FEATURE PREDICTABILITY AND UNDERSPECIFICATION: PALATAL PROSODY IN JAPANESE MIMETICS

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This paper argues that theories of phonological underspecification requiring the underlying absence of all predictable values of features are doubly problematic: too radical for certain cases, not radical enough for others. Relevant evidence in favor of a Restricted Theory of Underspecification is found in the palatalization prosody operative in the mimetic (sound-symbolic) vocabulary of Japanese. It is shown that mimetic palatalization is the surface manifestation of an independent autosegmental micromorpheme mapped from right to left onto the mimetic root. We argue furthermore that cases calling for radically underspecified representations are more adequately accounted for by a Theory of Privative Features, which alone correctly predicts the desired underspecification not only underlyingly but also throughout the phonological derivation.*

Introduction

1. Underspecification of features occupies a central place in phonological theorizing: it plays an important analytical role in Autosegmental Theory (Williams 1976, Leben 1973, Goldsmith 1976, Clements 1976b, and other work) and is one of the main theoretical tenets of Lexical Phonology (Kiparsky 1982, 1984, 1985, etc.). More recently, questions have arisen regarding the proper degree of underlying underspecification. On the one hand, it has been argued that all predictable features and feature values must be underspecified (Kiparsky 1982, Archangeli 1984, Borowsky 1986, Archangeli & Pulleyblank 1986, and others); on the other hand, arguments have emerged that call for a more limited degree of underspecification (McCarthy 1985, Mester 1986, Steriade 1987a, Clements 1988a, Christdas 1988). As we will see, the investigation of the palatal prosody operative in the mimetic vocabulary of Japanese also provides a novel type of argument against an approach that insists on total absence of specification for all predictable features.

The goal of this article is to organize and present various kinds of evidence bearing on the relation between feature predictability and feature specification. Section 2 lays out and discusses the main theoretical issues in Underspecifi-

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cation Theory, as they present themselves to us. Section 3 illustrates the empirical generalizations of the Japanese palatal prosody; the basic analysis and its theoretical ramifications regarding underspecification are discussed in §4. Focussing on the analysis of the voicing restrictions in Japanese, §5 explores the possibility of adopting a theory of privative features, which is desirable for reasons of restrictiveness. Section 6 concludes with suggestions for future lines of research, and the Appendix takes up further issues arising with respect to the segmental content of the palatal morpheme and its associative behavior.

APPROACHES TO UNDERSPECIFICATION

2. Under the representational assumptions of segmental phonology as developed in Chomsky & Halle 1968 (henceforth *SPE*), underspecification could only mean underspecification of features, since phonological representations consisted exclusively of linear sequences of unstructured sets of distinctive features, categorized into segments and boundary elements. The richer view of phonological structure in nonlinear phonology (see e.g. van der Hulst & Smith 1982 for a representative collection of papers) makes it imperative to broaden the scope of underspecification in various respects—for example, to allow for the underlying absence of predictable prosodic structure such as syllables and feet. Other less-discussed candidates for underspecification include length[1], linear order of melody elements (Prince 1987, McCarthy 1989), and canonical prosodic size (as, for instance, in cases of root monosyllabism or disyllabism; see McCarthy & Prince 1986, 1989).

All predictable information contained in the phonological representation is in principle a candidate for underspecification. The fact that certain information CAN be underspecified, however, does not immediately entail that it IS underspecified, and the degree of underspecification continues to be a moot point. In order to illustrate what is at issue, we will first present three archetypical approaches to underspecification—schematized types under which existing proposals can be classified[2]: Naive Underspecification, which uses underspecification as a purely descriptive device (§2.1); Radical Underspecification, which enforces maximal underspecification (§2.2); and Restricted Underspecification, which restricts underspecification to redundant information (§2.2). The ensuing discussion highlights the strengths and weaknesses of these approaches (§2.3), clearing the way for a more adequate theory of feature specification.

[1] For example, Kiparsky 1982 presents convincing arguments to the effect that in English the feature [long] in short vowels is not specified, whereas long vowels are marked as [+long]. The recognition that length is not a segmental feature but a configuration in prosodic structure (see Prince 1984 for a clear exposition of the arguments) has led to the elimination of the feature [long], and this of course means that unless underspecification is recognized for entities other than features, Kiparsky's important insight into the English vowel system will remain inexpressible. In a mora-based representation, McCarthy & Prince 1988 have proposed that long segments (as opposed to short segments) can be considered underlyingly marked as moraic.

[2] This way of proceeding appears useful to us because we are here concerned with the conceptual core of the different proposals, not with the details of ways in which various researchers have executed the general program.

2.1. Underspecification as an analytical device: Naive Underspecification. The idea that gaps in feature specifications can express significant phonological generalizations (e.g. the postulation of archiphonemes in vowel harmony systems) has led to significant progress in phonological theory ever since the work of the Prague school (Trubetzkoy 1939; see Davidsen-Nielsen 1978 for a comprehensive overview). Within archisegmentalist phonology, it is important to draw a preliminary distinction between Naive Underspecification, the simple incorporation of archisegments into phonological representations in order to express generalizations, and a theory of underspecification, which attempts to predict under what circumstances features remain unspecified and thus provides the explanatory basis for archisegmental practice.

Most of the work in classical autosegmental theory can be said to fall under Naive Underspecification.[3] The theory grants a crucial role to autosegmental spreading to unspecified positions and hence relies on underspecification as an integral part of the overall framework. Autosegmentalizing a feature onto a separate tier necessarily entails that at least some segments are unspecified for that feature. To illustrate briefly how underspecification is involved in autosegmental analyses, we will present the well known case of Turkish vowel harmony, as analyzed in Clements & Sezer 1982. The basic facts are these: Turkish suffix vowels generally harmonize with preceding vowels in backness and, if high, in roundness as well, as exemplified by the paradigm in 1 (cf. the Turkish vowel system in 2, provided for reference).

(1)

		GEN SG	NOM PL	GEN PL
		-In	-lEr	-lEr-In
'rope'	*ip*	*ip-in*	*ip-ler*	*ip-ler-in*
'stamp'	*pul*	*pul-un*	*pul-lar*	*pul-lar-ın*
'village'	*köy*	*köy-ün*	*köy-ler*	*köy-ler-in*
'face'	*yüz*	*yüz-ün*	*yüz-ler*	*yüz-ler-in*

(2) Turkish vowel system:

[−rd]	[+rd]	[−rd]	[+rd]
i	ü	ɨ	u
e	ö	a	o
[−bk]		[+bk]	

The autosegmental representations of the roots *pul* 'stamp' and *yüz* 'face' and those of the plural and genitive suffixes are given in 3, where backness ([±bk]) and rounding ([±rd]) occupy separate tiers (I = [+high] and E = [−high]).

(3)

a.	b.	c.	d.
[+bk]	[−bk]		
|	|		
p I l	y I z	l E r	I n
|	|	|	
[+rd]	[+rd]	[−rd]	
'stamp'	'face'	PLURAL	GENITIVE

[3] The term is not meant to be pejorative; rather, we use 'naive' as in 'Naive Set Theory'.

The roots (3a,b) are fully specified, both suffixes (3c,d) are underspecified for backness, and the genitive suffix is also underspecified for rounding.[4] When these morphemes are concatenated, the backness and rounding autosegments spread to unspecified positions and thus derive the correct harmony effects, as illustrated in 4 and 5.

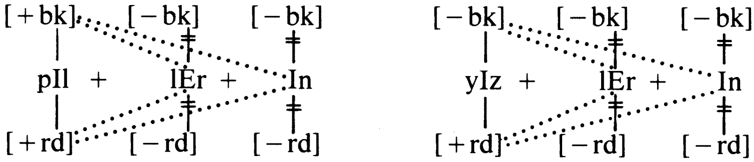
(4)


pulun 'of a stamp' *yüzün* 'of a face'

(5)


puların 'of stamps' *yüzlerin* 'of faces'

In 4, both the backness autosegment and the rounding autosegment lexically associated to the root spread to the suffix vowel in each word. In 5, however, the spreading features are the backness autosegment of the root and the [−rd] autosegment of the plural suffix. The [+rd] attached to the root is blocked from spreading to the genitive suffix by the No-Crossing-Convention of autosegmental theory (e.g. Goldsmith 1976). Notice that, if all the features were underlyingly specified and spreading proceeded in a feature-changing way (6), the ungrammatical **pulorun* and **yüzlörün* would be derived.

(6) Feature-changing spreading:


**pulorun* **yüzlörün*

This shows that, without resorting to other, more elaborate descriptive machinery, the opacity of the nonhigh vowels for rounding harmony remains unaccounted for if spreading is feature-changing (see Clements & Sezer 1982 for further instances of opaque vowels in Turkish). In this case, and quite generally in classical autosegmental studies, underspecification of features is essential for a maximally simple analysis. Given the correct representations, the basic mechanisms of autosegmental association take care of the rest. In this sense, autosegmentalism and underspecification of features are intrinsically con-

[4] Notice that the underlying representations in 3 use both values of the features [back] and [round] in addition to lack of specification. This is clearly an instance of ternary specification, perhaps the most-discussed issue related to underspecification (Stanley 1967, Kiparsky 1982, Archangeli 1984, Pulleyblank 1986, and others). Early autosegmental theory maintained that this kind of ternary specification is well grounded in the facts and should be allowed (Clements 1976b). See Dresher 1985 for a lucid discussion of the problems.

nected—any feature that can be autosegmentalized can be underspecified. In earlier studies, it was not clear which features are autosegmentalizable (at least there was no principled answer to this question), but it was implicitly assumed, for example, that the feature [nasal] is autosegmentalizable and can spread, but the feature [consonantal] is not autosegmentalizable and cannot spread.[5] Since it remains unclear what could prevent the analyst from setting up any feature as an autosegment, linking underspecifiability to autosegmentalizability in this way falls essentially under Naive Underspecification.

Classical autosegmental theory, primarily concerned with fundamental issues regarding the structure of phonological representations, did not often focus on underspecification as a theoretical issue.[6] However, this should in no way obscure its basic achievement in this area: by uncovering a substantial body of empirical evidence, autosegmental phonology conclusively demonstrated that the full specification theory embraced in *SPE* is hopelessly flawed, and it thus opened the road towards genuine theories of underspecification.

2.2. UNDERSPECIFICATION THEORY: RADICAL AND RESTRICTED. One desideratum for a theory of underspecification is that it set up an unambiguous relationship between feature predictability and feature specification. Two theories with differing predictions have emerged in recent work: RADICAL UNDERSPECIFICATION THEORY[7], with the overall imperative to minimize underlying specifications, and RESTRICTED UNDERSPECIFICATION THEORY[8], which restricts underspecification to noncontrastive redundant features.

For concreteness, we base our discussion of the distinction between these two theories on the consonant system of the West African language Diola (Sapir 1965), given in 7 after Maddieson (1984:288; we have taken the liberty of renaming and collapsing some place and manner categories).

In a system like 7, there are a number of candidates for underspecification; we will focus first on the voicing feature. A brief glance at 7 reveals a basic bifurcation: the obstruent system contains both voiced and voiceless segments, but the sonorant system contains only voiced segments. Sonorants are predictably voiced, and the feature can remain unspecified for this whole segment class. This is not the case in the obstruent system, where the feature is con-

[5] Recent work in Feature Geometry has come closer to a principled answer to this question; see in particular McCarthy 1988.

