

Coronal Sounds and Palatalizations:

An Analysis of Polish and English

by

Małgorzata Ćavar

Thesis

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Thesis supervisor: prof. Jerzy Rubach

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Małgorzata Cavar

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Promotor pracy: prof. zw. dr hab. Jerzy Rubach

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Preface

The subject of this thesis is palatalization processes, which are assumed to be assimilations of consonants to the front vowel. It is argued that the theory of feature geometry provides a more explanatory analysis of palatalization rules than the classical SPE approach. Yet, a detailed analysis shows that neither of the current models of feature geometry may be regarded as fully satisfactory.

Chapter 1 provides a theoretical background: it discusses briefly the notion of feature in SPE and introduces the framework of feature geometry. Chapter 2 presents the phonetic basis of our discussion, and traditional accounts of two rules of palatalization. In chapter 3, the English rule of palatalization is analysed in the framework of feature geometry within the Articulator-Based Model and the Constriction-Based Model. In chapter 4, both models are tested against Polish data. Finally, chapter 5 provides a summary of the results.

I would like to take this opportunity and thank to those who, in one way or another, contributed to this thesis. I want to thank my husband, Damir Cavar, for all the love and support as well as for introducing a broader perspective into my understanding of linguistics. I am grateful to the organisers and teachers of the Generative Summer School in Olomouc. In particular, I would like to thank Tracy A. Hall, who taught introductory courses in feature geometry in Olomouc in 1995 and 1996. These courses have inspired my interest in feature geometry and, in the long run, the choice of the topic of this thesis. Finally and most importantly, I thank my teacher and supervisor, Prof. Jerzy Rubach. To him I owe a debt of gratitude for his invaluable tuition in the preparation of this thesis and the most inspiring classes I have ever had a chance to attend.

Chapter 1

Introduction

1.1 Features in SPE

In the current phonological theory, the basic units of phonological operations are features, out of which segments are composed. This perspective allows us to disregard the great variety of possible types of segments in the languages of the world. Instead, we focus on the limited set of universal features and, thus, we may draw generalizations about human language based on phenomena from many languages. The approach using features is advantageous for formal reasons also. Consider the notation of the English rule of palatalization in (1):¹

(1) a. $s \quad z \quad t \quad d \longrightarrow \int \quad \text{ʒ} \quad \text{tʃ} \quad \text{dʒ} \quad _j$

b.
$$\begin{bmatrix} +obstr \\ +coron \\ +anter \end{bmatrix} \longrightarrow \begin{bmatrix} +strid \\ -anter \end{bmatrix} / _ \begin{bmatrix} -cons \\ -syll \\ +coron \\ -anter \end{bmatrix}$$

First, the notation using features has a higher explanatory value than a notation using segments, as it brings to light the fact that the process in question is an assimilation of the place

¹The notation in (1) is slightly simplified and differs from the statement proposed by Rubach (1984a), which will be discussed later. At this point, I use the notation in (1), because it shows clearly the properties of the formalism.

of articulation. Also, we do not need to enumerate in the statement of the rule all the segments which undergo the rule — thus, the notation in (1b) is more economical. Finally, the predictive power of (1b) is higher than that of (1a). It predicts that any segment which has the properties enumerated in the statement of the rule undergoes the change. In the English rule of palatalization this last argument is probably irrelevant, but it is not in other cases. In Polish, for instance, there is a rule of devoicing at the end of words. In Polish [dʒ] does not occur at the end of native words and would not be included in the rule of the type exhibited by (1a). However, some recent borrowings do have underlying [dʒ] and this [dʒ] does undergo devoicing to [tʃ], which shows that the lack of [dʒ] is merely an accidental gap. Yet, the rule listing segments of the output would wrongly predict that the [dʒ] in borrowings will not undergo devoicing.

Nowadays, the special status of features is indisputable. However, the relation between the segment and features has been much debated in the last decade.

For years, the prevailing view on the relation between the phoneme and features was that of Bloomfield, who defined the phoneme as ‘a bundle of features’. Two immediately apparent consequences of such a definition are that the phoneme has no internal organisation and that any two features of a segment are as closely related as any other two. This approach was basically adopted in Chomsky and Halle (1968, hereafter SPE), where segments are represented as columns of features:

“(...)phonetic representation has the form of a two-dimensional matrix in which the rows stand for particular phonetic features; the columns stand for the consecutive segments of the utterance generated; and the entries in the matrix determine the status of each segment with respect to the features.” (SPE: 5)

Given these assumptions, the feature matrix for the Polish word *kot* (‘cat’) is as follows:

(2)

	k	ɔ	t
consonantal	+	-	+
sonorant	-	+	-
continuant	-	+	-
coronal	-	-	+
anterior	-	-	+
distributed	-	-	-
delayed release	-	-	-
nasal	-	-	-
lateral	-		-
voiced	-	+	-
high	+	-	-
back	+	+	-
low		-	

Originally in SPE, vowels were described with vocalic features [high], [back], [low] and consonants with consonantal features, unless they had secondary articulation, which was expressed by vocalic features too. However in later works, velar consonants have been repeatedly referred to as [+back], and this approach we adopt here. Finally, one should bear in mind that phonetic symbols referring to segments are treated as informal abbreviations for the particular sets of features.

Further, the feature column itself is defined as:

“a function assigning a certain entity, a phoneme, to a set of phonetic categories which determine its physical properties.”

(Clements, 1985, after SPE: 164)

Thus, as Clements (1985) points out, features are not conceived of as entities which may expand or contract along a given row, but as phonetic categories to which entities are assigned. However, the last twenty years of research have shown that this view is wrong. In the next sections we will focus on the problems connected with the SPE approach and their possible solutions.

1.2 Feature Geometry

A phonological theory should be able to represent all possible and exclude all impossible phonological processes. Additionally, simplicity of the formalism should be proportionate to the relative naturalness of a given phonological change. In other words, the most common and natural changes should be represented by the simplest formal devices. Finally, the structure of phonological representation should reflect the structure of the phonological knowledge in the human brain (Sagey, 1990). In these respects the SPE approach presents several problems.

First, the theory is able to express possible phonological processes, but at the same time it overgenerates, namely, there are certain types of rules which could be easily expressed in the linear formalism, yet, they are not attested in any language of the world. Consider the rules in (3).

$$(3) \quad \text{a.} \quad \begin{bmatrix} +obstr \\ +coron \\ +anter \end{bmatrix} \longrightarrow \begin{bmatrix} +strid \\ -anter \end{bmatrix} / \text{---} \begin{bmatrix} -cons \\ -syll \\ +coron \\ -anter \end{bmatrix}$$

$$\text{b.} \quad \begin{bmatrix} +obstr \\ +coron \\ +anter \end{bmatrix} \longrightarrow \begin{bmatrix} -voice \\ -anter \end{bmatrix} / \text{---} \begin{bmatrix} -cons \\ -syll \\ +coron \\ -anter \end{bmatrix}$$

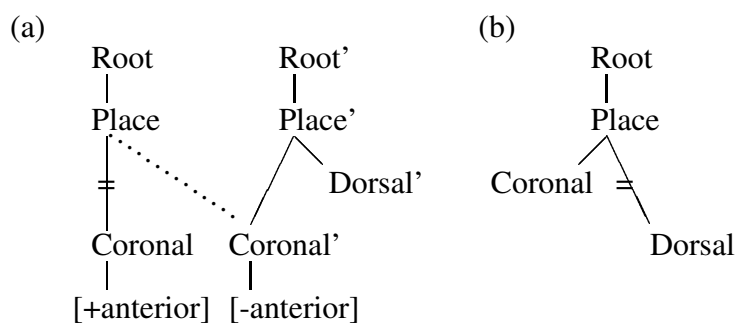
The first rule is the statement of a common phonological process, the second one is probably not attested in any language of the world. The problem is that the formalism does not distinguish between these rules. This way the criterion of excluding impossible representations and processes is not fulfilled. Second, the relation between naturalness of the rule and simplicity of the formal notation is not always retained. For example, assimilation in three features (e.g. place features) under this theory is viewed as more complex than assimilation in one feature; thus, the former should be less common in the languages of the world. Yet, no such relation seems to exist. Third, the SPE formalism does not explain why certain groups of features function together in phonological processes whereas some others never do so. Also, in this theory

it is not clear why assimilations should be more natural than other processes. The conclusion would be that any human being possesses some additional knowledge about language, which is not reflected in any way in our theory. Thus, the last criterion is not fulfilled.

A possible alternative to the SPE theory is feature geometry (Clements, 1985; Sagey, 1986; McCarthy, 1988; Hume, 1992; Clements & Hume, 1995; Halle, 1995, and others), which in actual fact is a further development of autosegmental phonology (cf. Goldsmith, 1990). The fundamental progress of autosegmental phonology was the assumption that assimilation is an extension or spreading of a given feature over a wider domain. Needless to say, under this approach the feature ceased to be a matrix entry, a logical category assigned to a segment by some function. It has started to be viewed as a phonological unit in its own right, which is able to extend, contract, may be inserted or deleted (Clements, 1985).

In feature geometry each distinctive feature is represented on a separate plane, or tier. Features constitute terminal nodes of the feature tree. Further, these individual features are dominated by superordinate nodes, which are called class nodes. These, in turn, are dominated by higher order class nodes or by the root node. The root node itself is linked to the skeletal tier. The dependency of nodes is represented by association lines. The functional relatedness of (groups of) features is expressed by ordering them under one common class node. In other words, for several features to function together in phonology, they have to be exclusively dominated by a single node in the universal feature tree (Clements, 1985). Thus, assimilation and reduction are seen as single operations, linking and delinking of single nodes respectively, as for example in (4):

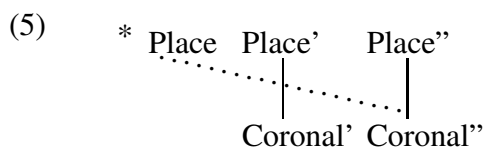
(4) **Assimilation and Reduction in Feature Geometry**



(4a) provides an example of assimilation in the place of articulation and (4b) — a reduction of a secondary articulation in a consonant. Place, Coronal, Dorsal represent class nodes of two neighbouring segments. For the sake of clarity, we distinguish the nodes of the two segments

by '. In the case of assimilation in (4a), Coronal' creates a new association line, or spreads, to Place. A new association line is represented by the dashed line. At the same time, the original specification of the Place node, i.e. the Coronal node, is delinked, which is represented by double horizontal line crossing the original association line. Reduction (of segments, groups of features or of single features) is effected by the delinking of nodes, as in (4b). Nodes which are not higher affiliated are later deleted.

Of course, spreading is not completely free. There are a number of constraints of universal type which limit such operations. A node may spread only to elements on the same plane (i.e. of the same category) as the node by which it was originally directly dominated. For example, features originally adjoined to the class node Place may only spread to another Place node. Spreading may not occur if there is an intervening node on the same plane, which in our formalism would result in crossing lines, as in (5):



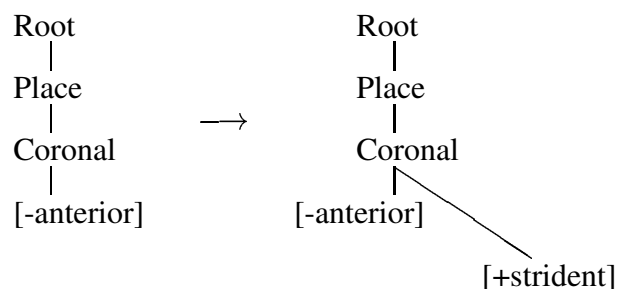
Crossing lines is impossible due to the Line-Crossing Constraint:

(6) **Line-Crossing Constraint** (Hume, 1992, after Clements, 19xx)

Association lines may not cross on a plane.

