1. Introduction

Archangeli (1987) has pointed out that the hierarchical model of feature representation combined with the statement of phonological rules in terms of conditions and parameters offers the advantage that it allows the expression as a single rule of unitary processes that must be stated as multiple operations within other frameworks. In this paper I will offer an example of this (cf. Hualde, 1987 for another example). I will show that a seemingly complex process of palatalization that must be stated as two related but different operations within a linear model, can be straightforwardly captured in the hierarchical/parametrical approach by taking into account the geometrical structures on which the palatalization rule applies; in particular, the branching structures created by a rule of place assimilation. I will assume that assimilatory processes have the effect of creating complex structures where features or nodes are shared by several segments. From this assumption we can make
predictions about how other rules may apply to the output of a process of assimilation. These predictions are very different in some cases from what one would expect from a formulation of the rules in a linear, feature-changing framework. In the case to be examined here, the predictions made by taking into account derived geometrical structures receive very strong confirmation.

I will consider a rule of palatalization in two Basque dialects. In one of them, the process of palatalization can be captured quite simply by a linear rule. In the other dialect, the facts appear as more complex and requiring several operations within a linear framework, but are actually simpler to state within a geometrical/parametrical framework. Only within such a theory can we capture the fact that the more pervasive palatalization observed in this second dialect arose from a simplification in the rule that other dialects possess.

2. Palatalization in Guipuscoan Basque

Basque possesses a rule of progressive palatalization, which in many central (Guipuscoan) dialects affects /l/, /n/ and /t/ preceded by a high front vowel or glide and followed by a vowel, as in the examples in (1) (adapted from Iverson and Oñederra, 1985):

(1) [ill] ‘die’ (perf.) [i xe te] ‘funeral’
[sayltašun] ‘difficulty’ [say xe] ‘difficult’
[xašin] ‘to know’ [xakiša] ‘known’
[alegindu] ‘to try’ (perf.) [alegiša] ‘effort’
[nolabayt] ‘somehow’ [nolabayteko] ‘of some sort’
/l a o gi Ke/ [la o gi xe] ‘worker’
/cf. /irakaš-1e/ [irakašle] ‘teacher’
/bi-na/ [bi na] ‘two for each’
/cf. /bat-na/ [ba na] ‘one for each’
/gel di-tu/ [geldit u] ‘stop (perf.)’
/cf. /aška-tu/ [aškat u] ‘lose (perf.)’

The rule of palatalization in these Guipuscoan dialects can be given a linear formulation as in (2):

(2) $\begin{bmatrix} [+\text{cor}] \rightarrow [+\text{high}] \\ [-\text{cont}] \end{bmatrix}$ $\begin{bmatrix} [+\text{high}] \\ [-\text{back}] \end{bmatrix}$ $\begin{bmatrix} [-\text{cons}] \end{bmatrix}$ $\begin{bmatrix} [-\text{cons}] \end{bmatrix}$
Conspicuously absent from the set of segments that undergo the palatalization rule is /d/. The explanation for the non-
palatalization of /d/ seems to be found in the fact that, as Iverson and Oñederra suggest, /d/ is not a [-cont] segment in this context. In Basque, voiced obstruents have stop and fricative allophones with the same distribution as in Spanish. Generally speaking, voiced stops occur after pause, after nasal and, in the case of /d/, also after lateral (cf. Holmer and Holmer, 1968: 93). The fricative allophones occur elsewhere. In the context of the rule of Palatalization /d/ will thus be a fricative, since it occurs after a vowel or glide and will then be excluded from undergoing the rule. Aside from this small complication, rule (2) can capture the palatalization process in a straightforward manner.

