis, the failure of the comparative suffix *-er* to appear in comparative forms of BAD is not attributed to an anti-redundancy principle, but is ultimately attributed to Pāṇini's principle: the rule (37b) of *-er* suffixation can only apply if the FCD causes $\mathrm{Nar}_{[\mathrm{I},0]}(<\mathrm{X},\sigma>)$ to be evaluated as $\text{Nar}_{\text{I}}(\text{Nar}_0(<\text{X},\sigma>))$; but when (40) is applicable, the FCD is overridden, in accordance with Pāṇini's principle.

Unlike (40), the stem-selection rule (42) introducing the comparative stem *bett-* is not a portmanteau rule; consequently, even though (42) associates *bett-* with the property set {DEG:compar}, the application of (42) is nevertheless compatible with that of (37b), which realizes the same property set. The proof in (43) illustrates.

(42) Stem-selection rule:
$\text{RR}_{0,\{\text{DEG:compar}\},\{\textsc{good}\}}(<\text{X},\sigma>) =_{\text{def}} <\textit{bett},\sigma>$

(43) $\text{PF}(<\textit{good},\{\text{DEG:compar}\}>)$
$= \text{Nar}_{[\text{I},0]}(<\textit{good},\{\text{DEG:compar}\}>)$ [by (38)]
$= \text{Nar}_{\text{I}}(\text{Nar}_0(<\textit{good},\{\text{DEG:compar}\}>))$ [by the FCD]
$= \text{RR}_{\text{I},\{\text{DEG:compar}\},\text{A}}(\text{RR}_{0,\{\text{DEG:compar}\},\{\textsc{good}\}}(<\textit{good},\{\text{DEG:compar}\}>))$
[by Nar_n notation]
$= <\textit{better},\{\text{DEG:compar}\}>$ [by (37b), (42)]

Consider now the verbs WALK and BE. The realization rules relevant to the forms *walks* and *walked* are given in (44); I assume that for verbal arguments, the English paradigm function has the partial definition in (45).

(44) a. $\text{RR}_{0,\{\},\text{V}}(<\text{X},\sigma>) =_{\text{def}} <\text{Y},\sigma>$, where Y is X's bare stem
b. $\text{RR}_{\text{I},\{\text{TNS:past}\},\text{V}}(<\text{X},\sigma>) =_{\text{def}} <\text{X}\textit{ed},\sigma>$
c. $\text{RR}_{\text{I},\{\text{TNS:pres, MOOD:indic, AGR:\{PER:3, NUM:sg\}}\},\text{V}}(<\text{X},\sigma>) =_{\text{def}} <\text{X}\textit{s},\sigma>$

(45) Where X is the root of a verbal lexeme (but not a word-to-word derivative) and $\sigma = \{\text{TNS:}\alpha, \text{MOOD:}\beta, \text{AGR:}\gamma\}$,
$\text{PF}(<\text{X},\sigma>) =_{\text{def}} \text{Nar}_{[\text{I},0]}(<\text{X},\sigma>)$

These rules correctly predict *walked* as the 3sg past indicative form of WALK, as in (46); likewise, they correctly predict *walks* as the 3sg present indicative form, as in (47).

(46) Where $\sigma = \{\text{TNS:past, MOOD:indic, AGR:\{PER:3, NUM:sg\}}\}$
$\text{PF}(<\textit{walk},\sigma>)$
$= \text{Nar}_{[\text{I},0]}(<\textit{walk},\sigma>)$ [by (45)]
$= \text{Nar}_{\text{I}}(\text{Nar}_0(<\textit{walk},\sigma>))$ [by the FCD]
$= \text{RR}_{\text{I},\{\text{TNS:past}\},\text{V}}(\text{RR}_{0,\{\},\text{V}}(<\textit{walk},\sigma>))$ [by Nar_n notation]
$= <\textit{walked},\sigma>$ [by (44a,b)]

(47) Where $\sigma = \{\text{TNS:pres, MOOD:indic, AGR:\{PER:3, NUM:sg\}}\}$,
$\text{PF}(<\textit{walk},\sigma>)$
$= \text{Nar}_{[\text{I},0]}(<\textit{walk},\sigma>)$ [by (45)]
$= \text{Nar}_{\text{I}}(\text{Nar}_0(<\textit{walk},\sigma>))$ [by the FCD]
$= \text{RR}_{\text{I},\{\text{TNS:pres, MOOD:indic, AGR:\{PER:3, NUM:sg\}}\},\text{V}}(\text{RR}_{0,\{\},\text{V}}(<\textit{walk},\sigma>))$
[by Nar_n notation]
$= <\textit{walks},\sigma>$ [by (44a,c)]

The inflection of BE, unlike that of WALK, involves suppletive stems: *was*, the singular past indicative stem, is introduced by a portmanteau stem-selection rule, (48a); by contrast, the stem-selection rule (48b) introducing the 3sg present indicative stem *i-* [ɪ] is not a portmanteau rule, but simply belongs to Block 0.

(48) Stem-selection rules for BE:

a. $RR_{[I,0],\{TNS:past,\ MOOD:indic,\ AGR:\{NUM:sg\}\},\{BE\}}(<X,\sigma>) =_{def} <\textit{was},\sigma>$

b. $RR_{0,\{TNS:pres,\ MOOD:indic,\ AGR:\{PER:3,\ NUM:sg\}\},\{BE\}}(<X,\sigma>) =_{def} <\textit{i},\sigma>$

As a consequence of these rules, the 3sg past indicative form of BE is determined to be *was* (as in (49)), while the 3sg present indicative form is determined to be *is* (as in (50)); the former correctly lacks the default past-tense suffix *-ed*, while the latter correctly carries the default 3sg present indicative suffix *-s*.

(49) Where $\sigma = \{TNS:past,\ MOOD:indic,\ AGR:\{PER:3,\ NUM:sg\}\}$,
$PF(<\textit{be},\sigma>)$
$= Nar_{[I,0]}(<\textit{be},\sigma>)$ [by (45)]
$= RR_{[I,0],\{TNS:past,\ MOOD:indic,\ AGR:\{NUM:sg\}\},\{BE\}}(<\textit{be},\sigma>)$ [by Nar_n notation]
$= <\textit{was},\sigma>$ [by (48a)]

(50) Where $\sigma = \{TNS:pres,\ MOOD:indic,\ AGR:\{PER:3,\ NUM:sg\}\}$,
$PF(<\textit{be},\sigma>)$
$= Nar_{[I,0]}(<\textit{be},\sigma>)$ [by (45)]
$= Nar_I(Nar_0(<\textit{be},\sigma>))$ [by the FCD]
$= RR_{I,\sigma,V}(RR_{0,\sigma,\{BE\}}(<\textit{be},\sigma>))$ [by Nar_n notation]
$= <\textit{is},\sigma>$ [by (44c), (48b)]

As in the case of *-er* and *worse*, the absence of *-ed* from *was* is not attributed to a questionable anti-redundancy principle; instead, the FCD makes it possible to treat the exclusion of *-ed* by *was* as an effect of Pāṇini's principle. Under this analysis, the difference between *was* and *i-* is in no way paradoxical, but follows purely and simply from the assumption that the realization rule selecting *was* is a portmanteau rule and that the one selecting *i-* is not.

7 *Syncretism*

In instances of syncretism, two or more cells within a lexeme's paradigm are occupied by the same form. Syncretism is an extremely common phenomenon in languages with inflectional morphology, one which raises a number of fundamental issues for morphological theory; in this chapter, I examine a number of these issues. I argue (section 7.1) that syncretisms are of at least four types (unidirectional, bidirectional, unstipulated, and symmetrical), and that the assumptions of PFM afford a natural means of capturing their distinctive characteristics: directional syncretisms are an effect of rules of referral (section 7.2), while symmetrical syncretisms are the effect of metarules pertaining to rules of exponence (section 7.3). Rules of referral serving to capture directional syncretisms may interact with other members of the same rule block in two ways (section 7.4): on the one hand, they participate in override relationships mediated by Pāṇini's principle; on the other hand, they participate in 'feeding' relationships. Although syncretism is customarily seen as a property of individual paradigms, there are clear instances of stipulated identity among members of distinct paradigms; in section 7.5, I argue that all such translexemic syncretisms are directional, hence an effect of rules of referral. I conclude (section 7.6) with a discussion of some apparent limits on the expressive potential of rules of referral and syncretism metarules.

7.1 Four types of syncretism

In the discussion of Bulgarian verb morphology in chapter 2, a clear instance of syncretism was encountered: in the preterite tenses (i.e. the imperfect and the aorist), a Bulgarian verb's 2sg forms are identical to its 3sg forms; see again table 2.3 (section 2.2). In instances of this kind, there is a clear sense in which the syncretism is DIRECTIONAL. In all three tenses, a Bulgarian verb's 3sg forms carry a termination -*e*; frequently, of course, this termination is elided by an independently motivated morphophonological rule (cf. section 2.6). A verb's 2sg forms share this termination *-e* in the preterite tenses but not in the present. Thus, the 2sg preterite forms are not only identical to their third-person counterparts; they clearly pattern after them, taking on morphology whose association with the third-person singular is, in the present tense, unambiguous (if somewhat opaque, given the incidence of elision). The second-person singular is, in other words, the DEPENDENT member of the syncretic pair, while the third person singular is the DETERMINANT member.[1]

Directional syncretisms are ordinarily UNIDIRECTIONAL: throughout the class of paradigms exhibiting the syncretism, the dependent and determinant members of the syncretic pair stand in the same paradigmatic relation to one another. There are, however, less usual instances in which the dependent and determinant members of the syncretic pair stand in one relationship in some paradigms but the opposite relationship in others. An instance of this sort comes from Rumanian. In Rumanian, verbs belonging to any but the first conjugation have present indicative paradigms in which the 1sg form is identical to the 3pl form; the examples in table 7.1 illustrate. In some paradigms, the 3pl form is the dependent member of the syncretic pair: in the paradigms of A UMPLEA 'to fill' and A ŞTI 'to know', for example, the syncretized forms exhibit the suffix *-u*, whose appearance in the paradigms of first-conjugation verbs is restricted to 1sg forms (e.g. *súfl-u* 'I breathe'). By contrast, it is the 1sg member of the syncretic pair that is the dependent member in the paradigm of A FI 'to be': in this paradigm, the 1sg form is based on the stem *sínt*, which is used throughout the plural portion of the paradigm but is otherwise absent from the singular portion. Thus, directional syncretisms are sometimes BIDIRECTIONAL rather than unidirectional.[2]

Not all syncretisms are directional, however; at least two kinds of NONDIRECTIONAL syncretism can be distinguished. Consider the present indicative paradigms of the first-conjugation verbs in table 7.1. In both paradigms, the 3sg form and the 3pl form are identical. This instance of syncretism is like neither of the syncretisms considered earlier: here, there's no sense in which the syncretism is directional; the syncretic pair cannot be seen as comprising a dependent member and a determinant member. Moreover, the property sets of the syncretized forms constitute a natural class (that of third-person present indicative forms). One can therefore simply say that the 3sg and 3pl forms of A INVITA 'to invite' and A SUFLA 'to breathe' have the same inflection because they both arise by means of a rule of *-ă* suffixation which expresses third person but is insensitive to

Table 7.1 *Present indicative forms of eight Rumanian verbs*

	A INVITA 'to invite'	A SUFLA 'to breathe'	A TĂCEA 'to be silent'	A UMPLEA 'to fill'	A FACE 'to do'	A ŞTI 'to know'	A VORBI 'to talk'	A FI 'to be'
CONJUGATION:	1	1	2	2	3	4	4	4
1SG	*invít*	*súfl-u*	*tác*	*úmpl-u*	*fác*	*ştí-u*	*vorbésc*	*sî́nt*
2SG	*invíţ-i*	*súfl-i*	*tác-i*	*úmpl-i*	*fác-i*	*ştí-i*	*vorbéşt-i*	*éşt-i*
3SG	*invít-ă*	*súfl-ă*	*tác-e*	*úmpl-e*	*fác-e*	*ştí-e*	*vorbéşt-e*	*ést-e*
1PL	*invitắ-m*	*suflắ-m*	*tăcé-m*	*úmple-m*	*fáce-m*	*ştí-m*	*vorbí-m*	*sî́nte-m*
2PL	*invitá-ţi*	*suflá-ţi*	*tăcé-ţi*	*úmple-ţi*	*fáce-ţi*	*ştí-ţi*	*vorbí-ţi*	*sî́nte-ţi*
3PL	*invít-ă*	*súfl-ă*	*tác*	*úmpl-u*	*fác*	*ştí-u*	*vorbésc*	*sî́nt*

Table 7.2 *Imperfect forms of two Rumanian verbs*

CONJUGATION:	A CÂNTA 'to sing' 1	A AUZI 'to hear' 4
1SG	*cântá-m*	*auziá-m*
2SG	*cântá-i*	*auziá-i*
3SG	*cântá*	*auziá*
1PL	*cântá-m*	*auziá-m*
2PL	*cântá-ţi*	*auziá-ţi*
3PL	*cântá-u*	*auziá-u*

differences of number. The syncretism in this case arises because of nothing more than a kind of poverty in the system of realization rules responsible for inflecting these forms: the system happens not to have any rule that is sensitive to number in the inflection of third-person present indicative forms of first-conjugation verbs. I shall call a nondirectional syncretism of this kind an UNSTIPULATED SYNCRETISM.[3] (Any syncretism which doesn't fall into this category will therefore be called a STIPULATED SYNCRETISM.)

Syncretisms involving forms whose property sets constitute a natural class aren't necessarily unstipulated syncretisms. Consider, for example, the Rumanian imperfect paradigms in table 7.2. Typically of verbs in all of the conjugations, the verbs in table 7.2 exhibit a syncretism of the 1sg form with the 1pl form in the imperfect tense. Although the property sets of the syncretized forms in table 7.2 constitute a natural class (that of first-person imperfect forms), this is not an unstipulated syncretism, because it is directional: in Rumanian, *-m* is the default expression of 1pl subject agreement (as in the present indicative forms in table 7.1); accordingly, the 1sg forms must be seen as patterning after the 1pl forms in the imperfect paradigms in table 7.2. The syncretism of first-person imperfect forms is therefore very different from the syncretism of third-person present indicative forms of first-conjugation verbs. The latter arises because none of the rules relevant to the inflection of the syncretized forms distinguishes singular from plural. The former, by contrast, arises as the effect of a stipulation that one form (the dependent member of the syncretic pair) patterns after another (the determinant member); were it not for this stipulation, the 1pl imperfect form and the 1sg imperfect form would be distinct, since only the first of these would involve the application of the 1pl rule of *-m* suffixation.

Although unstipulated syncretisms are necessarily nondirectional, not

Table 7.3 *Non-future-tense interrogative forms of three Hua verbs (Haiman 1980:47f)*

	Type I HU 'do'	Type II DO 'eat'	Type III MI 'give'
1SG	*hu-ve*	*do-ve*	*mu-ve*
2SG	*ha-pe*	*da-pe*	*mi-pe*
3SG	*hi-ve*	*de-ve*	*mi-ve*
1DU	*hu-'-ve*	*do-'-ve*	*mu-'-ve*
2/3DU	*ha-'-ve*	*da-'-ve*	*mi-'-ve*
1PL	*hu-pe*	*do-pe*	*mu-pe*
2/3PL	*ha-ve*	*da-ve*	*mi-ve*

Table 7.4 *Default and 2SG/1PL terminations in Hua (Haiman 1980:62)*

	DEFAULT	2SG/1PL
Indicative	*-e*	*-ne*
Interrogative	*-ve*	*-pe*
Relative	*-ma'*	*-pa'*
Purposive	*-mi'*	*-pi'*
Concessive	*-va*	*-pa*
Inconsequential	*-mana*	*-pana*
Medial (a)	*-ga*	*-na*
Medial (b)	*-ma*	*-pa*
Exclamatory (a)	*-mane*	*-pane*
Exclamatory (b)	*-mae*	*-pae*
Counterfactual protasis	*-hipana*	*-sipana*
Counterfactual apodosis	*-hine*	*-sine*

all nondirectional syncretisms are necessarily unstipulated. That is, there are instances of syncretism in which there is no discernible directionality but the property sets of the syncretized forms do not constitute any kind of natural class. A good example of this type is found in Hua, a language of New Guinea. In the inflection of Hua verbs, 2sg forms and 1pl forms always carry the same termination. In the non-future-tense interrogative forms in table 7.3, for example, the 2sg and 1pl forms carry the terminal suffix *-pe*, while all other forms instead have the default suffix *-ve*. This same pattern of syncretism arises again and again in one mood after another, regardless of the actual identity of the suffixes involved; table 7.4 reveals the breadth of

Table 7.5 *Simple perfect forms of Vedic* TUD *'strike'*

		SINGULAR	DUAL	PLURAL
Active:	1ST	*tutód-a*	*tutud-vá*	*tutud-má*
	2ND	*tutód-itha*	*tutud-áthur*	*tutud-á*
	3RD	*tutód-a*	*tutud-átur*	*tutud-úr*
Middle:	1ST	*tutud-é*	*tutud-váhe*	*tutud-máhe*
	2ND	*tutut-sé*	*tutud-ā́the*	*tutud-dhvé*
	3RD	*tutud-é*	*tutud-ā́te*	*tutud-ré*

this generalization. Here, there is no good basis for saying that the syncretism is directional, nor can the property sets of the syncretized forms be plausibly seen as constituting a natural class. I shall refer to nondirectional syncretisms of this kind as SYMMETRICAL SYNCRETISMS.

Thus, at least four types of syncretism can be distinguished: unidirectional (e.g. the syncretism of the second-person singular with the third person singular in Bulgarian preterite verb forms and the Rumanian first-person imperfect syncretism), bidirectional (e.g. the syncretism of the first person singular with the third-person plural in Rumanian), unstipulated (e.g. the nondirectional syncretism of the third-person singular with the third-person plural in the present indicative of first-conjugation verbs in Rumanian), and symmetrical (e.g. the nondirectional syncretism of 2sg and 1pl terminations in Hua).

The evidence discussed so far reveals an additional parameter by which instances of syncretism might be distinguished. The Bulgarian and Rumanian cases are WHOLE-WORD syncretisms: in these instances, the syncretized forms are entire words. In Hua, by contrast, the syncretism of second-person singular with first-person plural does not encompass entire words; rather, this syncretism is the property of a single block of rules, that supplying the terminal suffixes. BLOCK SYNCRETISMS of this sort may be nondirectional, as in the Hua case, but may also be directional. Consider, for example, the Vedic simple perfect paradigm in table 7.5. For present purposes, the forms in this paradigm can be assumed to involve two rule blocks: the first block contains stem-selection rules causing the strong stem *tutód-* to be chosen in the singular active and the weak stem *tutud-* to be chosen elsewhere; the second block contains rules determining the appropriate choice of suffix. In this paradigm, the 1sg and 3sg forms are syncretized in both the active and middle voices. Because the middle suffix *-e* showing up in *tutudé* 'I/s/he struck' also appears as a 1sg middle inflection

Table 7.6 *Singular active forms of four Vedic roots in the simple perfect*

	KṚ 'do'	NI 'lead'	STU 'praise'	VAC 'speak'
1ST	*cakár-a*	*ninác-a*	*tuṣṭáv-a*	*uvác-a*
2ND	*cakár-tha*	*niné-tha*	*tuṣṭó-tha*	*uvák-tha*
3RD	*cakā́r-a*	*ninā́y-a*	*tuṣṭā́v-a*	*uvā́c-a*

in the present tense (e.g. *bruv-é* 'I speak'), the syncretism is a directional one, in which the first-person singular is determinant, and the third-person singular, dependent. In table 7.5, the syncretism is of the whole-word type. There is, however, a certain class of Vedic verb roots whose simple perfect paradigms exhibit the lengthened-grade stem in the 3sg active, but instead exhibit the ordinary full-grade stem in 1sg active (e.g. *cakā́r-a* 's/he did', but *cakár-a* 'I did'); nevertheless, in their suffixal inflection, these verbs exhibit the syncretism of the 3sg active with the 1sg active. (The forms in table 7.6 illustrate.) Thus, block syncretisms may be directional as well as nondirectional.

In theoretical terms, the distinction between whole-word syncretisms and block syncretisms isn't necessarily an important one; that is, one might hypothesize that whole-word syncretisms are simply instances of block syncretism in which every block follows the same syncretic pattern. This is a more restrictive assumption than the hypothesis that morphological theory furnishes distinct means of accounting for whole-word and block syncretisms. In the absence of any compelling counterevidence, I therefore adopt the assumption that whole-word syncretisms are simply the cumulative effect of multiple, parallel block syncretisms.

7.2 Rules of referral

In section 2.7, rules of referral were introduced as a means of accounting for directional syncretisms. In particular, the syncretism exemplified by the Bulgarian forms in table 2.3 was accounted for by means of the rule of referral in (1) (cf. (33), section 2.7).[4]

(1) Where n is any of rule blocks **A** to **D**,
$\mathrm{RR}_{n,\leftarrow\{\mathrm{PRET:yes,\ AGR:\{PER:2,\ NUM:sg\}}\}\rightarrow,\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle Y,\sigma\rangle$, where
$\mathrm{Nar}_n(\langle X,\sigma/\{\mathrm{AGR:\{PER:3\}}\}\rangle) = \langle Y,\sigma/\{\mathrm{AGR:\{PER:3\}}\}\rangle$

The syncretism expressed by (1) is unidirectional; but rules of referral can also account for bidirectional syncretisms. Thus, suppose that every rule of referral $RR_{n,\tau,C}$ has a REFERRAL DOMAIN D such that $C \subseteq D$, and that the existence of a rule of referral always entails that of another, inverse rule of referral, in accordance with the BIDIRECTIONAL REFERRAL PRINCIPLE (2):

(2) Bidirectional Referral Principle:
The existence of a rule of referral '$RR_{n,\tau,C}(\langle X,\sigma\rangle) =_{def} \langle Y,\sigma\rangle$, where $Nar_n(\langle X,\sigma/\rho\rangle) = \langle Y,\sigma/\rho\rangle$' with referral domain D entails the existence of a second rule of referral '$RR_{n,\tau/\rho,D-C}(\langle X,\sigma\rangle) =_{def} \langle Y,\sigma\rangle$, where $Nar_n(\langle X,\sigma/\tau\rangle) = \langle Y,\sigma/\tau\rangle$' with referral domain D.

If a rule of referral $RR_{n,\tau,C}$ has C as its referral domain (as I assume it does, in the default case), then the inverse rule of referral determined by (2) is insignificant, since the class of expressions to which it applies (i.e. the class C–C) is necessarily empty; in that case, any syncretism expressed by $RR_{n,\tau,C}$ is unidirectional. (Thus, the Bulgarian rule of referral in (1) has V as its referral domain.) But if a rule of referral $RR_{n,\tau,C}$ has D as its referral domain and $C \neq D$, then the inverse rule of referral determined by (2) is nonvacuous in its application.

Thus, consider again the syncretism of the first-person singular and the third-person plural in the present indicative paradigms of Rumanian verbs outside the first conjugation: as was seen above, the determinant member of the syncretic pair is the 1sg form in some paradigms, but is the 3pl form in the paradigm of A FI 'to be'. I assume (a) that Rumanian verbs generally have two stems available for present indicative forms (an athematic stem and a thematic stem), and that the verbal lexemes in table 7.1 have the athematic and thematic stems listed in table 7.7; (b) that the rules of stem selection and inflectional suffixation relevant to the forms in table 7.1 are as in (3); (c) that the morphological metageneralizations relevant to the evaluation of the rules in (3b) include those in (4); and (d) that the definition of the Rumanian paradigm function determines a verbal lexeme's present indicative forms as in (6).