The Line-Crossing Constraint explains, for instance, the effect of opacity of segments in vowel harmony rules.

Of course, not all possible phonological processes may be reduced to the simplest operations on the nodes of feature tree. Sometimes, features are arbitrarily added or changed, which requires more complicated notations. Thus, for example, Polish (and English) Affrication, a late adjustment rule, is represented as in (7):

(7) **Affrication**

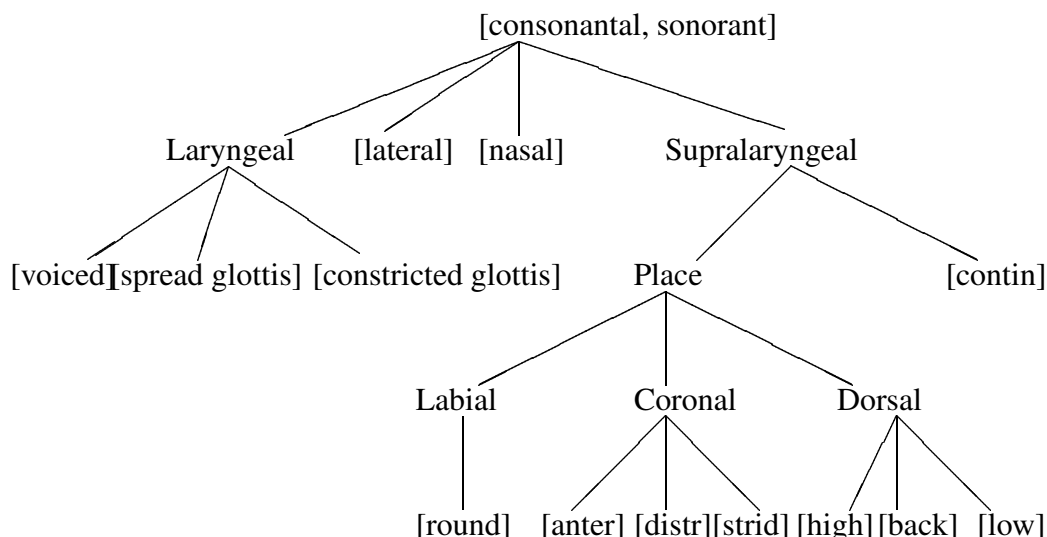
In the case of arbitrary feature change, the statement of the rule in feature geometry notation does not add anything. In such cases then, I will retain the linear notation of rules.

Summing up, feature geometry fulfills all the criteria for a phonological theory. It is much more restrictive than linear phonology, as it excludes impossible phonological rules. It represents the most common processes by means of the simplest formal devices, whereas arbitrary changes require in this theory more complicated statements. It seems also to reflect linguistic knowledge to a greater extent than the SPE approach. The outstanding problem is the details of the structure of the universal feature tree. As it is assumed that functional classes are dominated by single nodes, the geometry of the universal feature tree may be established by tracing all the natural groupings of features in processes of assimilation and reduction. In the following sections I will present two competing models of feature geometry.

1.3 Articulator-Based Model

It seems that certain groups of features not only function together in phonological processes but also are articulated by the same articulators. According to Halle (1995), this suggests that all functional feature classes have an anatomical basis. Consequently, in this approach, class nodes represent articulators by which a given set of features is produced. Consider the feature tree in (8), based on Rubach (?), who adopted the ideas from Clements (1985), Sagey (?) and Halle (?)² :

(8) **Feature Tree in Articulator-Based Model**



In the feature tree in (8), features are grouped under the articulator nodes: Laryngeal, Labial, Coronal, and Dorsal³. This implies that not only any single feature but also any grouping of features exclusively dominated by one articulator node may assimilate to the exclusion of the rest of the features. [voiced], [spread glottis] and [constricted glottis] are dominated by the Laryngeal node, since all these features are implemented phonetically by means of the excitation at the laryngeal part of the vocal tract and they function as a class in phonological processes. Further, traditional place features are grouped under three nodes, according to the articulator by which they are executed. All the features referring to vowels, except for [round], are grouped

²The feature tree in (8) does not correspond in all detail to the one presented in Rubach (?). The features [consonantal] and [sonorant] do not hang off the Root but, following suggestions of McCarthy (1988), they themselves constitute the Root.

³Notice that in (8), the features [ATR] and [suction] are left out, since they are irrelevant for our later discussion (cf. Halle, 1995).

under the Dorsal node, thus all vowels will be viewed as having a Dorsal node. Back vowels will be represented as dorsal [+back], front vowels — as dorsal [-back]. Consonants, on the other hand, make use of all the three nodes located under the Place node. Labial consonants have in their representation a Labial node. Dental, alveolar, post-alveolar, prepalatal and palatal consonants have a Coronal node. Velar consonants are specified for a Dorsal node. Consonants with a secondary articulation are double specified: they have normal consonantal features corresponding to the primary articulation, and additional nodes for the secondary articulation: Labial [round] (in the case of labialization), Dorsal [+back] (velarization) and Dorsal[-back] (palatalization).

Interestingly, in this model it is not encoded in the structure which articulation is major and which is secondary. This information is crucial for the complex segments which have in their structure more than one node dominated by Place; otherwise, the articulator-free features cannot be executed. Sagey (1990: 151) defines the property of being a major articulator as a relation between an articulator and the Root. To express this relation, Sagey (1990) has introduced the mechanism of a pointer

“where this pointer means nothing more than to apply the closure features specified at the Root to the articulator that the pointer points to.” (1990: 151)

The three articulators in the oral cavity are grouped under the Place node, which reflects the facts of place assimilations, where all place features and only place features assimilate at the same time. Further, the Place node is dominated by the Supralaryngeal node, which, like other class nodes, corresponds to a subpart of the vocal tract. The feature [continuant] in (8) is a sister node of the Place node, as argued by Sagey (1990). The features [lateral] and [nasal] are immediately dominated by the Root, because, first, each of them may spread independently of any other features and, second, they belong to the so-called articulator-free features (they can be executed by various articulators). They do not form a common node, because, as observed by Halle (1995), two articulator-free features assimilate together only in the case of total assimilation, i.e. they never assimilate together to the exclusion of other features, *ergo*, they are not dominated by a common node. Finally, the features [consonantal] and [sonorant] actually form the Root, because they never spread independently of each other. If they spread, then all the other features spread as well, which results in the total assimilation.

Unfortunately, the feature geometry in (8) is not uncontroversial, especially the affiliation of [consonantal], [sonorant], [lateral], [continuant] and [strident] are much debated. However, since we want to focus in further analysis on the Place node, we will simply assume the structure in (8).

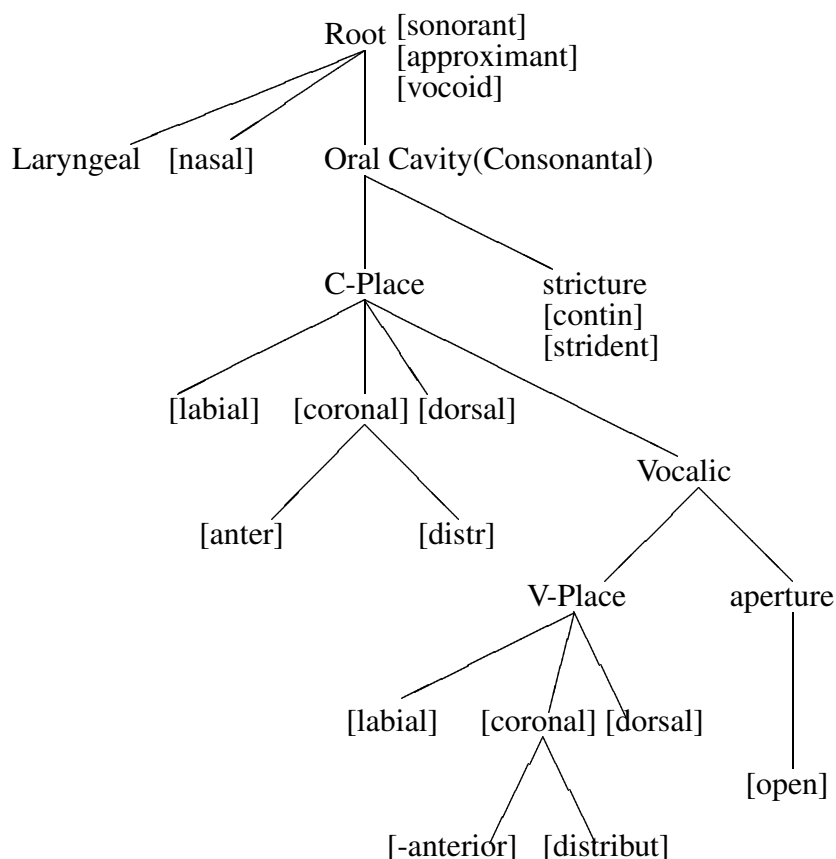
1.4 Constriction-Based Model

The Constriction-Based model (Clements & Hume, 1995) defines segments in terms of the constriction in their production. The constriction itself is defined in terms of its degree and location. The location of the constriction depends on the active articulators involved.

More interestingly, unlike the Articulator-Based Model, Clements and Hume's model uses the same set of features for vowels and consonants. This is motivated, among others, by palatalization processes, where consonants become [+coronal, -anterior] in the context of front vowels. If we want to express palatalization as an assimilation, we should assume that front vowels are coronal. Thus, in this approach, front vowels have a Coronal node, back vowels have a Dorsal node, central vowels are phonologically placeless, and additionally, roundness is represented by the presence or absence of a Labial node. Consonants are labial, coronal or dorsal, and finer distinctions in the coronal area are made through the use of the features [anterior] and [distributed].

However, for some processes (e.g. some vowel harmonies) vocalic and consonantal features have to be differentiated somehow. In this model it is done by segregating vocalic and consonantal features onto different planes. Consider the schema of the feature tree in (9), adopted from Hume (1992), and Clements and Hume (1995):

(9) Feature Tree in Stricture-Based Model



Constriction is represented by two nodes: the Oral Cavity node (or Consonantal) for vocalic features, and the Vocalic node for vocalic features. The location of constriction is specified by C-Place (Consonantal Place) for consonants, and by V-Place (Vocalic Place) for vowels. Both vowels and consonants potentially have all these nodes. The Vocalic node and its dependents in the representation of consonants represent a secondary articulation. The Consonantal node in the representation of vowels is motivated by the fact that there are assimilations of place of vowels across consonants but there are no assimilations of place of consonants across vowels. This suggests that vowels have the Consonantal node which blocks spreading of consonantal features.

In the approach of Clements and Hume, pointer is not necessary to encode the major articulation, as this information is encoded in the structure itself: the major articulator dominates the minor articulator.

This model is not without flaws, however. It is criticised for superfluous specifications of some information, e.g. the distinction between vowels and consonants. Another problem is the interplanar spreading proposed by Hume (1992). These issues will be discussed in detail in chapters 3 and 4.