[6] The discussion in Clements (1976b:48–55) of the ternary value problem (Lightner 1963, Stanley 1967) is exceptional in scrutinizing autosegmental underspecification in a theoretical light; see also Pulleyblank (1986:127–30) for a demonstration that autosegmental representation per se does not automatically solve the ternarity problem.

[7] This is also referred to as Maximal Underspecification or Minimal Specification. Works under this general approach include Kiparsky 1982, Archangeli 1984, Itô & Mester 1986, Archangeli & Pulleyblank 1986, Pulleyblank 1988, etc.

[8] This is also known as Contrastive Underspecification, Redundant Value Underspecification (Steriade 1987a), and Degree 2 Underspecification (Clements 1988a). Although not identical, these theories all share the fundamental idea that only redundant features are underspecified or, equivalently, that contrastive features are specified.

(7)

		LABIAL	CORONAL	PALATAL	VELAR	
OBSTRUENT						
PLOSIVE	voiceless	p	t	c	k	
	voiced	b	d	ɟ	g	
FRICATIVE	voiceless	f	s			h
SONORANT						
NASAL	voiced	m	n	ñ	ŋ	
FLAP	voiced		r			
LATERAL	voiced		l			
GLIDE	voiced	(w)		y	w	

trastive (carrying the distinction between *p* and *b*, etc.) and hence not predictable.

However, it might still be possible to leave unspecified one of the values of the feature [voiced], though not the feature itself. After all, whenever one value of a feature is uniformly specified within a class of segments, the other value is trivially predictable. The prediction is trivial because the system has only one degree of freedom: given any phonetic parameter that has either value α or β for a segment, once we know that its value for a certain segment is not α, it is bound to be β. The question remains, however, what criteria we should bring to bear on the selection of the value to be left out.

A number of markedness considerations can be interpreted as supporting the underlying absence of [−voiced]. First, a crude head count in 7 reveals a preponderance of voiceless segments in the obstruent inventory. In themselves such numbers carry little weight, but in this case numerical preponderance concurs with well-established implicational universals regarding voicing in obstruent systems (see Maddieson 1984:27,47–8): the presence of a voiced obstruent series implies the presence of the corresponding voiceless obstruent series, but not vice versa. Within the particular inventory of Diola (ex. 7), the marked character of obstruent voicing reveals itself in the fact that fricative obstruents are uniformly voiceless (*f*, *s*, *h*).

What do the two theories of underspecification, whose main tenets are briefly summarized in 8, predict for the Diola system?

(8) a. Radical Underspecification maintains that all predictable features, both redundant and unmarked, are left unspecified, thereby resulting in minimization of specification in underlying structure.

b. Restricted Underspecification maintains that only redundant features are underspecified, thereby positing a fundamental phonological distinction between features which function contrastively and those which do not.

The two theories share the claim that the redundant feature [+voiced] for sonorants should remain unspecified, but differ in their treatment of the unmarked [−voiced] value for obstruent voicing: Radical Underspecification forbids specification; Restricted Underspecification insists on specification.

Consider next place of articulation in 7. In an overall system with a four-way opposition labial-coronal-palatal-velar, the subsystem of liquids is characterized by lack of contrast: both *l* and *r* are coronal. In the absence of other evidence, arguments from distribution (in the case of the liquids) and universal markedness (in the case of the remaining consonants) can be taken to converge on the coronal place as a prime candidate for underspecification.[9]

Again we encounter the issue that crucially divides the two theories. With regard to coronality specifications, the contrast-based Restricted Underspecification Theory predicts suppression only for the liquids (with no place contrast), while Radical Underspecification Theory insists on uniform suppression throughout the entire system (with its fully developed place contrast)—or at least it should do so, if minimization is taken at all seriously as a principle.

2.3. Assessment of previous arguments. A general conceptual consideration sometimes adduced in favor of Radical Underspecification is brevity of grammar: fewer features, better grammar. However, such arguments from feature counting, i.e. from savings in underlying specifications, are begging the question, since what is at issue is precisely the nature of underlying representations.[10] The central task is to find a way to bring empirical evidence to bear on the question of what information is included in underlying specifications (see also Clements 1988a for discussion).

The above-mentioned argument sometimes comes in an acquisitional variant: the fewer features in underlying representations, the less the language learner has to learn and to memorize (see e.g. Archangeli 1984:41–2). It appears to us, however, that the crucial acquisition issue is not how to MEMORIZE underlying representations, but how to DISCOVER them. This means that underlying representations are not automatically easy to learn when they contain few feature specifications—on the contrary, learning such representations can be very hard in situations where the evidence for what is and is not to be specified is deeply embedded in the phonology.

Besides conceptual considerations of uncertain validity, significant empirical arguments have been offered in favor of Radical Underspecification. The strongest and most direct evidence for the absence of specifications comes from cases of phonological transparency, e.g. the transparency of neutral vowels for backness harmony in Finnish (Kiparsky 1979) or—to take the case most familiar to us—the transparency of (redundantly) voiced sonorants and (unmarked) voiceless obstruents for the Yamato Voicing Constraint in Japanese (Itô & Mester 1986). Such evidence is crucial for Radical Underspecification in that it requires the relevant feature to be maximally underspecified. Restricted Underspecification apparently makes the wrong prediction in the Japanese case, for example, as it insists on the presence of both values of [voiced] in obstruents (but see §5 for further discussion).

[9] For various phonological arguments for the underspecified nature of [coronal], see Kiparsky 1985, Borowsky 1985, Avery & Rice 1988, and Paradis & Prunet 1988.

[10] See Kiparsky 1971 for clarification on the logic of the argument in the context of the abstractness debate.

Having found what appears to be hard phonological evidence for the theory of Radical Underspecification, recent work has surprisingly also uncovered evidence in favor of Restricted Underspecification Theory. Indeed, the analysis of the palatal prosody facts in Japanese mimetics to be presented in this paper simultaneously demands the underlying ABSENCE of redundant features and the underlying PRESENCE of nonredundant unmarked features—a situation predicted by Restricted but not Radical Underspecification.

Indications pointing (directly or indirectly) toward serious inadequacies in Radical Underspecification Theory have been accumulating in the area of Morpheme Structure Constraints. The sound patterns of natural languages characteristically impose melodic restrictions on morphemic shape, and the important crosslinguistic finding is that the lexical presence of nonredundant unmarked features is required for a noncontrived explanation of these restrictions. As far as we know, an explicit argument to this effect was first given in McCarthy 1985, which emphasizes the central role of morpheme structure in the underspecification debate:[11] whichever theory of underspecification one happens to espouse, it is agreed that underspecification holds at least at this earliest level,[12] by definition unaffected by any prior phonological or morphological operations.

Restrictions on root consonantism in Semitic languages (Greenberg 1960, McCarthy 1985) and in certain Austronesian languages like Javanese (Uhlenbeck 1950, Kenstowicz 1986, Mester 1986, Yip 1988b) all follow the basic generalization that homorganic consonants cannot co-occur within a root morpheme (see the works cited for further discussion). Notice that under Radical Underspecification such constraints should not hold for unmarked place features, since the theory predicts their underlying absence. McCarthy 1985 and Mester 1986 point out that this prediction is contradicted by the facts: such homorganicity restrictions hold for ALL places of articulation, and no special status is accorded to the unmarked place, whatever it may be.[13]

In order to demonstrate the lexical presence of nonredundant unmarked feature values, we begin by retracing a reasoning familiar from work in Radical Underspecification (e.g. Archangeli 1984:89–92) regarding the points in the derivation where underlyingly unspecified values are inserted. In Archangeli 1984 a specific redundancy rule supplying [αF] is ordered before the first rule referring to [αF] by the so-called Redundancy Rule Ordering Constraint (RROC).[14] This is illustrated by the interaction of the vowel harmony rule of

[11] The TYPE of argument, however, goes back at least to Chomsky & Halle 1968; see e.g. pp. 418–19.

[12] We are using 'level' here in the sense introduced in the earliest work on Generative Grammar (Chomsky 1955), not in the more specific sense encountered in Lexical Phonology (Kiparsky 1982, etc.).

[13] Within Feature Geometry it is not unthinkable to regard 'labial', 'coronal', etc., as VALUES of a multivalued place feature rather than as FEATURES (see McCarthy 1988 and references cited there for discussion). If so, the point just made reduces to the specification of unmarked feature VALUES, see immediately below in the text.

[14] The position on feature specification taken in McCawley (1968:40–43) is similar to the central idea behind the RROC. See also Archangeli & Pulleyblank 1986 for more recent modifications, and Dresher 1985 for critical discussion.

Yawelmani (given in 9, from Archangeli 1984:90) with the rule filling in [+high], the underlying missing value of the feature.

(9) [+round]

[αhigh] [αhigh]

As is well known, Yawelmani vowels harmonize in [round] if they already agree in [high], and the harmony rule (ex. 9) expresses this by mentioning [αhigh] in its structural description. Both values of [high] must therefore be present before the rule can apply, and the RROC ensures that insertion of [+high] takes place before Harmony. Cross-coefficient regularities regarding a certain feature thus require prior insertion of the default value for that feature; see Archangeli (1984:89–92) for a clear exposition of the arguments. The importance of this observation for underspecification reveals itself when we turn to lexical cross-coefficient regularities holding in morpheme structure: by parity of reasoning, BOTH values must be present at the point where the regularity is expressed, namely in underlying representations. However, since this is the earliest level, it is incoherent to assume that some default rule has already applied at this stage.[15]

A case in point is the root vocalism pattern in Ngbaka (Congo-Kordofanian), analyzed in Mester 1986, 1988 as an effect of the Obligatory Contour Principle (OCP) (Leben 1973, McCarthy 1986), which prohibits adjacent identical elements on an autosegmental tier.[16] Ngbaka has two high vowels, four mid vowels, and one low vowel, and different vowels from the same height class do not co-occur in bisyllabic roots. Unless both [+high] and [−high] are underlyingly present, it is impossible to explain the vowel co-occurrence restrictions in terms of the OCP holding in underlying representations (which is the only stage where the constraint is operative). In fact, this point holds quite independently of the question as to whether the OCP is to be invoked here. As John McCarthy reminds us (personal communication, 1988), it is not even possible to state (or simply list) the morpheme-structure facts in any coherent phonological formalism, leaving us in an awkward situation where the restrictions can be neither explained nor stipulated.[17] Similar conclusions can be drawn for the feature [back] from melodic dissimilation in Ainu (Itô 1984; cf.

[15] Otherwise, degrees of underlyingness would be proliferated, and the theory would have to distinguish between UR_1 and UR_2, where the radically underspecified UR_1 exists only to serve as the input to the immediately applying default rules; in other words, UR_2, the level where morpheme structure constraints hold, is the only empirically justified level of underlying representation.

[16] Although the analysis is somewhat different, Steriade 1987a comes to similar conclusions. In various theoretical contexts, Ngbaka has been discussed in Chomsky & Halle 1968, Clements 1982, Churma 1984, Itô 1984, and other work.