(3) Realization rules:

a. i. $RR_{0,\{\},V}(\langle X,\sigma\rangle) =_{def}$ X's athematic stem
   ii. $RR_{0,\{AGR(su):\{NUM:sg\}\},\{\text{A FI}\}}(\langle X,\sigma\rangle) =_{def} \langle \textit{ést},\sigma\rangle$

b. i. $RR_{1,\{AGR(su):\{PER:1,\ NUM:sg\}\},V}(\langle X,\sigma\rangle) =_{def} \langle Xu',\sigma\rangle$
   ii. $RR_{1,\{AGR(su):\{PER:2,\ NUM:sg\}\},V}(\langle X,\sigma\rangle) =_{def} \langle Xi',\sigma\rangle$
   iii. $RR_{1,\{AGR(su):\{PER:3,\ NUM:sg\}\},V}(\langle X,\sigma\rangle) =_{def} \langle Xe',\sigma\rangle$

Table 7.7 *Athematic and thematic stems of eight Rumanian verbs*

	A INVITA	A SUFLA	A TĂCEA	A UMPLEA	A FACE	A ŞTI	A VORBI	A FI
Athematic stem:	*invít*	*súfl*	*tác*	*úmpl*	*fác*	*ştí*	*vorbésc*	*sî́nt*
Thematic stem:	*invitá*	*suflá*	*tăcé*	*úmple*	*fáce*	*ştí*	*vorbí*	*sî́nte*

iv. $RR_{1,\{AGR(su):\{PER:3\}\},[CONJ:1]}(<X,\sigma>) =_{def} <X\breve{a}',\sigma>$
v. $RR_{1,\{AGR(su):\{PER:1,\ NUM:pl\}\},V}(<X,\sigma>) =_{def} <Xm',\sigma>$
vi. $RR_{1,\{AGR(su):\{PER:2,\ NUM:pl\}\},V}(<X,\sigma>) =_{def} <X\c{t}i',\sigma>$

(4) Morphological metageneralizations:
a. If R belongs to Block 1, then (5a) $\in \phi_R$.
b. (5b) $\in \phi_{(3bi)}$
c. (5c) $\in \phi_{(3bv)}$

(5) Morphophonological rules:
Where $RR_{n,\tau,C}(<X,\sigma>) = <Y',\sigma>$:
a. If X is an athematic stem whose corresponding thematic stem is Z and Y = X[consonant]W, then $<Y',\sigma> = RR_{n,\tau,C}(<Z,\sigma>)$.
b. If the final two segments of X are decreasingly sonorous and Y = X[vowel]W, then Y′ = X.[5]
c. If X = Z*á*, then $<Y',\sigma> = RR_{n,\tau,C}(<Z\acute{\breve{a}},\sigma>)$.

(6) Where X is the root of a verbal lexeme and σ is any extension of {TNS:pres, MOOD:indic} that is a complete set of morphosyntactic properties for expressions of category V, $PF(<X,\sigma>) =_{def} Nar_1(Nar_0(<X,\sigma>))$.

Given these assumptions, the bidirectional syncretism of the first-person singular and the third-person plural in present indicative forms outside the first conjugation may be expressed by the rule of referral in (7).

(7) Where $n = 0$ or 1, $RR_{n,\{AGR(su):\{PER:1,\ NUM:sg\}\},\{\text{A FI}\}}(<X,\sigma>) =_{def} <Y,\sigma>$,
where $Nar_n(<X,\sigma/\{AGR(su):\{PER:3,\ NUM:pl\}\}>) = <Y,\sigma/\{AGR(su):\{PER:3,\ NUM:pl\}\}>$
Referral domain: V

In accordance with the Bidirectional Referral Principle, the existence of (7) entails the existence of its inverse, (8):

(8) Where $n = 0$ or 1, $RR_{n,\{AGR(su):\{PER:3,\ NUM:pl\}\},V-\{\text{A FI}\}}(<X,\sigma>) =_{def} <Y,\sigma>$,
where $Nar_n(<X,\sigma/\{AGR(su):\{PER:1,\ NUM:sg\}\}>) = <Y,\sigma/\{AGR(su):\{PER:1,\ NUM:sg\}\}>$
Referral domain: V

By rule (7), the 1sg present indicative form of A FI exhibits the athematic stem *sînt* rather than the singular stem *ést* introduced by (3aii); the proof in (9) demonstrates why this is so. (I assume here that A FI 'to be' has *sînt* as its root, though nothing hinges on this assumption.)

(9) Where σ = {AGR(su):{PER:1, NUM:sg}, TNS:pres, MOOD:indic},
a. PF(<*sînt*,σ>)
$= Nar_1(Nar_0(<sînt,\sigma>))$ [by (6)]

$= \mathrm{RR}_{1,\{\mathrm{AGR(su)}:\{\mathrm{PER}:1,\ \mathrm{NUM}:\mathrm{sg}\}\},\{\mathrm{A\ FI}\}}(\mathrm{RR}_{0,\{\mathrm{AGR(su)}:\{\mathrm{PER}:1,\ \mathrm{NUM}:\mathrm{sg}\}\},\{\mathrm{A\ FI}\}}(\langle$*sî́nt*$,\sigma\rangle))$ [by Nar_n notation]
$= \langle$*sî́nt*$,\sigma\rangle$ [by (7), (9b)]

b. $\mathrm{Nar}_1(\mathrm{Nar}_0(\langle$*sî́nt*$,\sigma/\{\mathrm{AGR(su)}:\{\mathrm{PER}:3,\ \mathrm{NUM}:\mathrm{pl}\}\}\rangle))$
$= \mathrm{RR}_{1,\{\},\mathrm{U}}(\mathrm{RR}_{0,\{\},\mathrm{V}}(\langle$*sî́nt*$,\sigma/\{\mathrm{AGR(su)}:\{\mathrm{PER}:3,\mathrm{NUM}:\mathrm{pl}\}\}\rangle))$ [by Nar_n notation]
$= \langle$*sî́nt*$,\sigma/\{\mathrm{AGR(su)}:\{\mathrm{PER}:3,\ \mathrm{NUM}:\mathrm{pl}\}\}\rangle$ [by (3ai) and the IFD]

By the inverse rule (8), the 3pl present indicative form of A ŞTI 'to know' exhibits the 1sg suffix *-u* introduced by rule (3bi); the proof in (10) demonstrates.

(10) Where $\sigma = \{\mathrm{AGR(su)}:\{\mathrm{PER}:3,\ \mathrm{NUM}:\mathrm{pl}\},\ \mathrm{TNS}:\mathrm{pres},\ \mathrm{MOOD}:\mathrm{indic}\}$,

a. $\mathrm{PF}(\langle$*ştí*$,\sigma\rangle)$
$= \mathrm{Nar}_1(\mathrm{Nar}_0(\langle$*ştí*$,\sigma\rangle))$ [by (6)]
$= \mathrm{RR}_{1,\{\mathrm{AGR(su)}:\{\mathrm{PER}:3,\ \mathrm{NUM}:\mathrm{pl}\}\},\mathrm{V}-\{\mathrm{A\ FI}\}}(\mathrm{RR}_{0,\{\mathrm{AGR(su)}:\{\mathrm{PER}:3,\ \mathrm{NUM}:\mathrm{pl}\}\},\mathrm{V}-\{\mathrm{A\ FI}\}}(\langle$*ştí*$,\sigma\rangle))$ [by Nar_n notation]
$= \langle$*ştíu*$,\sigma\rangle$ [by (8), (10b)]

b. $\mathrm{Nar}_1(\mathrm{Nar}_0(\langle$*ştí*$,\sigma/\{\mathrm{AGR(su)}:\{\mathrm{PER}:1,\ \mathrm{NUM}:\mathrm{sg}\}\}\rangle))$
$= \mathrm{RR}_{1,\{\mathrm{AGR(su)}:\{\mathrm{PER}:1,\ \mathrm{NUM}:\mathrm{sg}\}\},\mathrm{V}}(\mathrm{RR}_{0,\{\},\mathrm{V}}(\langle$*ştí*$,\sigma/\{\mathrm{AGR(su)}:\{\mathrm{PER}:1,\ \mathrm{NUM}:\mathrm{sg}\}\}\rangle))$ [by Nar_n notation]
$= \langle$*ştíu*$,\sigma/\{\mathrm{AGR(su)}:\{\mathrm{PER}:1,\ \mathrm{NUM}:\mathrm{sg}\}\}\rangle$ [by (3ai), (3bi)]

As this Rumanian case shows, the notion of referral domain and the Bidirectional Referral Principle afford a single, general approach to directional syncretisms, whether these be unidirectional or bidirectional.

7.3 Symmetrical syncretisms

Because they are nondirectional, symmetrical syncretisms must be accounted for by means other than rules of referral. The hypothesis that I shall adopt here is that all such syncretisms involve a metarule of the following type.

(11)
$$\mathrm{RR}_{n,\tau,\mathrm{C}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle Y,\sigma\rangle$$
$$\updownarrow$$
$$\mathrm{RR}_{n,\tau/\rho,\mathrm{C}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle Y,\sigma\rangle$$

A metarule of this sort, which I shall call a SYMMETRICAL SYNCRETISM METARULE, is to be interpreted as entailing that the existence of a rule of exponence of the form '$\mathrm{RR}_{n,\tau,\mathrm{C}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle Y,\sigma\rangle$' implies and is implied by that of a rule of exponence of the form '$\mathrm{RR}_{n,\tau/\rho,\mathrm{C}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle Y,\sigma\rangle$'. Thus, consider again the syncretism of the second-person singular with the first-person plural in Hua verb terminations. This may be expressed by means of the symmetrical syncretism metarule (12):

(12) Where τ is an extension of {AGR(su):{PER:2, NUM:sg}},
$$RR_{II,\tau,V}(\langle X,\sigma\rangle) =_{def} \langle Y,\sigma\rangle$$
$$\updownarrow$$
$$RR_{II,\tau/\{AGR(su):\{PER:1,\ NUM:pl\}\},V}(\langle X,\sigma\rangle) =_{def} \langle Y,\sigma\rangle$$

By virtue of this metarule, the existence of the rules in (13b) implies and is implied by that of the rules in (13c); the coexistence of (13b) and (13c) in a grammar containing metarule (12) therefore contributes no more to the complexity of the grammar than either (13b) alone or (13c) alone would in the absence of (12).

(13) Some rules for subject-agreement terminations in Hua

a. Default rules
$$RR_{II,\{MOOD:interrogative\},V}(\langle X,\sigma\rangle) =_{def} \langle X\mathit{ve}',\sigma\rangle$$
$$RR_{II,\{MOOD:medial(a)\},V}(\langle X,\sigma\rangle) =_{def} \langle X\mathit{ga}',\sigma\rangle$$

b. Second-person singular rules
$$RR_{II,\{MOOD:interrogative,\ AGR(su):\{PER:2,\ NUM:sg\}\},V}(\langle X,\sigma\rangle) =_{def} \langle X\mathit{pe}',\sigma\rangle$$
$$RR_{II,\{MOOD:medial(a),\ AGR(su):\{PER:2,\ NUM:sg\}\},V}(\langle X,\sigma\rangle) =_{def} \langle X\mathit{na}',\sigma\rangle$$

c. First-person plural rules
$$RR_{II,\{MOOD:interrogative,\ AGR(su):\{PER:1,\ NUM:pl\}\},V}(\langle X,\sigma\rangle) =_{def} \langle X\mathit{pe}',\sigma\rangle$$
$$RR_{II,\{MOOD:medial(a),\ AGR(su):\{PER:1,\ NUM:pl\}\},V}(\langle X,\sigma\rangle) =_{def} \langle X\mathit{na}',\sigma\rangle$$

7.4 Rule interactions involving rules of referral

While rules of referral belong to a language's system of realization rules, symmetrical syncretism metarules such as that in (12) express redundancies in that system of rules (specifically, redundancies among rules of exponence); this important difference is reflected in the fact that unlike symmetrical syncretism metarules, rules of referral interact with other realization rules in accordance with Pāṇini's principle (Zwicky 1985a; Stump 1993b:454ff.). Logically, realization-rule interactions involving rules of referral are of three possible types: (i) a rule of referral might override a rule of exponence; (ii) a rule of exponence might override a rule of referral; and (iii) one rule of referral might override another. Instances of each of these three types can be found.

Consider first the possibility of a rule of referral overriding a rule of exponence. Among the rules proposed in the analysis of Bulgarian conjugation in chapter 2 are the rules of exponence in (14):

(14) **B3**. $RR_{B,\{TNS:aor,\ PRET:yes\},V}(\langle X,\sigma\rangle) =_{def} \langle X\mathit{o}',\sigma\rangle$

B4/C1. Where n = **B** or **C**,
$$RR_{n,\{TNS:aor,\ PRET:yes,\ AGR:\{PER:3,\ NUM:sg\}\},V}(\langle X,\sigma\rangle) =_{def} \langle X',\sigma\rangle$$

C2. $RR_{C,\{PRET:yes\},V}(\langle X,\sigma\rangle) =_{def} \langle X\mathit{x}',\sigma\rangle$

Rules **B3** and **C2** are both applicable in the inflection of a 2sg aorist form; both are overridden, however, by the rule of referral in (1) – by virtue of whose application the rules **B4** and **C1** ultimately determine the form of the 2sg aorist member of a verb's paradigm.

There are, by contrast, clear instances in which a rule of exponence overrides a rule of referral. In Rumanian, for example, the rule of referral (8) is applicable in the inflection of a first-conjugation verb's 3pl present indicative form, but is overridden by the rule of exponence in (3biv), which is narrower by virtue of its class index [CONJ:1].

Finally, there are instances in which one rule of referral overrides another. Consider, for example, the partial case paradigms from Sanskrit in table 7.8. As these partial paradigms reveal, a Sanskrit dual or plural ablative form is, without exception, identical to the corresponding dative form; accordingly, Sanskrit might be assumed to have a general rule of referral causing the ablative to take on the form of the dative, as in (15a) (=(7s), section 6.2.3). In the singular, however, the ablative is identical not to the dative but (in most instances) to the genitive; thus, the general rule of referral in (15a) is apparently overridden by the more specific rule of referral in (15b) (=(7t), section 6.2.3). (Notice, though, that in the paradigms of *a*-stem nouns such as AŚVA 'horse', the ablative singular is distinct from the genitive singular – cf. again table 7.8; here, both of the rules of referral in (15a,b) are overridden by an even narrower rule of exponence, formulable as (15c).)

(15)
a. For any rule block n, $\mathrm{RR}_{n,\{\mathrm{CASE:abl}\},[\mathrm{Nominal}]}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{Y},\sigma>$, where $\mathrm{Nar}_n(<\mathrm{X},\sigma/\{\mathrm{CASE:dat}\}>) = <\mathrm{Y},\sigma/\{\mathrm{CASE:dat}\}>$.
b. For any rule block n, $\mathrm{RR}_{n,\{\mathrm{CASE:abl,\ NUM:sg}\},[\mathrm{Nominal}]}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{Y},\sigma>$, where $\mathrm{Nar}_n(<\mathrm{X},\sigma/\{\mathrm{CASE:gen}\}>) = <\mathrm{Y},\sigma/\{\mathrm{CASE:gen}\}>$.
c. $\mathrm{RR}_{1,\{\mathrm{CASE:abl,\ NUM:sg}\},[a\text{-stem nominals}]}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}at',\sigma>$

Rule interactions involving rules of referral aren't limited to override relations, however. By their nature, rules of referral also participate in 'feeding' relations: whenever a rule of referral applies, it refers the realization of some morphosyntactic property set to some other rule. In every one of the cases considered so far, the rule of referral refers a property set's realization directly to a rule of exponence. But there is no logical obstacle to the possibility that one rule of referral might refer a property set's realization to a second rule of referral. Indeed, there are apparent instances of this kind.

An example of this sort comes from Russian declensional morphology. Inspection of the examples in tables 7.9 and 7.10 reveals three directional syncretisms:

Table 7.8 *Dative, ablative, and genitive forms of some Sanskrit nouns*

		SINGULAR	DUAL	PLURAL
V-stems:				
a-stem: *aśva*- 'horse'	DAT	*aśvāya*	*aśvābhyām*	*aśvebhyas*
	ABL	*aśvāt*	*aśvābhyām*	*aśvebhyas*
	GEN	*aśvasya*	*aśvayos*	*aśvānām*
ā-stem: *senā*- 'army'	DAT	*senāyāi*	*senābhyām*	*senābhyas*
	ABL	*senāyās*	*senābhyām*	*senābhyas*
	GEN	*senāyās*	*senayos*	*senānām*
masculine *i*-stem: *agni*- 'fire'	DAT	*agnaye*	*agnibhyām*	*agnibhyas*
	ABL	*agnes*	*agnibhyām*	*agnibhyas*
	GEN	*agnes*	*agnyos*	*agnīnām*
polysyllabic *ī*-stem: *nadī*- 'river'	DAT	*nadyāi*	*nadībhyām*	*nadībhyas*
	ABL	*nadyās*	*nadībhyām*	*nadībhyas*
	GEN	*nadyās*	*nadyos*	*nadīnām*
C-stems:				
radical C-stem: *marut*- 'wind'	DAT	*marute*	*marudbhyām*	*marudbhyas*
	ABL	*marutas*	*marudbhyām*	*marudbhyas*
	GEN	*marutas*	*marutos*	*marutām*
neuter *as*-stem: *manas*- 'mind'	DAT	*manase*	*manobhyām*	*manobhyas*
	ABL	*manasas*	*manobhyām*	*manobhyas*
	GEN	*manasas*	*manasos*	*manasām*
an-stem: *rājan*- 'king'	DAT	*rājñe*	*rājabhyām*	*rājabhyas*
	ABL	*rājñas*	*rājabhyām*	*rājabhyas*
	GEN	*rājñas*	*rājños*	*rājñām*

(a) In the first of these syncretisms, the accusative takes the form of the corresponding nominative. This syncretism appears in the plural of inanimate nouns and in the singular of inanimate nouns belonging to the first and third declensions (or to such exceptional declensions as those of PUT' 'way' and VREMJA 'time').

(b) In the second of these syncretisms, the accusative takes the form of the corresponding genitive. This syncretism appears in the plural of animate nouns and in the singular of first-declension animate nouns.

(c) In the third of these syncretisms, the genitive singular and the nominative plural are affixally alike. This syncretism appears in second-

Table 7.9 *Nominative, accusative, and genitive forms of some inanimate nouns in Russian*

				SINGULAR		PLURAL	
			NOM	ACC	GEN	NOM/ACC	GEN
MASCULINE	1st declension						
	Type A	'factory'	*zavód*	*zavód*	*zavód-a*	*zavód-y*	*zavód-ov*
		'table'	*stol*	*stol*	*stol-á*	*stol-ý*	*stol-óv*
		'circle'	*krug*	*krug*	*krúg-a*	*krug-í*	*krug-óv*
		'market'	*rýnok*	*rýnok*	*rýnk-a*	*rýnk-i*	*rýnk-ov*
		'shoe'	*botínok*	*botínok*	*botínk-a*	*botínk-i*	*botínok*
		'museum'	*muzéj*	*muzéj*	*muzéj-a*	*muzé-i*	*muzé-ev*
		'briefcase'	*portfél'*	*portfél'*	*portfélj-a*	*portfél-i*	*portfél-ej*
		'ruble'	*rubl'*	*rubl'*	*rublj-á*	*rubl-í*	*rubl-éj*
	Type B	'house'	*dom*	*dom*	*dóm-a*	*dom-á*	*dom-óv*
		'chair'	*stul*	*stul*	*stúl-a*	*stúl'j-a*	*stúl'j-ev*
	Exceptional declension	'way'	*put'*	*put'*	*put-í*	*put-í*	*put-éj*
FEMININE	2nd declension	'map'	*kárt-a*	*kárt-u*	*kárt-y*	*kárt-y*	*kart*
		'melon'	*dýnj-a*	*dýnj-u*	*dýn-i*	*dýn-i*	*dyn'*
		'war'	*vojn-á*	*vojn-ú*	*vojn-ý*	*vójn-y*	*vojn*
		'hand, arm'	*ruk-á*	*rúk-u*	*ruk-í*	*rúk-i*	*ruk*
		'lip'	*gub-á*	*gub-ú*	*gub-ý*	*gúb-y*	*gub*
		'family'	*sem'j-á*	*sem'j-ú*	*sem'-í*	*sém'-i*	*sem-éj*
		'history'	*istórij-a*	*istórij-u*	*istóri-i*	*istóri-i*	*istórij*

	3rd declension		‘notebook’	*tetrád’*	*tetrád’*	*tetrád-i*	*tetrád-i*	*tetrád-ej*
			‘door’	*dver’*	*dver’*	*dvér-i*	*dvér-i*	*dver-éj*
Neuter	1st declension							
		Type C	‘swamp’	*bolót-o*	*bolót-o*	*bolót-a*	*bolót-a*	*bolót*
			‘place’	*mést-o*	*mést-o*	*mést-a*	*mest-á*	*mest*
			‘window’	*okn-ó*	*okn-ó*	*okn-á*	*ókn-a*	*ókon*
			‘wing’	*kryl-ó*	*kryl-ó*	*kryl-á*	*krýl’j-a*	*krýl’-ev*
			‘building’	*zdáni-e*	*zdáni-e*	*zdánij-a*	*zdánij-a*	*zdánij*
			‘sea’	*mór-e*	*mór-e*	*mórj-a*	*morj-á*	*mor-éj*
		Type D	‘apple’	*jáblok-o*	*jáblok-o*	*jáblok-a*	*jáblok-i*	*jáblok*
			‘shoulder’	*pleč-ó*	*pleč-ó*	*pleč-á*	*pléč-i*	*pleč*
	Exceptional declension		‘time’	*vrémj-a*	*vrémj-a*	*vrémen-i*	*vremen-á*	*vremën*

Table 7.10 *Nominative, accusative, and genitive forms of some animate nouns in Russian*

			SINGULAR			PLURAL	
			NOM	ACC	GEN	NOM	ACC/GEN
MASCULINE	1st declension						
	Type A	'student'	*studént*	*studént-a*	*studént-a*	*studént-y*	*studént-ov*
		'hero'	*gerój*	*gerój-a*	*gerój-a*	*geró-i*	*geró-ev*
		'genius'	*génij*	*génij-a*	*génij-a*	*géni-i*	*géni-ev*
		'father-in-law'	*test'*	*téstj-a*	*téstj-a*	*tést-i*	*tést-ej*
	Type B	'doctor'	*dóktor*	*dóktor-a*	*dóktor-a*	*doktor-á*	*doktor-óv*
		'kitten'	*kotënok*	*kotënk-a*	*kotënk-a*	*kotját-a*	*kotját*
		'citizen'	*graždanín*	*graždanín-a*	*graždanín-a*	*gráždan-e*	*gráždan*
		'husband'	*muž*	*múž-a*	*múž-a*	*muž'j-á*	*muž-éj*
	2nd declension	'grandfather'	*dédušk-a*	*dédušk-u*	*dédušk-i*	*dédušk-i*	*dédušek*
FEMININE	2nd declension	'woman'	*žénščin-a*	*žénščin-u*	*žénščin-y*	*žénščin-y*	*žénščin*
		'nurse'	*njánj-a*	*njánj-u*	*nján-i*	*nján-i*	*njan'*
		'squirrel'	*bélk-a*	*bélk-u*	*bélk-i*	*bélk-i*	*bélok*
		'female guest'	*góst'j-a*	*góst'j-u*	*góst'-i*	*góst'-i*	*góstij*
	3rd declension	'mother-in-law'	*svekróv'*	*svekróv'*	*svekróv-i*	*svekróv-i*	*svekróv-ej*
		'mother'	*mat'*	*mat'*	*máter-i*	*máter-i*	*mater-éj*

and third-declension nouns and in first-declension nouns of types B and C (as well as in such exceptional declensions as that of PUT’ ‘way’).

Two details concerning syncretism (c) should be carefully noted. First, the fact that forms exhibiting the affixal syncretism (c) aren’t necessarily alike in their stress placement (cf. e.g. DOM ‘house’, gen sg *dóma*, nom pl *domá*) implies that affixation and stress alternations are determined by distinct rule blocks, only one of which contains a rule of referral linking the exponence of the genitive singular and that of the nominative plural. Second, syncretism (c) is bidirectional: in the inflection of first-declension nouns of Types B and C, the nominative plural patterns after the genitive singular, exhibiting the default genitive singular suffix -*a*; but in the inflection of second- and third-declension nouns, it is the genitive singular that patterns after the nominative plural, exhibiting the default nominative plural suffix -*y* (or its phonologically conditioned alternant -*i*).[6]

In the inflection of certain forms, syncretism (a) feeds the affixal syncretism (c): thus, in the paradigms of inanimate nouns of Types B and C, the nominative plural, accusative plural, and genitive singular all exhibit the default genitive singular affix -*a*.

In a formal analysis of these facts, syncretisms (a) and (b) might be attributed to the default rules of referral in (16).[7]

(16) Where n is any rule block,

a. $\mathrm{RR}_{n,\{\mathrm{CASE:acc}\},[\mathrm{inanimate}]}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle Y,\sigma\rangle$, where $\mathrm{Nar}_n(\langle X,\sigma/\{\mathrm{CASE:nom}\}\rangle) = \langle Y,\sigma/\{\mathrm{CASE:nom}\}\rangle$.

b. $\mathrm{RR}_{n,\{\mathrm{CASE:acc}\},[\mathrm{animate}]}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle Y,\sigma\rangle$, where $\mathrm{Nar}_n(\langle X,\sigma/\{\mathrm{CASE:gen}\}\rangle) = \langle Y,\sigma/\{\mathrm{CASE:gen}\}\rangle$.