Chapter 2

The Background

The goal of this chapter is to prepare the ground for the discussion in chapters 3 and 4. Section 2.1 describes the articulation of Polish coronal sounds, which is necessary to understand how particular groups of sounds should be described in terms of phonological features. Section 2.2 presents the Polish rule of Coronal Palatalization and its traditional accounts within the SPE approach and in the approach of cyclic and lexical phonology. Section 2.3 provides a description of the articulation of coronal sounds in English. In section 2.4 the English rule of Palatalization and its account within the traditional framework are presented. The most important points are summarized in section 2.5.

2.1 Coronal consonants and front vowels in Polish

The peculiarity of the Polish consonantal system consists in the presence of the underlying three-way distinction in the place of articulation in the coronal area of the oral cavity.¹ Among Polish anterior sounds, [t d s z ts dz ɲ] are dental and [r ʎ] are alveolar. However, there

¹Some researchers argue that prepalatals are not underlying but derived through palatalization in the context of front vowels. In many cases, however, prepalatals appear invariably in all related forms although on the surface there is no trace of the front vowel which would trigger palatalization. On such occasions we would have to postulate an underlying front yer, a segment which would not be motivated otherwise and which would have to be deleted later on anyway. Whichever view we adopt, whether or not prepalatals are underlying, they are phonetically different from any palatalized sound of Polish and this fact must be reflected by their feature make-up. For the detailed discussion of the status of prepalatals, see Rubach (1984a).

are no two sounds of Polish which would differ only in that one would be dental and the other alveolar. Thus, we can assume that the exact place of articulation within the anterior area is not contrastive, and should be disregarded. Further, there are two groups of non-anterior coronals, namely post-alveolars [ʃ ʒ tʃ dʒ] and prepalatals (or alveopalatals) [ɕ ʑ tɕ dʑ ɲ]. All the surface non-anterior obstruents are [+strident] (there are no non-anterior stops in Polish) and [+distributed].

Additionally, Polish has palatalized counterparts of anterior and post-alveolar consonants, which are derived in the process of post-lexical Surface Palatalization and are phonetically different from prepalatals.

In surface terms, Polish has two front vowels: high, front, tense, unrounded [i] and front, tense, unrounded mid vowel [e]²

Additionally, it is assumed that Polish has underlying back and front yers. In some contexts, they surface as [e], in some others — as [i](front yer) or as [ɨ](back yer), or they delete. The representation of yers is matter of debate(cf. Rubach, 1986).³ We assume here the SPE-type analysis, namely that the front yer is [+high, -tense, -back], while the back yer is [+high, -tense, +back], and they differ from other high vowels in the feature [tense].

Palatalization processes are triggered by front vowels, however, only [i] (and the front glide [j]) causes Surface Palatalization, a late, post-lexical rule which palatalizes all consonants.

2.1.1 Polish front vowels

In Wierchowska (1967: 48, 87ff), Polish front vowels are described as articulated with the front position of the tongue, which is also characteristic of prepalatal and palatalized segments. Whereas the tip of the tongue points to the lower gums, the middle part is raised towards the hard palate. The acoustic consequence of the front tongue position is formant F2 at the level of 2300–3000 Hz. The lips are spread (in the case of [e] to a smaller degree than in the case of [i]) and lie flat on the front teeth.

²Additionally, it is argued that a distinction should be made between the upper and the lower mid front vowel (Gussmann, 1980; Rubach, 1984). In our analysis, this distinction is irrelevant.

³In the framework of autosegmental phonology, Rubach analyses yers as floating melodies without skeletal slots (?), and Gussmann treats them as floating skeletal slots (cf. Rubach, 1986).

2.1.2 Polish anterior coronals

Wierzchowska (1967: 48) describes Polish anterior coronals as pronounced with the flat position of the tongue, namely, with the tongue lying on the bottom of the mouth cavity. The acoustic effect is the presence of formant F2 at 1200–1700 Hz. Polish [t d s z ts dz n] are apical segments, pronounced with the tip of the tongue at the teeth ridge.

In articulating the lateral [l], the tongue assumes the flat position and can be even slightly concaved. Unlike the obstruents, it is articulated with the tip of the tongue in the area of the alveolar ridge.

Polish [r] may be described as multiple tapping of the tip of the tongue against the alveolar ridge.

In the pronunciation of anterior coronals, the lip position is not distinctive. They are usually in a neutral position like in breathing. They are rounded before [u] and protruded before post-alveolar sounds.

In feature geometry, anterior coronals are viewed as segments with a Coronal node dominating the feature [+anterior].

2.1.3 Polish post-alveolars

Wierzchowska (1967: 64ff) describes Polish post-alveolars as articulated with the flat tongue position. The constriction is located just behind the alveolar ridge. In the articulation of post-alveolars, the lips have a characteristic shape, namely they are substantially protruded and tensed. The characteristic shape of the lips is taken over by adjacent anterior coronals.

In feature geometry, Polish post-alveolars are represented as segments with the Coronal node dominating the feature [-anterior]. It is also argued in Hume(1992), after Dogil(?), that Polish post-alveolars have a Labial node in their representation. The labial node would distinguish palatalized post-alveolars from prepalatals. (cf. section 2.1.4).

2.1.4 Polish alveopalatals (prepalatals)

According to Wierzchowska (1980: 98), Polish alveopalatals are pronounced with a maximal raising of the blade of the tongue towards the hard palate. Prepalatals are crucially laminal, as the constriction is made by the blade. Lips are slightly protruded.

Hume cites the description from Halle and Stevens (1989) who show that “alveopalatals are articulated like palato-alveolars in that the blade of the tongue is raised toward the alveolar ridge” and “in addition, the front of the tongue is raised as it is for palatal consonants” (Hume, 1992: 104). Keating (1991) also assumes a complex status of alveopalatals, and describes them as involving both coronal and tongue-body articulation. Her analysis is based on the evaluation of X-rays of prepalatal consonants from Wierzchowska (1967, 1980).

Traditionally, prepalatal consonants are described as [-anterior, -back, +high]. Nowadays, depending on the model of feature geometry we adopt, they are complex segments with both Coronal and Dorsal nodes (Sagey’s approach) or with the specification of the secondary articulation at the vocalic Place node (Clements and Hume’s approach).

2.1.5 Polish palatalized coronals

Except for prepalatals, all coronal consonants in Polish have palatalized versions. Traditionally it is assumed that in palatalized segments one can observe two articulations: primary, with the constriction identical as in the case of the plain consonant, and secondary, namely, the raising of the front part of the tongue⁴ towards the hard palate. However, Wierzchowska (1980: 49) argues that X-rays do not motivate such claims. She describes their articulation as being as homogenous as that of prepalatals. Both groups are produced with the front position of the tongue. In both cases, one may observe raising of the tongue in the forward part of the mouth cavity. Additionally, on the basis of analyses of palatograms, Wierzchowska argues that there is no reason to claim that the area of constriction in palatalized consonants is, in comparison with plain counterparts, extended, as it was assumed traditionally. Thus, if the plain consonant is [-distributed], its palatalized counterpart will be also [-distributed].

⁴The term ‘the front part of the tongue’ is used here as it was defined in Keating (1991), namely the front part of the tongue without the tip and blade.

In [t' d'] the occlusion is performed not by the tip of the tongue, as in plain [t d], but by the blade. In [s' z'] the constriction occurs in the area between the teeth ridge and the alveolar ridge, extending onto the front part of the hard palate. In [š' ž'] the constriction is located behind the alveolar ridge, extending onto the forward part of the hard palate Wierchowska (1980: 109ff).

In the traditional SPE approach, palatalized consonants differ from the plain ones in the features [+high] and [-back], and the small differences in the articulation place, observed by Wierchowska, are disregarded. In the feature geometry approach, they are represented similarly as prepalatals, namely, with two place specifications. The difference between a palatalized consonant and a prepalatal must be then attributed to a different feature make-up, because the structure is the same.

The fact that palatalized sounds are pronounced as homogeneously as prepalatals is an indirect argument for the complex status of prepalatal sounds. If we want to treat palatalized consonants as having secondary articulation, this could be equally well the case with prepalatals. The fact that both prepalatal and palatalized consonants have the place of articulation different from the plain consonants may be attributed to some adjustment rules at the phonetic level.

2.2 Polish Coronal Palatalization

In Polish [s z t d n r w] alternate with [ɕ ʐ tɕ dʐ ɲ ʒ l] in the context of front vowels, as in (10). (All nouns in (10) and later in (12),(15), (17) are given in nominative singular, unless stated otherwise.)

(10)	masa	‘mass’	ma[ɕ]+e	‘dat.,loc.sg.’
	brąz	‘brown colour’	brą[ʐ]+e	‘loc.,voc.sg.’
	brat	‘brother’	bra[tɕ]+e	‘loc.,voc.sg.’
	kret	‘mole’	kre[tɕ]+ik	‘mole, dimunit.’
	moda	‘fashion’	mo[dʐ]+e	‘dat.,loc.sg.’
	Jan		Ja[ɲ]+e	‘loc.,voc.sg.’
	para	‘steam’	pa[ʒ]+e	‘dat.,loc.sg.’
	szko[w]a	‘school’	szkol+e	‘dat.,loc.sg.’

Before we continue, we have to make a few remarks on [w]. Phonetically, it is a back glide pronounced with the tongue in the back and high position (Wierzchowska, 1980). Lips are rounded only in the context of [u]. Yet, phonologically, it must be treated as a surface realization of the underlying //ʰ//. Actually, [ɸ], pronounced with the flat position of the tongue and the tip at the teeth ridge, used to be and, for some speakers of Polish, still is a surface pronunciation. For this reason, the surface [w] will be disregarded and I will limit the discussion to the alternation between the underlying [+anterior]//ʰ// and //ʰ//.

In the following sections traditional linear accounts of the rule will be summarized, first, the analysis proposed by Gussmann (1978) in the SPE approach, as it was introduced by Chomsky and Halle (1968), and, afterwards, the analysis of Rubach (1984a) within the framework of cyclic and lexical phonology.

2.2.1 SPE Approach

Gussmann (1978) treats the changes affecting anterior coronals together with the changes affecting labials and states the rule in question as in (11):

(11) **I-anterior Palatalization** (Gussmann 1978: 42)

$$[+anterior] \longrightarrow [+high] / \text{---} \left[\begin{array}{l} +syllabic \\ -back \\ -low \end{array} \right]$$

As in (11), the palatalization rule changes labial and anterior coronal consonants into their palatalized versions, however, it is not an assimilation but an arbitrary change of features. Further, the actual surface forms in (10) need to be attributed to later spell-outs, changing anterior palatalized coronals into [-anterior] prepalatals. In any case, under Gussmann's analysis, the rule is a two-stage process.

The notation of I-anterior Palatalization in (11) is problematic for two reasons. First, in the recent years the definition of the feature [+anterior] has changed, and, now [+anterior] does not include labials. This is not a serious problem, since we can simply postulate splitting the rule into two, one affecting labials, the other [+anterior] sounds. In actual fact, this is the solution

proposed by Rubach (cf. Rubach 1981, Rubach 1984a), which will be further discussed in the following section. Second, the context of the rule is not restrictive enough; it is not clear why the rule does not apply in a great number of forms. Consider the examples in (12):

- (12) pestka ‘seed/stone of a fruit’
 bez ‘without’
 te[ɛ][tɕ] ‘father-in-law’
 denko ‘bottom, dimunit.’
 setka ‘hundred’
 zez ‘squint’
 nerka ‘kidney’
 Ren ‘Rhine’
 łezka ‘tear, dimunit.’