[17] As pointed out by Diana Archangeli (personal communication, 1988), a conceivable way out would be to assume that even the DEFAULT rules are governed by the OCP, coupled with supporting no-branching constraints of the kind posited by Itô & Mester (1986:72) and McCarthy (1986:225). This type of analysis, it appears to us, runs into the problem that in the well-understood cases of morpheme structure constraints (e.g. Proto-Indo-European, Japanese) default rules simply do not operate in this way. If so, we would in any case be dealing with a language-specific stipulation, arguably incompatible with a restrictive universal theory of default rules.

also Mester 1986, 1988, and Steriade 1987a), as well as from morpheme-structure backness dissimilation patterns in Tamil (Christdas 1988).[18]

To recapitulate, the morpheme structure evidence requires the underlying presence of nonredundant unmarked features; on the other hand, no morpheme structure facts are known to us which would force truly redundant features to be underlyingly present. In fact, their absence seems well supported (e.g., the redundant sonorant voicing in Japanese does not interact with obstruent voicing in terms of the morpheme structure constraint that restricts voiced obstruents to one). The evidence from morpheme structure is thus fully compatible only with Restricted Underspecification Theory.

Radical Underspecification and Restricted Underspecification qualify as genuine theories of underspecification because they make predictions as to which features will be unspecified in which situations. The two are thus real alternatives, and empirical evidence should be able to decide the issue. As we have tried to show in this section, it appears that BOTH positions are empirically supported in different situations. The challenge now is to sharpen our understanding of underspecification so as to reconcile it with ALL of the available empirical evidence, overcoming the apparent contradiction in degree of underspecification. Our position on this issue is that, in the light of a deeper understanding of the nature of distinctive features, Restricted Underspecification is essentially correct. We will see in §5 that a theory of privative features, which recaptures some of the insight in the work of Trubetzkoy 1939, resolves the underspecification paradox in favor of Restricted Underspecification and furthermore eliminates certain problems inherent in the feature theory carried over from *SPE*.

PALATAL PROSODY: FACTS AND GENERALIZATIONS

3.1. PRELIMINARIES. The mimetic vocabulary of Japanese consists of a large number of sound-imitating and manner-symbolic roots traditionally classified into Giseigo (onomatopoetic) and Gitaigo (more broadly ideophonic). The canonical shape of these mimetic roots is bimoraic (CVCV, CVV, CVN); they usually occur either reduplicated (as in *pata-pata* 'palpitating'), or with the adverbial suffix *-ri*, often accompanied by gemination of the medial consonant (as in *patta-ri*). The prosodic invariant characterizing both reduplicating mimetics and geminating mimetics is a four-moraic (i.e. bipodic) template[19] of the form $[\mu\mu][\mu\mu]$. Some of the basic characteristics of Japanese mimetic words were discussed in early generative phonology (Kuroda 1965, McCawley 1968). Our discussion focusses on the palatalization prosody in the system of mi-

[18] A parallel, and entirely independent, line of argumentation can be developed on the basis of Syllable Theory, given that one of the central concepts of syllabification, namely relative sonority, is defined in terms of feature specifications, as most recently demonstrated by Clements 1988b. Since evidence has been accumulating that the initial assignment of syllable structure takes place early in the derivation, often in fact at the very beginning (see Itô 1986 and references cited there), this poses a serious problem for radical underspecification of segments (Levin 1985). Letting default rules precede syllabification essentially nullifies the empirical predictions of Radical Underspecification Theory in the same way as in the case of morpheme structure; see n. 15 above.

[19] See Poser 1984a,b for the role of this kind of template in Japanese phonology and morphology.

metics, and is based on the work of Hamano 1986, the most extensive recent documentation and survey of this important stratum of the Japanese lexicon.

The sound-symbolic import of mimetic palatalization can be characterized as adding an element of UNCONTROLLEDNESS to the base.[20] Hamano 1986 argues that, depending on the meaning of the base form, UNCONTROLLEDNESS conveys the more specific interpretations of 'childishness, immaturity, instability, unreliability, uncoordinated movement, diversity, excessive energy, noisiness, lack of elegance, and cheapness' (Hamano 1986:239).[21]

Minimal pairs illustrating the relative productivity of this palatal prosody are given in 10,[22] where palatalization is represented morphophonemically by a superscripted *y*.[23]

(10)	a.	*poko-poko*	'up and down movement'
		p^{y}oko-p^{y}oko	'jumping around imprudently'
	b.	*kata-kata*	'homogeneous hitting sound'
		kat^{y}a-kat^{y}a	'nonhomogeneous clattering sound'
	c.	*kasa-kasa*	'rustling sound, dryness'
		kas^{y}a-kas^{y}a	'noisy rustling sound of dry objects'
	d.	*pota-pota*	'dripping, trickling, drop by drop'
		pot^{y}a-pot^{y}a	'dripping in large quantities'
	e.	*zabu-zabu*	'splashing'
		z^{y}abu-z^{y}abu	'splashing indiscriminately'
	f.	*noro-noro*	'slow movement'
		n^{y}oro-n^{y}oro	'(snake's) slow wriggly movement'

Our proposal is that the palatal prosody is a surface manifestation of an independent autosegmental morpheme.[24] Similar to the feature-sized agree-

[20] This is comparable to sound-symbolic systems found in Northwest Amerindian languages (as documented in Nichols 1971; see also Cole 1987 for recent discussion).

[21] It is of interest in the present context that palatalization is pervasive in baby talk (adult modification of speech to children), which, according to impressionistic observations, is more widely used in Japanese than in English. Examples are *atsui* → *at^{y}ui* '(it's) hot'; *samui* → *s^{y}amui/t^{y}amui* '(it's) cold'; *kusai* → *kus^{y}ai/kut^{y}ai* '(it) stinks'. Note also that the formation of hypocoristics in Japanese (Sasaki 1977, Poser 1984a,b) involves the form *t^{y}an* related to *san*, and dialectally *s^{y}an* is found as well.

[22] For a more extensive list, see Hamano 1986. In order to simplify the presentation for non-Japanologists and at the same time preserve a certain naturalness in our examples (mimetic roots are hardly ever used in their bare form), we will from now on cite mimetic roots exclusively in their reduplicated forms, noting that everything in our analysis carries over to geminating mimetics. In any event, we are concerned here with the shape of the underlying mimetic root and how palatalization affects it, not with the altogether separate question of how the segmental melodies are applied to prosodic templates.

[23] Palatalization does not have the same surface realization among all segments. The characterization 'palatalized' is strictly speaking only accurate for the noncoronals, i.e. labials and velars. Palatalization of coronals (*t, d, s, z, n*), on the other hand, changes their primary place of articulation to palatal/alveopalatal (*č, dž, š,* (*ž*), *ñ*) and furthermore neutralizes the distinction between the voiced obstruent coronals *d* and *z*, usually to the affricate *dž*; see e.g. Vance (1986:24–25). In the interest of consistency and ease of representation, we adopt the morphophonemic representation C^y and will use the general term 'palatalized consonants'.

[24] A very similar system of palatal prosody (brought to our attention by Ian Maddieson) is found in Gude (Hoskison 1974), where 'motion to the speaker' is expressed by palatalization of one

ment morphemes of Chaha analyzed in McCarthy 1983, it consists of nothing but the feature complex characterizing palatalization and is predicted to occupy a separate plane (see McCarthy 1989 for relevant discussion). The palatalized forms in 10 are thus morphologically complex. For example, the form *p*^{y}*oko* 'jumping around imprudently' is derived by lexical association of the palatalization morpheme (11a) to the mimetic root *poko* (11b).[25]

(11) a. $\begin{bmatrix} +\text{high} \\ -\text{back} \end{bmatrix}$ UNCONTROLLEDNESS

b. *p o k o* 'up and down movement'

Not all mimetics have palatalized counterparts, and some have no nonpalatalized source.

(12) a.	No palatalized counterpart:	*paku-paku*	'munching'
		kura-kura	'dizzy'
b.	No nonpalatalized source:	*mun*^{y}*a-mun*^{y}*a*	'mumble'
		uz^{y}*a-uz*^{y}*a*	'swarming'

In some cases the meaning relation between root and palatalized counterpart has become somewhat opaque, for example in 13:[26]

(13) *horo-horo* 'weeping elegantly'
h^{y}*oro-h*^{y}*oro* 'looking thin and weak'

Idiosyncratic behavior as in 12 and 13, the hallmark of forms derived in an early lexical level (see e.g. Kiparsky 1982), confirms our hypothesis that palatalized mimetics are the results of a genuine lexical process and not of a 'surfacy' (say, postlexical) paralinguistic phonetic modification process.

We are interested here in the intricate and, at first glance, puzzling surface distribution of the palatal prosody, and not in its somewhat elusive semantic-pragmatic contribution to the meaning of the base. We will argue that its pattern of distribution follows from its autosegmental nature and provides important evidence for the theory of Restricted Underspecification discussed in §2.

3.2. Distributional generalizations. While palatalization in general has been extensively discussed in Japanese phonology and phonetics (e.g. McCawley 1968), as far as we know the distributional generalizations concerning mimetic palatalization were discovered by Hamano 1986. We restate them here in the form of four descriptive laws: [I] Monopalatality, [II] Initiality, [III] Coronal Dextrality and Dominance, and [IV] Rhotic Exclusion.

[I] Monopalatality: Only one palatalization is permitted per root. Forms

segment in the verbal root. The distributional generalizations are similar to the Japanese case (as discussed below in §3.2) in that the rightmost coronal is preferentially palatalized (although Gude seems to have a more complex system of ranking among the coronals).

[25] For the sake of representational clarity, the palatalization features are here taken to be [+high, −back] without further discussion. However, we will return in the Appendix to the problems related to the exact featural content of palatalization and the realizational differences noted in n. 23. See Bhat 1974 for a crosslinguistic study of palatalization.

[26] In fact, as one reviewer points out, the two forms in 13 need not even be (synchronically) related: *horo-horo* could belong to 12a and *h*^{y}*oro-h*^{y}*oro* to 12b.

like **p^{y}ok^{y}o-p^{y}ok^{y}o* and **p^{y}ot^{y}a-p^{y}ot^{y}a* in 14, with palatalization of both consonants, are unattested and judged ungrammatical.

(14)	*p^{y}oko-p^{y}oko*	'flip-flop'	**p^{y}ok^{y}o-p^{y}ok^{y}o*
	pot^{y}a-pot^{y}a	'splashing'	**p^{y}ot^{y}a-p^{y}ot^{y}a*

[II] Initiality: Palatalization of noncoronals is restricted to root-initial position and cannot occur medially. (The more specific generalization governing coronals is stated in Law III.) As illustrated in 15, palatalized segments are found in initial position and only there; medial palatalization, as in **pok^{y}o-pok^{y}o, *hok^{y}o-hok^{y}o*, or **gob^{y}o-gob^{y}o*, is nonexistent and ill-formed.