Suppose, in addition, that the default rules for the genitive singular and the nominative plural are formulated as in (17).[8]

(17)

a. $\mathrm{RR}_{\mathrm{I},\{\mathrm{CASE:gen,\ NUM:sg}\},\mathrm{N}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle Xa',\sigma\rangle$

b. $\mathrm{RR}_{\mathrm{I},\{\mathrm{CASE:nom,\ NUM:pl}\},\mathrm{N}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle Xy',\sigma\rangle$

Syncretism (c) may then be accounted for by means of the bidirectional rule of referral in (18):

(18) $\mathrm{RR}_{\mathrm{I},\{\mathrm{CASE:gen,\ NUM:sg}\},([\mathrm{Declension\ 2}]\cup[\mathrm{Declension\ 3}]\cup\{\mathrm{PUT'}\})}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle Y,\sigma\rangle$, where $\mathrm{Nar}_{\mathrm{I}}(\langle X,\sigma/\{\mathrm{CASE:nom,\ NUM:pl}\}\rangle) = \langle Y,\sigma/\{\mathrm{CASE:nom,\ NUM:pl}\}\rangle$.

Referral domain:

[Declension 2] ∪ [Declension 3] ∪ {PUT'} ∪ [Declension 1, Type B] ∪ [Declension 1, Type C]

By the Bidirectional Referral Principle, the existence of (18) entails that of (19).

(19) $\mathrm{RR}_{\mathrm{I},\{\mathrm{CASE:nom,\ NUM:pl}\},([\mathrm{Declension\ 1,\ Type\ B}]\cup[\mathrm{Declension\ 1,\ Type\ C}])}(<X,\sigma>) =_{\mathrm{def}} <Y,\sigma>$, where $\mathrm{Nar}_{\mathrm{I}}(<X,\sigma/\{\mathrm{CASE:gen,\ NUM:sg}\}>) = <Y,\sigma/\{\mathrm{CASE:gen,\ NUM:sg}\}>$.

In this analysis, the evaluation of $\mathrm{Nar}_{\mathrm{I}}(<X,\{\mathrm{CASE:acc,\ NUM:pl}\}>)$ inevitably involves the successive application of two rules of referral (namely (16a) and (19)) whenever X is a Type B masculine inanimate or a Type C neuter inanimate. The example of BOLOTO 'swamp' in (20) illustrates.

(20) a. $\mathrm{Nar}_{\mathrm{I}}(<\textit{bolot},\{\mathrm{CASE:acc,\ NUM:pl}\}>)$
$= \mathrm{RR}_{\mathrm{I},\{\mathrm{CASE:acc}\},[\mathrm{inanimate}]}(<\textit{bolot},\{\mathrm{CASE:acc,\ NUM:pl}\}>)$ [by Nar_n notation]
$= <\textit{bolota},\{\mathrm{CASE:acc,\ NUM:pl}\}>$ [by (16a), (20b)]

b. $\mathrm{Nar}_{\mathrm{I}}(<\textit{bolot},\{\mathrm{CASE:nom,\ NUM:pl}\}>)$
$= \mathrm{RR}_{\mathrm{I},\{\mathrm{CASE:nom,\ NUM:pl}\},([\mathrm{Declension\ 1,\ Type\ B}]\cup[\mathrm{Declension\ 1,\ Type\ C}])}(<\textit{bolot},\{\mathrm{CASE:nom,\ NUM:pl}\}>)$ [by Nar_n notation]
$= <\textit{bolota},\{\mathrm{CASE:nom,\ NUM:pl}\}>$ [by (19), (20c)]

c. $\mathrm{Nar}_{\mathrm{I}}(<\textit{bolot},\{\mathrm{CASE:gen,\ NUM:sg}\}>)$
$= \mathrm{RR}_{\mathrm{I},\{\mathrm{CASE:gen,\ NUM:sg}\},\mathrm{N}}(<\textit{bolot},\{\mathrm{CASE:gen,\ NUM:sg}\}>)$ [by Nar_n notation]
$= <\textit{bolota},\{\mathrm{CASE:gen,\ NUM:sg}\}>$ [by (17a)]

In summary, rules of referral are like rules of exponence in that they belong to rule blocks and their competition with other members of the same block is regulated by Pāṇini's principle; thus, a rule of referral may override or be overridden by a rule of exponence or by another rule of referral. But by their nature, rules of referral differ from rules of exponence in that they interact with other rules in an additional way: they 'feed' a rule of exponence or another rule of referral by deferring to that rule for the realization of a particular morphosyntactic property set.

7.5 Syncretism across paradigms

In the foregoing discussion, I have argued that syncretism is a heterogeneous phenomenon. Some instances of syncretism are unstipulated in the sense that they are merely the effect of a kind of poverty in the system of realization rules. Other instances of syncretism arise as the effect of special stipulations: rules of referral give rise to directional syncretisms, while

Table 7.11 *Periphrastic future paradigm of the Sanskrit verb* DĀ *'give'*

	SINGULAR	DUAL	PLURAL
1	*dātā́smi*	*dātā́svas*	*dātā́smas*
2	*dātā́si*	*dātā́sthas*	*dātā́stha*
3	*dātā́*	*dātā́rāu*	*dātā́ras*

metarules such as (12) give rise to symmetrical syncretisms. Despite their heterogeneousness, directional syncretisms and symmetrical syncretisms are alike in an important way: each involves a relation of stipulated identity (partial or total) between distinct members of the same paradigm (i.e. between distinct word forms of the same lexeme).[9] But relations of this sort are not the only relations of stipulated identity that arise in a language's inflectional morphology; one can also find relations of stipulated identity linking members of distinct paradigms.

The HAP, discussed at length in chapter 4, entails a kind of identity between members of distinct paradigms: the identity between an inflected form of a lexeme L and the head of the corresponding inflected form of any word-to-word derivative of L (e.g. the identity between *took* and the head of *undertook*); in such instances, the paradigm of a derivative lexeme patterns after that of the lexeme from which it derives. There are, however, instances of stipulated identity of the opposite sort, in which a lexeme's paradigm patterns after that of one of its derivatives. Sanskrit furnishes a particularly clear example of this.

In Sanskrit, verbs typically exhibit two future-tense paradigms: one of these, the *s*-future, is inherited from Proto-Indo-European; the other, the so-called periphrastic future, is the one of interest here. Table 7.11 presents the periphrastic future paradigm of the verb DA 'give'. The forms in this paradigm are built upon those of the masculine agent-noun DATṚ 'giver', whose declensional paradigm is given in table 7.12. As a comparison of tables 7.11 and 7.12 reveals, the third-person singular, dual, and plural forms in the periphrastic future paradigm of DA are identical to the nominative singular, dual, and plural forms in the paradigm of DATṚ; in the first and second persons, by contrast, the periphrastic future is expressed by combining present-indicative forms of the verb AS 'be' (cf. table 7.13) with the nominative singular form of the agent-noun DATṚ. Although the periphrastic future forms in table 7.11 are based on the nominal forms in

Table 7.12 *Paradigm of the Sanskrit noun* DĀTṚ *'giver'*

	SINGULAR	DUAL	PLURAL
NOM	*dātā́*	*dātā́rāu*	*dātā́ras*
VOC	*dātar*	*dātārāu*	*dātāras*
ACC	*dātā́ram*	*dātā́rāu*	*dātṝ́n*
INSTR	*dātrā́*	*dātṛ́bhyām*	*dātṛ́bhis*
DAT	*dātré*	*dātṛ́bhyām*	*dātṛ́bhyas*
ABL	*dātúr*	*dātṛ́bhyām*	*dātṛ́bhyas*
GEN	*dātúr*	*dātrós*	*dātṝṇā́m*
LOC	*dātári*	*dātrós*	*dātṛ́ṣu*

Table 7.13 *Present indicative paradigm of the Sanskrit verb* AS *'be'*

	SINGULAR	DUAL	PLURAL
1	*ásmi*	*svás*	*smás*
2	*ási*	*sthás*	*sthá*
3	*ásti*	*stás*	*sánti*

table 7.12, they behave syntactically as verbs. In (21), for example, the direct object of the periphrastic future-tense verb is assigned accusative rather than genitive case; moreover, the meaning of agency inherent in Sanskrit agent nouns is missing from the corresponding periphrastic future-tense verb forms, which may therefore even lack a subject argument (as in (22)). The periphrastic future is genuinely periphrastic, in that its two parts may be syntactically separated, as in (23).[10]

(21)

vaktā	*smo*	*vā*	*idaṃ*	*devebhyaḥ*
tell:AGENT.NOUN	we.are	EMPHATIC.PCL	this:ACC.SG	to.gods

We shall indeed tell this to the gods.

(*Āitareya Brāhmaṇa*; cited by Whitney (1889: section 949))

(22)

śvó	*vraṣṭā́*
tomorrow	rain:AGENT.NOUN

It will rain tomorrow.

(*Māitrāyaṇī-Saṃhitā*; cited by Whitney (1889: section 949))

(23)

pratigrahītā	*tām*	*asmi*
receive:AGENT.NOUN	her:ACC.SG	I.am

I will receive her. (*Mahābhārata*; cited by Whitney (1889: section 944))

Following Börjars, Vincent and Chapman (1997), I assume that the periphrastic formations into which a lexeme enters may figure as part of its inflectional paradigm (cf. section 1.4). That is, I assume that the periphrastic future paradigm of DA is literally as in table 7.11, and that the complementarity of affixation with periphrasis in this paradigm is accounted for entirely within the morphology. An analysis of this sort is sketched in (24)–(26).

(24) Derivational rule for agent nouns:
Where L-index(X) ∈ V, $\mathrm{DR}_{\text{agent}}(\mathrm{X}) =_{\text{def}} \mathrm{X}\textit{tṛ}$; L-index(X*tṛ*) ∈ N

(25) Realization rules for an agent noun's nominative forms:

a. Block 0
$\mathrm{RR}_{0,\{\text{GEN:masc, DIR:yes}\},[\text{C-stem nominal}]}(<\mathrm{X},\sigma>) =_{\text{def}} <\mathrm{Y},\sigma>$, where Y is X's Strong stem

b. Block 1
i. $\mathrm{RR}_{1,\{\text{CASE:nom, NUM:sg}\},[\text{Stem-truncating nominal}]}(<\mathrm{XR},\sigma>) =_{\text{def}} <\mathrm{X}',\sigma>$
ii. $\mathrm{RR}_{1,\{\text{DIR:yes, NUM:du}\},[\text{Nominal}]}(<\mathrm{X},\sigma>) =_{\text{def}} <\mathrm{X}\textit{āu}',\sigma>$
iii. $\mathrm{RR}_{1,\{\text{CASE:nom, NUM:pl}\},[\text{Nominal}]}(<\mathrm{X},\sigma>) =_{\text{def}} <\mathrm{X}\textit{as}',\sigma>$

(26) Realization rules for a verb's periphrastic future-tense forms:

a. Block 0
Where $\mathrm{DR}_{\text{agent}}(\mathrm{X}) = \mathrm{Y}^{\mathrm{A}}$, $\mathrm{RR}_{0,\{\text{TNS:periphrastic future}\},\mathrm{V}}(<\mathrm{X},\sigma>) =_{\text{def}} <\mathrm{Y}^{\mathrm{B}},\sigma>$.

b. Block 1
i. $\mathrm{RR}_{1,\{\text{TNS:periphrastic future}\},\mathrm{V}}(<\mathrm{X}^{\mathrm{A}},\sigma>) =_{\text{def}} <[\![\mathrm{Y},\mathrm{Z}^{\mathrm{A}}]\!],\sigma>$,
where PF(<*as*, σ/{TNS:pres}>) = <Y,σ/{TNS:pres}> and
$\mathrm{PF}(<\mathrm{X}^{\mathrm{B}},\{\text{GEN:masc, CASE:nom, DIR:yes, NUM:sg}\}>) =$
$<\mathrm{Z}^{\mathrm{B}},\{\text{GEN:masc, CASE:nom, DIR:yes, NUM:sg}\}>$
ii. $\mathrm{RR}_{1,\{\text{TNS:periphrastic future, AGR:}\{\text{PER:3, NUM:}\alpha\}\},\mathrm{V}}(<\mathrm{X}^{\mathrm{A}},\sigma>) =_{\text{def}} <\mathrm{Y}^{\mathrm{A}},\sigma>$,
where $\mathrm{PF}(<\mathrm{X}^{\mathrm{B}},\{\text{GEN:masc, CASE:nom, DIR:yes, NUM:}\alpha\}>)$
$= <\mathrm{Y}^{\mathrm{B}},\{\text{GEN:masc, CASE:nom, DIR:yes, NUM:}\alpha\}>$.

The derivational rule in (24) deduces agent nouns from the corresponding verb roots. The realization rules in (25) account for the nominative inflection of agent nouns: rule (25a) (=(3a), section 6.2.2) selects the Strong stem; by rule (25bi) (=(12), section 6.2.3), a nominal stem in the Stem-truncating class forms its nominative singular through the loss of its final resonant; and by rules (25bii,25biii) (=(7h,l), section 6.2.3), a nominal stem forms its nominative dual and plural through the affixation of -*āu* and -*as*, respectively.

The realization rules in (26) account for a verb's periphrastic future-tense forms. In these rules, the superscript notation is to be understood as follows: the morphological expressions chosen as values for two identically superscripted variables X^A,Y^A must be such that L-index(X^A) = L-index(Y^A) (but may be distinct in form), and the values chosen for two different superscriptings Y^A,Y^B of the same variable must be identical in form (but needn't be such that L-index(Y^A) = L-index(Y^B)). Thus, rule (26a) identifies a verb's periphrastic future-tense stem with the root form of the corresponding agent noun. As it is formulated, this rule doesn't stipulate that L-index(Y^A) ≠ L-index(Y^B). Nevertheless, (24) entails that L-index(Y^A) is nominal, while the requirement of rule–argument coherence ((12), section 2.5) and that of the persistence of L-indexing ((13), section 2.5) entail that L-index(Y^B) is verbal.

Rule (26bi), the default Block I rule for periphrastic future-tense forms, requires the periphrastic combination of an inflected auxiliary with the tense stem (whose form is like that of the corresponding agent noun's nominative singular); the more specific Block I rule (26bii) requires third-person members of a verb's periphrastic future-tense paradigm to assume the form of the corresponding nominative members of the paradigm of the associated agent noun. The nonidentity of L-index(X^A) with L-index(X^B), that of L-index(Y^A) with L-index(Y^B), and that of L-index(Z^A) with L-index(Z^B) are not stipulated by rules (26bi,ii), but these follow from the requirement of rule–argument coherence, that of the persistence of L-indexing, and the assumption that properties of gender and case aren't available to verbs in Sanskrit.

In accordance with Pāṇini's principle, the more specific rule (26bii) overrides the default rule (26bi). The third-person forms arising by means of (26bii) are inserted into individual terminal nodes; a periphrastic form $[\![\alpha,\beta]\!]$ arising by means of (26bi) is instead associated with a pair of nodes in syntactic structure, such that β heads α's complement.

The relation of formal identity stipulated by the rules in (26) contrasts sharply with the identity required by the HAP: according to (26), the periphrastic future-tense paradigm of a Sanskrit verb patterns after that of the agent noun to which that verb gives rise.

All of the examples that I have encountered of stipulated formal identity across paradigms are directional; in the case of the Sanskrit periphrastic future, for example, it is the future-tense verb which patterns after the agent noun, since the morphological markings represented in (25b) appear on nonagent nouns and not on verbs outside of the periphrastic future. Thus, like other directional syncretisms, translexemic syncretisms are best seen as the effect of rules of referral, such as those in (26b).

The formulation of the translexemic referrals in (26b) depends essentially on the definition of the Sanskrit paradigm function; thus, the incidence of such referrals provides further motivation for the postulation of paradigm functions in morphological theory.

7.6 Restrictions on the incidence of syncretism

A persistent objective in the study of syncretism has been that of uncovering principled limitations on the kinds of syncretism that may arise. There are, in fact, various kinds of limitations that might be proposed. Carstairs' (1987:87ff.) landmark work in this area focusses on the relation between a syncretism's DOMINANT properties (those morphosyntactic properties shared by the syncretized expressions) and what I shall call its SUBORDINATE properties (those morphosyntactic properties which distinguish the syncretized forms); according to his Systematic Homonymy Claim (Carstairs 1987:123; 1992:205), dominant properties and subordinate properties exhibit cumulative exponence in most syncretisms, and syncretisms in which this is not the case are directional syncretisms in which at least one dominant property is less relevant (in Bybee's (1985) sense) than the subordinate properties.

There are other respects in which the incidence of syncretism may be restricted. It is clear, for example, that the relative markedness of a paradigm's cells determines the relative likelihood that they will participate in relations of syncretism. Thus, consider the declensional paradigm of the Sanskrit noun AŚVA 'horse' in table 7.14. This paradigm consists of three subparadigms, one for each of the three properties in the Sanskrit category of number. Universally, the singular is the least marked of these three properties, and the dual is the most marked. Thus, there is a correlation between markedness and syncretism in this paradigm: the more marked a subparadigm's property of number is, the more syncretism it exhibits. The least marked, singular subparadigm exhibits no syncretism at all; the most marked, dual subparadigm exhibits a mere three forms distributed across eight cases; and intermediate between these extremes is the plural, which exhibits two instances of syncretism (namely the nominative/vocative and dative/ablative syncretisms).

This pattern – the correlation of high markedness with extensive syncretism – is widely observable in the world's languages. Analogous examples can be multiplied at will. Thus, in French, the morphology of the definite article expresses the gender distinction between the singular noun phrases *la vieille dame* and *le vieux monsieur*, but not the gender distinction

Table 7.14 *Declension of Sanskrit* AŚVA *'horse'*

	SINGULAR	DUAL	PLURAL
NOM	*aśvas*	*aśvāu*	*aśvās*
VOC	*aśva*	*aśvāu*	*aśvās*
ACC	*aśvam*	*aśvāu*	*aśvān*
INSTR	*aśvena*	*aśvābhyām*	*aśvāis*
DAT	*aśvāya*	*aśvābhyām*	*aśvebhyas*
ABL	*aśvāt*	*aśvābhyām*	*aśvebhyas*
GEN	*aśvasya*	*aśvayos*	*aśvānām*
LOC	*aśve*	*aśvayos*	*aśveṣu*

between the plural noun phrases *les vieilles dames* and *les vieux messieurs*. In Latin, adjectives exhibit distinct masculine and neuter forms in the less marked, direct cases (i.e. the nominative and accusative), but not in the more marked, oblique cases (the genitive, dative, and ablative). In Somali, verbs exhibit two subparadigms, a default subparadigm and a 'restricted' subparadigm used in focus and relative clause constructions; the latter, marked subparadigm exhibits much more syncretism than the former, unmarked subparadigm, as the examples in table 7.15 show.

In instances of this sort, the forms occupying the cells of a more marked subparadigm exhibit less diversity than those occupying the corresponding cells of a less marked subparadigm; the subparadigms differ not in the range of morphosyntactic distinctions which they make, but in the extent to which morphosyntactic distinctions are given formal substance. Such instances are therefore to be distinguished from cases in which a morphosyntactic distinction made in a less marked subparadigm simply isn't made in a more marked subparadigm. In Somali, for example, properties of tense and aspect are only distinguished in a verb's declarative and interrogative subparadigms; in the subparadigms of other, more marked moods (the imperative, conditional, optative, and potential), tense and aspect aren't distinguished at all (Saeed 1987:75). Instances of this latter sort cannot be compellingly portrayed as involving syncretism (the absence of any formal expression for an existing morphosyntactic distinction), but instead simply involve the absence of a morphosyntactic distinction.

The higher incidence of syncretism in the more marked portions of a lexeme's paradigm is the clearest correlation between the phenomenon of syncretism and that of markedness. Noyer (1998), however, has argued for

Table 7.15 *Simple past-tense forms of Somali* KÈEN *'bring' (Saeed 1987: 58ff.)*

			DEFAULT SUBPARADIGM	RESTRICTED SUBPARADIGM
SINGULAR	1st		*keenay*	*keenáy*
	2nd		*keentay*	*keenáy*
	3rd	masculine	*keenay*	*keenáy*
		feminine	*keentay*	*keentáy*
PLURAL	1st		*keennay*	*keennáy*
	2nd		*keenteen*	*keenáy*
	3rd		*keeneen*	*keenáy*

an additional kind of correlation. He argues that syncretisms arise as a consequence of what he calls IMPOVERISHMENT: the deletion of a particular morphosyntactic feature's value in a particular morphosyntactic context. Once this sort of deletion has taken place, the resulting, 'impoverished' morphosyntactic property set is fleshed out by means of redundancy rules which supply the default, unmarked value for any feature whose value has been deleted.[11]

An example will help clarify the content of this proposal. Recall that in Bulgarian, 2sg preterite forms pattern after their third-person counterparts. Under Noyer's assumptions, this syncretism can be accounted for by the impoverishment rule in (27) and the redundancy rule in (28). Rule (27) causes the value of the person feature to be deleted in any 2sg preterite property set; the redundancy rule (28) then supplies 'third' as the default value of the person feature.

(27) Impoverishment rule: $2 \rightarrow \varnothing$ / {PRET:yes, AGR:{PER:____, NUM:sg} ...}

(28) Redundancy rule: $\varnothing \rightarrow 3$ / {AGR:{PER:____ ...} ...}

Consequently, any verb carrying a 2sg preterite property set ends up with the corresponding 3sg preterite property set. Rules of exponence then spell out the affixal expressions of this modified property set. In this way, the Bulgarian syncretism is accounted for without recourse to the rule of referral given above in (1).

Two characteristics of Noyer's proposal should be carefully noted. First, it entails that in relations of directional syncretism, the morphosyntactic property set of the relation's dependent member is replaced by that of the determinant member; in this respect, the impoverishment approach contrasts starkly with the rule-of-referral approach advocated here, since rules of referral effect no change whatever in the set of morphosyntactic properties associated with a directional syncretism's dependent member. Second, Noyer's proposal entails that in a directional syncretism, the determinant member's morphosyntactic property set should always be less marked than that of the dependent member (prior to impoverishment); here, too, the impoverishment approach contrasts starkly with the rule-of-referral approach, which makes no predictions about the relative markedness of a directional syncretism's dependent and determinant members.

In view of this latter difference, Noyer argues that the impoverishment approach must be favoured as the more restrictive of the two approaches. But the issue here is obviously an empirical one, namely: can one maintain Noyer's conjecture that universally, a directional syncretism's determinant member is less marked than its dependent member? The answer, clearly, is no. First, the very existence of bidirectional referrals is incompatible with Noyer's conjecture. Moreover, there are unidirectional syncretisms in which the dependent member is less marked than the determinant member; the syncretism of the first-person singular with the first-person plural in the imperfect of Rumanian verbs (exemplified in table 7.2 above) is an instance of this sort. For that matter, there are bidirectional syncretisms in which neither the determinant member nor the dependent member is less marked than the other. An example is the bidirectional syncretism of the first-person singular with the third-person plural in the present indicative of Rumanian verbs belonging to conjugations other than the first: because there are good grounds[12] for regarding the third-person singular as the least marked person–number property in Rumanian, the cells participating in this syncretism are, to all appearances, equally marked.

Noyer's conjecture is an attempt to identify a principled asymmetry between the morphosyntactic properties of a directional syncretism's dependent member and those of its determinant member. Although this conjecture is empirically disconfirmed, there is evidence of another kind that syncretisms involve some sort of featural asymmetry. The asymmetry emerges not through the examination of any one syncretism, but rather through an inspection of the kinds of syncretisms that may coexist within an inflectional system.

In an inflectional system in which two or more stipulated syncretisms coexist, the features of which their dominant properties are specifications appear to stand in a fixed relation to the features of which their subordinate

Table 7.16 *Declension of Sanskrit* ALI *'bee'*

	SINGULAR	DUAL	PLURAL
NOM	*alis*	*alī*	*alayas*
VOC	*ale*	*alī*	*alayas*
ACC	*alim*	*alī*	*alīn*
INSTR	*alinā*	*alibhyām*	*alibhis*
DAT	*alaye*	*alibhyām*	*alibhyas*
ABL	*ales*	*alibhyām*	*alibhyas*
GEN	*ales*	*alyos*	*alīnām*
LOC	*alāu*	*alyos*	*aliṣu*

properties are specifications. Consider, for example, the declensional paradigm of Sanskrit ALI 'bee' in table 7.16. In this paradigm, there are several syncretisms, all of which I assume to be stipulated. In every one of these syncretisms, the dominant properties are specifications of the features of number and gender and the subordinate property is a specification of the feature of case. Evidence of this kind led Hjelmslev (1935:107ff.) to propose that a language's syncretisms reflect a fixed (though language-specific) ranking of features, such that the features specified by any given syncretism's dominant properties are higher ranked than those specified by that syncretism's subordinate properties. Hjelmslev's conjecture might be stated in more precise terms as the Feature Ranking Principle in (29):

(29) Feature Ranking Principle:
For any language ℓ, there is a ranking $>$ of morphosyntactic features in ℓ which satisfies the following condition: for every stipulated syncretism S in ℓ, if the dominant properties of S include a specification of the feature F_d and the subordinate properties of S include a specification of the feature F_s, then $F_d > F_s$.