In order to account for the apparent exceptions to the rule (11), Gussmann (?) invokes rules known as Lower (13) and Yer Deletion (14).

- (13) **Lower** (Rubach, 1984a)

$$\begin{bmatrix} +syllabic \\ +high \\ -tense \end{bmatrix} \longrightarrow [-high] / _ C_0 \begin{bmatrix} +syllabic \\ +high \\ -tense \end{bmatrix}$$

- (14) **Yer Deletion** (Rubach, 1984a)

$$\begin{bmatrix} +syllabic \\ +high \\ -tense \end{bmatrix} \longrightarrow \emptyset$$

Gussmann assumes that the [e] which does not trigger palatalization is not an underlying //e// but a back yer surfacing as [e] due to the operation of Lower (13). Thus, zez is analyzed as underlying //z ě z ě//. The second yer triggers Lower (13) and, subsequently, it is deleted by Yer Deletion (14). Similarly, words in (12) have the underlying representation as in (15):

- (15) Related forms with an alternation
- | | |
|--------------|------------------------------------|
| //přístřka// | pestek ‘stone of a fruit, gen.pl.’ |
| //břizř// | ’bezecny ‘without decency, adj.’ |
| //třscř// | |
| //dřnřko// | denek ‘bottom, gen.pl.’ |
| //sřřřka// | sto ‘hundred, numeral’ |
| | setek ‘hundred, gen.pl.’ |
| //zřřř// | |
| //nřřřka// | nerek ‘kidney, gen.pl.’ |
| //rřnř// | |
| //řřřřka// | řezek ‘tear, gen.pl.’ |
| | řza ‘tear, nom.sg.’ |

In the cases when there is a vowel-zero alternation, as it is indicated in (15), the presence of a yer is really motivated. However, if there is no such alternation on the surface, postulating a yer instead of //e// results in a structure more abstract than it is necessary. As observed by Rubach (1984a), the yer is postulated in these cases only and exclusively in order to block palatalization.

As pointed out in Rubach (1984a: 62), the yer blocking strategy fails completely in polysyllabic words or disyllabic words, which do not have the penultimate yer in their underlying representation, e.g. :

- (16) weteran ‘veteran’, peleryna ‘pelerine’, serweta ‘tablecloth’,
sekret ‘secret’, detektyw ‘detective’, determinizm ‘determinism’,
dezterter ‘deserter’, nesesor ‘dressing case’,
deser ‘dessert’, defekt ‘defect’, teren ‘terrain’,
desen ‘pattern’, trener ‘coach’, etc. (Rubach, 1984a)

We cannot account for the examples in (16) by claiming that the rule of palatalization in (11) does not apply to borrowings, which are marked in the lexicon as exceptions, because borrowings do undergo palatalization:

- (17) Honduras — Hondura[ç]e ‘loc.sg.’

Riviera	—	Rivie[ž]e	‘dat.,loc.sg.’
Trynidad	—	Trynida[dz]e	‘loc.sg.’

As we can see, the SPE approach does not provide adequate instruments of analysis, and in order to account for the Polish data the theory must be revised.

2.2.2 Coronal Palatalization in Lexical Phonology

The problems with the linear statement of the rule are easily solved as soon as we adopt the framework of lexical phonology (Rubach 1984, 1993). The rule of Coronal Palatalization is cyclic and applies only in derived environments.

(18) Coronal Palatalization (Rubach, 1984a)

$$\left[\begin{array}{l} +anterior \\ +coronal \\ -del.release \\ \alpha obstruent \end{array} \right] \longrightarrow \left[\begin{array}{l} -back \\ +distributed \\ +high \\ -anterior \\ \alpha strident \end{array} \right] / \text{---} \left[\begin{array}{l} -consonantal \\ -back \end{array} \right]$$

The rule of Coronal Palatalization in (18) incorporates assimilation in one feature, [-back], and a number of additional changes with respect to other features. It derives surface forms of all obstruents and of the prepalatal nasal. In the case of liquids, however, this rule provides merely an intermediate stage. Phonetically, [-anterior] palatalized /l̥/ surfaces as palatalized alveolar lateral before the high front vowel and as a plain alveolar lateral otherwise. /r̥/ surfaces as [r] before consonants and [ž] elsewhere. Thus, two spell-out rules are additionally postulated to account for the surface feature make up of liquids, Liquid Spell-out as in (19), and R-Spell-out as in (20).

(19) Liquid Spell-out (Rubach, 1984a)

$$\begin{bmatrix} -anterior \\ +sonorant \\ +consonant \\ -nasal \\ \alpha \text{ continuant} \end{bmatrix} \longrightarrow \begin{bmatrix} -high \\ -\alpha \text{ anterior} \end{bmatrix}$$

Liquid spell-out (19) eliminates the feature [+high] from [-anterior] liquids and at the same time changes the articulation place of the lateral to [+anterior]. It is assumed to act on both the /l/ derivable from //ɫ// and the underlying clear //l//, which is taken to be underlyingly [-anterior].

(20) **R-spell-out** (Rubach, 1984a)

$$\text{a. } \begin{bmatrix} +sonorant \\ +consonant \\ -anterior \\ -high \end{bmatrix} \longrightarrow [+anterior] / _ C$$

$$\text{b. } \begin{bmatrix} +sonorant \\ +consonant \\ -anterior \\ -high \end{bmatrix} \longrightarrow [+obstruent]$$

Again, the R-Spell-out in (20) actually collapses two changes: one changing the place of articulation of the sonorant, the other changing a sonorant into an obstruent.

An intermediate stage in the case of liquids – and, consequently, some spell-outs like those in (19) and (20) – is motivated by a number of reasons (Gussmann, 1978; Gussmann 1980; Rubach, 1984). First, consider the alternations in (21). Phonetic [ž] may be derived from //r// by Coronal Palatalization (21a), from //g// by Velar Palatalization and Spirantization (21c), or it may be underlying (21b). The suffix -ec //ĭc // is a palatalizing context.

(21) (a) star+y ‘old’ — sta[ž]+ec ‘old man’ — star+c+a (gen.sg.)

vs

- (b) grabie[ʒ] ‘plundering’ — grabie[ʒ]+c+a ‘plunderer’
 (c) ciemieg+a ‘oppression’ — ciemie[ʒ]+y+c ‘oppress’ — ciemie[ʒ]+c+a ‘oppressor’

In *star+c+a* the yer is deleted. Yer Deletion applies at the end of the derivation, Coronal Palatalization is cyclic, thus, /r/ must have undergone palatalization at some stage. Yet, we have [r] on the surface. On the other hand, the segments which do not result from Coronal Palatalization surface as [ʒ]. Consequently, it is argued that the change from //r// to [ʒ] is not direct but via some intermediate stage at which the segment is palatalized and at which it undergoes depalatalization. As pointed out by Rubach (1984: 72), if Coronal Palatalization changed //r// to [ʒ] directly, it would not be possible to recover /r/ in the context where it undergoes palatalization.

Second, an intermediate stage is also motivated by the facts of Strident Assimilation. //s z// assume the place of articulation of the following segment (cf. Rubach, 1984: 104), as in (22):

- | | |
|--------------------|--------------------------|
| (22) post ‘a fast’ | po[ɛ][tɛ]ic ‘to fast’ |
| jazda ‘a ride’ | je[ʒ][dʒ]ic ‘to ride’ |
| sen ‘a dream’ | [ɛ][ɲ]ic ‘to dream’ |
| z[ʂ]o ‘evil’ | [ʒ]le ‘badly’ |
| s[ʂ]ac ‘to send’ | [ɛ]le ‘send, 3.pers.sg.’ |

The lateral triggers the change of //s z// to [ɛ ʒ] as well as the other segments derived in Coronal Palatalization. Thus, we may assume that, in order to trigger assimilation, the lateral has to go through the intermediate stage at which it is palatalized.

Third, Rubach(1984a) argues that clear //l// is underlyingly [-anterior]. Clear //l// patterns phonologically with [-anterior] sounds rather than with [+anterior]. It triggers Fronting, the change of //l// to /i/ in the context of [-anterior] sounds. It does not undergo Coronal Palatalization, unlike the rest of anterior sounds. Finally, clear //l// functions with the class of anterior coronals with regard to the distribution of inflectional suffixes.⁵ Therefore, we need a spell-out which would change the place of articulation of [-anterior] clear //l//.

⁵For more discussion see Rubach(1984: 157ff).

Summing up, Rubach states the rule of Coronal Palatalization as a simultaneous change of the place of articulation and an addition of the secondary articulation, which avoids an intermediate stage of palatalized [+anterior] consonants. By assuming a direct change, we keep Coronal Palatalization distinct from Surface Palatalization not only by saying that one is cyclic and the other post-lexical, but also by assuming different outputs of the two rules. Further, there is the criterion of simplicity: in order to retain the intermediate stage we would need to postulate additional spell-outs to account for the surface prepalatals. Finally, there is evidence for the intermediate stage in the case of liquids, but no such evidence can be found in the case of the obstruents and the nasal. Still, the arguments for a direct change are rather vague, and there are no serious counterarguments. We will return to this issue in the discussion of the rule within the model of feature geometry.

2.3 Coronal Sounds in English

In English, there are two groups of coronal sounds: anterior and non-anterior. Anterior [t d s z n l] are produced with the primary constriction made between the tip and the rims of the tongue and the upper alveolar ridge and the side teeth or, in the case of the lateral, the centre of the upper teeth ridge (Gimson, 1989).

Gimson (1989) points out that the frictionless continuant [r] is usually post-alveolar: the tip of the tongue is held in the position near to, but not touching the rear part of the upper teeth ridge, whereas the central part of the tongue is lowered, with a general contraction of the tongue, so that the effect of the tongue position is one of hollowing and slight retroflexion of the tip. The degree of retroflexion is greater in American dialects and in the south-west of England than in the RP.

In the case of [-anterior] [ʃ ʒ tʃ dʒ], the constriction is, according to Gimson (1989: 176), made by the tip and blade of the tongue in the area of the upper alveolar ridge and the side teeth, while the front of the tongue is raised towards the hard palate.

On the basis of the descriptions from Gimson one may conclude that the main difference between [+anterior] and [-anterior] coronals in English is the position of the front of the tongue: in the case of [-anterior] sounds it is raised, similarly as in the front high vowel.