(15)	*p^{y}oko-p^{y}oko*	'jumping up and down'	**pok^{y}o-pok^{y}o*
	h^{y}oko-h^{y}oko	'lightly, nimbly'	**hok^{y}o-hok^{y}o*
	g^{y}obo-g^{y}obo	'gurgling'	**gob^{y}o-gob^{y}o*

[III] Coronal Dextrality and Dominance: Palatalization occurs on the rightmost coronal contained in a root. (The more specific generalization governing *r* is stated in Law IV.) Consequently, coronals always dominate over noncoronals. If a mimetic root contains both a coronal and a noncoronal, palatalization appears on the coronal, regardless of position. We find medial coronals dominating over initial noncoronals in 16a and initial coronals dominating over medial noncoronals in 16b.[27] The examples in 16c illustrate the fact that, in roots with two coronals, palatalization appears on the rightmost coronal segment.[28]

(16)	a.	*met^{y}a-met^{y}a*	'destroyed'
		kas^{y}a-kas^{y}a	'rustling'
		hun^{y}a-hun^{y}a	'limp'
	b.	*t^{y}oko-t^{y}oko*	'childish small steps'
		z^{y}abu-z^{y}abu	'dabble in liquid'
		n^{y}oki-n^{y}oki	'sticking out, one after another'
	c.	*dos^{y}a-dos^{y}a*	'in large amounts'
		nos^{y}o-nos^{y}o	'slowly'
		net^{y}a-net^{y}a	'sticky'

[IV] Rhotic Exclusion: The segment *r*, although coronal, is never mimetically palatalized. This is illustrated in 17:

(17)	*noro-noro*	'slow, lazy'	**nor^{y}o-nor^{y}o*
	goro-goro	'goggle-eyed'	**gor^{y}o-gor^{y}o*
	zara-zara	'coarse texture'	**zar^{y}a-zar^{y}a*
	toro-toro	'slow, dumb'	**tor^{y}o-tor^{y}o*
	horo-horo	'weak'	**hor^{y}o-hor^{y}o*

The correct palatalized counterparts of these forms have initial mimetic pala-

[27] Hamano (1986:231) notes that the form *k^{y}oto-k^{y}oto* 'to look around indeterminately' is the sole exception to this generalization, and she draws attention to the fact that this form has the same meaning as *k^{y}oro-k^{y}oro*, where the initial position of palatalization in lawful because *r* rejects palatalization, as stated in Law IV.

[28] Only few mimetic roots have two coronal consonants, conforming to a general pattern: as documented by Hamano 1986, there are no roots with identical consonants and very few with two consonants of the same place of articulation. This is probably not an accidental property of Japanese mimetics but rather a manifestation of crosslinguistic dissimilation constraints on root forms, ob-

talization, e.g. *n^{y}oro-n^{y}oro*. This gap is significant in that exclusion of *r* from palatalization is not a general property of Japanese phonology. Palatalized *r* occurs in all positions in nonmimetic words, as illustrated by such forms as *r^{y}uuk^{y}uu* 'the Ryukyu islands', *r^{y}okoo* 'travel', *r^{y}akusu* 'to abbreviate', *kar^{y}uudo* 'huntsman', *k^{y}oor^{y}uu* 'dinosaur', and a large number of loanwords such as *r^{y}ukkusakku* 'rucksack'.

The segment *r* is special in a second respect in that it never occurs initially. As a consequence, there are neither mimetic forms with initial plain *r* (**rogu-rogu*, **raba-raba*) nor mimetic forms with initial palatalized *r^y* (**r^{y}ogu-r^{y}ogu*, **r^{y}aba-r^{y}aba*).[29]

Palatal prosody: Analysis and theoretical consequences

4. Given the generalizations stated in §3, we are now in a position to present our analysis, which crucially involves the underspecification of *r*. After showing that the palatalization laws can be derived from a few basic principles (§4.1), we present independent evidence for *r* as the underspecified consonant (§4.2) and discuss how the analysis bears on the issue of underspecification (§4.3).[30]

4.1. Basic analysis. Our analysis is summarized in 18: an autosegmental morpheme consisting of the feature complex characterizing palatalization (abbreviated as π) occupies an independent plane and is mapped to coronals in the root from right to left.

(18) a. Morpheme: π (= palatalization features)
b. π-bearer: Coronal
c. Mapping: Right-to-left

Illustrative examples of associations appear in 19.

(19)	a.	b.	c.	d.	e.
	π	π	π	π	π
	p o t a	*k u n a*	*d o s a*	*z a b u*	*t o k o*
	pot^{y}a	*kun^{y}a*	*dos^{y}a*	*z^{y}abu*	*t^{y}oko*
	'splash'	'limp'	'thud'	'dabble'	'stepping'

servable, for instance, in Semitic (McCarthy 1985) and Javanese (Mester 1986). As these authors have argued, such dissimilation requirements can be understood as consequences of the OCP; see §2.3 above for some discussion.

[29] This constraint is shared by lexical Yamato (i.e. native Japanese) morphemes and reflects the well-known constraint in Old Japanese against initial /r b d g z/; cf. for example Miller (1967:194). According to a theory presented in Unger (1975:32–33), the absence of word-initial *r* in Old Japanese is the result of sound changes in Archaic Japanese that merged initial *r* with *y*, *w*, and *n*. While initial voiced obstruents appeared in late Old and Middle Japanese as the result of the loss of certain vocalic prefixes (e.g. *iduru* > *deru* 'come out'), *r* is still unattested initially in lexical (qua potentially word-initial) Yamato morphemes. Exclusion of initial *r* cannot be considered a general property of Modern Japanese phonology, since it occurs freely in the Sino-Japanese vocabulary and in loanwords: *ringo* 'apple', *ran* 'turmoil', *rendaku* 'sequential voicing', *randebuu* 'rendezvous', *rampu* 'lamp'.

[30] Two further details of the analysis, important in their own right but not directly relating to the issue of underspecification, are discussed in the Appendix: the status of universal default mapping, Appendix §(i), and the feature-geometrical expression of palatalization, Appendix §(ii).

In 19a–c the rightmost consonant is a coronal and receives the π-morpheme; in 19d–e the π-morpheme docks on the initial coronal because the rightmost consonant (a labial in 19d and a velar in 19e) is not a licit bearer of palatalization in terms of 18b. The form in 19c exhibits right-to-left mapping of π: both consonants in the root *dosa* are coronals, and right-to-left mapping (18c) ensures that the second and not the first coronal receives the π-morpheme.

Given this coronality-based analysis, we must now deal with mimetic roots containing only noncoronals. The mappings to be derived are given in 20, where the rightmost consonants are noncoronals and therefore resist linking of π by the mapping rule in 18. Instead, the initial consonants, although noncoronal, receive the palatal prosody.

(20) a. b.

a.	b.
π	π
p o k o	*g o b o*
p^y*oko*	*g*^{y}*obo*
'flip'	'gurgling'

This stands in direct contrast to the pattern for coronals, where the last coronal becomes palatalized.[31]

The two opposing patterns 'leftmost noncoronal' versus 'rightmost coronal' might at first glance appear to call for TWO association rules, one for coronals operating right-to-left and another one for noncoronals operating left-to-right. But such a proliferation of specific association rules is unwarranted, and we propose that the noncoronal cases simply result from a universally available association strategy. Two alternative conceptions of the universal association default, with slightly different empirical predictions, suggest themselves here. They are summarized in 21.

(21) a. UNIVERSAL L→R ASSOCIATION: Noncoronal palatalization is the result of a universal convention associating free autosegments to potential bearers one-to-one left-to-right (see e.g. Clements & Ford 1979). Universal L→R Association (as the elsewhere case) takes over whenever the language-specific mapping rule in 18 does not take effect.

b. DEFAULT DOCKING: Noncoronal palatalization is an instance of Default Docking, i.e. of default association at the end of the domain. Whenever π is still unlinked after the mapping rule in 18 has scanned the whole domain and has reached the periphery, π is simply linked at the edge where the scan ended, resulting in palatalization of the initial consonant.

Either alternative satisfactorily captures the basic generalizations, and since the choice is not directly relevant to the issue of underspecification we defer a detailed discussion to the Appendix.

[31] The one exceptional form *kyoto-kyoto,* mentioned above in n. 27, where association by rule would result in palatalization on the SECOND root consonant, can be descriptively handled by underlying prelinking of π to the initial consonant.

The question now arises as to how this analysis, with π seeking out coronals from right to left, can account for Rhotic Exclusion: why does *r* as rightmost coronal in a root NOT attract the π-morpheme? As noted earlier (see §3.1), π instead associates to the initial consonant, whether coronal (22a–b) or non-coronal (22c–d).

(22)	a.	b.	c.	d.
	π	π	π	π
	n o r o	*z a r a*	*h o r o*	*g o r o*
	n^yoro	*z^yara*	*h^yoro*	*g^yoro*
	'slow'	'coarse'	'weak/thin'	'goggle-eyed'

It would of course be possible to solve the problem trivially by adding a special proviso for Rhotic Exclusion in the mapping rule, but this would be nothing more than an unilluminating stipulation. It does not explain why *r* resists palatalization in mimetics even though r^y is a licit segment in Japanese (see the discussion at the end of §3.1), nor does it relate Rhotic Exclusion to other properties of *r* in Japanese phonology. A more satisfying explanation, we suggest, locates the cause of the apparently idiosyncratic behavior of *r* in its underspecified nature. There are good reasons (which we elaborate on in the following section) to assume that *r* is not marked for [coronal] at the stage of π-morpheme attachment. Since the π-morpheme seeks out coronals from right to left, the underspecified *r* does not qualify as a legitimate bearer. At the relevant stage, it is simply not a coronal.

With this solution of the Rhotic Exclusion problem (to be motivated more fully below), our analysis now successfully derives the four descriptive laws formulated in §3.2. Monopalatality follows from the status of π as an autosegmental morpheme, associated by 18 or, failing that, by universal default (21). It should be noted that every palatalization in mimetics is sound-symbolic, i.e. a manifestation of the π-morpheme.[32] Coronal Dextrality and Dominance follow from the fact that the specific mapping rule in 18, operating right-to-left, takes precedence, whereas Initiality is just the universal default 21. Rhotic Exclusion, finally, is not stipulated but follows from the underspecified character of *r*, which lacks a specification for place.

4.2. RHOTIC UNDERSPECIFICATION. In the analysis given above, the fact that the coronal *r* is excluded from competing for the π-morpheme is not accidental

[32] Note that we are here referring to lexical palatalization and not to the postlexical allophonic palatalization before high front vowels (e.g. *tas-u* 'add, PLAIN PRESENT' but *tas^y-i-masu* 'add. POLITE PRESENT'. As expected, this automatic palatalization does not count as a realization of the π-morpheme, and does not interact with the palatal prosody. In our analysis, π-morpheme mapping takes place lexically, hence before the postlexical rule of palatalization has a chance to apply, and we predict the observed noninteraction.

McCawley (1968:65) treats syllables with high vowels as phonologically /C^yi/ for the onomatopoetic (i.e. mimetic) stratum. As Hamano (1986:237–38) points out, positing underlying palatal consonant + high front vowel (/C^yi/) has the unfortunate consequence that, for example, /pit^ya/ 'splashing' would have to be analyzed with two palatalized consonants (i.e. as /$p^y it^y$a/), destroying the generalization of Monopalatality.

but has a systematic cause. We will now motivate our contention that *r* is indeed underspecified for [coronal] and discuss how this bears on the choice between the different theories of feature underspecification.

Three independent sources of evidence lend support to the hypothesis that Japanese *r* is underspecified: (i) position in the segment inventory, (ii) appearance as an epenthetic consonant, and (iii) resistance to gemination.

First of all, given the underlying resonant system of Japanese (23),[33] the place specification of *r* is clearly redundant, since it is the only liquid and contrasts with no other consonant in place of articulation.

(23) Japanese resonants:

Nasals:	m	n	N
Liquids:		r	
Glides:	w	y	

All other major segment categories are characterized by at least one internal contrast: place is distinctive in nasals; the glides *y* and *w* carry specifications for the tongue body features; and the obstruent system displays contrasts in voicing and place.

The second source of evidence for *r* as the unmarked sonorant is the occurrence of epenthetic *r* in the verbal paradigm. Consider the present and passive forms in 24.