Given this principle, one can say that number and gender are ranked higher than case ('number, gender > case') in Sanskrit, a ranking which entails – for example – that no syncretism in Sanskrit will ever have a dominant case property beside a subordinate number property.

All of the stipulated syncretisms discussed in this chapter conform to the Feature Ranking Principle.[13] Special note should be taken of the manner in which this principle is reflected in the nominative/accusative, accusative/genitive, and genitive-singular/nominative-plural syncretisms in Russian. In instances of the former two syncretisms, the dominant properties are specifications of number and gender and the subordinate property is a specification of case; in the third syncretism, by contrast, the dominant property is a specification of gender and the subordinate properties include specifications of both number and case. Nevertheless, if one assumes the feature ranking in (30) for Russian, then all three of the Russian syncretisms conform to the Feature Ranking Principle.

(30) gender > number > case

As Hjelmslev (1935:108) recognized, the feature ranking implied by a language's syncretisms is language-specific. Although number outranks case in Sanskrit, the reverse is true in Finnish (Carstairs 1987:119ff.). But even if the relevant feature rankings are language-specific, it is clear how the Feature Ranking Principle enhances the learnability of an inflectional system's patterns of syncretism: once a child has learned a stipulated syncretism in which a specification of feature F_1 is dominant and a specification of feature F_2 is subordinate, s/he need never entertain the possibility of a second stipulated syncretism in which a specification of F_2 is dominant and a specification of F_1 is subordinate.

Under the assumptions of PFM, the Feature Ranking Principle can be represented as a well-formedness condition on rules of referral and symmetrical syncretism metarules:

(31) A rule of referral (a) is well-formed only if every pairing $<X,\sigma>$ for which (a) is defined satisfies condition (b); a symmetrical syncretism metarule (c) is well-formed only if every rule R licensed by (c) is such that every pairing $<X,\sigma>$ for which R is defined satisfies condition (b).

a. $RR_{n,\tau,C}(<X,\sigma>) =_{def} <Y,\sigma>$, where $Nar_n(<X,\sigma/\rho>) = <Y,\sigma/\rho>$;

b. for every feature F_1 specified in σ but not in ρ and for every feature F_2 specified in ρ, $F_1 > F_2$;

c. $$RR_{n,\tau,C}(<X,\sigma>) =_{def} <Y,\sigma>$$
$$\updownarrow$$
$$RR_{n,\tau/\rho,C}(<X,\sigma>) =_{def} <Y,\sigma>.$$

The well-formedness condition in (31) is like Noyer's impoverishment approach to syncretism in that it entails that every directional syncretism embodies an asymmetry. But the differences between the two approaches are considerable. In Noyer's approach, the operative asymmetry is a difference in the relative markedness of the morphosyntactic properties associated with a syncretism's dependent member and those associated with its determinant member. According to (31), by contrast, the operative asymmetry is a difference in the (language-specific) ranking of the features specified by a syncretism's dominant properties and those specified by its subordinate properties. The two approaches therefore make different predictions. Noyer's approach wrongly predicts the nonoccurrence of the first-singular/third-plural and first-singular/first-plural syncretisms in Rumanian; but as long as the features of tense and mood outrank those of person and number in Rumanian, (31) correctly allows these syncretisms. By the same token, Noyer's approach does not exclude the possibility that Sanskrit might have an impoverishment rule such as (32), whose effect would be to engender a locative-singular/locative-plural syncretism in which locative case is a dominant property and singular and plural number are subordinate properties; but given that number outranks case in Sanskrit, (31) categorically excludes the possibility of a stipulated syncretism of this sort.

(32) Hypothetical impoverishment rule: pl → ∅ / {CASE:loc, NUM:____, ...}

It is important to emphasize that the well-formedness condition (31) pertains to stipulated syncretisms, not to syncretisms generally. Thus, consider the fact (Corbett 1991:194) that Zande subject pronouns exhibit both a syncretism of the masculine and feminine genders in the plural and a syncretism of the singular and plural numbers in the neuter gender: in the former syncretism, number is dominant and gender is subordinate, while in the latter syncretism, just the reverse is true. Nevertheless, this is not counterevidence to (31), since it is not necessary to view either of the two syncretisms as being stipulated: one can instead simply assume that the default plural inflection is insensitive to the masculine/feminine distinction and that neuter inflection is effected by an expansion schema overriding that default. Because neither rules of referral nor symmetrical syncretism metarules need to be invoked to account for these syncretisms, they have no bearing on the validity of (31).

8 *Conclusions, extensions, and alternatives*

In the foregoing chapters, I have introduced a range of evidence favouring the cluster of assumptions constituting the theory of Paradigm Function Morphology. In this concluding chapter, I summarize the central properties of PFM and the principal arguments favouring its adoption (section 8.1); I explore some of the implications of PFM for grammatical theory beyond the boundaries of pure inflectional morphology (section 8.2); and I discuss some alternative choices of execution for PFM suggested by recent work in the framework of Network Morphology (section 8.3).

8.1 A synopsis of PFM

PFM is an inferential–realizational theory of inflectional form; as such, it differs from Lieber's (1992) lexical–incremental theory, Halle and Marantz's (1993) lexical–realizational theory, and Steele's (1995) incremental–inferential theory, and is akin to the inferential–realizational theories advocated by Matthews (1972) and Anderson (1992). But as I have shown in the preceding chapters, there are certain key assumptions which set PFM apart from all of these theories. These assumptions might be summarized as follows.

First, PFM presumes the rich hierarchy of rule types in (1).

(1)
- A. Paradigm functions
- B. Inflectional rules
  - 1. Realization rules
    - a. Rules of exponence
    - b. Rules of referral
  - 2. Morphomic rules
    - a. Rules of stem formation
    - b. Rules of stem indexing
- C. Morphological metageneralizations

Each of these rule types plays a different role in the definition of a language's inflectional morphology.

Paradigm functions (1A) are central; indeed, PFM equates the definition of a language's inflectional morphology with the definition of its paradigm function. Intuitively, a language's paradigm function imposes inviolable strictures on the extent to which the language's inflected forms may vary in their morphology. For the child, these strictures make forms incorporating novel stems or inflectional markings easier to learn; for all speakers, they streamline both the production and the analysis of lexically unlisted forms. Where a lexeme L has X as its root in language ℓ, ℓ's paradigm function is a function applying to the root pairing $<X,\sigma>$ to yield the σ-cell in L's paradigm (where σ is any complete set of morphosyntactic properties appropriate to L).

The postulation of paradigm functions makes it possible for PFM to capture several types of generalizations which remain elusive in other frameworks. First, paradigm functions make it possible to express the dependency which exists between the inflectional morphology of a headed derivative (of the word-to-word type) and that of its head; in particular, PFM attributes inflectional head-marking to the HAP (a universal principle for the evaluation of paradigm functions applying to headed roots; section 4.5), and thereby captures both the Coderivative Uniformity Generalization (section 4.3.3) and the Paradigm Uniformity Generalization (section 4.3.4). Second, paradigm functions make it possible to express dependencies between a word's set of morphosyntactic properties and the number, identity, and definitional sequence of rule blocks effecting the realization of those properties (sections 5.2–5.4). These are the two principal motivations for the postulation of paradigm functions. At least two additional motivations have nevertheless been encountered: paradigm functions make it possible to express the principle by which word-to-stem derivatives form their inflectional stems (namely the universal metarule (28), section 6.5.2); and they make it possible to define translexemic rules of referral (section 7.5).

Inferential–realizational theories lacking the notion of paradigm functions fail to afford a satisfactory account of any of these four phenomena. To account for the inflectional parallelism between a headed derivative and its head, proponents of other inferential–realizational frameworks sometimes invoke the notion of head operations, but as I have shown (section 4.4), the Head Operation Hypothesis fails to entail either the Coderivative Uniformity Generalization or the Paradigm Uniformity Generalization; the HAP, by contrast, entails both. Interactions among a language's realization-rule blocks are, in other theories, assumed to be of the simplest possible sort, involving nothing more than a fixed linear ordering of one block after another: if the interaction of realization-rule blocks were really that simple, that fact would at least partially obviate the need to postulate paradigm functions; but as is abundantly clear from the evidence discussed in chapter 5, the Fixed Linear Ordering Hypothesis is empirically disconfirmed by a variety of complex modes of interaction among realization-rule blocks, interactions whose regularities require expression by a higher-order rule – in other words, by a paradigm function. To my knowledge, neither the inflection of word-to-stem derivatives nor the incidence of translexemic syncretisms has ever been addressed in any framework other than PFM.

In PFM, a paradigm function's definition is stated in terms of realization rules (1B1) – rules which, through their application, give morphological expression to a specified set of morphosyntactic properties. Realization rules are organized into disjunctive blocks; in PFM, the membership of any such block is assumed to satisfy the Pāṇinian well-formedness condition on realization-rule blocks ((16) in section 3.5). A given realization rule is defined as applying in one of two modes: a rule applying in unexpanded mode realizes a specific property set, while a rule applying in expanded mode realizes all well-formed extensions of a specified property set (section 3.4). Competition among realization rules belonging to the same block is in all instances resolved by Pāṇini's principle (= the Pāṇinian Determinism Hypothesis; (23), section 1.5.2). Pāṇini's principle is enforced by the definition of the Nar_n notation ((24), section 2.7). Every portmanteau rule block in every language is assumed to have an instantiation of the FCD (a universal rule of referral; (5), section 5.2) among its members; any other rule block in any language is assumed to have an instantiation of the IFD (a universal rule of exponence; (6), section 5.2) among its members.

Realization rules are of two types. Rules of exponence (1B1a) directly specify the concrete exponents (or occasionally, the significative absence thereof) associated with the property set being realized. Rules of referral (1B1b) instead refer the realization of some property set to some other realization rule(s). The rule(s) to which a property set's realization is referred in this way may realize (i) the same property set, but in some other block(s) (cf. e.g. (5), section 5.2; (11b), (12b), section 5.3; (28), section 5.4) or (ii) a contrasting property set (cf. e.g. (33), section 2.7; (7), section 7.2; (15a,b), (16a,b), (18), section 7.4); these options allow rules of referral to play an expanded role in PFM, serving not merely to define directional syncretisms (the phenomenon originally used to motivate their existence), but also to define (a) the relation between a portmanteau rule block and the blocks to which it is paradigmatically opposed (section 5.2); (b) parallelisms among distinct rule blocks (section 5.3); and (c) the incidence of rule-block reversal (section 5.4).

In some instances, the definition of one class of realization rules is deducible from that of some distinct class; in such instances, the relation between the two classes is captured by means of a metarule (e.g. (20), (27), (32), section 3.6.1; (40), section 3.6.2; (12), section 7.3). A set of realization rules may also be given a single, schematic definition through the use of metalinguistic variables; some examples of realization-rule schemata are (14) **B4/C1**, section 2.5; (33), section 2.7; (4), (5), section 3.2; (14), section 3.4; (38a), section 3.6.2; (26ai), section 5.4; (7j,k,s,t), section 6.2.3; (7), section 7.2; and (16a,b), section 7.4.

In PFM, the morphophonological modifications associated with a realization rule are regarded as a part of that rule (section 2.6); when two or more realization rules are associated with the same morphophonological regularity, that association is expressed by means of a morphological metageneralization (1C).

Syncretism is assumed to arise in several ways: directional syncretisms (whether unidirectional or bidirectional) are the effect of rules of referral (section 7.2); symmetrical syncretisms are the effect of symmetrical syncretism metarules (section 7.3); and a language's unstipulated syncretisms are the effect of nothing more than a kind of poverty in that language's system of realization rules.

Stem choice is effected in two ways (section 6.2): where stem choice is determined by the morphosyntactic property set being realized, the choice is effected by a stem-selection rule (a type of rule of exponence); where stem choice is determined syntagmatically, the choice is effected by a morphological metageneralization.

In accordance with the Indexing Autonomy Hypothesis ((14), section 6.3.1), rules of stem formation (1B2a) are in principle distinguishable from rules of stem indexing (1B2b). Rules of both of these sorts are morphomic rather than realizational: they define the classes of stem-forms to which specific realization rules are defined as applying, but they do not, in and of themselves, express a particular set of morphosyntactic properties.

In the preceding chapters, I have motivated the principal characteristics of PFM with empirical evidence drawn from a genetically and typologically diverse range of languages; in elucidating these characteristics, I have tried to be as precise and explicit as possible about my conclusions. I have tried to avoid theoretical preconceptions; in particular, I have resisted assuming that the principles of inflectional morphology are, in some way, deducible from logically independent theories of syntax and phonology. Nevertheless, I am convinced that PFM is fundamentally compatible with a broad spectrum of current theories in both of the latter domains; for example, I see no obstacle to embedding a PFM-style morphology within a range of current syntactic theories, including Chomskyan Minimalism, Head-Driven Phrase Structure Grammar, and Lexical–Functional Grammar.

8.2 Beyond inflection

For the reasons discussed in chapter 1, I have assumed, throughout this work, that the rules and principles determining a word's inflectional form are properly morphological (being reducible neither to principles of syntax nor to principles of phonology), and that the interfaces of these rules and principles with other grammatical components are in general extremely limited.[1] Nevertheless, the principles of PFM shed important light on other grammatical components and the nature of their interface with inflectional morphology. In this section, I examine two cases in point: the semantics of inflected words and the analogy between inflectional and derivational paradigms.

8.2.1 Morphosemantic mismatches

The study of inflectional semantics is, in one sense, still in its infancy: although a good deal is known about the semantic characteristics of specific inflectional categories, such as mood, aspect, voice, tense, person, number, case, gender, definiteness, and degree,[2] the precise manner in which a morphologically complex expression comes to be associated with its semantic representation remains a matter of considerable speculation and a source of continuing disagreement (as does the precise manner in which the semantic properties of individual words enter into the semantic composition of larger syntactic constituents).

The need for a carefully articulated theory of the linkage between inflectional morphology and semantics has been made particularly clear in recent discussions of the problem of morphosemantic mismatches – instances in which an inflected word's morphology and its semantics seem to be out of synch. A classic example is the so-called *unhappier* paradox. On the one hand, *unhappier* seems to arise morphologically through the prefixation of *un-* to *happier*; the possibility that it arises through the suffixation of *-er* to *unhappy* is seemingly excluded by the restriction that prevents *-er* from combining with adjectives of three or more syllables (except those exhibiting the special prosodic pattern of *rickety*, *slippery*, and so on). On the other hand, the meaning of *unhappier* is 'more unhappy' – not 'not happier', as the assumed morphological analysis would imply.[3] Thus, the meaning of *unhappy* seems to be part of the meaning of *unhappier* even though, morphologically speaking, *unhappy* isn't a constituent of *unhappier*.

Various ways of resolving this apparent paradox have been proposed. One especially common approach has been to assume the existence of a principle allowing a single morphological expression to have two distinct structural bracketings, each of which satisfies the requirements of a different grammatical component; on this view, *unhappier* has both the bracketing [*un*[*happier*]] (which satisfies the prosodic restriction which the comparative suffix imposes on the stem with which it joins) and the bracketing [[*unhappi*]*er*] (which determines the word's semantic interpretation). Approaches of this general character have been proposed by Pesetsky (1985), Marantz (1988), Sproat (1988), and others. The rebracketing principle has generally been seen as licensing string-vacuous bracketing alternatives (i.e. alternative bracketings which imply the same linear ordering of the bracketed parts), but this assumption is not reconcilable with the full range of observable 'bracketing paradoxes'. In Breton, for example, the productive sort of nominal compound is one which is left-headed and inflects on its head, as in table 8.1. Compounds of this sort evince a paradox comparable to that of *unhappier*: for instance, the idiosyncratic meaning of *tour-tan* 'lighthouse' is part of the meaning of *tourioù-tan* 'lighthouses' even though, morphologically speaking, *tour-tan* isn't a constituent of *tourioù-tan*. If this paradox is to be attributed to the availability of alternative bracketings, then the alternatives cannot be seen as string-vacuous – that is, one would seemingly have to assume the bracketing [[*tourioù*] *tan*] for morphological purposes and something like [[*tour-tan*] *-ioù*] for semantic purposes.

But the idea of appealing to bracketing alternatives does not, in any event, solve the problem of morphosemantic mismatches in any general way, because there are mismatches involving expressions for which alternative bracketings are not available. Consider the additional examples of Breton nominal compounds in table 8.2. In each of these examples, the head of the compound is a noun which inflects for number purely by means of stem suppletion. The noun *ki* 'dog', for instance, has the morphologically unanalysable plural *chas*; for this reason, there is only a single possible

Table 8.1 *Breton nominal compounds*

	SINGULAR	PLURAL
'trowel'	*loa-vañsoner* [spoon-mason]	*loaioù-mañsoner*
'grandmother'	*mamm-gozh* [mother-old]	*mammoù-kozh*
'water mill'	*milin-zour* [mill-water]	*milinoù-dour*
'straw hat'	*tok-kolo* [hat-straw]	*tokoù-kolo*
'lighthouse'	*tour-tan* [tower-fire]	*tourioù-tan*

Table 8.2 *Breton nominal compounds with suppletively inflecting heads*

	SINGULAR	PLURAL
'milk cow'	*bioc'h-laezh* [cow-milk]	*saout-laezh*
'otter'	*ki-dour* [dog-water]	*chas-dour*
'bicycle'	*marc'h-houarn* [horse-iron]	*kezeg-houarn*
'brother-in-law'	*breur-kaer* [brother-fine]	*breudeur-kaer*
'locomotive'	*marc'h-du* [horse-black]	*kezeg-du*

bracketing for the plural compound *chas-dour* 'otters', namely [*chas-dour*].[4] Nevertheless, the compounds in table 8.2 exhibit the same kind of morphosemantic mismatch as *tourioù-tan* and *unhappier*: the idiosyncratic meaning of *ki-dour*, for example, is part of the meaning of *chas-dour* even though *ki-dour* is not a morphological constituent of *chas-dour*.

While the idea of appealing to bracketing alternatives does not afford a general account of morphosemantic mismatches, there is an approach which does. This approach rests on the HYPOTHESIS OF PARADIGM-BASED INFLECTIONAL SEMANTICS:

(2) Where <W,σ> is a cell in the inflectional paradigm of some lexeme L, the semantic representation of <W,σ> is determined by L and σ.

According to this hypothesis, semantic representations are assigned to each of the cells in a lexeme's paradigm; on this view, cells that are occupied by the same phonological word (e.g. the cells <*deer*,{NUM:sg}> and <*deer*,{NUM:pl}> in the paradigm of English DEER) may nevertheless have distinct semantic representations. Hypothesis (2) has very different implications from the approach which invokes alternative bracketings. The latter approach identifies a word's inflectional exponents with scope-bearing semantic operators; hypothesis (2), by contrast, entails that a word's inflectional exponents are in principle irrelevant to its semantics, which instead depends solely on the word's association with a particular cell in the paradigm of a particular lexeme.

In the context of this hypothesis, the semantics of words such as *unhappier*, *tourioù-tan*, and *chas-dour* ceases to be paradoxical. Consider again the case of *unhappier*. A satisfactory morphosemantic analysis of *unhappier* must account for two facts:

(3) the fact that *-er* doesn't join with *unhappy* in the formation of *unhappier*

and

(4) the fact that *unhappier* means 'more unhappy' rather than 'not happier'

In order to account for fact (4) in a manner consistent with hypothesis (2), one need only assume the semantic rule in (5):

(5) Where X is the root of an adjectival lexeme L having the semantic representation X', the cell PF(<X,{DEG:compar}>) in L's paradigm has the semantic representation $\mathit{More}_y(X')$.

The logical operator More_y in (5) applies to the semantic representation of an adjectival lexeme's root to yield the semantic representation of the comparative cell in that lexeme's paradigm: if happy' is the semantic representation of the root *happy*, then $\mathit{More}_y(\mathit{happy}')$ is the semantic representation of <*happier*,{DEG:compar}>. (The subscript variable *y* ranges over standards of comparison; the value assigned to *y* is therefore determined either by an accompanying *than* phrase or by contextual inference.) The semantic rule in (5) assigns exactly the desired representation to the comparative cell in the paradigm of UNHAPPY: if $\mathit{unhappy}'$ is the semantic representation of the root *unhappy*, then by (5), the semantic representation of PF(<*unhappy*,{DEG:compar}>) is $\mathit{More}_y(\mathit{unhappy}')$.

Although the semantic rule in (5) accounts for fact (4) in a manner consistent with hypothesis (2), it has no implications at all for fact (3); (3) can instead be attributed to the HAP ((12), section 4.5). Thus, suppose that the English rules for the inflection of comparative adjectives include the realization rules in (6) (=(37), section 6.5.3): (6a) identifies an adjective's bare stem as its default stem; (6b) attaches *-er* to an adjective in the formation of its comparative, and is defined only if the argument meets certain prosodic conditions. Suppose, in addition, that the derivational rule of *un*-prefixation in (7) is a word-to-word rule (section 4.5) that applies to an adjectival root X to yield the corresponding negative adjectival root *un*X, a form headed by X. Suppose finally that (8) (=(38), section 6.5.3) is part of the definition of the English paradigm function.

(6) a. $\mathrm{RR}_{0,\{\},\mathrm{A}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{Y},\sigma>$, where Y is X's bare stem
b. $\mathrm{RR}_{\mathrm{I},\{\mathrm{DEG:compar}\},\mathrm{A2}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}\mathit{er}',\sigma>$
[where A2 contains adjectival lexemes whose roots meet certain prosodic conditions, which ordinarily entail that X has fewer than three syllables]

(7) Word-to-word rule:
Where X is an adjectival root,
$\mathrm{DR}_{un}(\mathrm{X}) =_{\mathrm{def}} \mathit{un}\mathrm{X}$

(8) Where X is the root of an adjectival lexeme (and is not a word-to-word derivative),
$\mathrm{PF}(<\mathrm{X},\sigma>) =_{\mathrm{def}} \mathrm{Nar}_{[\mathrm{I},0]}(<\mathrm{X},\sigma>)$

On these assumptions, PF(<*unhappy*,{DEG:compar}>) is evaluated as in (9):

(9) $\mathrm{PF}(<\mathit{unhappy},\{\mathrm{DEG:compar}\}>)$
a. $= <\mathrm{DR}_{un}(\mathrm{Y}), \{\mathrm{DEG:compar}\}>$,
where $<\mathrm{Y},\{\mathrm{DEG:compar}\}>$
$= \mathrm{PF}(<\mathit{happy},\{\mathrm{DEG:compar}\}>)$ [by the HAP]
b. $= \mathrm{Nar}_{\mathrm{I}}(\mathrm{Nar}_0(<\mathit{happy},\{\mathrm{DEG:compar}\}>))$
[by (8) and the FCD]
c. $= \mathrm{RR}_{\mathrm{I},\{\mathrm{DEG:compar}\},\mathrm{A2}}(\mathrm{RR}_{0,\{\},\mathrm{A}}(<\mathit{happy},\{\mathrm{DEG:compar}\}>))$
[by Nar_n notation]
d. $= <\mathit{happier},\{\mathrm{DEG:compar}\}>$ [by (6a,b)]
e. $= <\mathit{unhappier}, \{\mathrm{DEG:compar}\}>$ [by (7)]

Because *unhappy* arises from *happy* through the application of the word-to-word rule (7), the application of PF to <*unhappy*,{DEG:compar}> is evaluated in accordance with the HAP, as in (9a); thus, in the evaluation of PF(<*unhappy*,{DEG:compar}>), the *-er* suffixation rule applies to <*happy*, {DEG:compar}> (as in (9c)) rather than to <*unhappy*,{DEG:compar}>. In short, the HAP guarantees that the prosodic conditions on rule (6b) will be satisfied in the evaluation of PF(<*unhappy*,{DEG:compar}>) while the semantic rule (5) guarantees the desired scope for the comparative operator More_y in the semantic representation of PF(<*unhappy*,{DEG:compar}>).

The morphosemantic mismatches exhibited by the Breton compounds in tables 8.1 and 8.2 admit a similar analysis. Thus, suppose that plural nouns are assigned their semantic representation by rule (10):

(10) Where X is the root of a nominal lexeme L having the semantic representation X', the cell PF(<X,{NUM:pl}>) in L's paradigm has $pl'(X')$ as its semantic representation.