2.4 Palatalization in English

In English, one may observe a number of alternations between [+anterior] and [-anterior] coronal sounds, as in (23):

- (23) (a) [s] — [ʃ]
- | | | |
|---------|---|------------|
| impress | — | impre[ʃə]n |
| digress | — | digre[ʃə]n |
| grace | — | gra[ʃə]s |
- (b) [z] — [ʒ]
- | | | |
|-----------|---|--------------|
| diffuse | — | diffu[ʒə]n |
| supervise | — | supervi[ʒə]n |
- (c) [t] — [tʃ]
- | | | |
|---------|---|--------------|
| Christ | — | Chris[tʃə]n |
| congest | — | conges[tʃə]n |
- (d) essence — essent[ʃi: əe]lity
- | | | |
|----------|---|--------------------|
| artifice | — | artifi[ʃi: əe]lity |
|----------|---|--------------------|
- (e) [t] — [ʃ]
- | | | |
|---------|---|-------------|
| opt | — | op[ʃə]n |
| protect | — | protec[ʃə]n |
- (f) [d] — [ʒ]
- | | | |
|---------|---|------------|
| invade | — | inva[ʒə]n |
| collide | — | colli[ʒə]n |
- (g) habit - habi[tʃu]al
 architect - architec[tʃə]re
- (h) [d] — [dʒ]
- | | | |
|---------|---|--------------|
| grade | — | gra[dʒu]al |
| proceed | — | proce[dʒə]re |
- (i) [s] — [ʒ]
- | | | |
|----------|---|------------|
| Paris | — | Pari[ʒə]n |
| Caucasus | — | Cauca[ʒə]n |
- (j) I miss it - I mi[ʃ] you
 I supervi[z]e it — I supervi[ʒ]e your project

I hate it — I ha[tʃ]e you
 I nee[d] it — I nee[dʒ] you

On the basis of the examples in (23a-i) alone it is difficult to state the context and the scope of the rule. However, when we also take into account the alternations in casual/rapid speech in (23j), then certain generalizations are easy to discover. Thus, we observe that [+anterior] coronals alternate with [-anterior] strident coronals in the context of the front glide. To account for the changes in (23a-i), we have to assume rules which delete the glide in certain contexts, vocalize it in some other contexts, and insert it, if it is not present in the underlying representation. Also, rules which would explain the unexpected change of the manner of articulation in (23e-f) and voicing in (23i), are necessary. In the following section, we will approach these problems within the framework of linear phonology. The argument is based on the analysis in Rubach (1984b), where the approach of cyclic phonology is utilized. In our analysis, however, only the ordering of rules is crucial, because all the rules mentioned in the following section are post-cyclic, except for Spirantization, which is cyclic. For this reason I do not present full derivations.

2.4.1 English Palatalization in Linear Phonology

Rubach (1984b) states the rule of palatalization in English as in (24):

(24) **English Coronal Palatalization** (Rubach, 1984b)

$$\left[\begin{array}{l} +obstruent \\ +coronal \end{array} \right] \longrightarrow \left[\begin{array}{l} +strident \\ -anterior \end{array} \right] / \text{ — } \left[\begin{array}{l} -consonantal \\ -syllabic \\ -back \end{array} \right]$$

English Coronal Palatalization in (24) has a two-fold result. It changes [+anterior] obstruents to [-anterior] obstruents and adds feature [+strident], which for the [+anterior] stops gives as a result a change of stops into affricates. The rule applies vacuously also to [-anterior] obstruents. What seems important, English Coronal Palatalization in this statement is not a rule of assimilation.

Through the operation of the single rule in (24), we explain forms in (23j). Then, the glide in some cases deletes, as in (23a-c), and in some cases vocalizes, as in (23d). These results are derived by the rules of J-deletion in (25), which deletes the front glide after [-anterior] obstruents, and J-vocalization in (26), which turns /j/ to [i].

(25) **English J-deletion** (Rubach, 1984b)

$$j \rightarrow \emptyset / \left[\begin{array}{l} +coronal \\ -anterior \\ +obstruent \end{array} \right] _$$

(26) **English J-vocalization** (Rubach 1984a, after Hayes 1980)

$$j \rightarrow [+syllabic] / C _ \left[\begin{array}{l} +syllabic \\ -stress \end{array} \right]$$

At this point we are in a position to account for the forms in (23a-d). A sample derivation follows in (27). In the word *artificial* J-Vocalization applies, and thus, the context of J-Deletion is not met. Notice that the rules are ordered in a bleeding fashion; if we ordered them the other way round, we would not derive the correct output.

(27)	artificiality	artifis+jæel+iti		impression	impres+jon
		—————	Vowel Reduction (SPE)		impres+jæn
		artifiʃ+jæel+iti	Palatalization (24)		impref+jæn
		artifiʃ+iæel+iti	J-Vocalization (26)		—————
		—————	J-Deletion (25)		impref+æn

In the cases of [t d] versus [ʃ ʒ] alternations, the presence of the fricative instead of the regular affricate is still not accounted for. Thus, an additional rule of Spirantization⁶, (29), is postulated, which changes stops into fricatives after a sonorant or a stop and before the front glide. (The rule applies vacuously to fricatives.)

⁶The rule of Spirantization is also motivated on independent grounds, namely, it is necessary to account for the alternation of *vacant-vacancy* type.

(28) **English Spirantization** ((Rubach, 1984b)
$$[+obstr, +cor, +ant] \rightarrow [+strid, +cont] / \{ [+son] \text{ or } [-cont] \} _ [-cons, -syll, -back]$$
(29) **English Spirantization** (Rubach, 1984b)

$$\left[\begin{array}{c} +obstruent \\ +coronal \\ +anterior \end{array} \right] \rightarrow \left[\begin{array}{c} +strident \\ +continuant \end{array} \right] / \left\{ \begin{array}{l} [+sonorant]continuant > -continuant \\ \end{array} \right.$$

Rubach argues that Spirantization is cyclic. Consequently, it must apply before Palatalization, which is post-cyclic. At this point, the examples in (23e-f) are perfectly regular. To illustrate this, in (30) two derivations are contrasted: in *option* Spirantization applies and produces a fricative, in *congestion* the context for Spirantization is not met, since the dental sound is preceded by a fricative, and consequently, Palatalization produces an affricate. The derivation of *option* is cited from Rubach (1984b).

(30)	option	ɔpt+jon		congestion	kɔndʒest+jon
		ɔps+jon	Spirantization (29)	_____	
		ɔpʃ+jon	Palatalization (24)		kɔndʒestʃ+jon
		ɔpf+on	J-Deletion (25)		kɔndʒestʃ+on
		ɔpʃ+ən	Vowel Reduction (SPE)		kɔndʒestʃ+ən

An additional problem is prompted by words with no underlying front vowel or front glide, such as *habitual* and *architecture*. For such words, Rubach proposes a rule of J-insertion, which applies after a consonant before /u/, as in (31):

(31) **English J-insertion** (Rubach, 1984b)

$$\emptyset \rightarrow j / C_ \left[\begin{array}{l} +syllabic \\ +high \\ +round \end{array} \right]$$

Through the operation of the rule in (31), /j/ is inserted in the context of /u/, which creates a context for palatalization. J-Insertion must crucially apply before J-Deletion, since on the surface the only trace of J-Insertion in the examples in (23g-h) is a palatalized coronal. Now the examples in (23g-h) may be derived as for instance in (32):

(32) *architecture* *arkitekt+ur*
 ————— Spirantization (29)
 arkitekt+jur J-Insertion (31)
 arkitektʃ+jur Palatalization (24)
 arkitektʃ+ur J-Deletion (25)
 arkitektʃ+ər Vowel Reduction (SPE)

Finally, we need to account for the words with a voiced fricative consonant, such as those in (23i). Following SPE, Rubach postulates CiV Tensing, as in (33), and subsequent Voicing, as in (34):

(33) **English CiV Tensing** (Rubach, 1984b)

$$\left[\begin{array}{l} +syllabic \\ -high \end{array} \right] \rightarrow [+tense] / _ C \left[\begin{array}{l} -consonantal \\ +high \\ -stress \end{array} \right] \left[\begin{array}{l} +syllabic \\ +low \end{array} \right]$$

(34) **English Voicing** (Rubach, 1984b)

$$s \longrightarrow [+voiced] / \left[\begin{array}{l} +syllabic \\ +tense \end{array} \right] \text{ — } [-consonantal]$$

CiV Tensing (33) tenses mid and low vowels before a sequence of a consonant, an unstressed high vowel or glide and a low vowel. This rule creates a context for Voicing (34) which voices [+anterior] fricatives in the context between a tense vowel and another vowel or glide.

Thus, the words in (23i) are derived as follows:

- (35) e s+jəen Parisian pəeres+jəen
 pəer CiV Tensing (33)
 pəer Voicing (34)
 pəri:z+jəen Vowel Shift (SPE)
 pəri:ʒ+jəen Palatalization (24)
 pəri:ʒ+əen J-Deletion (25)
 pəri:ʒ+ən Vowel Reduction (SPE)

2.5 Summary

Polish Coronal Palatalization is in the traditional approach an assimilation in the feature [-back], however, a number of features are arbitrarily changed at the same time. Rubach analyses the rule as a direct change to the prepalatal place of articulation for obstruents and the nasal. In the case of liquids, Coronal Palatalization is supplemented by later spell-outs.

In English, the alternations of coronal sounds in the context of the front glide may be attributed to the operation of two rules: Spirantization, which turns [+anterior] stops into fricatives, and Palatalization, which takes [+anterior] fricatives and stops to [-anterior] fricatives and affricates, respectively. In the linear approach, the rule of Palatalization performs two operations at a time: it changes the place of articulation and adds the feature [+strident]. The linear statement does not show the assimilatory nature of the rule.

The traditional formalism does not reflect the fact that there is a formal relatedness between the two rules of palatalization. This relatedness is best expressed within the framework of feature geometry, which will be adopted for the analyses in chapters 3 and 4.

Chapter 3

Palatalization in English

In the second chapter, we summarized the analysis of English Palatalization within the framework of cyclic phonology from Rubach (1984b). Let us now turn to the English rule from the perspective of feature geometry. At this point we will actually depart from accounting of rule interaction and ordering. Instead, we will focus on the non-arbitrary relations between sounds that alternate. In section 3.1, we analyse the rule in the Articulator-Based Model, in section 3.2, we take up the Constriction-Based Model, and finally, section 3.3 contains a summary of the results.

3.1 Analysis in the Articulator-Based Model

In the approach proposed by Sagey (1990) and Halle (1995), contrary to our intuitions, English Palatalization may not be viewed as an assimilation. Spreading of the specification of the front vowel, i.e. of [–back] , results in this model in palatalized sounds, and not in the [–anterior] coronal. If we forced further analysis, the necessary spell-out, as in (37), would be an arbitrary change of features and not an assimilation.

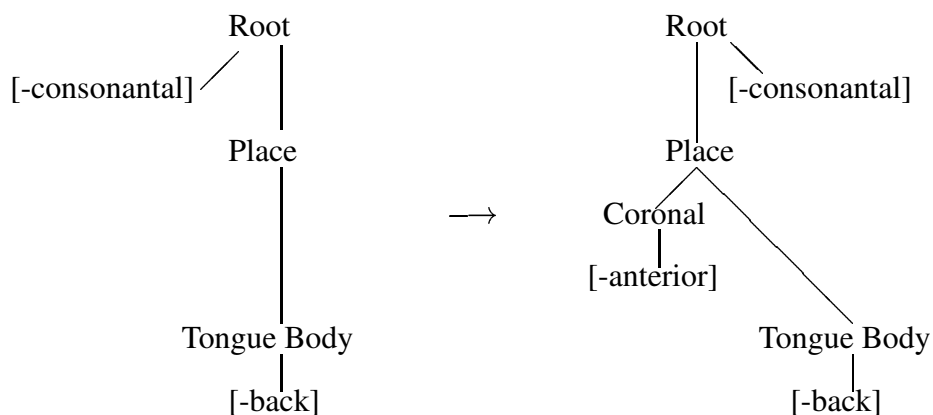
(36) [+coronal, +anterior, –back] \longrightarrow [+coronal, –anterior]

$$(37) \begin{bmatrix} +coronal \\ +anterior \\ -back \end{bmatrix} \longrightarrow \begin{bmatrix} +coronal \\ -anterior \end{bmatrix}$$

Also, in English there is no trace of the intermediate stage of palatalized sounds, which could serve as an independent counterargument for such an analysis.