(24)

	PRESENT	PASSIVE STEM	
a. C-final roots:	*kak-u*	*kak-are*	'write'
	nom-u	*nom-are*	'drink'
b. V-final roots:	*tabe-ru*	*tabe-rare*	'eat'
	mi-ru	*mi-rare*	'see'

Consonant-final verbs take *-u* and *-are* in the present indicative and passive, respectively, but vowel-final verbs take *-ru* and *-rare*. The most straightforward analysis here is to posit a consonant epenthesis rule inserting the unmarked sonorant to break the vowel hiatus. This is arguably superior to an alternative consonant deletion analysis, with underlying *-ru* and *-rare*. Unambiguously consonant-initial suffixes like the past tense marker *-ta* and gerundive *-te* do not lose their initial consonant but rather trigger a different set of morphophonemic rules such as Gemination, Coda Nasalization, and Velar Vocalization (see e.g. McCawley 1968 and Itô & Mester 1986 for discussion of these rules).[34]

[33] N denotes the so-called moraic nasal; see Vance (1986:34–39) for a survey of the various phonetic realizations.

[34] Brent de Chene (personal communication, 1988) suggests that certain dialectal evidence may lend independent support to our *r*-insertion analysis (cf. de Chene 1985 and references cited there). On the other hand, as two reviewers remind us, the case for *r*-insertion in the verbal paradigm is not entirely without problems, since the allomorphs of the causative *-ase*/*-sase* and the hortative *-oo*/*-yoo* also show consonant/zero alternations. Poser 1986 points out that there is historical evidence for *y*-insertion in the case of *-oo*/*-yoo*. As for *s*, it should be mentioned that positing underlying *s* in *-sase* leaves unanswered the question why the gemination rule applying to *t* in *kaw + ta* → *katta* 'buy + PAST' does not apply in *kaw + sase + ta* → **kassaseta* 'buy + CAUSATIVE + PAST' (instead we find *s*-deletion: *kawaseta*). It would be incorrect to restrict gemination to *t*, because outside of the verbal paradigm the rule applies more generally. Examples of gemination can be found in

The third line of argumentation, pointed out to us by Bill Poser (personal communication, 1988), builds on the observation that, of all the Japanese consonants, *r* is the only one that cannot be geminated. Some other consonants cannot appear as surface geminates, but even in these cases there is reason to believe that they go through a derivationally intermediate gemination stage. As mentioned in §3, many of the reduplicated Japanese mimetics have a parallel form with an adverbial suffix *-ri* plus gemination of the root-medial consonant (cf. Kuroda 1965):

(25) *pattari* < *pata* 'palpitating'
nikkori < *niko* 'smiling'
sinnari < *sina* 'supple'
simmiri < *simi* 'quiet, abject, spiritless'

Medial voiced consonants (except nasals) do not occur as surface geminates, but instead appear as moraic nasal + consonant:

(26) s^y*oNbori* < s^y*obo* 'lonely'
uNzari < *uza* 'bored, disappointed'
boNyari < *boya* 'vague'
fuNwari < *fuwa* 'light'

The moraic nasal is here realized as homorganic to the following obstruent (e.g. s^y*ombori*) or, in the case of the glides, as a nasalized approximant (e.g. *boỹyari*). Phonologically, all these clusters can be characterized as partial geminates (Steriade 1982, Hayes 1986) sharing place of articulation.

Poser's interesting observation is that this gemination process never turns *r* into a true (27a) or a partial (27b) geminate; only simple nongeminate forms are found (27c).[35]

(27) (Poser, personal communication, 1988)

a.	b.	c.		
**hurrari*	**huNrari*	*hurari*	< *hura*	'swaying'
**horrori*	**hoNrori*	*horori*	< *horo*	'weeping'

We must explain not only why geminate *r* is absent from underlying representations, but also why it cannot be created by processes that otherwise produce geminates and partial geminates with nasalized first halves. Both

the formation of intensive adverbs, as argued by Kuroda 1965, and in compound verbs such as *but+korosu* → *bukkorosu* 'kill violently', lit. 'hit + kill' *hik+saku* → *hissaku* 'tear by pulling', lit. 'pull + tear', where the second example shows gemination of *s* (see Poser 1984a for discussion of these compound verbs). If we look beyond the confines of the verbal paradigm, then, it becomes more reasonable to regard *s* as the epenthetic obstruent. Although it is not productive, there is some independent evidence for epenthetic *s* in compounds like *harusame* 'spring rain' (*haru+ame*), where the *s* can be viewed as a hiatus breaker. The facts clearly deserve further investigation, and a thorough analysis of the verbal paradigm from the perspective of Japanese phonology and morphology is called for.

[35] The grammaticality of the examples in 27c is not a special fact about bases with *r*. The nongeminated base + *ri* adverb exists in all other cases as well, alongside the geminated form. Thus we find *nikori* beside *nikkori* 'smiling' and *yahari* beside *yappari* 'after all' (note that single *h* and geminate *p*'s are morphophonemically related; see e.g. Martin 1952). The point is rather that the nongeminated form is the only one for bases with *r*.

restrictions can be argued to follow from the conjunction of three premises: (i) the underspecified character of *r*; (ii) the Nasal Coda Restriction, requiring all voiced or sonorant codas in Japanese to be nasal; and (iii) double linking of the medial consonant as a characteristic property of the intensive adverb template. The basic idea is that for *r* neither total nor partial gemination is possible. Total gemination is impossible because it violates the Nasal Coda Restriction, and partial gemination is impossible because the underspecified *r* has no distinguishable parts available for separate linkage.[36]

While none of the three arguments presented above is incontrovertible, together they lend credibility to the claim that *r* is the underspecified sonorant of Japanese. A completely independent line of argumentation is of course to be found in our analysis of the π-morpheme, where underspecification of *r* allows an explanatory and nonstipulative analysis.

4.3. Rhotic Exclusion and Restricted Underspecification. Turning now to the theoretical issue of this paper, let us consider how the analysis of the palatal prosody bears on the choice of theories of underspecification. To state the conclusion at the outset, this analysis provides clear evidence in favor of Restricted Underspecification Theory. Recall that the crucial distinction between Restricted and Radical Underspecification lies in the treatment of nonredundant but unmarked features and feature values. For [coronal], the unmarked place of articulation in Japanese, Radical Underspecification Theory requires across-the-board minimization of specification, while Restricted Underspecification Theory requires absence of specification only where coronality is totally redundant, namely in the case of the sonorant *r*. Notice that the situation predicted by Restricted Underspecification is exactly what the present analysis demands. For the π-morpheme to seek out its bearer, it is crucial that the feature [coronal] be underlyingly present in the obstruent and nasal system. In order to explain Rhotic Exclusion, only *r* should be unspecified for coronality. After all, it is only in virtue of the fact that the other coronals are SPECIFIED for [coronal] that the segment *r* stands out as UNSPECIFIED. Otherwise the analysis fails to derive the palatalization behavior of the segment *r* from its general phonological properties. In this respect, no analysis is acceptable that contains any special proviso about *r* and palatalization.[37]

To recapitulate, the evidence offered by this analysis is twofold: both the UNDERSPECIFICATION of redundant coronality and the SPECIFICATION of nonredundant but unmarked coronality are required—exactly the situation predicted by Restricted Underspecification Theory.

[36] Construed in feature-geometric terms (see e.g. Clements 1985), total gemination is spreading of the root node, and partial gemination spreading of the place node. Geminated voiceless obstruents and geminated nasals do not violate the Nasal Coda Restriction, and remain unmodified. Geminated voiced obstruents and geminated glides fulfill the Nasal Coda Restriction after being turned into partial geminates, with doubly linked place nodes but separate root nodes for each part. Since the underspecified *r* is nothing but a root node (with internal major class specifications, see McCarthy 1988), it has no further structure, in particular no place node. As a consequence, all possibilities of double linking are excluded.

[37] Note that it would not help to assume that the π-morpheme links to segments UNSPECIFIED for place: again there would be no reason why it should not link to *r*.

UNDERSPECIFICATION AND PRIVATIVE FEATURES

5. Although the analysis of the mimetic forms presents quite strong arguments for Restricted Underspecification, there still remains a class of cases where Radical Underspecification appears to fare better (see §2 above). We will address this issue by calling on the example most familiar to us, namely, the analysis of Japanese Compound Voicing presented in Itô & Mester 1986. We argue in §5.1 that a theory of voicing as a privative (single-valued, or unary) feature presents a principled solution and reconciles this case and others like it with Restricted Underspecification. The discussion in §5.2 on the theoretical and empirical consequences of privative voicing in general leads to the conclusion that a substantive theory of privative features preserves the beneficial effects of Radical Underspecification, and at the same time correctly goes beyond it in excluding specification throughout the phonological derivation.

5.1. RENDAKU AND LYMAN'S LAW REVISITED. The compound voicing process known as RENDAKU voices the initial segment of the second compound member:

(28)	a. *ori*	+	*kami*	→	*origami*
	'fold'		'paper'		'origami paper'
	b. *onna*	+	*kokoro*	→	*onnagokoro*
	'woman'		'heart'		'feminine feelings'
	c. *ko*	+	*tanuki*	→	*kodanuki*
	'child'		'racoon'		'baby raccoon'
	d. *neko*	+	*šita*	→	*nekojita*
	'cat'		'tongue'		'aversion to hot food'

Rendaku voicing is blocked by Lyman's Law (a condition prohibiting multiple voiced obstruents in a morpheme) whenever the second compound member already contains a voiced obstruent:

(29)	a. *kita*	+	*kaze*	→	*kitakaze*	(**kitagaze*)
	'north'		'wind'		'(freezing) north wind'	
	b. *onna*	+	*kotoba*	→	*onnakotoba*	(**onnagotoba*)
	'woman'		'words'		'feminine speech'	
	c. *doku*	+	*tokage*	→	*dokutokage*	(**dokudokage*)
	'poison'		'lizard'		'poisonous lizard, Gila monster'	
	d. *taikutsu*	+	*šinogi*	→	*taikutsušinogi*	(**taikutsujinogi*)
	'boredom'		'avoiding'		'time-killer'	

The analysis in Itô & Mester 1986 conceives of Rendaku as an autosegmental morpheme consisting of the voicing feature, which is associated to the initial segment of the second compound member:

(30)

a.

onna + k o k o r o

[+v]

onnagokoro 'woman's heart'

b.

ko + t a n u k i

[+v]

kodanuki 'baby raccoon'

Lyman's Law, construed as a deletion rule on the voicing tier (31), deletes Rendaku voicing when the root already contains [+voi], as shown in 32.[38]

(31) [+voi] → Ø / ___ [+voi]

(32) a. *taikutsu + š i n o g i*
[+v] [+v]
↓
Ø
taikutsušinogi 'time-killer'

b. *doku + t o k a g e*
[+v] [+v]
↓
Ø
dokutokage 'poison lizard'

As the examples show, this analysis crucially relies on the underlying absence of all predictable values of voicing, including the redundant [+voi] for sonorants and the unmarked [−voi] for obstruents. Itô & Mester 1986 argued that Radical Underspecification immediately predicts, in a unified way, the transparency both of intervening sonorants such as *n* in *šinogi* (32a) and of intervening voiceless obstruents such as *k* in *tokage* (32b). The latter case creates a problem for Restricted Underspecification, where both values of the distinctive obstruent voicing are present in pre-Rendaku representations (33).

(33) a. *onna + k o k o r o*
[−v][−v]

b. *onna + k o t o b a*
[−v][−v][+v]

Notice first that the association of Rendaku voicing must now be feature-changing: the [−voi] of the first *k* in *kokoro* must be overridden by the [+voi] of Rendaku. More importantly, we lose the explanation for the long-distance blocking of Rendaku in *onna-kotoba*. Once voiceless obstruents like *t* in *kotoba* are marked as [−voi] on the voicing tier, they are predicted to be opaque for Lyman's Law.