The operator pl' applies to the semantic representation of a count noun's root to yield the semantic representation of the plural cell in that noun's paradigm. Thus, where (11a) and (11b) are the semantic representations of *tour-tan* and *ki-dour*, (10) assigns PF(<*tour-tan*,{NUM:pl}>) and PF(<*ki-dour*,{NUM:pl}>) the respective semantic representations in (12); accordingly, whatever semantic idiosyncrasies inhere in (11a,b) are preserved in (12a,b).

(11) a. *tour-tan′*
b. *ki-dour′*

(12) a. *pl′(tour-tan′)*
b. *pl′(ki-dour′)*

The fact that *tour-tan* and *ki-dour* are not themselves constituents of *tourioù-tan* and *chas-dour* can be attributed to the HAP. Suppose that the Breton rules of nominal inflection include the rules in (13):

(13) a. $\mathrm{RR}_{0,\{\mathrm{NUM:pl}\},\mathrm{Ni}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}i,\sigma>$
b. $\mathrm{RR}_{1,\{\mathrm{NUM:pl}\},\mathrm{N}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}o\grave{u},\sigma>$
c. $\mathrm{RR}_{[1,0],\{\mathrm{NUM:pl}\},\{\textsc{ki}\}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <chas,\sigma>$

Given the root X of a lexeme belonging to the subclass Ni of nouns, (13a) supplies a plural stem of the form X*i*; rule (13b) introduces the default plural suffix -*où*; and rule (13c) – a portmanteau stem-selection rule (section 6.5.3) – introduces the suppletive plural stem *chas* of the lexeme KI 'dog'. Suppose in addition that (14) is part of the definition of the Breton paradigm function, and that the productive rule of nominal compounding in Breton is the word-to-word rule in (15).

(14) Where X is the root of a nominal lexeme (and is not a word-to-word derivative), $\mathrm{PF}(<\mathrm{X},\sigma>) =_{\mathrm{def}} \mathrm{Nar}_{[1,0]}(<\mathrm{X},\sigma>)$

(15) Word-to-word rule:
Where $\mathrm{X} \in \mathrm{N}$, $\mathrm{Z} \in \mathrm{N} \cup \mathrm{A}$, $\mathrm{DR}_{\mathrm{compound}}(\mathrm{X,Z}) =_{\mathrm{def}} \mathrm{X\text{-}Z}$

On these assumptions, PF(<*tour-tan*,{NUM:pl}>) is evaluated in accordance with the HAP; that is, the plural morphology is spelled out on the head of *tour-tan*, as in (16).

(16) PF(<*tour-tan*,{NUM:pl}>)
a. $= <\mathrm{DR}_{\mathrm{compound}}(\mathrm{Y}, tan), \{\mathrm{NUM:pl}\}>$,
where <Y,{NUM:pl}> = PF(<*tour*,{NUM:pl}>) [by the HAP]

b. $= \mathrm{Nar}_{[1,0]}(<\textit{tour}, \{\mathrm{NUM{:}pl}\}>)$ [by (14)]
c. $= \mathrm{Nar}_{1}(\mathrm{Nar}_{0}(<\textit{tour}, \{\mathrm{NUM{:}pl}\}>))$ [by the FCD]
d. $= \mathrm{RR}_{1,\{\mathrm{NUM:pl}\},\mathrm{N}}(\mathrm{RR}_{0,\{\mathrm{NUM:pl}\},\mathrm{Ni}}(<\textit{tour}, \{\mathrm{NUM{:}pl}\}>))$ [by Nar_n notation]
e. $= <\textit{touriou\grave{}}, \{\mathrm{NUM{:}pl}\}>$ [by (13a,b)]
f. $= <\textit{touriou\grave{}-tan}, \{\mathrm{NUM{:}pl}\}>$ [by (15)]

Similarly, PF(<*ki-dour*,{NUM:pl}>) is evaluated as in (17), where the HAP requires pluralization to be expressed by means of the stem-suppletion rule (13c).

(17) PF(<*ki-dour*,{NUM:pl}>)
a. $= <\mathrm{DR}_{\mathrm{compound}}(\mathrm{Y}, \textit{dour}), \{\mathrm{NUM{:}pl}\}>$,
where $<\mathrm{Y}, \{\mathrm{NUM{:}pl}\}> = \mathrm{PF}(<\textit{ki}, \{\mathrm{NUM{:}pl}\}>)$ [by the HAP]
b. $= \mathrm{Nar}_{[1,0]}(<\textit{ki}, \{\mathrm{NUM{:}pl}\}>)$ [by (14)]
c. $= \mathrm{RR}_{[1,0],\{\mathrm{NUM:pl}\},\{\mathrm{KI}\}}(<\textit{ki}, \{\mathrm{NUM{:}pl}\}>)$ [by Nar_n notation]
d. $= <\textit{chas}, \{\mathrm{NUM{:}pl}\}>$ [by (13c)]
e. $= <\textit{chas-dour}, \{\mathrm{NUM{:}pl}\}>$ [by (15)]

As these examples show, the HAP (an independently motivated principle of morphology) and the hypothesis of paradigm-based inflectional semantics together resolve a range of morphosemantic mismatches and afford a more general account of such mismatches than an approach appealing to bracketing alternatives.[5] More broadly, this evidence reinforces PFM's guiding insight that the paradigm is an indispensable unit of grammatical analysis: in each of the cases at hand, a word's meaning is a function not of its morphological form, but of its situation in a particular cell of a particular lexeme's paradigm.

8.2.2 *Derivational paradigms*

Like inferential–realizational theories generally, PFM presumes that the traditional notion 'inflectional paradigm' is, in some sense, a theoretically significant one. Recently, however, the possibility has been raised that paradigms might have an equally substantial role in the architecture of derivational morphology; see, for example, Bauer 1997, Booij 1997, and the references cited there. In this section, I show that the principles of PFM favour the conclusion that derivation, like inflection, is regulated by paradigmatic principles; in particular, I suggest that certain similarities between inflection and derivation can be most simply accounted for by assuming that a language's paradigm function determines derivational as well as inflectional relationships in that language's morphology.

It should be noted at the outset of discussion that there are a number of pretheoretic similarities between inflectional paradigms and derivational paradigms; Bauer (1997) discusses a number of these. First, both inflectional paradigms and derivational paradigms are inventories projected from a single lexeme; for instance, both the inflectional paradigm (18) and the derivational paradigm (19) are projections of the lexeme ARM. Moreover, prototypical instances of inflectional paradigms and derivational paradigms both involve a basic form from which other, more complex members of the paradigm arise by morphological principles: thus, both the inflectional paradigm in (18) and the derivational paradigm in (19) have the root *arm* as their basic form.

(18) <*arm*,{NUM:sg}>
<*arms*,{NUM:pl}>

(19) <*arm*, body-part noun>
<*armful*, measure noun>
<*armless*, privative adjective>

Second, just as the pattern embodied by one lexeme's inflectional paradigm is generalizable to other lexemes, so is the pattern embodied by a lexeme's derivational paradigm, though not always to the same extent; EAR, for example, exhibits an inflectional paradigm parallel to (18) and a derivational paradigm parallel to (19), as in (20) and (21).

(20) <*ear*,{NUM:sg}>
<*ears*,{NUM:pl}>

(21) <*ear*, body-part noun>
<*earful*, measure noun>
<*earless*, privative adjective>

Bauer also observes that the cells of a derivational paradigm, like those of an inflectional paradigm, may be of unequal status. First, there may be an implicational relation such that the form occupying one cell uniquely determines that occupying some other cell (recalling Wurzel's (1989:118) 'paradigm-structure conditions'): an abstract noun in *-ism*, for instance, generally implies a personal noun in *-ist*. Moreover, one cell may be less marked than another, exhibiting, for example, a larger range of formal distinctions; in Dutch, for instance, deverbal agentive nouns unmarked for gender exhibit more formal distinctions than those marked for feminine gender (e.g. *gokk-er* 'gambler', *huur-der* 'renter', but *gokk-ster* 'female gambler', *huur-ster* 'female renter').

Other, related, similarities can be found between inflectional and derivational paradigms. Just as inflectional paradigms sometimes exhibit stem

Table 8.3 *Some toponyms, inhabitant names, and toponymic adjectives in Dutch (from Bauer 1997:254)*

TOPONYM	INHABITANT	ADJECTIVE	FEMALE INHABITANT
België	*Belg*	*Belg-isch*	*Belg-isch-e*
Finland	*Fin*	*Fin-s*	*Fin-s-e*
Noorwegen	*Noor*	*Noor-s*	*Noor-s-e*
Rusland	*Rus*	*Russ-isch*	*Russ-isch-e*

suppletion (e.g. the use of *wend-* in the past-tense paradigm of GO), so likewise do derivational paradigms (e.g. the use of *gubernator-* in GOVERNOR's adjectival derivative in *-ial*). Moreover, derivational paradigms exhibit systematic patterns of syncretism comparable to those explored in chapter 7; Booij (1997) presents evidence of a striking case of this sort. In Dutch, the adjectives associated with non-native toponyms are not based on the stem of the toponym itself, but on that of the associated personal noun; moreover, the corresponding female personal noun is based not on the stem of the unmarked personal noun, but on that of the toponymic adjective. The examples in table 8.3 illustrate. In Bauer's (1997:254) words, '[t]he importance of such cases for the argument here is that we have instances where a particular form can be derived only from another form in the same paradigm, even though it is not semantically the most obvious word to base the derivative on'; mutatis mutandis, this is precisely the motivation for postulating rules of referral in the inflectional domain.

Notwithstanding the numerous similarities between inflectional and derivational paradigms, there are certain obvious differences as well; these follow from independent facts about inflection and derivation. First, it is usual for lexemes belonging to the same category to exhibit parallel inflectional paradigms; derivational paradigms exhibit such parallelism to a much lesser degree. Thus, while the nouns *hospital* and *satire* have the verbal derivatives *hospitalize* and *satirize*, the nouns *clinic* and *farce* have nothing comparable (**clinicize*, **farcize*). This difference is a natural consequence of the different functions which inflection and derivation serve. Inflection serves to provide a lexeme L with a paradigm of alternative realizations expressing the distinct sets of morphosyntactic properties which distinct syntactic contexts may associate with L; given that lexemes belonging to the same category may appear in the same range of syntactic contexts (and may therefore have the same morphosyntactic property sets associated with them), they will, optimally, have parallel paradigms of forms. Derivation, by contrast, makes it possible to express complex meanings lexically. Because language users require lexical expression of some meanings more urgently than others, a system of derivational morphology isn't necessarily dysfunctional if it doesn't supply every member of the same category with the same sort of paradigm.

A second potential area of difference between inflectional and derivational paradigms relates to semantics. On the one hand, it is usual for the semantic relationships among the cells of an inflectional paradigm to remain constant from one lexeme to another; for instance, the semantic difference between the singular and plural members of ARM's paradigm is identical to the semantic difference between the corresponding cells in the paradigm of any other count noun in the language. Derivation, by contrast, is often marked by semantic irregularity; thus, the semantic relation between *hospital* and *hospitalize* is not like the semantic relation between *burglar* and *burglarize*, *winter* and *winterize*, *vapor* and *vaporize*, *terror* and *terrorize*, and so on.

Whether this constitutes a genuine difference between inflectional and derivational paradigms is ultimately a matter of definition. In principle, there are two contrasting ways in which the notion of a derivational paradigm might be developed. On the approach exemplified in (18)–(21), each cell in a derivational paradigm corresponds to a syntacticosemantic category ('privative adjective', 'personal noun', and so on), so that the morphological marking distinguishing the form occupying a given cell may vary with the choice of base; the personal-noun cell in a verb's paradigm of derivatives might, for example, be occupied by a noun in *-er* (as in the case of *sing*), by a noun in *-ist* (as in the case of *accompany*), by a noun in *-ent* (as in the case of *adhere*), and so on.

An alternative approach is to assume that each cell in a derivational paradigm corresponds to a particular rule of derivational morphology (e.g. the rule of *-ist* suffixation, that of *-less* suffixation, and so on), so that the morphological marking distinguishing the form occupying a given cell remains essentially invariant, regardless of the choice of base. On this latter approach (that of Stump 1991), forms occupying the same cell in the paradigms of different bases might differ semantically: thus, while the *-ent* cell in *preside*'s paradigm would be occupied by a personal noun, the corresponding cell in *precede*'s paradigm would be occupied by a form whose meaning isn't necessarily personal. Discussions of the notion 'derivational paradigm' have generally assumed the former of these two approaches, to which I shall therefore restrict my attention here.

If the cells of a derivational paradigm are associated with syntacticosemantic categories rather than with specific derivational rules, then one needn't assume that the cell occupied by *burglarize* in BURGLAR's derivational paradigm is the same as the cell occupied by *hospitalize* in HOSPITAL's derivational paradigm; if not, then the purported difference in semantic regularity between the cells of an inflectional paradigm and those of a derivational paradigm is not an actual difference. It is true, of course, that the class of forms arising through the application of a particular derivational rule is, on average, more semantically disparate than the class of forms arising through the application of a particular inflectional rule, but it is also clear enough why this should be so: the semantic difference between a derivative and its base is often underdetermined by the grammar, and therefore depends on the intentions and inferences of language users at the moment of the derivative's first use. This fact guarantees that derived forms will sometimes have highly idiosyncratic meanings (requiring lexical storage), and hence that coderivative forms may fail to occupy parallel cells in the derivational paradigms of their bases.

One piece of evidence which superficially militates against the postulation of derivational paradigms is the existence of derivational 'doublets' (Stump 1991:721f.). Sometimes, the same base gives rise to competing derivatives which are close if not identical in meaning: *conformance* vs. *conformity*, *legitimate* (v) vs. *legitimize* vs. *legitimatize*, *variance* vs *variation*, and so on. Given that each cell in a prototypical paradigm is occupied by exactly one form, should the existence of derivational doublets be seen as evidence that derivatives are not, after all, organized paradigmatically? A similar question actually arises in the inflectional domain, since there are occasional instances of inflectional doublets (e.g. *burned* vs. *burnt*). The decisive fact, in my view, is that although doublets are close or even identical in meaning, language users do not regard them as strictly interchangeable. In my own speech, I always prefer the use of *legitimize* over that of either *legitimate* (v.) or *legitimatize*. And while I use both *variance* and *variation*, there are contexts in which they do not actually compete (e.g. *free variation/*variance of allophones*; *at variance/*variation with*) – as is also the case with *burned* and *burnt* (*Your attitude really burned/*burnt him up*). The existence of distributional differences among derivational (and inflectional) doublets suggests that they occupy distinct paradigmatic cells – cells whose forms are syncretized in the paradigms of most other lexemes of the same category.

In general, then, the pretheoretic facts discussed thus far suggest that the definition of a language's derivational system may, like that of its inflectional system, be sensitive to paradigmatic structure. The assumptions underlying PFM lend additional support to this conclusion.

Under the assumptions of PFM, the claim that a base and its derivatives constitute a paradigm amounts to the claim that a base is associated with its derivatives by means of a paradigm function, in much the same way as a lexeme's root is associated with its various inflected forms. On this view, the English paradigm function applies not only to a root pairing <X,σ> (where σ is a morphosyntactic property set) to yield the σ-cell in X's inflectional paradigm, as e.g. in (22); it also applies to a root pairing <X,δ> (where δ is some syntacticosemantic category) to yield X's δ-derivative, as in (23).

(22) PF(<*friend*,{NUM:pl}>) = <*friends*,{NUM:pl}>

(23) PF(<*friend*, privative adjective>) = <*friendless*, privative adjective>

As was seen in section 8.1, the two principal motivations for the postulation of paradigm functions are (a) the need for an adequate account of the phenomenon of inflectional head-marking, and (b) the need to capture dependencies between a word's morphosyntactic property set and the number, identity, and definitional sequence of inflectional rule blocks realizing that property set. As I now show, the postulation of paradigm functions is similarly motivated in the derivational domain.

Consider first motivation (b) in the inflectional domain. Does this have any analogue in the domain of derivation? The question is particularly salient in the context of Beard's (1995) Separation Hypothesis, which entails that rules of derivational morphology are 'realizational' in much the same way that rules of inflection are: a derived lexeme's membership in a particular syntacticosemantic category induces the application of morphological rules expressing that category membership. One ordinarily thinks of a derivative as arising from its base through the application of a single rule of derivational morphology, but in Beard's theory, the possibility exists that a derivative's membership in a particular syntacticosemantic category may be expressed by several rules of derivational marking in unison. If there are in fact cases of this sort, then paradigm functions are clearly called for in the derivational domain to account for dependencies between a derivative lexeme's syntacticosemantic category and the number, identity, and definitional sequence of derivational rules effecting the realization of that category.

There are, of course, cases of the sort at issue. In Sanskrit, for example, the derivation of a desiderative verb stem from a verb root involves three conjoint rules: a rule prefixing an accented reduplicative syllable; a rule selecting the appropriate grade of the root itself; and a rule suffixing *-sa* (or *-iṣa*) to the root. Thus, from the root *śubh-* 'adorn' comes the desiderative stem *śuśobhiṣa-* 'want to adorn' (in which the Guṇa-grade form of the root is selected). This dependency between the syntacticosemantic category 'desiderative verb' and the complex morphology of *śuśobhiṣa-* must be stated somewhere; the analogy of inflection suggests that it is stated in the definition of a paradigm function applying to the root pairing <*śubh*, desiderative verb> to yield the form *śuśobhiṣa* occupying the desiderative cell in ŚUBH's derivational paradigm.[6]

The conclusion that paradigm functions are necessary to regulate the number, identity, and definitional sequence of rules expressing the syntacticosemantic category of certain classes of derivatives receives additional support from position-class systems in which the affixal slots encoding inflection are interspersed with those expressing derivation, as e.g. in Sarcee (Cook 1984:125ff.); to account for such instances, it may well be necessary to assume that in some languages, paradigm functions apply to triplets consisting of a root, a set of morphosyntactic properties, and a syntacticosemantic category, and that in such languages, the value of a paradigm function for a particular argument potentially depends upon both realization rules and derivational rules.

In the inflectional domain, the postulation of paradigm functions is motivated not only by the need to express dependencies between a word's morphosyntactic property set and the number, identity, and sequence of rule blocks realizing that property set. It is also motivated by the need for an adequate account of inflectional head-marking: in particular, it is paradigm functions that make it possible to state the HAP; cf. (12), section 4.5. As it turns out, the postulation of paradigm functions is similarly motivated in the derivational domain by the incidence of derivational head-marking. Consider a case in point.

Many 'disciplinary' nouns in *-ic-s* have a corresponding personal noun in *-ist*; those that do, however, vary in the precise nature of their morphological relationship to their corresponding personal noun. Thus, *physics* and *physicist* differ in that one has *-s* where the other has *-ist*; *economics* and *economist*, by contrast, differ in that one has *-ic-s* where the other has *-ist*; and *linguist* and *linguistics* differ in that one has *-ic-s* where the other has nothing at all. Such examples show that the morphology of derivationally related stems needn't be uniform even if the same formatives are involved:

given *physicist*, one might wrongly expect **economicist*; given *linguistics*, one might wrongly expect **economistics*; and so on.

With that in mind, consider the compound personal nouns *high-energy physicist*, *home economist*, and *Romance linguist*. Each of these examples exhibits two important properties. The first such property is the semantic fact that the meaning of the compound personal noun is a function of the meaning of a corresponding compound disciplinary noun (namely *high-energy physics*, *home economics*, and *Romance linguistics*, respectively): in each instance, it is the disciplinary noun that determines the semantic contribution of the nonhead constituent; thus, a high-energy physicist may be a sluggish person, but must in any event study high-energy physics. For this reason, compound personal nouns such as these might be said to exhibit a 'bracketing paradox': despite the fact that it is a morphological combination of *high-energy* with *physicist*, *high-energy physicist* is interpreted as if it were a combination of *-ist* with *high-energy physics*.

The second important property exhibited by compound personal nouns such as *high-energy physicist*, *home economist*, and *Romance linguist* is the fact that in each instance, the morphological relationship between the compound personal noun and the corresponding compound disciplinary noun duplicates the idiosyncratic morphological relationship between their uncompounded heads. Thus, *high-energy physics* and *high-energy physicist* differ morphologically in just the same way as *physics* and *physicist*; *home economics* and *home economist* differ in the same way as *economics* and *economist*; and so on.

These two properties are important because together, they constitute clear evidence of derivational head-marking – that is, they are exactly the properties that one would anticipate if headed personal derivatives in *-ist* arose from headed disciplinary nouns by means of head marking. Suppose, for example, that the disciplinary nouns *physics*, *economics*, and *linguistics* are associated with the corresponding personal nouns as in (24):

(24) PF(<*physics*, personal noun>) = <*physicist*, personal noun>
PF(<*economics*, personal noun>) = <*economist*, personal noun>
PF(<*linguistics*, personal noun>) = <*linguist*, personal noun>

Suppose, in addition, that the English rule of endocentric compounding is formulated as in (25):

(25) Word-to-word rule:
$\mathrm{DR}_{\mathrm{endo}}(\mathrm{X,Y}) =_{\mathrm{def}} \mathrm{YX}$

Under these assumptions, the desired associations in (26) follow from the generalization of the HAP in (27), where δ is either a morphosyntactic property set or a syntacticosemantic category.

(26) PF(<*high-energy physics*, personal noun>) = <*high-energy physicist*, personal noun>
PF(<*home economics*, personal noun>) = <*home economist*, personal noun>
PF(<*Romance linguistics*, personal noun>) = <*Romance linguist*, personal noun>

(27) Generalized HAP:
If M is a word-to-word rule and Y, Z are roots such that for some (possibly empty) sequence <S>, Y = M(Z,S), then where PF(<Z,δ>) = <W,δ>, PF(<Y,δ>) = <M(W,S),δ> if this is defined.

Thus, just as the 'bracketing paradoxes' presented by the inflected forms *unhappier*, *tourioù-tan*, and *chas-dour* can be resolved by appealing to the HAP (section 8.2.1), so can the 'bracketing paradoxes' presented by *high-energy physicist*, and so on.[7]

These considerations strongly favour the conclusion that a language's paradigm function serves not only to determine the paradigm of inflected forms associated with each lexeme in that language, but also to determine each lexeme's paradigm of derivatives.

8.3 Alternatives

In presenting the principles of PFM in the foregoing chapters, I have made a number of choices of execution for the sake of maximal explicitness. Nevertheless, it is clear that the central principles of the theory admit of more than one possible execution. The theory of Network Morphology (whose principal references include Corbett and Fraser (1993), Brown and Hippisley (1994), Fraser and Corbett (1995), Brown et al. (1996), Hippisley (1996, 1997, 1998), Fraser and Corbett (1997), and Brown (1998a–c); cf. also Cahill and Gazdar (1997)) is broadly compatible with the principles of PFM but suggests a number of alternatives for the formal implementation of these principles. In this section, I explore some of these alternatives.

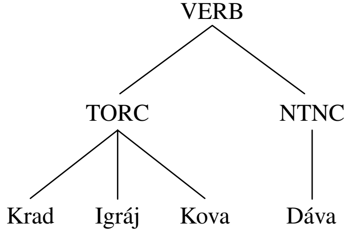
In elucidating the characteristics of Network Morphology and their implications for PFM, I shall draw upon the same fragment of Bulgarian verb inflection as served to illustrate the characteristics of PFM in chapter 2; refer again to tables 2.2 and 2.3 for the relevant paradigms.

8.3.1 An informal exemplification of Network Morphology

The central assumption underlying Network Morphology is that '[l]exical information is organized as a network whose basic elements are nodes and facts, and whose structure consists of relationships between basic elements' (Corbett and Fraser 1993:116). Each of the nodes in a network of this sort is a location at which facts may be situated. Thus, in the Network-Morphologic analysis which I shall propose for Bulgarian, the nontruncating vocalic ([−T, −C]) conjugation (that of DÁVA 'give') is represented as a node NTNC housing those facts pertinent to the inflection of verbs belonging to this conjugation; a different node TORC houses facts relevant to the inflection of verbs (e.g. KRAD 'steal', IGRÁJ 'play', KOVA 'forge') belonging to the truncating or consonantal conjugations; still another node VERB houses facts which are, by default, relevant to the inflection of all verbs, regardless of their conjugation-class membership. Individual lexemes are likewise represented as nodes; facts peculiar to the inflection of a particular lexeme L are accordingly housed by the node representing L.

The nodes in a Network Morphology description constitute a network because one node may inherit facts from another. For instance, the lexical node Dáva[8] inherits from the node NTNC, which houses facts about members of the [−T, −C] conjugation. The NTNC node in turn inherits facts from VERB, which characterizes verbs generally; because it inherits from NTNC, Dáva therefore likewise inherits from VERB. A network of nodes can be represented as a hierarchy in which dominated nodes inherit from dominating nodes; for instance, the inheritance hierarchy for the fragment of Bulgarian verb morphology can be represented as in (28).[9] Nodes representing individual lexemes naturally occupy the lowest level in the hierarchy.