3. Palatalization in Biscayan Basque

Consider now the situation in the dialects spoken in the northern part of Biscay (Biscayan subdialects of Gernika and Markina). In these dialects /l/, /n/ and /t/ are palatalized in the same circumstances as in the Guipuscoan dialects just examined, with the difference that a following vocalic segment is not necessary. Palatalization may also operate if the target is word-final. In addition, /t/ and /d/ are palatalized in the groups /ilt/, /int/, /ild/, /indl/. A minor difference is that the palatal allophone of /t/ is often the affricate /tʃ/, although some speakers have a palatal stop /t/, as in Guipuscoan dialects. The data are from the town of Ondarroa:

(3) /barki-tu/ [barkitʃu] 'to renew (perf.)'
/amai-tu/ [amaytʃu] 'to finish (perf.)'
/mendi-tik/ [menditʃik] 'from the mountain'
/mutil-a/ [mutiʃe] 'the boy' (abs.)
/il-a/ [iʃe] 'dead'
/mila/ [miʃa] 'a thousand'
/ipin-i/ [piɲi] 'to put' (perf.)
/min-es/ [miɲes] 'with pain'
/bi-na/ [biɲe] 'two for each'
/i1/ [iʃ] 'to die (perf.)'
/egin/ [eyɲ] 'to make (perf.)'
/d-aki-t/ [dakitʃ] 'I know'
/indari/ [iɲaɾi] 'strength'
Directly after /i/, however, /d/ is not palatalized, as in the Guipuscoan dialects considered above:

(4) /bide/ [bide], [bire] 'way'
    /bideɾ/ [bideɾ] 'time'
    /idi/ [idi], [iri] 'ox'
    /iduri/ [iduri] 'image'

Compared with the Guipuscoan data seen above in (1), the Biscayan data show that the process of palatalization has been expanded in its application to additional targets. The normal expectation would be for such an expansion of the range of a phonological process to come about by a simplification in the phonology of the language. Within a linear framework, however, to capture the Biscayan facts we need a more complex rule or system of rules.

A first attempt at characterizing these facts within a linear theory would be to formulate two ordered rules: one rule that palatalizes /l/, /n/ and /t/ after a high front vowel or front glide, and another rule that palatalizes /t/ and /d/ after [ŋ] and [ɾ] created by the first rule. In examples such as [iŋjɾaɾ], the palatalization process would involve two steps:

(5) indaɾ --> iŋdaɾ --> iŋjɾaɾ

We could also presumably have one single rule applying repeatedly to sequences of palatalizable segments. In any case we would need more than one operation of palatalization to produce the wanted results.

Formulated in a linear way, the palatalization facts in (3) do not seem to reflect a particularly natural process. Certainly they would seem to constitute a more complex process than the rule of palatalization in Guipuscoan dialects shown in (2). I will show now
that if we view the palatalization rule as a spreading operation on geometrical structures, and specifically on the structures created by a rule of lateral and nasal assimilation in place of articulation, the facts in (3) actually follow directly from a simplification in the rule that gives the facts in (1). This simplification is precisely the removal of the constraint that requires a vowel to follow for the rule to apply, or that the target be in an onset (which amounts to the same thing).

We must now consider two processes which directly affect the application of the palatalization rule: nasal and lateral assimilation and assignment of continuancy to voiced obstruents.

4. Nasal and Lateral Assimilation

In Basque, as in many other languages, nasals agree in point of articulation with a following consonant. Laterals also assimilate in point of articulation to a following consonant, with the restriction that a lateral cannot be labial or velar (cf. Salaburu 1984):

(6)  

\[
\begin{align*}
\text{egu}[n]a & \quad \text{'the day'} & \text{ata[l]}a & \quad \text{'the section'} \\
\text{egu}[m] \text{ berri } & \quad \text{'new day'} & \text{ata[l]} \text{ berri } & \quad \text{'new section'} \\
\text{egu}[n] \text{ fresku } & \quad \text{'cool day'} & \text{ata[l]} \text{ fresku } & \quad \text{'cool section'} \\
\text{egu}[n] \text{ denak } & \quad \text{'every day'} & \text{ata[l]} \text{ denak } & \quad \text{'every section'} \\
\text{egu}[n] \text{ ttiki } & \quad \text{'small day'} & \text{ata[k]} \text{ ttiki } & \quad \text{'small section'} \\
\text{egu}[n] \text{ gorri } & \quad \text{'red day'} & \text{ata[l]} \text{ gorri } & \quad \text{'red section'}
\end{align*}
\]

The more restrictive character of lateral assimilation is due to universal constraints on feature compatibility. Labial laterals are universally excluded, whereas velar laterals are extremely rare and found only in a few languages of Papua New Guinea (cf. Ladefoged 1982: 156). I will assume that the assimilation in point of articulation of both nasals and laterals is accomplished by one rule. The application of this rule will be blocked when it would produce a segment bearing the incompatible features [lateral] and [labial] or [lateral] and [velar].