Taking up a line of thinking recurrent in a variety of theoretical perspectives in recent work (see e.g. Anderson & Ewen 1987, Clements 1988a, den Dikken & van der Hulst 1988, Goldsmith 1987, Steriade 1987a), we propose that the transparency problem bears on Feature Theory and not on Underspecification Theory. It does not even arise in theories (e.g. that of Trubetzkoy 1939) where voicing is regarded as a phonologically PRIVATIVE feature [voice], and [−voiced] simply does not exist. As pointed out by Steriade 1987a and independently suggested to us by John McCarthy (personal communication, 1987), this makes it possible to retain the essence of the explanation for the Japanese voicing facts unaltered. What does not exist a fortiori cannot be present in representations and create opacity. Under privative voicing, the Rendaku/Lyman's Law derivations proceed as in 34:

[38] As argued in Itô & Mester 1986, this is presumably an effect of the Obligatory Contour Principle (OCP), which disallows identical adjacent elements on a single tier. Sharon Inkelas (personal communication, 1988) and Kang 1988 point out that OCP effects of this kind are systematic problems for the view that all morphemes occupy separate planes, the so-called Morpheme Plane Hypothesis (McCarthy 1979, 1981, 1989, Cole 1987).

(34)
a. *onna + kokoro*
[v]
→ *onnagokoro*

b. *onna + kotoba*
[v] [v]
↓
Ø
→ *onnakotoba*

Here voicelessness carries no mark NOT because it is the unmarked value, but because there is no such value. Since the explanatory residue of Radical Underspecification is now subsumed under privativeness, the analysis of Rendaku and Lyman's Law is fully compatible with Restricted Underspecification Theory. The single-valued feature approach, far from being a notational variant of Radical Underspecification, is inherently more restrictive. Since there is (phonologically) only one value, there is no stage in the phonological derivation where both values of the feature become operative. It is also important to realize that Radical Underspecification Theory cannot readily adopt privative features without undermining its own theoretical basis. The theory already contains entirely separate feature minimization mechanisms designed to ensure that all features are underlyingly single-valued. Espousing privative features in addition would make the minimization machinery largely otiose.

5.2. VOICING AS A UNIVERSALLY PRIVATIVE FEATURE. It is now incumbent on us to address the question of whether the privative status of a feature is a language-particular property (as maintained, for instance, by Goldsmith 1987 and Steriade 1987a), or a universal one. The logic of restrictiveness compels us to opt for the universalist position, according to which the privative character of a feature is settled once and for all in Universal Grammar, and is never subject to language-specific stipulation. Focussing on the voicing feature, we will briefly consider the consequences of such a move for the expressive power of underlying representations and phonological rules (see den Dikken & van der Hulst 1988 for general discussion). In both areas, it is apparent that universally privative voicing makes fewer representations and rules available than the alternative of allowing binary voicing on a language-specific basis.[39]

On the one hand, the privative voicing theory provides no way of marking any segment as underlyingly voiceless. This immediately makes the strong prediction that no language can have underlying voiceless vowels or voiceless resonants. The first is a welcome result while the second requires further study, but we note as support for our position that the voiceless laterals of Klamath must be viewed as underlyingly ASPIRATED and not voiceless, as cogently argued by Clements 1985.[40]

[39] We are here excluding the possibility, available in less restrictive variants of Feature Geometry, of using a bare laryngeal node as a stand-in for [−voiced]. The latter move is unable to explain the asymmetry often found between marked and unmarked values in morpheme structural dissimilation (governing, e.g., Japanese voicing).

[40] Another related question is the distinction between voiceless lateral approximants and voiceless lateral fricatives. Pike 1943 and Catford 1977 have doubted that this is a phonetically valid

Other cases of voiceless resonants fall to a similar analysis. A particularly strong case for aspiration (and not voicelessness) as the phonologically operative feature can be made for Burmese,[41] which distinguishes three series of obstruents (voiced, voiceless, and voiceless aspirated) and two series of resonants (voiced and voiceless aspirated). There are several arguments for regarding the voiceless aspirated resonants as having aspiration as their primary feature.

(i) Phonetic realization: Okell (1969:9) characterizes the sounds represented as *hl, hm, hn, hng, hny, hw* as aspirate correlates of *l, m, n, ng, ny, w*, 'but with the breath expelled quietly through the nose (through the mouth for *hl, hw*) before voicing begins ....'

(ii) Voiceless aspirated resonants derived from *h* + resonant clusters: when *h* becomes adjacent to a voiced resonant through an optional elision process, the cluster is realized as the corresponding voiceless aspirated resonant, e.g. *măhouʔ* > *hmouʔ* 'be not true' (Okell 1969:21–22).

(iii) Blockage of voicing: Burmese has a rule which voices initial consonants of morphemes when they occur word-medially through morpheme concatenation (Okell 1969:12–18). For example, plain voiceless *p* in *pouñ* 'can' corresponds to voiced *b* in *hsi+bouñ* 'oil can', and aspirated *ht* in *(ă)hte* 'inside' corresponds to voiced *d* in *eiñ+de* 'in the house'. The rule is fully productive and fails to apply only when the preceding syllable ends in a glottal stop. The plain and aspirated voiceless obstruents turn into their plain voiced counterparts, but, crucially, the rule does not apply to aspirated resonants; cf. *(ă)hniʔ* 'year', *kou+hniʔ* 'nine years', **kou+niʔ*. We understand this as a consequence of structure preservation: linking of voicing to resonants is not allowed (see e.g. Kiparsky 1985, Itô & Mester 1986). Obstruents, on the other hand, can be marked for voicing, triggering concomitant delinking of aspiration (see Rice 1988 for a theory of structure preservation with the desired consequences).

A second case of blocking has exactly parallel characteristics and is found in a voicing morpheme that nominalizes verb bases, deriving e.g. *byaʔ* 'abruptness' from *pyaʔ* 'be cut off, severed' (Okell 1969:114–15). Again, the process applies only to plain and aspirated voiceless obstruents and never to aspirated resonants.

Turning next to the operation of phonological rules, we observe that universally privative voicing means that voicelessness will remain phonologically inert and can play no active role in the phonology. Phonological rules cannot (a) insert, (b) spread, or (c) delete [−voiced], and (d) they cannot use it as a context predicate in nonassimilatory rules.[42] This is probably a good step towards narrowing down the class of possible rules. We are not familiar with any

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distinction, and Ladefoged 1982 points out that these phonetic segment types never contrast. Maddieson & Emmorey 1984 have argued, however, that they are nevertheless phonetically distinct and show distinct phonological patterning.

[41] Thanks to two anonymous reviewers for bringing this example to our attention.

[42] We would like to thank Henry Churchyard for discussion regarding the role of privative voicing in phonological derivations. His perceptive and challenging comments led to a substantial improvement of this section.

cases crucially involving (c) and (d), and if there are none a binary voicing theory with [±voiced] would have to find other ways of excluding them.

The fact that [−voiced] cannot be inserted turns out to be another point in favor of the privative voicing theory. Position-dependent devoicing phenomena (e.g. German syllable-final devoicing) now have only a single analysis—as neutralization, i.e. delinking of [voice]. A theory with [−voiced] is at a disadvantage here in having to contend with the competing analysis inserting [−voiced].

This leaves the last stronghold of the binary voicing theory—cases which look like spreading of [−voiced] or [αvoiced]. Well-known phenomena usually analyzed in this way include, e.g., Russian or English voicing assimilation.[43] Closer inspection reveals that, far from being problematic, such cases are at least compatible with, and perhaps even support, the privative voicing theory.

The classical Praguean conception of the relation between neutralization and assimilation, which we have been assuming throughout, conceives of all unmarked assimilation processes as contingent on prior neutralization (cf. Davidsen-Nielsen 1978 for a comprehensive overview; see also Kiparsky 1985:98). This directly entails an analysis in which voicing distinctions are neutralized before assimilation, i.e. before spreading of [voice]. For the Russian case (where on the surface both [+voiced] and [−voiced] appear to have spread leftwards; see e.g. Hayes 1984, Kiparsky 1985), the analysis proceeds along the following lines: except in prevocalic position, all [voice] specifications are delinked (and subsequently deleted by Stray Erasure); remaining [voice] specifications are spread leftwards.[44]

The standard analysis of the alternations in the English plural morpheme (*cat*[*s*], *bird*[*z*], and *bush*[*ɪz*])[45] posits the voiced variant as the underlying form, which undergoes devoicing if the stem ends in a voiceless segment and triggers [ɪ] insertion if the stem ends in a sibilant.[46] Notice that this solution, if correct, would involve voicelessness spreading from the stem to the plural morpheme (*lip* + *z* → *lips*)—an impossible event under the privative voicing theory.

The problem here, we believe, can be traced back to a style of phonological thinking which strives to mirror every surface alternation by a language-specific

[43] Another often-cited example is devoicing of high vowels in voiceless environments in Japanese, but see Beckman & Shoji 1984 for a convincing demonstration that this is not a phonological operation.

[44] We note in passing that there are in effect drawbacks to solutions operating with [−voiced]. For example, in Kiparsky (1985:108) the decision to describe devoicing in clusters as leftwards spreading of [−voiced] entails an analysis of final devoicing not as simple neutralizing delinking, but instead as insertion of [−voiced]—arguably a universally impossible operation (see our discussion above). The marked characteristic of the Russian case lies in the fact, which any analysis must come to terms with, that resonants are transparent for the process. This seems to be related to the fact that Russian surface syllabification allows sonority-violating initial resonants.

[45] The same alternations are found in the present singular (*pick*[*s*], *love*[*z*], *los*[*ɪz*]), and the possessive (*Rick'*[*s*], *Bob'*[*z*], *Liz'*[*ɪz*]), and parallel alternations are encountered in the past morpheme (*pick*[*t*], *row*[*d*], *want*[*ɪd*]); see Pinker & Prince 1988 for detailed discussion.

[46] The other possible hypotheses have also been pursued, with underlying /ɪz/ (Borowsky 1987) and underlying /s/ (Kiparsky 1985:93); see Pinker & Prince 1988 for arguments why /z/ must be taken as basic.

rule responsible for that alternation. Consider for a moment the situation that would arise if devoicing did not occur after a voiceless obstruent. We would routinely encounter voicing reversals in final obstruent clusters, such as **wim*[*pz*], **hi*[*tz*], **tre*[*kz*], **brie*[*fd*], **ki*[*sd*], **win*[*kd*]. Such patterns do not just happen to be impossible in English, but are presumably universally unattested as syllable-final clusters (as are their mirror-image counterparts in syllable-initial clusters). Greenberg (1978:261) convincingly demonstrates that universal syllable well-formedness demands voicing agreement in syllable-internal obstruent clusters. Devoicing (i.e. delinking of [voice]) of /z/ (and similarly /d/) after voiceless obstruents should thus be the result of a universal default mechanism ensuring successful syllabification, rather than a language-specific rule. The other plausible outcome, where the added consonant induces voicing in the already present voiceless obstruent, is arguably available only through a special rule of [voice] spreading, a situation in fact instantiated by the special lexical fricative voicing rule (as in e.g. *wolf* ~ *wolves*). In contrast, the devoicing (= delinking) pattern does not involve any language-particular cost, provided that delinking is the universal default mechanism. It is surely a prime candidate for this role, given that it introduces no new information and relates the phenomenon under discussion to the enforcement of Structure Preservation, where delinking occupies a central position (see also Myers 1987 and Rice 1988).