Thus, we cannot analyse English Palatalization within Sagey and Halle's framework without accepting the idea of Rubach (1993). In Rubach's analysis of Slovak it is assumed that front vowels are dorsal and at a fairly early stage, before the application of palatalization rules, they are redundantly specified as [-anterior] at the Coronal node by Coronal Specification as in (38). Notice that the Tongue Body node in (38) corresponds to the Dorsal node in (8). In order to preserve unified terminology, I will refer in the later discussion to the Dorsal node, which is a technical change with no theoretical consequences.

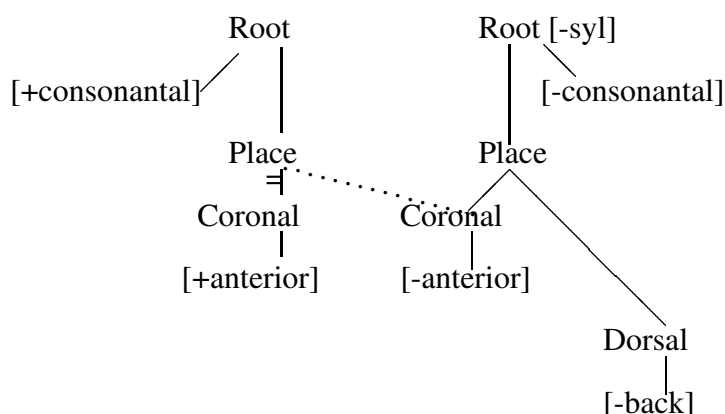
(38) **Coronal Specification** (Rubach, 1993: 100)



The rule of Coronal Specification is also well motivated phonetically for English. Front vowels are defined as those in which the main articulatory gesture is the raising of the front part of the tongue to the hard palate. (Gimson, 1989). The same is true for the front glide (Gimson 1989: 212ff). Now, English Palatalization may be analysed as a simple process of assimilation of the consonant to the following glide. Through the coronal specification of the vowel, the change appears as straightforward spreading of the Coronal node of the glide to the Place node of the consonant, as presented in (39). The original Coronal node in the consonant is delinked.

Two additional remarks are in order. First, in all the feature trees I irrelevant nodes are omitted. Second, the difference between the glide and the vowel is marked by using feature [syllabic]. However, in this analysis, [syllabic] is just a notational shortcut. It is not claimed that the glide differs from the vowel in the feature make-up. The difference between vowels and glides is made in terms of syllable structure. The former are [-consonantal] segments that are linked to the nucleus. The latter are instances of [-consonantal] that are not directly linked to the nucleus.

(39) **English Palatalization** (Rubach's approach)



Rule (39) does not account for the fact that stops change into affricates. To derive the affricates, we need a spell-out as in (41), cf. (7):¹

(40) **Affrication**

[+coronal, -anterior] → [+strident]

(41) **Affrication**

$$\left[\begin{array}{l} +coronal \\ -anterior \end{array} \right] \rightarrow [+strident]$$

3.2 Analysis in the Constriction-Based Model

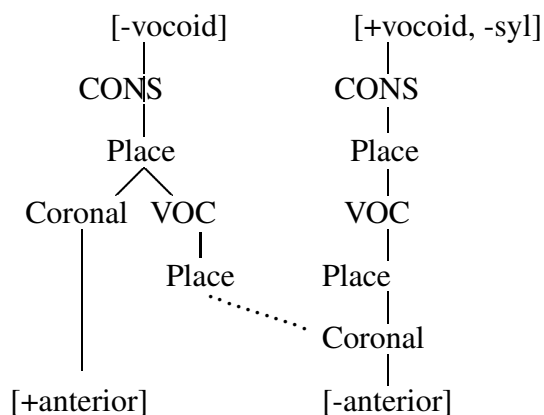
Within the theory originally proposed by Clements (1985), English Palatalization has to go through the stage of palatalized sounds, as the Coronal node of the vowel could only anchor

¹Further, strident stops are interpreted as affricates by phonetic implementation rules.

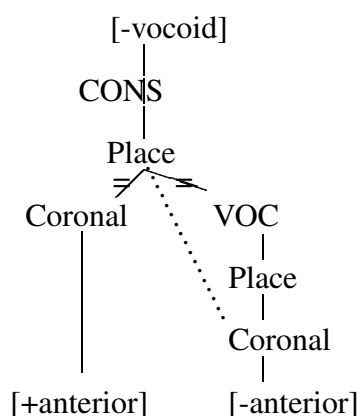
under the vocalic Place. Then, by feature promotion, [-anterior] is raised to the consonantal Place node.

(42) **English Coronal Palatalization** (Clements's approach)

a. Spreading



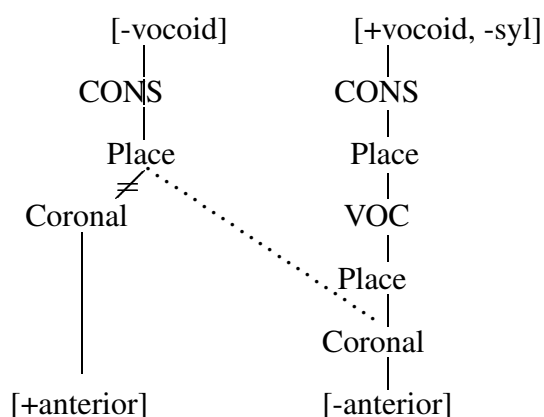
b. Feature Promotion



Further, Affrication, as in (41), changes stops into affricates.

In this model, it is not clear what actually triggers feature promotion. The other problem is that the model, like in the analysis in the original Sagey-Halle approach, forces a two-step account, although there is no trace of an intermediate stage in English.

In line with the analysis in Hume (1992), we can at least dispose of one problem: the intermediate stage. Hume proposes interplanar spreading, and thus, we may analyse English Palatalization as a direct spreading of the Coronal node under the vocalic Place of the vowel to the consonantal Place of the consonant.

(43) **English Palatalization** (Hume's approach)

Change the constriction status: yes

The rule in (43) moves [+anterior] coronals to [-anterior] coronals in one step and, at this point a rule of Affrication, as in (41), comes into play.

However, there are some formal objections to (43). Accepting the spreading between planes weakens the theory. The former version of feature geometry proposed by Clements is more restrictive and formally more elegant. Also, the parameter which in Hume's model must be included in the statement of the rule in order to account for the spreading either to the Place linked under the Consonantal node or to the Place linked under the Vocalic node is as unmotivated as feature promotion proposed by Clements.

3.3 Conclusions

The analysis in the approach of Sagey, as it was proposed originally in 1986 (1986, 1990), cannot adequately account for the English data. The model is able to express the assimilatory nature of the rule only if we adopt the amendments by Rubach (1993). The representation of the front vowel as proposed by Rubach, unlike in the Constriction-Based Model, has two specifications of the Place node. Yet, it is possible to draw parallels between the two models. Thus, 'Coronal', as used by Rubach, corresponds to Coronal linked under the consonantal Place in Clements' terms, and [-back] in Rubach's terms may be translated as the Coronal node under the vocalic Place node in the model of Clements. Unlike in the Constriction-Based Model, in Rubach's approach, the Coronal node is used as kind of a distributional variant of the feature

[-back]: the former is responsible for the change of the consonantal place features, which is a change of the major articulation place of the consonant, the latter imposes vocalic features on the adjacent consonant, which results in the presence of a secondary articulation. Rubach's model predicts three possible kinds of spreading: spreading of the Coronal node, spreading of the Dorsal node and spreading of the Place node. On the other hand, in Clements and Hume's approach, the front vowel may spread in one operation either to the vocalic or to the consonantal Place. The Clements-Hume model predicts that there should be no such change in a natural language changing both the main articulation to coronal [-anterior] and adding the secondary palatalization.

In the approach proposed by Rubach, English Palatalization is a spreading of the Coronal node. Within the Constriction-Based Model, it also spreads the Coronal node. In respect to the English data the two models make the same predictions, thus, it is rather difficult to distinguish between them only on this basis. We postpone, therefore, the systematic evaluation of the two models until the discussion of Polish Coronal Palatalization, which requires slightly different solutions than English Palatalization.

Chapter 4

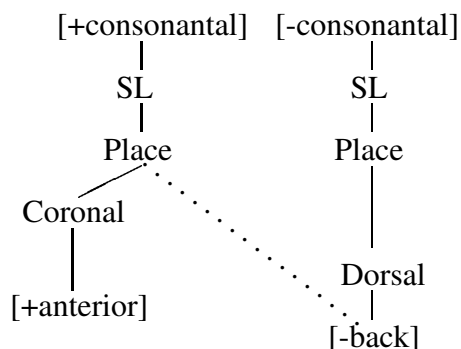
Polish Coronal Palatalization

Polish has a rule of Affricate Palatalization, which changes [+anterior] affricates to postalveolar affricates. I assume that in this case the analysis runs parallel to the analysis of English Palatalization in the previous chapter. For this reason, in the following sections we will focus exclusively on Coronal Palatalization, whose output are prepalatals. I will try to answer two questions: (1) Does the framework favour a direct analysis, with a change of major place and the addition of the secondary articulation in one step?, and (2) Which model of Feature Geometry provides a better account of the Polish rule?

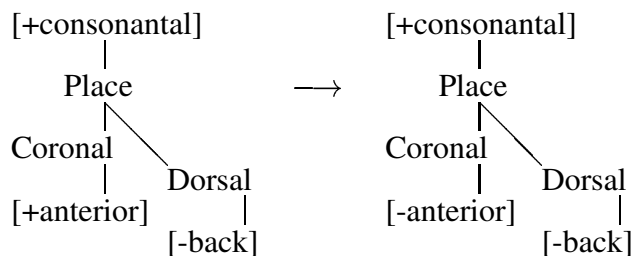
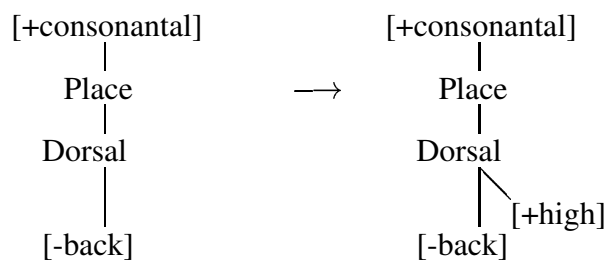
The chapter is organized as follows. First, we will analyse the data in the framework which treats front vowels as dorsal. In section 4.1 we adopt the model as it was proposed by Sagey (1990) and Halle (1995). In section 4.2, we adopt the idea from Rubach (1994) that front vowels are dorsal and redundantly specified as coronal. In sections 4.3 and 4.4, the rule is reconsidered in the model of feature geometry which treats front vowels as coronal (Clements 1985, Hume 1992, Clements & Hume 1995). The final section recapitulates the results and compares the models.

4.1 Spreading of [-back]

Following the analysis of palatalization proposed by Sagey (1990), Polish Coronal Palatalization may be viewed as spreading the feature [-back] from the front vowel to the Place node of the consonant, as in (44):

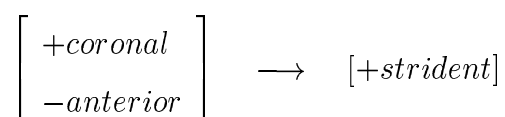
(44) **Coronal Palatalization in Sagey's model**

The feature [-back] spreads to the Place node of the consonant. Since [-back] by definition may only be dominated by the Dorsal node, the node is inserted by convention. The result of this operation, however, is nothing else but a palatalized consonant, i.e. this approach forces an intermediate stage of /t' d' s' z' l' r'/. To account for the surface facts, we have to assume at this point a spell-out rule which changes [+anterior] to [-anterior] in the consonant with the vocalic feature [-back], as in (45). We also need to add the feature [+high] by a redundancy rule, as in (46). Notice that the feature [+high] may not be spread from the vowel, because the process is triggered by both high and mid front vowels.

