On the formal description of palatalisation

Haike Jacobs and Jeroen van de Weijer

0. Introduction

In this paper we discuss the formal description of palatalisation processes in three feature geometry proposals. First, we will clarify our use of the term ‘palatalisation’, by giving a brief overview of the different processes subsumed under this name in Bhat’s (1978) cross-linguistic study. Then we will show how these processes are formally described in the phonological feature models of Sagey (1986), Clements (1991), and Lahiri and Evers (1991). Finally, we discuss how the problems associated with the description in the earlier formalisms might be avoided.

1. Different palatalisation processes

Bhat (1978) gives a cross-linguistic overview of a number of (synchronic and diachronic) processes traditionally referred to by way of the cover term ‘palatalisation’. Bhat makes a distinction between the addition of a high, front secondary articulation, and a shift in primary place of articulation. There are two subtypes of place of articulation shift: either a coronal (i.e. dental or alveolar) articulation shifts to the palatal place of articulation, or a velar articulation shifts to the same place. The three types of changes typically take place before (or after) front vowels and/or the semivowel /j/. In (1), these processes are summarised, where ‘c’ is used as an abbreviation symbol for a consonant produced at either the palatal or the palato-alveolar place of articulation.

(1) P1 addition of a secondary articulation
   e.g. p → p̥

   P2a shift of coronal place of articulation
   e.g. t → c

   P2b shift of velar place of articulation
   e.g. k → c (cf. Bhat 1978:52, 67)

One of the main reasons for assuming a geometrical model of feature representation is that it permits to define natural classes of consonants and vowels. With regard to palatalisation, two aspects deserve attention. First, a shift in
primary place of articulation (P2) typically affects velars and coronals, but not labials (cf. Bhat 1978, Foley 1977). Second, a front vowel is the strongest environment for the palatalisation of velars, whereas a palatal glide is the strongest environment for the palatalisation of coronals, as Bhat (1978:52) points out. Thus, in English, for instance, /j/ palatalises the alveolar stops /t d/ in some varieties, whereas the front vowels have no such effect.

Following Clements (1976), we assume that palatalisation is an assimilation process, and hence should be described as autosegmental spreading. We will discuss to what extent this is possible in various current proposals of feature geometry, and to what extent these proposals can account for the two natural-classlike aspects mentioned above. This paper is organised as follows: in section 2 below, we discuss the description of palatalisation in the feature geometry models of Sagey (1986), Clements (1991) and Lahiri and Evers (1991). We focus on the problems encountered within each of these models. In section 3 we explore a possible way of avoiding these problems.

2. Palatalisation in three feature geometry models

2.1. Sagey (1986). In Sagey’s (1986) geometry, the different sounds relevant to palatalisation are represented as in (2). Here we give the major class and Place representations of front vowels, the semivowel /j/, coronal stops and velar stops, respectively (V = Vowel, S = Semivowel, C = Consonant).

\[
\begin{array}{cccc}
V & S & C & C \\
\text{Place} & \text{Place} & \text{Place} & \text{Place} \\
\text{Dorsal} & \text{Dorsal} & \text{Coronal} & \text{Dorsal} \\
[-\text{back}] & [-\text{back}] & [-\text{high}] \\
\end{array}
\]

In this framework type P1 palatalisation, addition of a secondary articulation, is formalised by spreading the feature [-back] from the front vowel. The spreading of [-back] entails the creation of a Dorsal articulator node if the target consonant is coronal or labial. Sagey (1986:106-16) discusses two languages where palatalisation of coronals leads to complex segments, namely Zoque and Pame. The resulting complex segments are simplified again, respectively by fusion of the Dorsal and Coronal articulator nodes to a Coronal node dominating [-anterior], and by deletion of the Coronal node.

The second type of palatalisation, however, cannot be expressed as autosegmental spreading in Sagey’s framework. It is clear from the representations
in (2) that a velar stop /k/ cannot become coronal by spreading when it is followed by a front vowel or /j/, because the latter two segments are only specified for a Dorsal articulator node, but not for a node (or feature) Coronal.