The rule assimilating nasals and laterals to the point of articulation of a following consonant can be formulated as in (7) by means of parameter settings and conditions, following Archangeli and Pulleyblank (1986), Archangeli (1987). This is a process that spreads the place node of a segment leftwards to a nasal or lateral...
in a rime:

(7) Nasal and Lateral Assimilation
   Operation: Spread
   Argument: Place Node
   Direction: leftwards
   Target Conditions: [-cont], [+son], Rime

Graphically, the process is illustrated in (7'):

(7')

\[
\begin{array}{c}
\text{Rime} \\
\text{[-cont]} & X & X \\
\text{[+son]} & \text{-} & \text{-} \\
\end{array}
\]

Let us consider now the processes governing the distribution of continuant and noncontinuant voiced obstruents, which determine whether a given instance of /d/ will be palatalizable.

5. Allophonic Distribution of Voiced Obstruents

As mentioned above, voiced obstruents present both fricative and stop allophones with the same distribution as in Standard Castilian Spanish. Voiced stops appear after pause, nasal, and, in the case of /d/, also after /l/. Examples are given in (8):

(8) [beri] [emboxa] [elboan] [abere] [dezberdin] [arbi]
    'new' 'trunk' 'beside' 'cattle' 'uneven' 'turnip'
[deri] [mendi] [talde] [adar] [ezduyn] [ardi]
    'tower' 'mountain' 'group' 'horn' 'unworthy' 'sheep'
[goiri] [ango] [algodoy] [lagun] [dezgogo] [argi]
    'red' 'of there' 'cotton' 'friend' 'reluctance' 'light'

To account for the distribution of continuant and noncontinuant allophones of voiced obstruents in Basque and Spanish, Mascaró (1984) assumes that these segments are underlyingly unspecified for continuancy and receive their surface value by autosegmental spreading from a segment to their left. In case there is no segment to the left of the voiced obstruent (i.e. after pause), it will be assigned a [-cont] value. Mascaró's (1984) analysis can thus be
summarized as in (9):

(9)  a. Spread [α cont] to a sequence of nonstrident voiced obstruents (p. 296).
    b. Assign [- cont] after pause.

It is easy to see that the analysis outlined in (9) will produce the correct results in all the environments exemplified in (8) except for the examples in the third column, i.e., after a lateral. Leaving this case aside for a moment, the rules in (9) would operate as exemplified in (10). In the two first examples, rule (9a) operates, and in the third example (9b) applies:

(10) [+ct] [-ct] [-ct]
    aBere emBořa Beři

Consider now the application of the rules in (9) in the environment after a lateral. As the examples in (9) show, after a lateral, the coronal voiced obstruent surfaces as a stop [d], but the labial [b] and the velar [g] are fricatives. If laterals are noncontinuant segments, rightward spreading from these segments will cause following voiced obstruents to surface as stops, which is correct for /D/, but not for /G/ or /B/. If, we assume, on the other hand, that laterals bear the feature [+cont], the rule in (9b) will produce adequate results for /B/ and /G/ but not for /D/. It would seem that the only way out would be to assume that /l/ bears the feature [-cont] when it is followed by /D/, but it bears the opposite value when it is followed by /B/ or /G/. Only under this assumption can each of /B/, /D/, /G/ obtain the adequate value for continuancy by spreading from a lateral to its left. Mascaró’s solution is precisely this: "One might suggest that laterals are stops with respect to some segments (dentals, alveolars, palatals), but fricatives with respect to other segments (labials, velars)." (Mascaró 1984; 293).

This suggestion makes the analysis totally circular: to determine the value that a lateral must bear for the feature [cont], we must see if it is the case that there is a following dental /D/, in which case the lateral will be [-cont], or a labial /B/ or a velar /G/ follows, and, the lateral must be considered [+cont]. Only once we have assigned the adequate [cont] value to /l/ in this way, can we
obtain the correct specification for a following /B/, /D/, /G/ by
rightward autosegmental spreading.