(45) **Place Adjustment**(46) **[+high] Specification**

The change of the value of the feature [anterior] must occur before Surface Palatalization, because, as we observed in section 2.2.1, the outcome of the Surface Palatalization may not undergo the spell-out (45). In respect to the change to [+high], the exact rule ordering cannot be established. In principle, the application of (46) might be postponed until after Surface Palatalization. Alternatively, the two spell-outs might be collapsed into a single rule.

An additional problem is the derivation of affricates by Coronal Palatalization, as in (44). To derive the affricates, we postulate a rule of Affrication, identical as in English, which takes [-anterior] stops to affricates, as in (47):

(47) **Affrication**

Another outstanding problem is the derivation of liquids. The Place Adjustment in (45) does not yield the correct surface output. Recall that the lateral segment appears phonetically as a plain alveolar or as a palatalized alveolar before the surface high front vowel (cf. section 2.2.2). The restricted context in which the palatalized lateral appears suggests that the surface secondary articulation of [l'] is an effect of Surface Palatalization. /ɫ'/, on the other hand, surfaces as [r] before consonants, and as /ʒ/ elsewhere. Thus, similarly as in the linear approaches, we are forced to postulate additional spell-out rules. These spell-outs are examples of changes, where nothing can be gained by stating them in feature geometry; in any framework they change features in an arbitrary fashion. Thus, for the reason of limited space, we will retain the traditional linear statement. One should bear in mind, however, that these changes may be expressed in feature geometry: notice that the features changing in (48) are dominated by a common node (Place).

(48) **Liquid Spell-out** (Rubach 1984, repeated as in (19))

$$\begin{bmatrix} -anterior \\ +sonorant \\ +consonantal \\ -nasal \\ \alpha \text{ continuant} \end{bmatrix} \longrightarrow \begin{bmatrix} -high \\ -\alpha \text{ anterior} \end{bmatrix}$$

(49) **R-spell-out** (Rubach, 1984a)

$$\text{a. } \begin{bmatrix} +sonorant \\ +consonant \\ -anterior \\ -high \end{bmatrix} \longrightarrow [+anterior] / \text{ __ } C$$

$$\text{b. } \begin{bmatrix} +sonorant \\ +consonant \\ -anterior \\ -high \end{bmatrix} \longrightarrow [+obstruent]$$

By (48) /r̥/ and /l̥/ are turned into [-anterior] /r/ and [+anterior] /l/. Rule (49) is responsible for the further change of /r/ to [r] before a consonant and to the fricative [ʒ] elsewhere. Notice that it is impossible to eliminate the rules in (48)-(49), by limiting the input of Place Adjustment. /r/ must be changed to [-anterior] at some stage, even if feature [-anterior] were to be deleted later, because otherwise [r] probably would not turn into [-anterior] [ʒ]. The motivation for the Liquid Spell-out and the R-Spell-out has been discussed in greater detail in section 2.2.2.

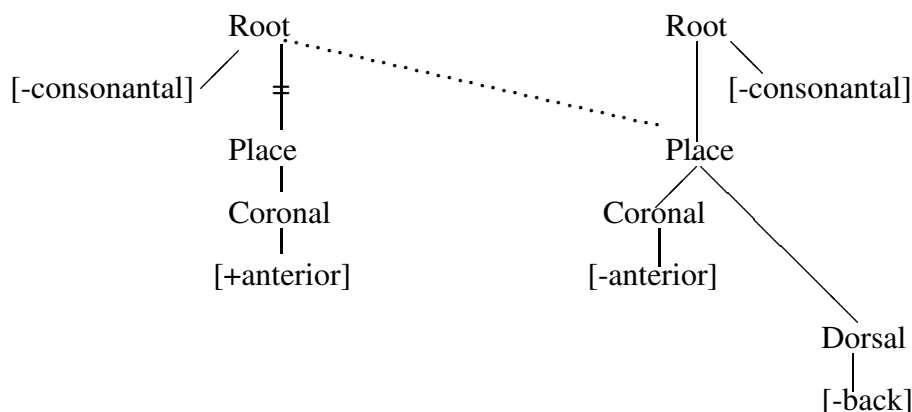
Summing up, Coronal Palatalization in Sagey's model is an indirect change. One rule takes coronals to palatalized coronals, and then, another rule arbitrarily changes the place of articulation to [-anterior]. In addition, we need a spell-out adding the feature [+high], the rules accounting for the surface feature make-up of liquids and Affrication must be postulated. Thus, the analysis within the Sagey-Halle model is highly complex.

4.2 Spreading of Place

The supporters of the Constriction-Based Model point to the fact that front vowels behave as if they had coronal specification, which is supported by both the facts of articulation and the operation of phonological rules. First, according to Wierzbowska (1967) front vowels [i, e], prepalatal coronals and palatalized consonants are produced with the same tongue position, namely, with 'a front position of the body of the tongue' (translation M.C.). Second, they commonly trigger the change of the articulation place of adjacent consonants from dorsal or [+anterior] coronal to coronal [-anterior]. These processes are attested cross-linguistically. The obvious examples are English Palatalization, Polish Affricate Palatalization or Polish First Velar Palatalization.¹ Therefore, it seems reasonable to claim that front vowels have a Coronal node in their structure. In Rubach's analysis of Slovak (Rubach, 1993), it is assumed that front vowels are dorsal and they are redundantly specified by Coronal Specification (38) as having a Coronal node with the feature [-anterior]. On the assumption that front vowels have both coronal and dorsal articulation, one could consider Coronal Palatalization as a rule spreading the Place node, as in (50).

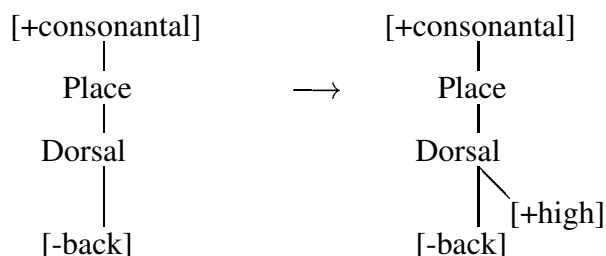
(50) Coronal Palatalization as Spreading of Place

¹For a more detailed survey of palatalization processes, see Bhat (1978)



Since the trigger is not always [+high], we cannot simply assume that the surface [+high] comes from the front vowel. Hence, an additional spell-out rule is necessary to ensure that the resulting segment is always [+high]. [high]-Specification is identical to the rule postulated in the analysis of Coronal Palatalization conceived of as the spreading of [-back].

(51) **[+high] Specification** (repeated (46))



At this point, similarly as in the original approach of Sagey, further spell-outs need to be postulated. Thus, [-anterior] stops become [+strident] due to Affrication (47). Spell-outs in (48)-(49) change /ɹ'/ into /r/ and then either it becomes [+anterior] in the context of a consonant, or it is changed into an obstruent. Similarly, the lateral loses the secondary articulation and becomes [+anterior].

In conclusion, if we view Coronal Palatalization as spreading the Place node, the change of the major articulation, which in the previous account was effected by the Place Adjustment rule (45), can be included in the rule of palatalization. Bearing in mind the fact that the Place Adjustment is rather arbitrary, and that the solution proposed in this section is simpler, the

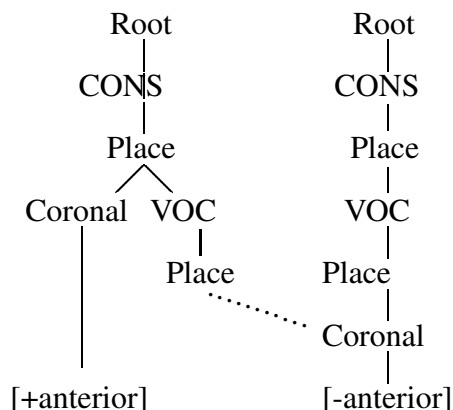
account of Coronal Palatalization as Place spreading should be favoured over the account using [-back] spreading.

4.3 Spreading of Coronal to Vocalic Place

In the discussion of Coronal Specification (38) in the previous chapter, we pointed to the relatedness of Rubach's approach to the Constriction-Based Model. At this point, we will try to find out whether the model advocated by Clements and Hume really makes the same predictions as the approach of Halle and Sagey.

In the approach of Clements and Hume, front vowels are coronal. Thus, palatalizations are viewed as the spreading of the Coronal node to the Place node of the adjacent consonant. The difference between the addition of the secondary articulation and the actual change of the major articulation place is expressed here in terms of spreading to either consonantal or to the vocalic Place node of the consonant. The former results in the change of the primary articulation place, the latter — in the additional secondary articulation. However, Polish Coronal Palatalization performs both operations: the place of articulation is changed from [+anterior] to [-anterior], and additionally, the tongue raises towards the hard palate, which is expressed by adding the feature [+high], or, as it was proposed by Clements and Hume (1995), [-open]. Thus, if we claim that Coronal Palatalization is an assimilation process, we may analyse it as adjoining the Coronal node to the vocalic Place. Alternatively, we may claim that it is the linking the vocalic Place to the consonantal Place node of the consonant. In this section we will pursue the first option.

The first stage in the process of Coronal Palatalization is the spreading of the Coronal node, which was originally adjoining under the vocalic Place of the vowel, to the vocalic Place of the consonant:

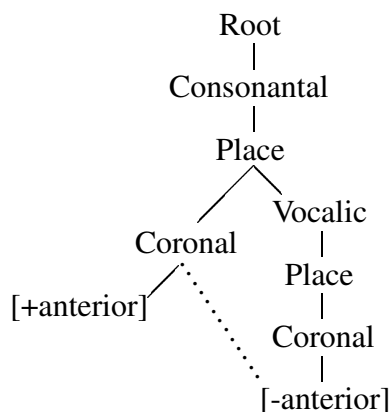


Change of the constriction status: no

The spreading occurs on the same plane. Hume assumes that whether or not the status of the spread constriction is changed is determined by the parameter that the rule selects. The parameter is included in the statement of the rule.

An effect of (52) is a palatalized anterior coronal, as in the SPE-type rule proposed by Gussmann(1978) and in the original approach of Sagey(1990). Then, the necessary step is Prepalatal Default Rule in (53).

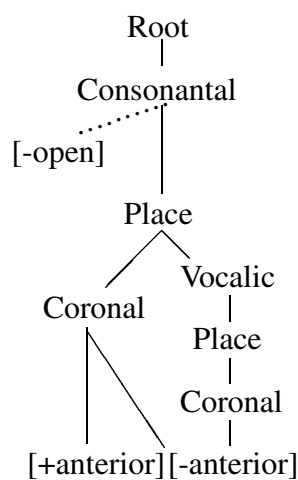
(53) Prepalatal [-anterior] Spreading



As in the Halle-Sagey approach, the feature [-open] or, traditionally, [+high] has to be redundantly specified as in (54)².

²Features in Clements's model describe the constriction made by articulators, whereas in the model of Halle and Sagey features are articulatory instructions for the articulators. In order to replace the traditional [high], Clements introduced [open], which refers to the constriction rather than to the position of the tongue. Thus, the feature [open] in the theory of Clements corresponds to the traditional feature [high].