Building on the above considerations, we can actually argue that the English case constitutes evidence FOR privative voicing. Delinking of [voice] triggered by universal syllable well-formedness, and not voicelessness spread, offers an explanatory account of the facts. Seen in this light, the superior theory is the one which does not even have the means to ever formulate a language-particular rule of voicelessness spread; the binary voicing theory is therefore at a disadvantage, because it makes available an arguably wrong analysis of English. What these considerations show is that Radical Underspecification, implemented within an overall binary feature theory, is in fact not radical enough in this respect.

CONCLUDING REMARKS

6. In summary, the palatal prosody in Japanese mimetics is analyzed here as a feature-sized morpheme, mapped to coronal consonants from right to left. Underspecification of the redundant place feature for *r* makes it possible to state a simple right-to-left association rule for the π-morpheme, free of any stipulative exception clauses. The rest is taken care of by the universal association default. This analysis provides a strong argument for Restricted Underspecification as the only theory predicting exactly the correct array of specifications. Finally, it was proposed that the apparent cases of Radical Underspecification are in effect consequences of the existence of privative features.

A number of questions remain open and occupy the top of the agenda for future research. First and foremost, the development of a substantive theory of privative features is called for. If not all features are privative (see den Dikken

& van der Hulst 1988 and references cited there for a strictly single-valued approach), a principled typology of features must be developed. Otherwise privative features could be invoked ad libitum whenever it seems that Radical Underspecification is needed. A number of pertinent results in this direction can be found in recent work on Feature Geometry, where primary articulator features are considered privative (McCarthy 1985, Mester 1986, Sagey 1986), and perhaps laryngeal specifications in general are also single-valued (see Clements 1985, 1988a for discussion along these lines). We expect that future research will lead to a deeper exploration of Feature Theory, undoubtedly relating to privative features and their relationship to theories of underspecification.

Appendix: The mapping and substance of π

This Appendix takes up some important questions regarding the association and the phonological substance of π that were left open above. Our immediate purpose is to clarify and sharpen the basic analysis of the palatal prosody as presented in §4, and our broader goal is to cast new light on questions about nonlinear association mechanisms and segment-internal structure. Although the complexity of the issues involved prevents us from reaching definite conclusions, we take this opportunity to address the problems as they present themselves to us.

(i) The mapping of π. As discussed in §4, the two views of Default Association (Universal L→R Association in 21a and Default Docking in 21b) both capture the central generalization, but they make slightly different empirical predictions. Universal L→R Association is in principle able to pass by the initial consonant (when for some reason it is unfit as a π-bearer) and attach π to a medial consonant. This is by definition impossible for Default Docking, where the π-morpheme can be linked to noncoronals only as a last resort, namely in case the mapping rule has not turned up any coronal in its right-to-left scan of the base. Association of π to noncoronals can only take place at the end of the association domain—that is, initially.

This stubborn peripherality gives Default Docking a slight competitive edge, because palatalized noncoronals are in fact only found in strictly initial position. Empirical evidence appears in forms with the vowel *e*. In Modern Japanese, this vowel is subject to the restriction that it cannot be preceded by a palatalized consonant or *y*.[47] This constraint, which is of interest to syllable theory in straddling the onset-rhyme boundary (see Clements & Keyser 1983), is formulated in A1.

(A1) C^ye Constraint:

$$*_{\sigma}[\ \underset{\left[\begin{smallmatrix}-\text{back}\\ +\text{high}\end{smallmatrix}\right]}{\overset{\textstyle C}{|}}\ \ e$$

The crucial facts present themselves in mimetic roots of the general form /CeCV/. If the medial consonant is noncoronal, as in A2, neither initial (A2b) nor medial (A2c) palatalization is possible.[48]

[47] The single exception is the swear word t^ye*ʔ*. In recent foreign loans C^y*e* does occur, e.g. t^y*ekku* 'check' or s^y*erii* 'sherry'. The constraint in A1 might ultimately follow from the structure of the Japanese vowel system, for example if the surface five-vowel system is derived from an underlying four-vowel system /a e o u/, as proposed by Bloch 1950. Palatalized consonants are then represented as C*y* (adopting the analysis implicit in the kana syllabaries), and a special rule takes /ye/ to /i/ in all contexts (see McCawley 1968 for critical discussion). While rather problematic in a number of respects (such as the existence of epenthetic *i*), this approach elegantly captures the general combinatorial possibilities of the Japanese vocoids.

[48] If the medial consonant is a coronal it can of course receive the π-morpheme by the mapping rule in 18. Examples are *net*^{y}*a-net*^{y}*a* 'sticky', *bet*^{y}*a-bet*^{y}*a* 'sticky and wet', *bes*^{y}*a-bes*^{y}*a* 'wet', and *pet*^{y}*a-pet*^{y}*a* 'chattering'.

(A2)

a.		b.	c.
keba-keba	'gaudy'	*$^*k^yeba$-k^yeba*	*$^*keb^ya$-keb^ya*
neba-neba	'sticky'	*$^*n^yeba$-n^yeba*	*$^*neb^ya$-neb^ya*
gebo-gebo	'gurgling'	*$^*g^yebo$-g^yebo*	*$^*geb^yo$-geb^yo*
teka-teka	'shining'	*$^*t^yeka$-t^yeka*	*$^*tek^ya$-tek^ya*

The forms in A2b are ruled out by Structure Preservation (Kiparsky 1985), which enforces A1 and in this way prohibits onset palatalization in syllables with *e*. It is the forms in A2c that present a problem for Universal L→R Association. After the initial consonants are declared unfit for association of the π-morpheme by Structure Preservation, the left-to-right search for a licit bearer should continue, and the π-morpheme is predicted to associate to the medial (noncoronal) consonant, deriving the ungrammatical *$^*keb^ya$-keb^ya*, etc., in A2c. Default Docking, on the other hand, makes the right predictions here without any special pleading, since its very definition restricts it to peripheral association. After the initial consonant is checked for associability and rejected by Structure Preservation, nothing further is expected to happen, and the procedure terminates.

If we generalize beyond the case under discussion, facts like those in A2 might indicate that the association process for any given autosegment allows only a scan in a single direction. Then the search for an appropriate bearer cannot go back and forth over a given domain.

Notice also that this association pattern can be said to display the classical Q-variable[49] behavior that is typical of *SPE*-style stress rules and is also found in some formalizations of autosegmental phonology (e.g. Clements & Ford 1979).[50]

Although we have seen reasons for preferring the Default Docking alternative, the empirical evidence was rather remote, and it is legitimate to ask whether an analysis with the Universal L→R Association is still an option—if not in the present case, then for some other similar phenomenon. Restrictiveness demands eliminating this option altogether, and this requires setting up the theory in such a way that such analyses are in principle unavailable, not just unpreferred.

Suppose then that rule 18, which we have so far conceived of as a language-specific rule, is in fact subsumed under edge-in association of autosegmental morphology (cf. Marantz 1982, McCarthy & Prince 1986, Yip 1988a). For example, reduplicated melodies are associated to a prefixal template left-to-right and to a suffixal template right-to-left, i.e. always proceeding from the free edge. If the π morpheme is an autosegmental SUFFIX, its associative behavior would follow from a generalized notion of 'suffix': suffixes are always applied from right to left. In the case of segmental suffixes, this simply means concatenation at the right edge; for autosegmental suffixes, it means that mapping starts from the right edge, i.e. right-to-left. This account no longer resorts to the language-specific rule in 18, and it also successfully eliminates the additional Universal L→R association as an available option in the theory.

Directly linking affixal status and direction of association in this way raises the question of whether there are also autosegmental PREFIXES in the mimetic vocabulary. Hamano's 1986 study in fact reveals that there is a voicing prosody applicable to mimetic roots whose direction of mapping

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49 A Q-subscript on a term of the structural description of a rule requires that the term be satisfied maximally.

50 Default Docking is also reminiscent of Kiparsky & Halle's 1977 Basic Accentuation Principle of Proto-Indo-European, and of Haraguchi's 1977 similar melody association rule for Tokyo Japanese. The examples from stress (such as that of Eastern Cheremis) arguably fall under a different explanation (Prince 1983, 1985). Morris Halle (personal communication, 1988) has suggested to us a metrical approach to mimetic palatalization which emphasizes the structural similarities with these earlier cases in terms of the theory developed in Halle & Vergnaud 1987. The idea is to find the location of the π-morpheme by constructing a bracketed grid structure on onsets. Assignment of a line 0 asterisk to all syllable onsets other than *r* and of line 1 asterisks to all marked onsets containing a coronal is followed by construction of unbounded left-headed constituents on line 0 and unbounded right-headed constituents on line 1; the constituents constructed have a unique head (namely the rightmost coronal or the leftmost noncoronal), which will be the bearer of the π-morpheme.

is opposite to that found in the palatal prosody. Voicing of the initial consonant always brings with it a negative connotation ('bulky, violent, inelegant'), as illustrated by the examples in A3.

(A3)	a.	*pota-pota*	'drop of thin liquid'
		bota-bota	'drop of thick liquid'
	b.	*kira-kira*	'shining, shimmering'
		gira-gira	'glaring'
	c.	*tsuka-tsuka*	'walking in unhesitatingly'
		dzuka-dzuka	'walking in unhesitatingly where unwanted'
	d.	*koto-koto*	'clattering noise'
		goto-goto	'clattering noise of a heavy object'
	e.	*sawa-sawa*	'the sound of a breeze'
		zawa-zawa	'the bustle of a crowd'
	f.	*moso-moso*	'movement of small object'
		mozo-mozo	'movement of bulky object'

We are dealing here with an autosegmental voicing morpheme (unrelated to the compound voicing morpheme) which we will refer to as 'β' (mnemonic for 'bulkiness'). In A3 we see the effects of Left-to-Right Mapping (now construed as left-edge setting of edge-in association, triggered by the prefixal status of β). Note that the bearer of β is strictly initial in all examples except A3f, where the initial sonorant *m* is redundantly voiced and β-voicing appears on the medial obstruent *s*. The segment *m* does not qualify as a bearer because Structure Preservation prohibits the specification of voicing on sonorants during the lexical phonology (where β-voicing clearly belongs).[51] Unable to link β-voicing to *m*, association proceeds rightwards to the medial consonant.

To recapitulate, Default Docking and Edge-In Association together allow a simple analysis with right-edge setting for the π-suffix and left-edge setting for the β-prefix. Both empirical evidence and theoretical considerations have led to the conclusion that Default Docking is superior to Universal L→R Association. Furthermore, a relationship is established between the mapping characteristics of autosegmental morphemes and the more usual segmental prefixes and suffixes attached to the beginnings or ends of words.

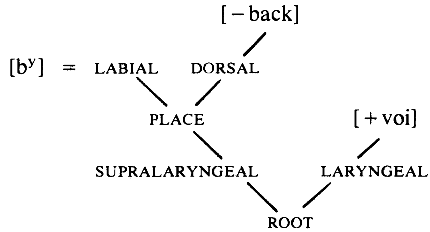
(ii) THE SUBSTANCE OF π. Here we consider the phonological content of what has up to now been informally designated as π in our representations. The discussion below explores ways in which to integrate our analysis of the π-morpheme into a theory of segment structure and reveals that the currently prevailing assumptions on Feature Geometry (Clements 1985, Sagey 1986) do not readily capture the correct generalizations. We offer a somewhat different view of segment-internal structure, which captures the intrinsic connection between coronals and palatalization. Our solution, however, has far-reaching consequences for Feature Geometry beyond the present study, and the main goal of this section is to make clear what must minimally be accounted for in an adequate theory.