The circularity in the analysis can be avoided by incorporating
into the spreading rule a factor that makes the sequence /1D/
different from the other two sequences /1B/ and /1D/; the fact that
the former constitutes a homorganic cluster. This is a fact that was
also taken into account in earlier linear formulations of the rule for
Spanish, such as the one in Harris (1969).

Since in Basque, nasals always have the same point of
articulation as a following consonant, there are only two contexts
where the feature [-cont] will be assigned to a voiced obstruent: in
homorganic clusters created by rule (8) above and after pause.
Elsewhere the feature [+continuant] will be inserted by default.

To begin with, to capture the distribution of continuant and
noncontinuant allophones after nasal or lateral, we may assume a
rule that spreads the feature [-cont] in homorganic clusters, as in
(11); graphically represented in (11'):

(11) Continuancy Assignment to Voiced Obstruents
   Operation: Spread
     Argument: [-continuant]
     Direction: Rightwards
     Target Conditions: [+voice], [-sonorant]
     Trigger/Target Condition: Homorganic cluster (shared P)

(11')

This rule will have the effect of assigning the feature [-cont]
to all three voiced obstruents after nasals. After a lateral,
however, only /D/ will receive the feature [-cont], since in the case
of /B/ or /G/ homorganic clusters are not created by rule (7). A
second rule will assign the feature [-cont] to a voiced obstruent
after pause by insertion:
(12) [-cont] Insertion After Pause  
   Operation: Insert  
   Argument: [-cont]  
   Target Conditions: [+voice], [-son], 

   In all other contexts a default [+cont] feature will be assigned to the voiced obstruents:

(13) Default  
   [+voice]  
   [-son] ----> [+cont]  

   It is on the output structures created by the rules of place assimilation and continuancy assignment that the rule of palatalization applies.

6. Formulating the rule of Palatalization

   Palatalization in Biscayan Basque can be formulated as in (14):

(14) Palatalization in Biscayan Basque  
   Operation: Spread  
   Argument: P2  
   Direction: Rightwards  
   Trigger Conditions: [+high], [-back]  
   Target Conditions: [-continuant], [coronal]  

   As formulated, the rule will apply to homorganic sequences exactly in the same way it applies to single segments, since homorganic sequences share the target node. The representation in (15) shows how a sequence /it/ is affected by the rule and the representation in (16) shows an /ind/ sequence:

(15)
On the other hand, /d/ will not be palatalized directly after /i/, since in that environment /d/ does not fulfill the condition of being [-cont].

The seemingly complex palatalization facts in Biscayan Basque do, then, follow directly from the geometry created by the rule of place assimilation. This geometry is also used by the rule that assigns continuancy to voiced obstruents.

Now we must explain why palatalization does not apply to homorganic clusters in Guipuscoan varieties. The absence of palatalization in consonant clusters can be related to the blockage of the process word-finally. In the Guipuscoan dialects exemplified in (1), the rule of palatalization has the further condition on the target that it must be in an onset. This condition will block the application of the rule both before pause and before another consonant, since in homorganic clusters only the second segment will fulfill this condition of being in an onset. Viewed in this way, the palatalization of noncontinuant coronals word-finally and the palatalization of /t/ and /d/ after [ś] and [ñ] in Biscayan varieties appear as related phenomena, which are brought about by the removal of a single target condition in the rule of palatalization which is found in Guipuscoan dialects.

ENDNOTES

1 In the dialect of San Sebastián, which Iverson and Oñederra (1985) describe, the palatalization of /t/ is only optional. In other towns of the same area /t/ palatalizes obligatorily in the same contexts as /l/ and /n/.

2 In some of these Biscayan varieties, instances of /s/ are also
found palatalized in the same context; but only morpheme internally and then with exceptions. Thus, corresponding to Guipuscoan [gison] 'man' and [bisar] 'beard', in the Biscayan of Ondarroa, we find [gišon] with palatalization of the original /s/, but [bisar], without palatalization. The phenomenon seems to be a recent innovation which is spreading through the lexicon. In Rollo’s (1925) description of the Markina variety, which is in the same subdialect group as Ondarroa, /is/ is not affected by palatalization. I will thus not consider the palatalization of /s/ here.

3 I want to thank Amaia Iparragirre for the Ondarroa data.

REFERENCES