(54) [-open] Specification



At first sight, rules (53) and (54) seem to be merely notational variants of the spell-outs (45) and (46), proposed for the analysis in Sagey and Halle's approach. Rule (53) changes the primary place of articulation, similarly as Spell-out (45). Spell-out (54) adds the feature [+open] (which corresponds to the traditional [+high]). This is parallel to the operation performed by rule (46). However, there is a slight difference. Rule (53), unlike Prepalatal Spell-out (45) in the approach of Sagey, is motivated by the model and may be expressed in terms of spreading.

In this approach too, the rule of Affrication is necessary to account for the change from stops to affricates, as in (55):

(55) **Affrication** (repeated)

$$\left[\begin{array}{l} +coronal \\ -anterior \end{array} \right] \longrightarrow [+strident]$$

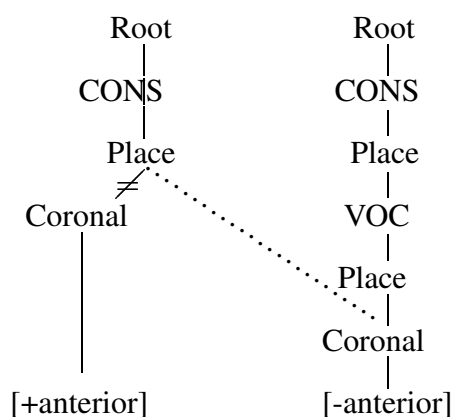
Finally, we need to postulate rules responsible for the surface feature make-up of liquids, as was the case in the Sagey-Halle model. Also the approach of Clements and Hume does not offer a simpler statement than the linear approach.

4.4 Spreading of Coronal to Consonantal Place

In the model, where front vowels are specified for the Coronal node under the vocalic Place, the spreading of the higher-ordered consonantal Place would not differ from the spreading of the

Coronal node alone, because the consonantal Place dominates only the Coronal node. However, in Hume's model, we can still approach Coronal Palatalization in yet another way. We may start from the assumption that the spreading of vocalic Place, dominating the Coronal node, to consonantal Place of the consonant lies at the heart of the process, as in (56):

(56) **Coronal Palatalization as Spreading to CONS** (Hume's approach)



Change of the constriction status: yes

The rule in (56) derives plain [-anterior], exactly the same as in the case of Affricate Palatalization or First Velar Palatalization. Still, the output of Coronal Palatalization is different from the outputs of Affricate Palatalization and First Velar. Thus, postulating further spell-outs would be unmotivated, as we would derive inappropriate outputs for the other palatalization processes in Polish.

4.5 Conclusions

Chapter 4 has provided a survey of possible analyses of Polish Coronal Palatalization in different models of feature geometry. As we have seen, the two models offer different accounts of the same data.

Within the Articulator-Based Model, Polish Coronal Palatalization could be viewed as the spreading of [-back] or the spreading of the Place node after redundant Coronal Specification of the front vowel. The former analysis involves an arbitrary change, as opposed to the latter analysis, which is first, direct and simpler, second, not arbitrary. Thus, the conclusion is that,

within the Articulator-Based Model as in Rubach, Coronal Palatalization is a direct change performed by spreading of the Place node.

In the Constriction-Based Model, Polish Coronal Palatalization is a rule spreading the Coronal node to the vocalic Place. The spreading of the Coronal node to the consonantal Place would derive an incorrect output. The account in Clements and Hume's model views Coronal Palatalization as an indirect change, not only for liquids, but also for all other coronals involved in the rule. Although it is indirect, unlike in the Articulator-Based Model, both steps are motivated and may be expressed in terms of spreading.

Within the Clements-Hume model, an option parallel to the account in section 3.2 is not available. In other words, the spreading of both Place nodes together produces the same effect as the spreading of the vocalic Place alone, because the consonantal Place in the vowel is not specified. Possibly, this could be amended by postulating double coronal specification of the vowel: at consonantal and at the vocalic Place nodes. Such a modified model would be able to spread the Place (consonantal and vocalic nodes at a time), the consonantal Place node alone, and the vocalic Place alone. This would correspond to the three types of outputs, that we obtain in the palatalization processes in Polish. The spreading of the Place node would derive the output of Coronal Palatalization, the spreading of the specification of the consonantal Place node — would be responsible for Affricate Palatalization and First Velar, the spreading of the vocalic Place node would produce Surface Palatalization. At the same time we would not have to resort to inter-planar spreading and the specification of the parameter of the rule, as in Hume (1992), and to the mechanism of a pointer in order to distinguish between the major and the minor articulation, as in Sagey (1990). However, pursuing this suggestion would go beyond the scope of this thesis, which is to test the existing models against the data.

We may conclude that both models provide accounts to the data, however the analysis in Rubach's approach is simpler and more natural. Still, the opponents raise arguments against the Articulator-Based Model.

The opponents of the Articulator-Based Model argue that velar consonants and vowels do not function as a natural class in phonology (Clements & Hume, 1995). Further, if it were the case that front vowels are dorsal, one would expect that coronal consonants should, at least in some languages, change their major place of articulation to dorsal. Yet, apparent examples of such assimilations reported in Sagey (1990), are merely examples of acquiring a secondary

articulation. However, the same rules are analysed in the Constriction-Based Model as a spreading of the Coronal node. Thus, the rules analysed by Sagey are not good examples to prove her theory. Next, under the theory of Sagey and Halle (but not in Rubach's approach), the change from velar to palato-alveolar place of articulation is a complete mystery. Providing it were a dissimilation, it is still not clear why the output of the rule is a coronal [-anterior] segment, since equally legitimate and arbitrary in this model would be change to e.g. labial. The last objection is of formal nature. Sagey differentiates between major and minor articulators using the device of a pointer. This seems to be an ad hoc solution with no independent role in her theory.

The approach of Clements and Hume elegantly accounts for the distinction between major and minor articulation, by assuming a hierarchical structure of the two Place nodes. However, the opponents take this to be a disadvantage, since the same specifications can appear many times in different positions of the representation. Also, certain specifications are superfluous, for example, the distinction between consonants and vowels. It is made at the Root with the use of feature [vocoid]. Then, the same information is encoded in the specification of the constriction either at the consonantal Stricture (for consonants) or at the vocalic Stricture (for vowels). Finally, vowels are defined using the feature [open] and consonants — the feature [continuant]. Another counterargument against the model of Clements and Hume is that it allows spreading between planes, which is a serious weakening of the theory. Whether spreading occurs on the same plane or reaches another plane is determined by the parameter that a given rule selects. This parameter setting seems to be a purely formal device with little explanatory value. In sum, there are arguments against both models of feature geometry.

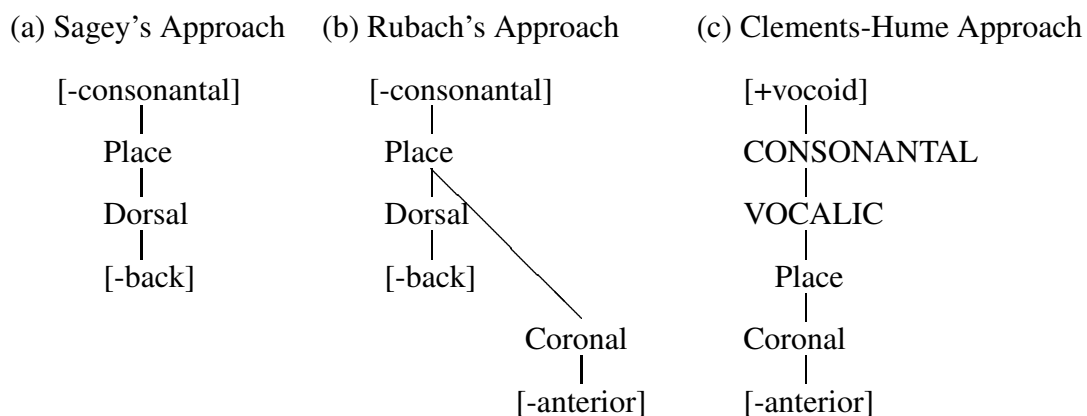
Chapter 5

Summary

As argued in section 1.2, linear phonology does not differentiate formally between possible and impossible phonological rules of language. No such flaw has the theory of feature geometry, which, by excluding impossible phonological rules, is much more restrictive. It is also capable of expressing the relation between the formal complexity of representation and the naturalness of the phonological process: in feature geometry the most common processes are simplest in formal terms. We have assumed, following Bhat (1978), Clements (1985), Hume (1992), Clements & Hume (1995), and others that palatalizations are simple assimilatory processes and, as such, they should be viewed in feature geometry as a simple spreading of single nodes. With this assumption, the questions are what implications the analyses of English Palatalization and Polish Coronal Palatalization have for the universal feature tree, and what predictions are made by different models of feature geometry. English Palatalization and Polish Coronal Palatalization are analysed in chapters 3 and 4 respectively, within the co-called Articulator-Based Model (Sagey, 1990; Halle, 1995; Rubach, 1993) and within the Constriction-Based Model (Clements, 1985; Hume, 1992; Clements & Hume, 1995).

In the model proposed by Sagey (1990), front vowels are dorsal [-back], as in (57a). As argued in sections 3.1 and 4.2 – 4.1, this approach proves to be inadequate in the cases of the two palatalization rules analysed in this thesis.

(57) **Representation of the front vowel**



In the Articulator-Based Model with the amendments introduced by Rubach (1993), the front vowel is both dorsal and coronal, as in (57b). Consequently, it may spread either the Dorsal node, or the Coronal node, or the Place, which is the mother-node of the two former nodes. The spreading of the Dorsal node results in the secondary palatalization (compare analyses in Sagey 1990). The effect of adjoining the Coronal node is coronalization, i.e. the change of the major articulation place to coronal. Finally, a spreading of the Place node results in combining the former two effects.

In the Constriction-Based Model, the front vowel is coronal, as in (57b). The Coronal node may spread either to the Place under the Consonantal node (coronalization), or to the Place dominated by the Vocalic node (secondary palatalization). Spreading to both nodes would involve two separate operations.

As argued in chapter 3, in the case of English Palatalization, the two models make the same predictions. The English rule is analysed as spreading the Coronal node (see sections 3.1-3.2). However, in the case of Polish Coronal Palatalization, the predictions made by the two models differ. The Polish rule changes both the major place of articulation to coronal [-anterior] and adds a secondary articulation. As shown in sections 4.3-4.4, in the Constriction-Based Model, this change may only be viewed as a sequence of two rules, the first one palatalizing consonants and the second one changing the major articulation place of the palatalized consonants to [-anterior]. Both steps may be expressed in terms of spreading. The necessary consequence of this approach is an intermediate stage of palatalized consonants. Thus, the Constriction-Based Model actually excludes the possibility that Coronal Palatalization can be a single rule. On the other hand, in the Articulatory-Based Model with the amendments introduced by Rubach(1993), the Polish rule may be analysed as a simple spreading of the Place node. (section 4.2).

In fact, in Polish there are no traces of any intermediate stage in the case of obstruents, which supports the analysis proposed by Rubach. This analysis is also simpler and more natural. Thus, judging on the basis of the analysis of Polish, we would favour Rubach's approach over Clements and Hume's approach. Still, there are some problems connected with the Articulator-Based model, and in certain cases the Constriction-Based Model seems to be more advantageous. (section 4.5). We conclude that, at this stage, the Articulator-Based Model may not be regarded as a fully satisfactory approach and should be revised.

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