It has long been known that segments have more internal structure than that of a simple set of features, and beginning with Lass & Anderson 1975 a significant number of proposals have been put forth. In the feature-geometric approach outlined in Clements 1985 and further developed in Halle 1986, Sagey 1986, and Schein & Steriade 1986, among others, palatalization features are located on the Dorsal node, mirroring the articulatory fact that palatalization is executed by the dorsum of the tongue. For example, a palatalized labial [b^y] has roughly the structure in A4, with two articulators, Labial and Dorsal, where palatalization is a specification of the dorsal features of the affected consonant:[52]

[51] Alan Prince (personal communication, 1988) points out that, instead of appealing to Structure Preservation, we could build an alternative explanation on the fact that β-voicing on *m* would not produce an audible difference with respect to the source form, and the presence of the β-morpheme would be undetectable—a singularly unsuccessful way of conveying the concept of bulkiness.

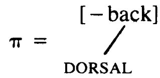
[52] There is a lively debate as to where in the hierarchy specific features should be located, how the geometric characterization of the place and laryngeal nodes fares in comparison with multi-

(A4)

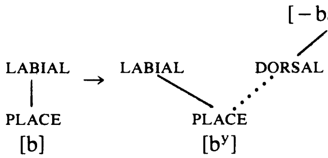


In these terms, the π-morpheme can be conceived of as a Dorsal node (perhaps underspecified) with the feature [– back] (A5). Association of the π-morpheme to a segment now formally means association of the feature constituent in A5 to the segment's place node, creating a complex segment with two articulators as shown in A6.

(A5)



(A6)[53]

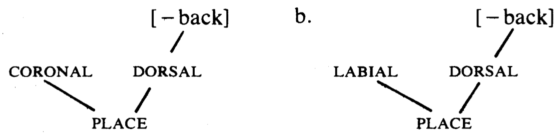


This approach, however, fails to adequately express the interaction of palatalization as a secondary articulation with the primary place of articulation of segments. There are at least two pertinent issues to be discussed in this context.

The first concerns the correct representation of palatalized velars (e.g. k^y and g^y). The Dorsal node carries the features characterizing vowels and secondary articulation, in particular palatalization, but velars are also defined by the Dorsal node. There is a longstanding problem of adequacy here dating back to the *SPE* approach to secondary articulation (cf. Campbell 1974, and most recently Keating 1987), in that the system is unable to express the phonetic distinction between true palatals (e.g. the stop denoted by IPA [c]) and palatalized velars like [kʸ]. A possible way out is to add a special velar articulator for consonants, different from the dorsal articulator (as proposed in Steriade 1987b). The palatalized velar would then contain the two articulator nodes Velar and Dorsal and in this way differ from a true palatal. However, node-proliferating proposals of this kind are fraught with inherent problems. On the one hand, phonological relatedness (here, between velar consonants and back vowels; see e.g. Reighard 1972) is lost, a high price to pay for an additional phonetic distinction; on the other hand, as convincingly demonstrated in McCarthy 1989, the usual noninteraction between back vowels and velar consonants in templatic systems is due to plane segregation (i.e. underspecification of concatenation structure) and needs no feature-geometric explication.

The second, and much more serious, problem lies in the fact that the intimate relation between palatalization and coronality goes unexpressed. Crosslinguistically, coronals are most susceptible to palatalization (Maddieson 1984), and this is of course precisely reflected in the mimetic system of Japanese. There is little hope for representations like A7 to bring out this affinity. Palatalized coronals (A7a) have exactly the same degree of complexity as palatalized labials (A7b).

(A7) a.



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valued features, and how much of the node structure is empirically justified; see McCarthy 1988 for illuminating discussion of the various possibilities.

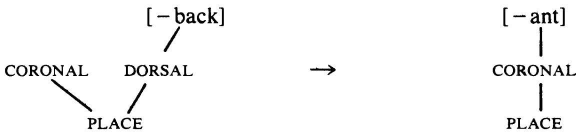
[53] Irrelevant nodes and features will henceforth be suppressed for simplicity of representation.

For the π-prosody, this means that the dominance of coronals over noncoronals in association can be expressed only clumsily, by stipulating that the R→L mapping rule associates a floating Dorsal node to a place node, provided the segment already possesses a Coronal node. This is at best an unrevealing description, and it remains a mystery why coronality attracts palatalization. In an adequate account this coronal-palatal connection should be brought out by anchoring the palatalization features in the Coronal node. There is a dependency here that is clearly missed in the approach via added Dorsal node.[54]

Given these rather fundamental inadequacies, we might consider taking π to be characterized as [−anterior] (perhaps the unique value of a privative anteriority feature). Assuming that [anterior] anchors in the Coronal node and is in fact undefined for other places of articulation (see McCarthy 1988), this successfully explains why π maps to coronals; however, since [−anterior] is by definition unable to express palatalization of noncoronals, this proposal incorrectly predicts that π cannot anchor in noncoronal segments at all. This holds unless we add the implausible stipulation that unassociated π undergoes radical metamorphosis, with [−anterior] reemerging as another feature (e.g. [−back]) that can associate to noncoronals.

The problem here is not specific to our analysis, and Sagey (1986:109–10) appeals to precisely this kind of reanalysis, as depicted in A8. What is phonologically a palatalized coronal (i.e. a complex segment) in A8a is reanalyzed in A8b as alveopalatal (i.e. a simplex segment with [−ant] dependent on Coronal).

(A8) a. b.



Apart from the fact that such reanalysis appears to be an arbitrary move designed to capture a principled connection, it fails to reflect the fact that palatalized coronals are PHONOLOGICALLY noncomplex and differ in this way from palatalized labials and velars.

The proposal that we would like to put forth tentatively can be characterized by this motto: PALATALIZATION IS CORONALIZATION. As suggested to us independently by Alan Prince and Morris Halle, the term 'palatalization' might in fact be nothing but a traditional misnomer for what is more adequately characterized as 'coronalization'. Roughly speaking, the idea is that the added articulatory gesture consists in raising the tongue blade. In general, coronalization consists in the addition of a coronal component or, if such a component is already present, in its enhancement (by the addition of [−ant]).

Our proposal is that the features characterizing front vowels reside on the Coronal node, and

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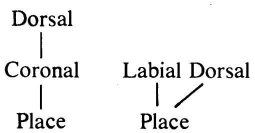
[54] A possible solution might be found in the theory of dependent tier ordering developed in Mester 1986, 1988 (see also Selkirk 1988). The idea is that a feature or node may occupy certain different positions in the feature geometry. For the case at hand, we could assume that Dorsal (acting like [−ant]) is dependent on Coronal, but in the absence of a Coronal node it is directly linked to the Place node. Palatalization then means for coronals that Dorsal associates to the Coronal node (i), and for noncoronals that it associates to Place (ii).

i. ii.



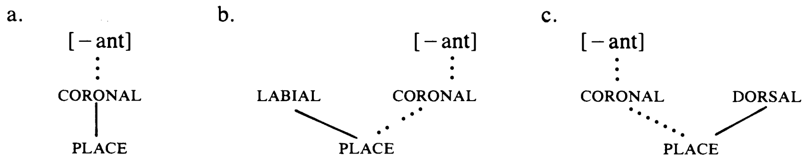
This approach captures the asymmetry with respect to palatalization between coronals and noncoronals. See Mester 1986, 1988 for a discussion of such conditions of adequacy that any model of feature structure must fulfill, and den Dikken & van der Hulst 1988 for a recent presentation of the issues.

not on the Dorsal node. This is no more than a feature-geometric implementation of a proposal made in Clements 1976a, where a number of convincing arguments for the coronality of front vocoids are presented. As Clements points out, this is already an automatic consequence of the definition of the feature [coronal], namely, raising of the tongue blade from its neutral position.[55] The acoustic definition of the corresponding feature [grave][56] in Jakobson & Halle 1956 also draws the same distinction: front vowels and dental/alveolar/palatal consonants fall under [−grave], back vowels and peripheral consonants under [+grave].

Numerous phonological arguments can be found in the area of consonant-vowel interactions. Just as [+back] characterizes back vowels and back consonants as a natural class, and [+labial] covers both rounded vowels and labial consonants, [+coronal] should be shared by front vowels and coronal consonants. Clements 1976a argues that this is the only way of consistently characterizing palatalization as assimilation, and of explaining cases where coronal consonants play a crucial role in rules creating front vowels.

In this light, the previously rejected [−anterior] proposal merits serious reconsideration. Let us assume, then, that the π-morpheme consists of this feature (or an equivalent feature docking only on the Coronal node). Its association proceeds as follows: if the segment already has a Coronal node, the result is simply [−anterior] associated to that node (A9a); if the segment has no Coronal node, such a node is automatically created to provide a docking site. Palatalized labials and palatalized velars are thus represented not with a secondary Dorsal node, but with a secondary Coronal node (A9b,c).

(A9)



This coronalization approach solves the two problems mentioned earlier. First, it obviates the necessity for creating a separate Velar node and in this way eschews node-proliferation. Second, and more importantly, 'palatalization' of coronals is correctly characterized as a shift in primary articulation, while 'palatalization' of noncoronals is the addition of a secondary coronal articulation. The attraction of palatalization to coronals now follows from a preference for dependently defined simplex structures over complex structures. Our proposal therefore formally incorporates the intrinsic connection between palatalization and coronality.

Empirical evidence supporting the coronality of π is found in the interaction of the palatal glide *y* with the palatal prosody in mimetics.[57] Although forms like *boya-boya* 'absentminded' and *yobo-yobo* 'staggering' exist, comparable forms with an additional palatalized consonant (such as **b^yoya-b^yoya* and **yob^yo-yob^yo*) are unattested and are judged ill-formed. This complementarity of the glide *y* and palatalized consonants is only explained if *y* is included in the class of coronals. We can assume, for concreteness, that *y* is a coronal with the root node configuration [−cons, +son] and can thus serve as an anchor of π.

[55] Given that both front vowels and coronal consonants fall under the category denoted by the German term 'Vorderzungenlaut' in the phonetic tradition following Sievers 1901, it is in fact rather surprising that the question of whether there should be a feature characterizing them as a natural class was not even considered in *SPE*. In order to exclude front vowels from the class of coronals, Chomsky & Halle (1968:300) make the rather implausible move of defining the neutral position of the tongue as 'about the level that it occupies in the articulation of the English vowel [e] in the word *bed*'.

[56] Graveness (opposite: acuteness) is defined as lower (versus higher) concentration of energy in the lower frequencies of the spectrum.

[57] The glides *w* and *y* have a limited distribution in Japanese: *w* occurs only before *a*, and *y* only before *a*, *u*, and *o*.

A final argument for palatalization as coronalization can be found in connection with the issue of π-mapping. Given the above analysis, there is no longer any need to specify π-bearers as coronal: π, being what it is, will seek out coronals on its own. This is more than a simplification of the analysis; it is in fact crucially necessary once the analytical proposals in the previous section, 'The mapping of π', are accepted. Since right-to-left association is performed by universal edge-in association (applying to a suffixal autosegment) and not by a language-specific mapping rule, there is no way in which the restriction to coronals could be specified in the grammar.

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