(28)



Each fact in a Network-Morphologic analysis is expressed in a format that is both highly precise and highly compact: in particular, Network-Morphologic descriptions are, as a uniform practice, formulated in the

DATR language, a nonmonotonic language for the definition of default inheritance hierarchies designed by Roger Evans and Gerald Gazdar (Evans and Gazdar 1996). DATR is well-suited for the representation of lexical knowledge: it has an explicit proof theory (Evans and Gazdar 1989a) and a formal, model-theoretic semantics (Evans and Gazdar 1989b); accordingly, definitions in DATR are directly evaluable by computer, a decided advantage for the assessment of large-scale morphological analyses.[10]

In DATR, each fact situated at a given node takes the form of a pairing of a path with a value, where a path is defined as a sequence of (zero or more) attributes. For example, the fact that [−T, −C] verbs in Bulgarian have -*m* as their 1sg present-tense suffix (in slot D) is expressed as the path–value pairing in (29), which is situated at the NTNC node:

(29) NTNC:
<slot_d present 1 sg> == *m*
etc.

In general, the value of a fact is a sequence of zero or more atomic morphological expressions. In many instances, however, it is desirable to be able to identify the value of a fact situated at some node N in an indirect way with reference to the value paired with another path at N or with a particular path at some distinct node. Consider a pair of examples. Among the facts situated at the VERB node in Bulgarian are those in (30a–c):

(30) VERB:
<slot_d $tense 3 sg> == *e* (a)
<$slot $preterite 2 sg> == <$slot $preterite 3 sg> (b)
<slot_a aorist> == "<stem2>" (c)
etc.

In (30a), $tense is a variable over the attributes 'present', 'aorist', and 'imperfect'; according to (30a), a verb's 3sg forms exhibit the slot D suffix -*e*, whatever their tense. In (30b), the variable $slot ranges over 'slot_a', 'slot_b', 'slot_c', and 'slot_d' and the variable $preterite ranges over 'aorist' and 'imperfect'; according to (30b), a verb's 2sg exponents are identical to its 3sg exponents in the aorist and imperfect tenses, whatever the slot. Thus, the value of fact (30b) at the VERB node depends on the values paired with other paths at that same node, including, for example, the path in (30a).

Now consider (30c). Fact (30c) is slightly different from (30b) because the path <stem2> isn't paired with anything at the VERB node itself; as a consequence, fact (30c) only pairs the path <slot_a aorist> with a specific value at a lower-level, lexemic node which inherits (30c) from the VERB node and at which <stem2> is itself paired with a specific value; the quotation marks in (30c) indicate that the evaluation of the path <stem2> is deferred in this way. The value paired with <stem2> – hence also the value paired with <slot_a aorist> – may of course vary with the choice of inheriting node. For instance, the lexemic nodes Krad and Dáva both inherit (30c) from VERB: because <stem2> is paired with the value *krád* at the Krad node (as in (31)), <slot_a aorist> is there paired with *krád*; but because <stem2> is paired with *dáva* at the Dáva node (as in (32)), <slot_a aorist> is there paired with *dáva*.

(31) Krad:
<stem2> = = *krád*
etc.

(32) Dáva:
<stem2> = = *dáva*
etc.

The inheritance relations in which a node participates are expressed as facts situated at that node. The Krad node houses the fact (33a), which causes it to inherit from the TORC node; TORC, in turn, houses the fact (33b), which causes it to inherit from the VERB node. The import of the notation in (33) will be taken up momentarily.

(33) a. <> = = TORC
b. <> = = VERB

The DATR language incorporates two modes of inference by which new facts may be added to those which are, by stipulation, situated at a particular node: these are DEFAULT INFERENCE and RULE-BASED INFERENCE (Evans and Gazdar 1989a). The principle of default inference allows new facts to be inferred at a given node from the existing facts at that node. Central to understanding this principle is the notion of PATH CONCATENATION: the concatenation of path <X> with path <Y> (represented notationally as '<X>^<Y>') is the path <X,Y>. In this case, <X,Y> will be called a path-extension (or P-EXTENSION) of <X>, and will furthermore be called a STRICT P-EXTENSION of <X> if Y is nonnull. Now, suppose that by stipulation, the node N houses a fact *f* having the form 'path_{f} = = Y'. In that case, the principle of default inference allows N to be inferred to house an additional fact *f′* having the form '$\text{path}_{f'}$ = = Y′' (where for some path p, $\text{path}_{f'}$ = path_{f}^p and Y′ is like Y except that for any path p′ in Y, Y′ instead has p′^p). This inference is allowed, however, only if N isn't stipulated as housing a fact *f″* having the form '$\text{path}_{f''}$ = = Z' such that (a) path$_{f'}$ is a p-extension of path$_{f''}$ and (b) path$_{f''}$ is a strict p-extension of path$_{f}$; that is, in order for f' to be inferred from f, it must be the case that among all the paths whose pairing with some value is stipulated at N, path$_{f}$ is the most specific one having path$_{f'}$ as a p-extension. Thus, consider the node VERB, at which the facts in (34a,b) (among others) are situated by stipulation:

(34) VERB:
<slot_b aorist> == *o* (a)
<slot_b aorist 3 sg> == (b)
etc.

The principle of default inference allows each of the facts in (35a–e) (among many others) to be inferred from the stipulated fact in (34a); on the other hand, the stipulated fact (34b) prevents the inference of the fact in (36).

(35) VERB:
<slot_b aorist 1 sg> == *o* (a)
<slot_b aorist 2 sg> == *o* (b)
<slot_b aorist 1 pl> == *o* (c)
<slot_b aorist 2 pl> == *o* (d)
<slot_b aorist 3 pl> == *o* (e)
etc.

(36) <slot_b aorist 3 sg> == *o*

In DATR, a fact f of the form 'path$_{f}$ == NODE' may be equivalently represented as 'path$_{f}$ == NODE:path$_{f}$'. Thus, the fact in (33b) (situated at the TORC node) is equivalent to (37a).

(37) TORC:
< > == VERB:< > (a)
<slot_d present 1 pl> == *m*. (b)

By the principle of default inference, each of the facts in (38) (among many others) can be inferred from the stipulated fact (33b)/(37a):

(38) TORC:
<slot_b aorist> == VERB:<slot_b aorist> (a)
<slot_b aorist 1 sg> == VERB:<slot_b aorist 1 sg> (b)
<slot_b aorist 3 sg> == VERB:<slot_b aorist 3 sg> (c)
etc.

The import of the notation in (33) is therefore clear in the context of the principle of default inference: if NODE$_1$ houses a fact of the form '< > == NODE$_2$', then by default, the value paired with a path at NODE$_1$ is the same as the value paired with that path at NODE$_2$; that is, NODE$_1$ inherits facts from NODE$_2$.

It is essential to understand, however, that as the principle of default inference is formulated, a node housing the fact '< > == NODE_2' may sometimes fail to inherit facts housed at NODE_2. Thus, although the principle of default inference allows each of the facts in (38) to be inferred from the stipulated fact in (37a), the stipulated fact in (37b) excludes the default inference of the fact in (39).

(39) <slot_d present 1 pl> == VERB:<slot_d present 1 pl>

That is, the principle of default inference is overridden by (37b): the value paired with the path <slot_d present 1 pl> at TORC cannot be inferred to equal the value paired with this path at VERB. Inheritance of a fact *f* from a dominating node by a dominated node is overridden if the dominated node already houses a distinct fact whose path is identical to that of *f*.

Alongside the principle of default inference, DATR incorporates a second, rule-based mode of inference; this comprises seven rules of inference whose effect is to pair paths with sequences of atomic expressions in those instances in which no such pairing is explicitly stipulated. Consider, for example, the value paired with the path <slot_a aorist 1 sg> at the Krad node. The desired value is the stressed stem *krád*, but this pairing needn't be explicitly stipulated at the Krad node, since it is deducible from other facts by means of the rules of inference. In particular, the following chain of inferences leading to the conclusion (42c) is licensed by the seven rules of inference (for whose formal definition see Evans and Gazdar (1989a:68f.)).

(40) a. VERB:<slot_a aorist 1 sg> == "<stem2 1 sg>" [by default inference from (30c)]
b. TORC:<slot_a aorist 1 sg> == VERB:<slot_a aorist 1 sg> [= (38b)]
therefore
c. TORC:<slot_a aorist 1 sg> == "<stem2 1 sg>"

(41) a. TORC:<slot_a aorist 1 sg> == "<stem2 1 sg>" [= (40c)]
b. Krad:<slot_a aorist 1 sg> == TORC:<slot_a aorist 1 sg> [by default inference from (33a)]
therefore
c. Krad:<slot_a aorist 1 sg> == "<stem2 1 sg>"

(42) a. Krad:<slot_a aorist 1 sg> == "<stem2 1 sg>" [= (41c)]
b. Krad:<stem2 1 sg> == *krád* [by default inference from (31)]
therefore
c. Krad:<slot_a aorist 1 sg> == *krád*

Deducible pairings of paths with (sequences of) atomic expressions are distinctively represented with a single '=' sign; thus, the deducible pairing in

(42c) is represented as in (43).

(43) Krad:<slot_a aorist 1 sg>=*krád*

In the architecture of DATR, default inference precedes rule-based inference; that is, all of the unstipulated facts that can be situated at a given node by default inference are available to the seven rules of inference for deducing pairings of paths with (sequences of) atomic expressions.

Drawing on the foregoing assumptions, the inflectional morphology of the four paradigms in table 2.3 might be defined in Network-Morphologic terms as in (44). (This definition abstracts away from the morphophonological phenomena discussed in section 2.6. There are various ways in which (44) might be augmented to account for these phenomena, but because these options are peripheral to the concerns of the present discussion, I won't pursue them here.)

(44)
```
VERB:
   < > == "<slot_a>" "<slot_b>" "<slot_c>" "<slot_d>"          (a)
   <slot_a aorist> == "<stem2>"                                (b)
   <slot_a> == "<stem1>"                                       (c)
   <slot_b present> == e                                       (d)
   <slot_b imperfect> == A                                     (e)
   <slot_b aorist> == o                                        (f)
   <slot_b aorist 3 sg> ==                                     (g)
   <slot_c aorist 3 sg> ==                                     (h)
   <slot_c $preterite> == x                                    (i)
   <slot_c> ==                                                 (j)
   <slot_d present 1 sg> == ə                                  (k)
   <slot_d present 2 sg> == š                                  (l)
   <slot_d $tense 3 sg> == e                                   (m)
   <slot_d $tense 1 pl> == me                                  (n)
   <slot_d $tense 2 pl> == te                                  (o)
   <slot_d present 3 pl> == ət                                 (p)
   <slot_d $preterite 3 pl> == a                               (q)
   <slot_d> ==                                                 (r)
   <$slot $preterite 2 sg> == <$slot $preterite 3 sg>.         (s)
NTNC:
   < > == VERB                                                 (a)
   <slot_d present 1 sg> == m.                                 (b)
TORC:
   < > == VERB                                                 (a)
   <slot_d present 1 pl> == m.                                 (b)
Krad:
   < > == TORC                                                 (a)
   <stem1> == krad                                             (b)
```

<stem2> == *krád.* (c)
Igráj:
< > == TORC (a)
<stem1> == *igráj* (b)
<stem2> == *igrá.* (c)
Kova:
< > == TORC (a)
<stem1> == *kov* (b)
<stem2> == *kova.* (c)
Dáva:
< > == NTNC (a)
<stem1> == *dáva* (b)
<stem2> == *dáva.* (c)

Given this definition, the evaluation of the eighteen paths in (45) at each of the nodes Krad, Igráj, Kova, and Dáva yields the respective paradigms in table 2.3; that is, Krad:<present 1 sg> = *kradeə*, Krad:<present 2 sg> = *kradeš*, etc.[11]

(45)

<present 1 sg>	<imperfect 1 pl>
<present 2 sg>	<imperfect 2 pl>
<present 3 sg>	<imperfect 3 pl>
<present 1 pl>	<aorist 1 sg>
<present 2 pl>	<aorist 2 sg>
<present 3 pl>	<aorist 3 sg>
<imperfect 1 sg>	<aorist 1 pl>
<imperfect 2 sg>	<aorist 2 pl>
<imperfect 3 sg>	<aorist 3 pl>

This analysis should not be taken to embody all of the principles constituting the theory of Network Morphology; for instance, it does not involve multiple inheritance (i.e. instances in which a node inherits facts from two nodes neither of which inherits from the other), for which provisions exist in the theory (see e.g. Corbett and Fraser 1993:122; Brown et al. 1996:64). Nevertheless, this brief exemplification of the theory furnishes some precise points of comparison with PFM, to which I now turn.

8.3.2 PFM and Network Morphology

As the foregoing analysis suggests, Network Morphology and PFM rest on a number of shared assumptions. Both theories are inferential and realizational (in the sense defined in section 1.1), and there is a systematic correspondence between their elements: in general, a given realization rule $RR_{n,\tau,C}$ in PFM can be seen as corresponding to a fact *f* in Network

Table 8.4 *Rule correspondences between two analyses of Bulgarian verb morphology*

PFM analysis (chapter 2)	Network Morphologic analysis (= (44))
Paradigm function (= (26), §2.7)	VERB:(a)
Rules of exponence (= (14), §2.5):	
Block **A**	
A1	VERB:(b)
A2	VERB:(c)
Block **B**	
B1	VERB:(d)
B2	VERB:(e)
B3	VERB:(f)
B4	VERB:(g)
Block **C**	
C1	VERB:(h)
C2	VERB:(i)
Block **D**	
D1	VERB:(k)
D2	NTNC:(b)
D3	VERB:(l)
D4	VERB:(m)
D5	TORC:(b)
D6	VERB:(n)
D7	VERB:(o)
D8	VERB:(p)
D9	VERB:(q)
Rule of referral (= (33), §2.7)	VERB:(s)
Instantiations of the IFD (= (6), §5.2)	VERB:(j), VERB:(r)

Morphology; the morphological class C to which $RR_{n,\tau,C}$ is restricted in PFM then corresponds to the node N which houses *f* in Network Morphology; and the morphosyntactic property set τ realized by the application of $RR_{n,\tau,C}$ in PFM likewise corresponds to a path *p* in Network Morphology, where *f* is the pairing of *p* with some value. The full extent of this correspondence can be best appreciated by comparing the Network-Morphologic analysis in (44) with the PFM analysis of Bulgarian verb morphology developed in chapter 2; table 8.4 lists the specific points of correspondence between these two analyses. As table 8.4 shows, the rules in the PFM analysis stand in a remarkably close correspondence to the facts in (44); indeed, the facts in (44) can be categorized according to the kind of counterpart they have in the PFM analysis. Thus, fact VERB:(a) (i.e. the fact ‘< > = = "<slot_a>" "<slot_b>" "<slot_c>" "<slot_d>"’ situated at the VERB node in (44)) corresponds to the partial definition of the Bulgarian paradigm function given as (26) in section 2.7; fact VERB:(b) corresponds to the rule of exponence **A1**; VERB:(s) corresponds to the rule of referral given as (33) in section 2.7; and so on.

On first consideration these sorts of correspondences suggest that PFM and Network Morphology are simple notational variants. Were that the case, one might well favour the generality of the DATR notation (which has diverse applications in all components of grammar) over the notation of PFM (which is purpose-built for the analysis of inflectional morphology), as Gazdar (1992) observes. But there are some subtle differences between PFM and Network Morphology. In particular, they differ in their representation of rules of referral; they differ in that one employs sets of morphosyntactic properties where the other, in effect, employs sequences thereof; and they differ in the manner in which they formalize Pāṇini’s principle. None of these differences is insignificant; consider each one in turn.

The first difference relates to the representation of rules of referral. Recall that in PFM, a rule of referral expressing a directional syncretism has the format in (46):

(46) $RR_{n,\tau,C}(<X,\sigma>) =_{def} <Y,\sigma>$, where $Nar_n(<X,\sigma/\rho>) = <Y,\sigma/\rho>$.

According to (46), the Block *n* morphology of the form occupying the σ-cell in X’s paradigm is identical to that of the form occupying the σ/ρ-cell in that paradigm. The format in (46) requires the morphosyntactic property set σ/ρ of the determinant cell to be like the property set σ of the dependent cell except insofar as the former set is an extension of ρ. In view of this fact, this format makes some referrals easier to express than others. Consider, for example, the rule of referral for Bulgarian verbs (= (1), section 7.2):

(47) Where *n* is any of rule blocks **A** to **D**,
$RR_{n,\leftarrow\{PRET:yes,\ AGR:\{PER:2,\ NUM:sg\}\}\rightarrow,V}(<X,\sigma>) =_{def} <Y,\sigma>$, where
$Nar_n(<X,\sigma/\{AGR:\{PER:3\}\}>) = <Y,\sigma/\{AGR:\{PER:3\}\}>$.

Rule (47) entails that by default, a 2sg preterite form exhibits the morphology of its 3sg counterpart. Now, imagine a pseudo-Bulgarian language in which a 2sg preterite form instead exhibited the morphology of its 3pl present counterpart (so that in this pseudo-Bulgarian, KRAD would have *kradǝ̀t* as both its 2sg imperfect and 2sg aorist forms as well as its 3pl present-tense form); in that hypothetical language, the rule of referral in (48) would take the place of (47).

(48) Where *n* is any of rule blocks **A** to **D**,
$\mathrm{RR}_{n,\leftarrow\{\mathrm{PRET{:}yes,\ AGR{:}\{PER{:}2,\ NUM{:}sg\}}\}\rightarrow,\mathrm{V}}(\langle X,\sigma\rangle) =_{\mathrm{def}} \langle Y,\sigma\rangle$, where
$\mathrm{Nar}_n(\langle X,\sigma/\{\mathrm{TNS{:}pres,\ PRET{:}no,\ AGR{:}\{PER{:}3,\ NUM{:}pl\}}\}\rangle) =$
$\langle Y,\sigma/\{\mathrm{TNS{:}pres,\ PRET{:}no,\ AGR{:}\{PER{:}3,\ NUM{:}pl\}}\}\rangle$.

Intuitively, the 2sg-preterite/3pl-present referral in pseudo-Bulgarian is less natural than the 2sg-preterite/3sg-preterite referral in authentic Bulgarian. The format in (46) predicts that this should be so: in the specification of the property set σ/ρ of the determinant cell, (47) simply stipulates that ρ = {AGR:{PER:3}}; (48), by contrast, must carry the more complex stipulation that ρ = {TNS:pres, PRET:no, AGR:{PER:3, NUM:pl}}.

It isn't clear that the standard Network-Morphologic representation of rules of referral can capture this same difference as easily. Thus, consider again the Network-Morphologic account of Bulgarian, in which the fact corresponding to (47) is VERB:(s); in a Network-Morphologic account of pseudo-Bulgarian, fact (49) would take the place of VERB:(s).

(49) <\$slot \$preterite 2 sg> == <\$slot present 3 pl>

In this Network-Morphologic analysis, the 2sg-preterite/3pl-present referral in pseudo-Bulgarian and the 2sg-preterite/3sg-preterite referral in authentic Bulgarian are portrayed (by facts (49) and VERB:(s)) as being equivalent in complexity. Notice, in particular, that it is not possible to simplify fact VERB:(s) as in (50), because the principles of DATR do not require the righthand path in (50) to share the number attribute of the left-hand path; for this reason, (50) would not allow a unique value to be assigned to <imperfect 2 sg> or <aorist 2 sg> at any lexical node.

(50) <\$slot \$preterite 2 sg> == <\$slot \$preterite 3>

Thus, the representation of rules of referral in PFM allows generalizations to be captured which are not automatically captured by the usual Network-Morphologic representation of rules of referral.[12] It must nevertheless be said that the expressive resources of DATR (which is not itself a theory but a language for the expression of theories) should make it possible to reconstruct PFM-style rules of referral which are compatible with the central assumptions of Network Morphology.

A second, obvious difference between the Network-Morphologic analysis in (44) and the PFM analysis in chapter 2 is that the former employs sequences (of attributes) where the latter employs sets (of morphosyntactic properties). This difference stems from the fact that in DATR, the use of attribute sequences affords a deterministic definition of the principle of default inference; the use of attribute sets would not. For instance, if a node N housed just the definitional facts in (51a,b), then the principle of default inference would allow the inference of (52) from (51a).

(51) $\mathrm{N}{:}\ < \mathrm{a} > == x$ (a)
$< \mathrm{b} > == y.$ (b)

(52) $\mathrm{N}{:} < \mathrm{a\ b} > == x$

But if attribute sequences (i.e. paths) were simply replaced with attribute sets in the definition of DATR (and the notions of p-extension and path concatenation were correspondingly replaced with the notions of extension and unification defined in section 2.3), then the newly redefined principle of default inference would not allow a unique value to be associated with the set {a,b} at node N on the basis of the facts in (53).

(53) $\mathrm{N}{:}\ \{ \mathrm{a} \} == x$
$\{ \mathrm{b} \} == y.$

By the same token, the definition of Nar_n notation in PFM would not allow $\mathrm{Nar}_n(<\mathrm{X},\{\mathrm{a,b}\}>)$ to be assigned a unique value on the basis of an inflectional rule block *n* containing exactly the rules in (54).

(54) $\mathrm{RR}_{n,\{\mathrm{a}\},\mathrm{C}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}x,\sigma>$
$\mathrm{RR}_{n,\{\mathrm{b}\},\mathrm{C}}(<\mathrm{X},\sigma>) =_{\mathrm{def}} <\mathrm{X}y,\sigma>$

But Block *n* fails in any event to conform to the Pāṇinian well-formedness condition on realization-rule blocks (section 1.5.2, section 3.5). Thus, there is an irreducible difference of execution between PFM and Network Morphology: in PFM, the determinism of Nar_n notation is guaranteed by conformity to the Pāṇinian well-formedness condition on realization-rule blocks; in DATR and hence in Network Morphology, by contrast, the determinism of the principle of default inference is guaranteed by imposing a linear ordering on attribute sets.

Is there any reason to prefer one execution to the other? In fact, the Network-Morphologic approach leads to an apparent complication which doesn't arise in the PFM approach. This kind of complication is exemplified in the Bulgarian analysis in (44). In the paths in (44) (and hence in the paradigm-defining paths in (45)), attributes of number are always preceded by attributes of person, which are in turn always preceded by attributes of tense. This sequencing of attributes facilitates the expression of generalizations which pertain to tense independently of agreement: the fact VERB:(f), for example, identifies -*o* as the aorist suffix without reference to agreement. At the same time, the assumed sequencing of attributes complicates the statement of generalizations which pertain to agreement independently of tense; thus, the fact VERB:(o) identifying -*te* as the 2pl suffix must include a variable $tense over the possible tense attributes, even though -*te* is nowhere an exponent of tense. In the PFM analysis, by contrast, the rule **D7** of -*te* suffixation makes no reference to tense at all. This is at least prima facie evidence in favour of enforcing the determinism of Pāṇini's principle by means of the Pāṇinian well-formedness condition rather than by means of attribute sequencing.

Evans (1997) has proposed a DATR/PFM hybrid ('DPFM') which resolves this difficulty. In essence (and I am abstracting here), Evans' idea is (a) to let paths consist of an initial, identifying feature followed by a set of morphosyntactic properties; (b) to assume a total, linear ranking of morphosyntactic properties; and (c) to redefine the principle of default inference as in (55). Otherwise, DPFM is assumed to be like DATR.

(55) Suppose that by stipulation, the node N houses a fact f_τ having the form '<F τ> = = Y', where F is a path-initial, identifying feature. In that case, the principle of default inference allows N to be inferred to house an additional fact f_σ having the form '<F σ> = = Y′' (where for some morphosyntactic property set ρ, σ is the unification of τ and ρ, and Y′ is like Y except that for any property set τ′ in Y, Y′ instead has the unification of τ′ and ρ). This inference is allowed only if N isn't stipulated as housing a fact $f_{\tau''}$ having the form '<F τ″> = = Z' such that (a) σ is an extension of τ″ and (b) either (i) the cardinality of τ″ exceeds that of τ or (ii) τ″ and τ have the same cardinality and τ″ has a member which is ranked higher than every member of τ.

Although DPFM presumes that a node's paths comprise sets (rather than sequences) of attributes, the definition abstracted in (55) allows default inference to proceed deterministically. Accordingly, a DPFM reformulation of the Bulgarian analysis in (44) would allow the association of 2pl agreement with the slot D suffix -*te* to be expressed without reference to tense, as in (56).

(56) <slot_d {2, pl}> = = t e

More recently, Shen (1999) has developed and implemented an extension of DATR called KATR, which allows a node's facts to be expressed either as path–value pairings or as set–value pairings. Unlike DPFM, the KATR engine does not presume a total, linear ranking of morphosyntactic properties; it does, however, check input programs for conformity to the Pāṇinian well-formedness condition. In this respect, it is more fully congruent with the assumptions of PFM.

A final difference between PFM and Network Morphology is in the manner in which they formalize Pāṇini's principle. In PFM, Pāṇini's principle is formalized as the Nar_n notation (57).

(57) Nar_n notation (=(24), section 2.7):
Where $\mathrm{RR}_{n,\tau,\mathrm{C}}$ is the narrowest rule in block *n* which is applicable to $<\mathrm{X},\sigma>$,
'$\mathrm{Nar}_n(<\mathrm{X},\sigma>)$' represents $\mathrm{RR}_{n,\tau,\mathrm{C}}(<\mathrm{X},\sigma>)$.

This notation is therefore employed wherever Pāṇini's principle is to be invoked: in the definition of paradigm functions and of rules of referral, including the FCD (=(5), section 5.2), a universal rule of referral. In Network Morphology, by contrast, there is nothing strictly comparable to the Nar_n notation: this is because Pāṇini's principle is, in DATR, embodied by the principles of default inference.

This difference between PFM and Network Morphology raises the possibility of modifying PFM by dispensing altogether with the Nar_n notation and by introducing a set of default principles of rule inference analogous to the default principles for the inference of facts in DATR. By virtue of the latter principles, the facts which are situated at a particular node N in a Network-Morphologic description are of two kinds: some (N's DEFINITIONAL facts) are situated at N by simple stipulation, while others (what I shall call N's DEDUCIBLE facts) are situated at N by default inference from N's definitional facts (Evans and Gazdar 1989a:69f.). Analogously, imagine a PFM description in which a language's realization rules are of two kinds: some rules are definitional, being directly stipulated by the grammar; others are deducible, in the sense that their characteristics are fully determined by those of the definitional rules. Given a set DEF_ℓ of definitional rules in a language ℓ, the complementary set DED_ℓ of deducible rules is the smallest set satisfying the following criterion:

(58) For any rule $\mathrm{RR}_{n,\tau,\mathrm{C}} \in \mathrm{DEF}_\ell$, there is an otherwise identical rule $\mathrm{RR}_{n,\sigma,\{\mathrm{L}\}} \in \mathrm{DED}_\ell$, provided that:
a. the lexeme $\mathrm{L} \in \mathrm{C}$,
b. σ is a complete set of morphosyntactic properties appropriate to L,
c. σ is an extension of τ,
d. $\mathrm{RR}_{n,\sigma,\{\mathrm{L}\}}$ is narrower than $\mathrm{RR}_{n,\tau,\mathrm{C}}$ (in the sense defined in section 2.7), and
e. for any other rule $\mathrm{RR}_{n,\tau',\mathrm{C}'} \in \mathrm{DEF}_\ell$,

if i. $L \in C'$,
ii. σ is an extension of τ', and
iii. $RR_{n,\sigma,\{L\}}$ is narrower than $RR_{n,\tau',C'}$,
then $RR_{n,\tau,C}$ is narrower than $RR_{n,\tau',C'}$.

Each of the deducible rules licensed by (58) is maximally narrow, in the sense that it realizes a complete set of morphosyntactic properties and is restricted in application to a single lexeme; moreover, in order for $RR_{n,\sigma,\{L\}}$ to be deducible from a definitional rule $RR_{n,\tau,C}$, it must be the case that among all the definitional rules at Block n, $RR_{n,\tau,C}$ is the narrowest one that $RR_{n,\sigma,\{L\}}$ is both narrower than and potentially compatible with (in the sense defined in section 1.5.2). Thus, (58) generates a (sometimes huge) set of theorems for each of the definitional rules in a language's inflectional system.

Consider an example. Suppose that $DEF_{Bulgarian}$ contains the rule blocks **A**–**D** proposed in chapter 2 ((14), section 2.5), including – in each block – an instantiation of the IFD. In that case, the criterion in (58) requires $DED_{Bulgarian}$ to include each of the (a) rules in (59) (among many others), and by virtue of clause (58e), to exclude each of the (b) rules (among many others).

(59) Where σ = {VFORM:fin, VCE:act, TNS:aor, PRET:yes, MOOD:indic, AGR:{PER:3, NUM:sg}},

a. $RR_{A,\sigma,\{\text{KRAD}\}}(\langle X,\sigma\rangle) =_{def} \langle Y',\sigma\rangle$, where Y is X's Second stem
$RR_{B,\sigma,\{\text{KRAD}\}}(\langle X,\sigma\rangle) =_{def} \langle X',\sigma\rangle$
$RR_{C,\sigma,\{\text{KRAD}\}}(\langle X,\sigma\rangle) =_{def} \langle X',\sigma\rangle$

b. $RR_{A,\sigma,\{\text{KRAD}\}}(\langle X,\sigma\rangle) =_{def} \langle Y',\sigma\rangle$, where Y is X's First stem
$RR_{B,\sigma,\{\text{KRAD}\}}(\langle X,\sigma\rangle) =_{def} \langle X\mathit{o}',\sigma\rangle$
$RR_{C,\sigma,\{\text{KRAD}\}}(\langle X,\sigma\rangle) =_{def} \langle X\mathit{x}',\sigma\rangle$

Given the criterion in (58), the FCD can now be defined without reference to the Nar_n notation, as a generalization over the union of DEF_ℓ and DED_ℓ in any language ℓ.

(60) Function Composition Default:
Where L-index(X) = L, $RR_{[n,m],\{\},U}(\langle X,\sigma\rangle) =_{def}$
$RR_{n,\sigma,\{L\}}(RR_{m,\sigma,\{L\}}(\langle X,\sigma\rangle))$.

Moreover, the rule of referral in (47) can be redefined as in (61):

(61) Where n is any of rule blocks **A** to **D** and L-index(X) = L,
$RR_{n,\leftarrow\{\text{PRET:yes, AGR:\{PER:2, NUM:sg\}}\}\rightarrow,V}(\langle X,\sigma\rangle) =_{def} \langle Y,\sigma\rangle$,
where $RR_{n,\sigma/\{\text{AGR:\{PER:3\}}\},\{L\}}(\langle X,\sigma/\{\text{AGR:\{PER:3\}}\}\rangle) =$
$\langle Y,\sigma/\{\text{AGR:\{PER:3\}}\}\rangle$.

And in general, a language ℓ's paradigm function can be defined in terms of the union of DEF_ℓ and DED_ℓ. Suppose, for instance, that $DEF_{Bulgarian}$ contains all of the rule blocks proposed in section 2.5 (including – in each block – an instantiation of the IFD) as well as the portmanteau blocks [B,A], [C,[B,A]], and [D,[C,[B,A]]], each having an instantiation of the newly redefined FCD as its sole definitional rule; in that case, the earlier partial definition of the Bulgarian paradigm function ((26), section 2.7) can be restated without reference to Nar_n notation as in (62).

(62) Where σ is a complete set of morphosyntactic properties for lexemes of category V, X is not a word-to-word derivative, and L-index(X) = L, $PF(<X,\sigma>) =_{def} RR_{[D,[C,[B,A]]],\sigma,\{L\}}(<X,\sigma>)$

In this way, the Nar_n notation can be altogether dispensed with in PFM; in this modified version of the theory, Pāṇini's principle has precisely the same role that it has in Network Morphology – that of a constraint on default inference.

The foregoing considerations make it clear that PFM and Network Morphology are not the same theory: rules of referral work slightly differently in the two theories; in PFM, the determinism of Pāṇini's principle hinges on the assumption that realization-rule blocks are constrained by the Pāṇinian well-formedness condition, while in Network Morphology, it instead hinges on the assumption that attributes are organized into paths; and Pāṇini's principle is formalized as the Nar_n notation in PFM but as a principle of default inference in Network Morphology.

Notwithstanding these differences, the two theories are strongly convergent in their basic assumptions: both theories are inferential and realizational; both presume that the evaluation of one rule (or path) may inherently depend upon the evaluation of other rules (or paths), as the evaluation of a language's paradigm function depends on that of its realization rules, or as the evaluation of a rule of referral depends upon that of the specific rules to which it refers; both theories attribute central importance to Pāṇini's principle of general defaults and specific overrides; both presume the existence of morphomic properties (or attributes); neither presumes an invariant linear ordering of rule blocks; and so on.

The convergence of theories is always a promising sign in the evolution of a discipline; it suggests a developing consensus on the proper resolution of foundational issues and a corresponding circumscription of the field of debate. The conceptual proximity of PFM and Network Morphology suggests to me that in our understanding of the fundamental principles regulating inflectional morphology in human language, we may actually be getting somewhere.

Notes

1 Inferential–realizational morphology

1 The notion of lexeme assumed here is that of e.g. Matthews 1972, Aronoff 1994; in Aronoff's words, 'a lexeme is a (potential or actual) member of a major lexical category, having both form and meaning but being neither, and existing outside of any particular syntactic context' (p.11).

2 Thanks to Andrew Spencer for suggesting this term.

3 Halle and Marantz (1993:138f.) state that in Distributed Morphology, 'there is no "multiple exponence" of features from a single syntactic or morphological node'; nevertheless, Distributed Morphology allows extended exponence by allowing the same morphosyntactic property to appear in more than one morphemic node in a word's constituent structure.

4 See Stump (1993d) for a formal analysis of the Nyanja facts in an inferential–realizational framework.

5 Ortmann (1999) goes to considerable lengths to argue that the outer prefix is not just featurally redundant in words like *ca-ci-kulu*. His analysis depends on (a) the assumption that *-bwino*-type adjectives are basically nominal, while *-kulu*-type adjectives are basically verbal; (b) the assumption that the qualifying prefix in *ca-bwino* and *ca-ci-kulu* serves simultaneously to express noun-class agreement and as a marker of adjective derivation; and (c) the assumption that the appearance of the inner, concordial prefix in forms such as *ca-ci-kulu* is in some way necessary to satisfy a principle according to which 'their predicative nature requires a specification of a potential individual referent' (p. 96). Given that assumption (a) is without independent motivation, that assumption (b) entails the postulation of a typologically unprecedented rule type, and that the principle to which (c) appeals is both ad hoc and vague in its precise content, Ortmann's conclusions can scarcely be accepted at face value. There is, in any event, massive counterevidence to the hypothesis that inflectional marking is constrained by any sort of anti-redundancy principle; cf. section 6.5.3. See also Donohue (1999).

6 The realization of the imperfect suffix *-'á* as *-é* is conditioned not only by the phonological context, but by grammatical information as well; thus, despite the presence of a front vowel in the following syllable, the imperfect suffix in *krad'áxme* 'we stole' and *krad'áxte* 'you (pl) stole' is not realized as *-é*. See Scatton (1984:79f.) for a complete discussion of the various factors conditioning the form of the imperfect suffix.

7 Marantz (1993) has argued that while an inflectional affix may join with an expression that is already marked with one or more inflectional affixes, nonconcatenative processes always apply prior to affixal inflection (so that their effects are always recorded on a stem rather than on any inflectional affix carried by that stem). If this were true, it might constitute an argument against the assumption in (6). But the purported difference between affixal and nonconcatenative inflection is simply illusory; nonconcatenative processes may affect inflectional affixes as well as stems. A particularly clear example of this comes from Hua, a Papuan language described by Haiman (1980). In Hua, certain verb forms carry two agreement inflections: the MEDIAL DESINENCE expresses agreement with the verb's subject, while the ANTICIPATORY DESINENCE expresses agreement with the subject of the subsequent clause (p.57); where the anticipatory desinence encodes neither first person nor singular number, the medial desinence undergoes a process of ablaut (p.65). The claimed difference between affixal and nonconcatenative inflection would, in any event, be quite unexpected in a theory which (like Distributed Morphology) treats affixes and stems as lexically listed elements of the same fundamental sort: if one regards affixes and stems as the same sort of thing, then one would seemingly expect affixes to be as available to nonconcatenative processes as stems are.

8 There are other reasons for rejecting the assumption that inflectional affixes may carry quasi-syntactic subcategorization restrictions; for instance, subcategorization frames are inadequate to account for affix distribution in languages with complex systems of position classes (Stump 1992, 1993c).

9 Although inferential–realizational morphology is incompatible with theories in which functional heads are identified with affixes, it does not, of course, exclude the existence of functional heads in syntax.

10 The Bulgarian forms cited here represent a conservative variety of the language; cf. chapter 2, note 8.

11 This notion is defined more precisely in section 2.7.

12 Despite the high incidence of featural coherence in Swahili inflectional rule blocks, there are some instances of featural heterogeneousness; for example, the negative past-tense rule of *ku*-prefixation is unlike the other members of its rule block (Block B in (18)) in realizing polarity as well as tense.

2 Paradigm functions

1 The evolution of this theory can be traced through a series of earlier publications: Stump 1991, 1992, 1993a–e, 1995a, b, 1997.

2 I follow Matthews' (1972) practice of representing lexemes in small capital letters.

3 Paradigm functions have a close analogue in Network Morphology, whose important similarities to PFM are discussed in section 8.3.

4 My terminology differs from that of some morphologists, for whom roots are, by definition, neither inflectionally nor derivationally complex. As I use the term, a root may or may not be morphologically unanalysable, since a lexeme arising by a rule of derivation or compounding will ordinarily have a root which

is morphologically complex; thus, roots are basic only in the inflectional sense of lacking overt inflectional exponents.

5 Thus, PFM is not in any sense a 'transformational' theory of inflectional form; cf. Zwicky (1992:346).

6 Verbal lexemes belonging to the perfective aspect are systematically defective in lacking present active participles (Aronson 1968:71; Scatton 1984:179).

7 This classification of Bulgarian conjugations differs from the traditional classification (for a summary of which see Scatton (1984:436ff.)), in which a verb's conjugation-class membership is determined by its present-tense theme vowel. A comparative evaluation of these contrasting approaches to Bulgarian conjugation classes would be tangential to the theoretical concerns at issue here.

8 As Scatton (1984:185) observes, some speakers of Bulgarian employ *-me* in the first-person plural present of all declensions; thus, the dialect represented in table 2.2 is a conservative one (the literary language, as described by Aronson (1968)).

9 A number of additional factors condition the *jat* alternation in other morphological contexts, but because these factors play no role in the morphophonology of the imperfect suffix, they are ignored here. For full discussion of the details of the *jat* alternation, see Aronson (1968:45f.) and Scatton (1984:77ff.).

10 The forms in table 2.3 have no theoretical status; in particular, they are not 'underlying representations' in any sense. They are included here only to make the system of Bulgarian verb inflection more transparent to the reader.

11 One might question whether properties of tense are actually morphosyntactic properties in the sense assumed here, since tense distinctions (unlike e.g. the finite/participial distinction or the indicative/imperative distinction) seem to be purely semantic in Bulgarian; it isn't obvious that they have any irreducibly syntactic correlates. But properties of tense are more similar in their morphological expression to indubitably morphosyntactic properties than to purely morphological properties of conjugation-class membership or to derivational categories; for instance, they are comparable to properties of mood and finiteness in the high degree of morphological fusion which they exhibit with properties of agreement.

12 Typically of Slavic languages, Bulgarian exhibits a systematic opposition between perfective and imperfective verbal lexemes; because this opposition is mediated by derivational rather than inflectional principles (Scatton 1984:179, 285ff.), feature–value pairings representing aspectual properties are excluded from the inventory in (2).

13 An alternative conception of 'cell' is possible. If one distinguishes between a lexeme's l-properties (those morphosyntactic properties shared by every member of the lexeme's paradigm, e.g. the property 'neuter' in the paradigm of German BUCH) and its w-properties (those which distinguish members of the paradigm from one another, e.g. the property 'plural' in the paradigm of BUCH), then one might assume that the property sets associated with the cells in the paradigm of some lexeme L only include L's w-properties (and are therefore complete only with the addition of L's l-properties). The choice between this conception of 'cell' and that assumed in the text is, for the most part, not critical;

however, the Kikuyu analysis developed in section 6.5.2 presumes the former conception.

14 These blocks cannot (pace Inkelas 1993) be identified with strata in a level-ordered morphology, since there are instances in which the sequence of blocks varies with the set of morphosyntactic properties being realized (see section 5.4), instances in which the same rule acts as a member of two noncontiguous blocks in a word's morphology (section 5.3), and instances in which a single rule occupies two successive blocks (section 5.2); none of these phenomena is compatible with any usual formulation of the level-ordering hypothesis.

15 The notation '$=_{\text{def}}$' means 'equals by definition'.

Readers familiar with Stump (1993b) should note that in that article, the notation 'RR' was used to represent rules of referral; here, 'RR' is used to represent ALL realization rules, including rules of exponence as well as rules of referral.

16 Given any argument <X,σ> to which a realization rule applies, the corresponding value <Y′,σ> shares the property set σ. In view of this, one might well ask why the definition of a realization rule ever needs to make explicit reference to the shared property set. As it turns out, one can't assume that a language's realization rules are simply functions in its set of morphological expressions (simply applying to stems to yield stems or words) because there is a subclass of realization rules – namely rules of referral – whose application yields a value <Y′,σ> such that the form of Y′ depends on the specific identity of σ; for this subclass of realization rules, mention of the shared property set σ cannot be suppressed. The need for schematization in the definition of paradigm functions makes it desirable to employ a format for the definition of realization rules which is usable for any such rule (whether or not it is a rule of referral); thus, if it is necessary to treat some realization rules as functions in the set of FPSPs, it is desirable to treat all realization rules as functions of this sort.

17 In Bulgarian orthography, the suffixal schwa introduced by **D1** and **D8** is represented as *a*.

18 In Stump (1993b:452), I propose a similar rule of referral for similar facts in Macedonian. Wunderlich (1996:109) brands that rule a substitution transformation, which of course it is not; his confusion seems to stem from a mistaken assumption that PFM is an incremental rather than a realizational theory of inflection.

19 Inkelas and Orgun (1998) have proposed an approach to morphophonology which is quite similar to the one developed here; cf. also Bochner (1993:183ff.). See Stump (1998) for discussion of the differences between Inkelas and Orgun's approach and the approach advocated here.

20 According to (18e), (17g) is associated with **B1**. Although it isn't motivated by any of the paradigms in table 2.2, this association is motivated by other paradigms. For instance, the 3sg present-tense form of the [+T,+C] verb ŽIVAJ 'live' is *živéj-e*, in which the present-tense suffix *-e* introduced by **B1** causes *Á* to be realized as *é*; cf. the corresponding 3sg aorist form *živ'á.*

21 The morphological metageneralizations in (18) all serve to associate realization

rules with morphophonological rules. Metageneralizations, however, may also effect stem selection in certain cases; this point is taken up in section 6.2.3.

22 In (19) and several subsequent examples, the realization rules in (14) are represented in an abbreviated form; rule **D5**, for example, is represented by the abbreviation $\mathrm{RR}_{\mathbf{[D5]}}$ rather than by its full form $\mathrm{RR}_{\mathrm{D},\{\mathrm{TNS:pres,\ AGR:\{PER:1,\ NUM:pl\}}\},([\mathrm{CONJ:+T}]\cup[\mathrm{CONJ:+C}])}$.

23 The IFD is revised in section 5.2.

In earlier work (e.g. Stump 1992:216; 1993b:458; 1993c:147), I formulated the IFD not as a realization rule, but as a special principle operative in the absence of any applicable realization rule; the present definition is preferable, since it subsumes the IFD under an independently motivated rule type.

24 This definition is partial in the sense that it only accounts for verb conjugation; a complete definition of the Bulgarian paradigm function would also have to account for the declensional morphology of nominal expressions.

3 Rule competition

1 The Potawatomi forms cited in tables 3.1 – 3.4, 3.8 – 3.11 are cited from Hockett (1948). The forms in tables 3.5 and 3.12 are deducible from his discussion; cf. also Anderson (1992:167), Steele (1995:263).

2 The rule introducing the third-person indirect-object agreement prefix *s-* ~ *h-* does not belong to the block of rules in (8). In one variety of Georgian, this rule applies before block (8), yielding forms such as *v-h-itxav* 'I shall ask him'; in another variety, it applies after (8), yielding such alternative forms as *v-itxav* (where the phonological conditions on the appearance of *s-* ~ *h-* prevent either alternant from appearing before *v*). Cf. Aronson (1990:174,182f.).

3 Halle and Marantz (1993) sketch an analysis of Georgian verb morphology to illustrate their theory of Distributed Morphology, a lexical–realizational theory of inflection. They argue that prior to lexical insertion, an inflected word's structure consists of a set of hierarchically organized morphemes, each of which comprises one or more morphosyntactic properties; each such morpheme ultimately hosts the insertion of a featurally compatible lexical item. The lexical items competing for insertion into the same abstract morpheme form a list such that the first featurally compatible item in the list overrides the others when lexical insertion takes place. While they hopefully leave open the possibility that some kind of universal hierarchy of morphosyntactic properties might suffice to determine the order in which competing items are listed, they acknowledge that '[i]f this should turn out not to be the case, the correct output can be obtained by imposing an extrinsic order of precedence' (p.120). And in fact, they resort to just this move in their Georgian analysis; the ordering of *g-* before *v-*, for example, is just stipulated. Because it allows the ordering of competing lexical entries to be stipulated in exactly the way that the ordering of competing rules is stipulated in Anderson's theory, Halle and Marantz's theory is unwarrantably unrestrictive: like Anderson's theory, it fails to exclude the hypothetical (and apparently unattested) situation depicted in (17) and (18).

4 The verb root *min-* 'give to' in tables 3.8 – 3.10 has an alternant *miš-*; in the conjunct paradigm, this alternant appears in forms exhibiting first-person exclusive object agreement. Cf. Hockett (1948:4).

5 These facts would likewise require a proponent of the rule-ordering approach to find some way of generalizing over the ordering relations among distinct sets of rules within the same rule block.

6 Anderson (1992:130) cites evidence from Plains Cree (another Algonkian language) which is, in all relevant respects, parallel to the Potawatomi evidence at issue here: when rules of verb inflection expressing 1pl agreement and 2pl agreement come into competition, the rule expressing 1pl agreement wins. Anderson's discussion focusses on the indicative paradigm in Plains Cree, but a perusal of the conjunct paradigm (Wolfart 1973:42) reveals the same pattern (though with different morphology); my assumption, therefore, is that Plains Cree has an expansion metarule directly analogous to (27).

Anderson mentions (p.130) a divergent dialect of Cree in which the competition between 1pl and the 2pl is resolved in favour of 2pl. He regards this dialect difference as a difference in rule ordering; under my assumptions, by contrast, the divergent dialect would be assumed to have a metarule expanding 2pl agreement rules rather than 1pl agreement rules.

7 As it is formulated, (30c) also applies in the conjunct mood; according to Hockett (1948:149), its application in the conjunct mood is optional.

8 This latter suffix should naturally be identified with the *-t* whose optional appearance expresses number agreement with a second-conjugation verb's 3pl indirect object provided that its subject is neither first nor second person. See Hewitt (1996:135f.), Aronson (1990:345); cf. also Anderson (1984:188n.).

9 As it is formulated, rule (38e) implies that in the inversion construction, -t_2 should mark the presence of a 2pl subject and a singular direct object. This implication might appear to be at odds with the appearance of -t_2 in intransitive inverted forms such as *g-iiria-t* 'you (pl) have cried' (Aronson 1990:269); but it is a general property of intransitive inverted forms that they inflect as if they had a 3sg direct object – cf. Anderson (1984:175f.), Aronson (1990:268, 346).

4 Headedness

1 This chapter is based on Stump (1995a), with several important modifications.

2 In this example, the derivational marker *-aka* is external to what Booij (1994, 1996) calls an INHERENT inflection; but there are also instances of head marking in which the internal inflectional marking is (in Booij's sense) CONTEXTUAL, e.g. Russian *móem-sja* 'we wash ourselves'. Nevertheless, inherent and contextual inflections do (as Booij argues) interact differently with derivational morphology: in particular, the former may be internal to category-changing derivation (cf. Stump 1990a,b), while the latter generally cannot.

3 Booij (1989) proposes an account of this sort to explain the difference between e.g. *understand/understood* and *grandstand/grandstanded*: on his view, *understand* exhibits the same strong inflection as *stand* because the morphological

property [strong] percolates from the head of a compound verb to the verb as a whole; the weak inflection of *grandstand* then follows from the fact that conversion creates headless roots (as argued earlier by Williams 1981). Like Booij, I assume that the lack of inflectional parallelism between *grandstand* and *stand* follows from *grandstand*'s headlessness (section 4.3.1); nevertheless, my conclusion here is that the inflectional parallelism that exists between *understand* and *stand* is an effect of head marking rather than percolation. Cf. note 4.

4 Generalization (5) entails that English exhibits a good deal of head marking; for instance, the inflectional parallelism between *undertake* and *take* (cf. the past participles *undertaken* and *taken*) can only be viewed as an effect of head marking once (5) is assumed. This is at odds with the widely held view that whatever property causes *take* to 'select' *-en* percolates from *take* to *undertake*, causing it to select *-en* as well (cf. Williams 1981:255f.). The latter view is necessitated by the assumption that *undertaken* has the hierarchical structure [[*under take*] *en*], whose motivation is purportedly semantic: because the meaning of *undertake* is a part of the meaning of *undertaken*, *undertake* itself must – it is reasoned – be a structural constituent of *undertaken*. This reasoning is fallacious, however; morphological structure is not consistently isomorphic to semantic structure (Stump 1991). This lack of isomorphism is obvious in many languages (cf. Sanskrit *nyapatat*, German *eingesehen*, and so on), but is not so obvious in English: the fact that the head of an endocentric word in English is typically its final constituent and the fact that English inflectional affixes are suffixal conspire to make the isomorphism fallacy look reasonable.

5 Several other high-frequency verbs exhibit a similar development in Early Modern English; see Barber (1976:320ff.).

6 Given the extent to which uniform head marking enhances the learnability of a language's inflectional morphology, the question naturally arises why some headed roots should exhibit external marking or double marking rather than head marking – that is, the question arises why the EM and 2M subclasses should even exist. I have no definitive answer to propose here. It should be pointed out, however, that the phenomenon of head marking sometimes conflicts with what Haspelmath (1993:12) calls the Inflection-outside-Derivation Principle ('A morphologically complex word is preferred if its inflectional affixes are further away from the root than its derivational affixes'), whose psycholinguistic importance (both in the domain of sentence processing and in that of lexical storage) has sometimes been asserted. Perhaps the three-way subclassification of headed roots is in some way a compromise amid conflicting demands. There are, in fact, some tantalizing regularities in the ways in which such compromises are played out. For instance, head marking by its nature gives rise to expressions in which inflection is internal to (category-preserving) derivation, but it is much more likely to be tolerated if the exponents of inflection are not linearly internal to the derivational formative(s); thus, in languages with suffixal inflection, roots in the HM subclass tend to arise through the application of category-preserving rules of prefixation. Moreover, linearly internal inflections are more likely to be tolerated if they are exponents of number than if they are exponents of case; cf. note 2. Less explicably, many of the clearest examples of double marking involve

evaluative derivatives – diminutives, augmentatives, and pejoratives (Stump 1993a). A systematic account of such regularities must await further research.

7 Halpern (1992:148ff.) proposes an apparent counterexample to this claim: ordinal marking only appears on the last element of a compound numeral (*three hundred and twenty-ninth*) and is therefore seemingly an edge marking – yet certain ordinal numerals have the status of portmanteaus relative to their cardinal counterparts (e.g. cardinal *one*, ordinal *first*, **oneth*). See Stump (1995a: 292f.) for discussion of this claim.

8 On the other hand, (24) is compatible with the assumption that German has a morphological rule of endocentric nominal compounding which requires the nonhead member of any such compound to assume its conjunct form (if it has one); on this assumption, the identification of *Schwanen-* and *Freiheits-* as conjunct forms of *Schwan* and *Freiheit* suffices to account for the appearance of *-en* and *-s* in *Schwanengesang* and *Freiheitskämpfer*.

5 Rule blocks

1 The phenomena of portmanteau, parallel, and reversible rule blocks were first discussed, in slightly different terms, by Stump (1993c).

2 In earlier work (e.g. Stump 1993c:149), I formulated the FCD not as a realization rule, but as a special principle operative in the absence of any applicable realization rule; the present definition is preferable, since it subsumes the FCD under an independently motivated rule type.

3 In reality, the full complexity of Swahili verb inflection necessitates a paradigm function whose definition is much more complex than (7); see Stump (1993c) for a closer approximation of this more complex definition.

4 Zwicky (1992:353) cites another example of this phenomenon.

5 See Arnott (1970:316ff.) for a detailed discussion of the range of syntactic contexts in which the relative tenses are used.

6 Fula has an elaborate system of twenty-five noun classes. Thus, there are many additional verbal affixes used to encode agreement with third-person arguments having nonpersonal reference; see Arnott (1970:193ff.;209ff.).

7 Noyer's principle of feature discharge and his Spell-Out Ordering Hypothesis (given in (34) below) both have close analogues in Beard's theory of Lexeme-Morpheme Base Morphology; see Beard (1995:51ff.).

8 Moreover, Bentolila (1981:122) once records a suffixal alternation of *-mt* with *-nt* in a 2pl feminine verb form.

9 It should be carefully noted that rejecting the notion of feature discharge doesn't entail rejecting some notion of 'discontinuous bleeding' – the override of a rule of prefixation by a rule of suffixation, or vice versa. Under the assumptions of PFM, it is perfectly possible to have a single rule block in which rules of prefixation compete with rules of suffixation and in which that competition is resolved by Pāṇini's principle. In Stump (1993c:138ff.), I refer to a class of affixes introduced by a block of this sort as an AMBIFIXAL position class. As examples, I cite the block of rules introducing the Swahili relative affixes and the block of rules introducing the Fula preterite affixes. (In Fula, the default preterite rule is the

rule (26b) of *-noo* suffixation; but in the first stative and first continuous tenses, this rule is overridden by a more specific rule of *noo*-prefixation; see Arnott (1970:216ff.).)

6 Stem alternations

1 Maiden (1992) presents diachronic evidence from Romance which strongly supports the postulation of morphomic stem classes: as he shows, morphological change often has the effect of reinforcing or amplifying paradigmatic patterns of stem alternation which are without synchronic phonological motivation and which fail to express any natural contrast among morphosyntactic properties.

2 The few feminine nouns belonging to the subclass of multiple-C-stem nominals exhibit the same pattern of stem alternation as the masculine members of the subclass. Adjectival members generally build all of their feminine forms on a special feminine stem (the result of suffixing *-ī* to the Weak stem) which does not participate in the system of Strong/Weak alternations at issue here; for some systematic exceptions to this regularity, see Whitney 1889: section 378.

3 Regarding the following sandhi modifications in tables 6.3 and 6.4, see Whitney 1889: reduction of underlying word-final *ns-s* to *n* in the masculine nominative singular, section 150; change of stem-final *ns-* to *ṃs-* in the other Strong cases, sections 70ff.; assimilative voicing of stem-final *t* in the instrumental, dative, and ablative of the dual and plural, sections 111 and 157. Concerning the phonetic quality of *ṃ*, see Whitney 1889:sections 70ff.

Only seven cases figure in the paradigms given in tables 6.1–6.4; Sanskrit does, however, have an eighth case – the vocative – discussion of which will be deferred until section 6.3.3.

4 It should be emphasized that although *tasthúṣ-* is restricted to prevocalic positions and *tasthivát-* is restricted to nonprevocalic positions, this restriction is morphological rather than phonological in nature; that is, there is no general property of Sanskrit phonology that would exclude either the prevocalic appearance of *tasthivát-* or the nonprevocalic appearance of *tasthúṣ-*.

5 The conclusion that stem-selection rules must be dissociated from morphological operations was, to my knowledge, first argued for by Zwicky in a 1992 manuscript and in class lectures (from a 1992 graduate seminar at the Ohio State University and from the 1993 LSA Summer Institute).

6 The simplified reformulation is given below in (7b).

7 On the other hand, (8) would – in a more comprehensive account of Sanskrit morphology – have to be stated in somewhat more general terms, to account for the fact that the special stem on which most multiple-C-stem nominals build their feminine paradigm is ordinarily derived from the Weakest stem through the suffixation of *-ī* (e.g. *tasthúṣ-ī-*). That is, where X and Y are (respectively) the Middle and Weakest stems of some nominal belonging to the Weakest class, the application of the morphological rule of *-ī* suffixation (a derivational rule, unlike those in (7)) to X should have the substitution of Y for X as a concomitant.

8 Not all nominal stems ending in a resonant consonant form their masculine or

feminine nominative singular through the loss of this consonant rather than through the suffixation of *-s*; cf. Whitney 1889: sections 391–2.

9 Clause (c) in (13) doesn't imply (a) and (b), because a perfect active participle having a Weakest stem of the form X*úṣ*- may have X*vā́ns*- as its Strong stem and X*vát*- as its Middle stem: VIDVANS 'knowing', Strong stem *vidvā́ns*-, Middle stem *vidvát*-, Weakest stem *vidúṣ*-. This difference between TASTHIVANS and VIDVANS is one manifestation of a more general problem in Sanskrit morphology, namely that posed by the incidence of what Whitney (1889: section 254) calls 'union-vowels'. Various ways of addressing this problem are imaginable, but will not be pursued here.

10 In (15), the variable C_0 represents zero or more consonants, and the variable (R) represents an optional resonant consonant.

11 This formulation of (15) makes it possible to assume that for some gradational lexemes, it is the Vṛddhi-grade stem that is lexically listed; that for others, the Guṇa-grade stem is instead listed; and that for still others, it is the Zero-grade stem that is listed. This property of (15) is desirable because none of the three vowel grades can be satisfactorily viewed as basic in all instances; see Stump (1984) for evidence to this effect.

Because rules of derivation may give rise to vowel-grade alternations in a stem's first (rather than its final) syllable (cf. e.g. Whitney 1889: section 1204), (15) does not characterize the full range of vowel-grade alternations observed in Sanskrit derivational morphology; various ways of generalizing (15) so as to cover both derivational and inflectional phenomena suggest themselves, but will not be pursued here.

12 The change of *n* to *ñ* in *rā́jñ*- is the effect of a regular sandhi process; see Whitney 1889: section 201.

13 The use of rules of referral in accounting for systematic syncretism is discussed in detail in chapter 7.

14 Two other situations in which it might be desirable to postulate stem-selection rules making direct reference to the Guṇa grade arise in the paradigms of *n*-stem nominals (e.g. RAJAN, NAMAN 'name', AHAN), which allow the Guṇa-grade stem as an optional alternative to the Middle or Weakest stem in the formation of the locative singular and the neuter nominative/accusative dual (Whitney 1889: section 421): thus, alongside loc sg *rā́jñ-i*, *nā́mn-i*, *áhn-i* one also finds *rā́jan-i*, *nā́man-i*, *áhan-i*; and alongside nom/acc du *nā́mn-ī*, *áhn-ī* one finds *nā́man-ī*, *áhan-ī*. Moreover, the Strong, Guṇa-grade stem appears instead of or alongside the Weakest, Zero-grade stem in the neuter nominative/accusative dual of some present and future active participles (Whitney 1889: section 443).

15 The Zero-grade stem *pd*- of PAD can appear under the right prosodic circumstances; as an example, Burrow (1973:109) cites the derived adjectival stem *upa-bd-á*- 'trampling under foot', where the change of *p* to *b* is by regular assimilation.

16 Concerning the corresponding feminine forms, see again note 2.

17 I have said little here about the declension of Sanskrit nominals whose stems end in vowels; these are numerous and diverse, and their inflectional characteristics differ sharply from those of the C-stems at issue here. The reader is directed to Whitney (1889: chapter V) for details.

18 Not all of the derivatives determined by a word-to-stem rule are necessarily inflectable; metarule (28) has no observable consequences for those that are not. For example, although gradable adjectives generally inflect for degree in Breton, it is not clear that diminutive adjectives ever do. When the root of an adjectival lexeme is diminutivized, the resulting form has a clearly evaluative meaning: *pell* 'far' → *pellig* 'a little (too) far'. There is no way to inflect *pellig* for degree so as to preserve this evaluative meaning. The comparative form *pelloc'h* 'farther' can itself be diminutivized, but the resulting form *pelloc'hig* 'a little farther' cannot obviously be regarded as the comparative form of *pellig*, since its meaning is not evaluative in the way that *pellig*'s is: if *pellig* had a comparative form, its meaning would instead seemingly have to be 'possessing to a greater degree the property of being a little too far'. The superlative form *pellañ* 'farthest' can likewise be diminutivized, to produce a form whose meaning ('farthest by a little bit') again lacks the evaluative quality of *pellig*'s meaning. In some (but not all) varieties of Breton, the diminutive of a superlative exhibits a kind of double marking: *pellaïkañ* (< *pell-añ-ig-añ*; Trépos 1968:106); despite its superficial similarity to *bagoùigoù*, *pellaïkañ* can't clearly be seen as evidence that *pellig* – like *bagig* – belongs to the 2M subclass.

19 This analysis of Kikuyu embodies a possibility that was raised earlier (chapter 2, note 13): that in the pairing <X,σ> to which a paradigm function applies, the set σ of morphosyntactic properties only includes w-properties (i.e. properties which distinguish members of X's paradigm from one another). This assumption is necessitated by the formulation of metarule (28), according to which the morphosyntactic properties associated with the singular and plural cells in the paradigm of RŨŨTHI$_{\text{BASE}}$ must match those associated with the corresponding cells in the paradigm of RŨŨTHI$_{\text{DIM}}$; if properties of gender were associated with these cells, they wouldn't match.

20 Similarly, recall Nyanja *zi-pewa za-zi-kulu* 'large hats', in which the adjective *-kulu* carries two affixal exponents of the property set {GEN:7/8, NUM:pl} – the class 8 qualifying prefix *za-* and the class 8 concordial prefix *zi-*; see section 1.2. Cf. Plank (1985) for additional examples of this sort.

7 Syncretism

1 See Zwicky (1990:223), Stump (1993b:468ff.); cf. also Carstairs (1987:114ff.).

2 Stump (1993b:468ff.) discusses examples of bidirectional referrals from Old Icelandic and Russian; the latter of these is taken up below.

3 Stump (1993b:450f.) discusses an example of unstipulated syncretism from Welsh Romany.

Unstipulated syncretisms correspond to what Blevins (1995) calls 'artifactual' syncretisms. Blevins argues that apparent instances of this sort of syncretism should instead be seen as instances of featural underspecification. On this view, the verb form *walk* doesn't occupy five different cells in the present indicative paradigm of WALK; rather, it occupies a single cell unspecified for either person or number. Its competitor *walks* occupies the cell specified 'third-person singular' in WALK's present indicative paradigm, and lexical insertion is constrained by a blocking principle which guarantees the priority of *walks* over *walk* in 3sg contexts.

Blevins' arguments presume an incremental conception of inflectional morphology. In a realizational theory, 'underspecification' (or rather, underdetermination) is a property of the rule system rather than of the paradigms that this system defines; accordingly, no blocking principle is necessary to guarantee the choice of *walks* over *walk*.

4 Rules of referral have sometimes been characterized (e.g. by Noyer 1998:267; Corbett and Fraser 1993:122f.) as feature-changing operations, but if they are defined according to the format for realization rules given in (11), section 2.5, then this characterization is simply wrong: according to that format, a rule of referral applies to a pairing $<X,\sigma>$ to yield a pairing $<Y,\sigma>$, leaving the morphosyntactic property set σ unaffected. Rules of referral don't change an expression's properties; they just cause its properties to be realized in the same way as some distinct set of properties is realized.

5 See Juilland and Edwards (1971:79) for discussion.

6 The bidirectionality of this syncretism seems to counterexemplify Carstairs' (1987:42ff.) Paradigm Economy Principle; in particular, it is unclear how this principle might be reconciled with the fact that *studént*, *dóktor*, and *déduška* exhibit three different declensional contrasts between the genitive singular and the nominative plural.

7 I assume here that (16a,b) are both overridden in the accusative singular inflection of second-declension nouns. For instance, the Block I instantiations of (16a,b) are overridden by the following rule schema introducing the second-declension accusative singular suffix *-u*:

$$\text{Where } L \in \text{Declension 2, } RR_{I,\{\text{CASE:acc, NUM:sg}\},\{L\}}(<X,\sigma>) =_{def} <Xu',\sigma>.$$

In addition, I assume that third-declension animates fail to undergo (16b) in the accusative singular because (16b) is overridden by a narrower rule referring the accusative singular realization of third-declension animates to that of the nominative singular.

8 The suffixes in *vrémen-i* and *vremen-á* (the genitive singular and nominative plural forms of VREMJA 'time' in table 7.9) should not be identified with the suffixes introduced by the rules in (17). In the paradigm of VREMJA, the suffix *-a* appears in the nominative and the accusative of both the singular and the plural (and nowhere else), while the suffix *-i* appears in the prepositional singular and dative singular cases in addition to the genitive singular. Apparently, the rules in (17) are overridden by more specific rules in the inflection of VREMJA: a highly restricted rule realizing nominative case (singular or plural) through the suffixation of *-a* and an equally restricted rule realizing the singular oblique cases (other than the instrumental) through the suffixation of *-i*.

9 When an inflected form has two or more distinct 'shapes' appearing in complementary distribution, one of these shapes may, on its own, participate in a relation of stipulated identity with some other member of the same paradigm. In French, for example, the feminine singular form of the possessive pronoun 'my' has two shapes, one appearing preconsonantally and the other prevocalically (*ma copine*, *mon amie*). The latter shape is identical to the masculine singular form of 'my'; Zwicky (1985b) argues that this relation is stipulated by a rule

having essentially the character of a rule of referral. (Perlmutter (1998) argues for an alternative, optimality-theoretic account according to which the need to avoid vowel hiatus (**ma amie*) outweighs the need for gender concord; see Janda (1998) for compelling counterarguments.)

10 One can easily imagine a feature-checking analysis of the Sanskrit periphrastic future. In such an analysis, a node AGR would carry specifications for person and number, and would, as a bound element, need to end up with an identically specified verb adjoined to it. Verbs would have highly defective periphrastic future paradigms, consisting only of third-person forms plus a default form; the verb DA 'give', for example, would have the paradigm in (i).

(i)	default:	*dātā́*
	third-person singular:	*dātā́*
	third-person dual:	*dātā́rāu*
	third-person plural:	*dātā́ras*

Fully inflected third-person forms would adjoin to third-person AGR to have their features of person and number checked; but since there would be no first- or second-person forms to adjoin to first- or second-person AGR, a rule of auxiliary support would, as a last resort, introduce appropriately inflected forms of AS 'be' into AGR.

This analysis would reconcile the properties of the periphrastic future with the assumptions of inferential–realizational morphology; to its discredit, however, it would portray the stipulated defectiveness of periphrastic future paradigms and the stipulated existence of the auxiliary support rule as a coincidence. The approach proposed below, by contrast, is free of this (or any analogous) defect.

11 See Halle and Marantz (1993), who likewise invoke impoverishment in their theory of Distributed Morphology.

12 For example, in the Rumanian impersonal construction, the verb appears in the third-person singular (*Se pare că el a plecat* 'It seems that he has left'); and the third-person singular is morphologically unmarked in the imperfect.

13 Scrutiny of the much larger selection of syncretisms tabulated by Carstairs (1987:141ff.) likewise reveals general conformity. The few apparent counterexamples arguably involve unstipulated syncretisms, for which the Feature Ranking Principle is by definition irrelevant.

8 Conclusions, extensions, and alternatives

1 Spencer (1997) develops some detailed proposals concerning the morphology/syntax interface in the context of PFM and Jackendoff's (1997) grammatical architecture.

2 On mood, aspect, and tense, see Comrie (1976, 1985), Chung and Timberlake (1985), and Palmer (1986); on voice, Keenan (1985); on person and number, Anderson and Keenan (1985); on case, Andrews (1985); on gender, Corbett (1991); on definiteness, Lyons (1977); and on degree, Stassen (1985).

3 Sproat (1992) advances the idea that *unhappier* isn't actually a bracketing

paradox, arguing that in its semantics, the negative operator actually has scope over the comparative operator. This isn't a defensible analysis; cf. Kang (1993).

4 Proponents of a less restrictive morphological theory might postulate a phonologically empty plural suffix -∅ such that *chas-dour* could be assigned the alternative bracketings [[*chas*-∅] -*dour*] and [[*chas-dour*] -∅]; equivalently, they might assume that *ki* has a plural stem ∅ which takes a special plural suffix -*chas*, affording the bracketing alternatives [[∅-*chas*] -*dour*] [[∅-*dour*] -*chas*]. If issues of learnability are to be taken seriously, then analyses of this character must be rejected in principle.

5 Certain purported 'bracketing paradoxes' do not involve headed structures and therefore cannot be resolved by appealing to the HAP; such is the well-known *ungrammaticality* paradox. But *ungrammaticality* is paradoxical only if one subscribes to the Affix Ordering Generalization of Lexical Phonology. (According to this generalization, *ungrammaticality* must have the structure [*un*[*grammaticality*]] because -*ity* is a Level I affix while *un*- is a Level II affix; yet, the meaning of *ungrammaticality* favours the alternative bracketing [[*ungrammatical*]*ity*].) If one simply rejects the Affix Ordering Generalization (section 2.6), then there is nothing paradoxical about *ungrammaticality*. Ironically, the purported paradoxicality of unheaded structures such as *ungrammaticality* seems to have obscured the possibility of explaining the *unhappier* paradox (and others like it) as an effect of head marking.

6 One could attempt to counter this line of reasoning by suggesting that *śuśobhiṣa*- arises from *śubh*- by means of a single rule of derivational morphology which happens to introduce three different markings. But the evidence from Sanskrit (Whitney 1889:372ff.) suggests otherwise. The three markings of desiderativity in *śuśobhiṣa* are 'separable' in the sense that they don't always coincide. In many desideratives, the root does not assume its Guṇa-grade form, but instead remains unchanged (e.g. *rurudiṣa*-, from *rud*- 'weep') or is merely lengthened (e.g. *śuśrūṣa*-, from *śru*- 'hear'); in some desideratives, there is no reduplication (e.g. *dipsa*-, from *dabh*- 'injure'); and so on.

7 As formulated, the Generalized HAP (27) leaves open the possibility that a word-to-word rule M might be defined for a root Z but not for Z's δ-derivative W. Instances of this sort do arise. In Icelandic, middle verbs in -*st* exhibit head marking – their inflectional marking precedes the -*st* suffix; for instance, the middle verb stem KALLST 'be called' has *köll-uð-um-st* as its 1pl preterite form ('we were called'). Nevertheless, if a middle verb has a past participle which inflects for agreement, this participle's agreement marking is external to the -*st* suffix – that is, the participle fails to exhibit head marking: e.g. *leggjast* 'lie down', past participle *lagztur* (masc nom sg); *setjast* 'sit down', past participle *setztur* (masc nom sg). Anderson (1992:205f.) treats this as evidence of a distinction between head operations and simple operations (section 4.4) in Icelandic. The principle in (27), however, affords an alternative analysis.

In Icelandic, the morphological properties of past participles are unmistakably adjectival: they inflect for case, number, and gender, as well as for degree (Einarsson 1949:95). Thus, following Anderson (1990:249), one would surely want to regard the rule of past-participle formation as a rule of category-changing derivation producing deverbal adjectives; in the default case, it must be seen as a rule of conversion applying to a verb's past-tense stem (e.g. LEGGJA 'lay down', past-tense stem *lagð-* → past-participial root *lagð-*). But if this is so, then the failure of a middle verb's past participle to exhibit head marking can be simply accounted for by assuming that the word-to-word rule of *-st* suffixation is, by its definition, applicable to verbs but not to adjectives. On that assumption, the forms in the inflectional paradigm of the middle verb LEGGJAST arise from their counterparts in the paradigm of LEGGJA 'lay down' by *-st* suffixation, in accordance with (27); but being adjectival, neither the root nor the inflected forms of LEGGJA's past participial derivative are subject to *-st* suffixation, and therefore they do not give rise to the root and inflected forms of LEGGJAST's past participle. Instead, the root of LEGGJAST's past participle arises from LEGGJAST's past-tense stem *lagzt-* (= *-st* plus the past-tense stem *lagð* of LEGGJA) through the application of the default conversion rule; the resulting unheaded root then inflects in the usual way for a participial root.

The category-preserving rule of *-sja/-s'* suffixation in Russian, though functionally comparable to the Icelandic rule of *-st* suffixation, applies both to verbs and to their adjectival derivatives (Stump 1995a:281ff.). As a consequence, both MÝT'SJA 'to wash oneself' and its present active participle MÓJUŠČIJSJA 'who is washing up' exhibit inflectional head marking, in accordance with (27): 3pl pres *mójutsja*, dat pl *mójuščimsja*, and so on.

8 Following the usual practice in Network Morphology, I represent lexical nodes in lower-case letters with initial capitalization.

9 Compare the hierarchy proposed by Corbett and Fraser (1993:126) and Fraser and Corbett (1995:126) in their account of Russian declensional morphology.

10 See Evans and Gazdar (1996) concerning some of the existing computer implementations of DATR.

11 The validity of this analysis has been confirmed computationally by means of the QDATR implementation of DATR written by James Kilbury, Petra Barg, Ingrid Renz, and Christof Rumpf at the University of Düsseldorf.

12 Rules of referral having the general character of VERB:(s) in (44) are proposed by Corbett and Fraser (1993), Fraser and Corbett (1995), Brown (1996, 1998a), and Brown et al. (1996).

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