2.2. Clements (1991). In (3) below, the model of feature organisation proposed by Clements (1991) is given, a rewritten version of Clements (1989a). Because of space limitations, we only give nodes and features from the Oral Cavity node downwards.

(3)

```
      Oral Cavity
        /       \    
       C-Place  Vocalic
         /   \    /       \    
      labial  coronal  [open]  [dorsal]
       /     \    /           \   
  [labial] [coronal] [dorsal] [radical]

The addition of a palatal secondary articulation (P1) is straightforward in Clements's model. This is achieved by spreading the Vocalic node of a front vowel to a neighbouring consonant. This model, like Sagey's, correctly predicts that consonants are susceptible to this kind of palatalisation regardless of their primary place of articulation. It is schematically represented in (4) (irrelevant nodal material omitted):

(4)

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```
      C  V
       |  |
    /  \ /  \  
   C-Place  Vocalic  Aperture
               /  |
              /  + coronal
```


The description of a shift in primary place of articulation (P2) proceeds along different lines, however. The feature involved is again [+coronal], which all front vowels have, but this feature has to acquire the status of a primary articulation, which cannot be expressed by spreading. With respect to this issue, Clements (1991:22) observes that “palatalization processes can often be treated as involving two stages, the second of which involves promotion. In stage I, vowel features spread to a neighboring consonant, creating a secondary articulation, e.g. [ki] > [k\textipa{̯}i], [ti] > [t\textipa{̯}i]. In stage II, the secondary articulation of the consonant is promoted to primary articulation: [k\textipa{̯}i] > [c\textipa{̯}i], [t\textipa{̯}i] > [c\textipa{̯}i].”

This way of describing type P2 palatalisations raises a number of problems. First, as observed by Lahiri and Evers (1991:85), it is predicted that type P2 palatalisation should always be preceded by type P1 (either historically or derivationally). This is contrary to fact (cf. Bhat 1978:51, 68). Furthermore, both types of palatalisation may take place within the same language. Finally, as the same authors point out, “given the option of tier promotion, diachronically one might expect a [k\textipa{̯}] to lead to a multiply articulated coronovelar segment as an intermediate stage during the palatalization process, just as a labialized [k\textipa{̊}] may lead to a complex segment [kp]. This, to our knowledge, never happens” (Lahiri and Evers 1991:85).

Finally, this way of describing palatalisation (P2) is unable to account for the fact that this type of palatalisation typically occurs with dorsal and coronals, and not with labials, because there is no reason why the V-place to C-place shift of [+coronal] should only take place with the former.

2.3. Lahiri and Evers (1991). Lahiri and Evers (1991) propose the following revision of Clements’s (1989a) model, in an article that explicitly attempts to provide an adequate formal expression of palatalisation. Only structure below the Place node is provided (Lahiri and Evers 1991:87):

(5)

In this model the first kind of palatalisation (P1) is expressed as spreading of the feature [high] under the Tongue Position node to the target consonant.
Type P2 palatalisation is expressed as spreading of the Coronal articulator node dominating [-anterior], which both front vowels and /j/ have.

Again, this model raises some problems. First, it is predicted that type P1 palatalisation is only triggered by high vowels. However, in a number of languages this type of palatalisation is triggered by any front vowel, whether high or not. Lahiri and Evers note in this respect that "in languages like Nupe and Kinyarwanda (Sagey 1986:209-18, 227-40), secondary palatalization is triggered by [i] as well as [e]. As in other languages, the palatalized consonants are phonetically produced with an off-glide. In these special cases where the secondary palatalization is produced by nonhigh [e], this glide could also be present as an on-glide of vowel. That is, the [e] would be phonologically [je]." (Lahiri and Evers 1991:94f.). It is doubtful, however, whether all cases of type P1 palatalisation can be analysed in this way. Also, it is certainly not typical that all high vowels, including /u/, trigger this kind of palatalisation. Rather, it is usually restricted to front vowels.

With respect to the P2 types of palatalisation, note that in this proposal vowels must be specified as [-anterior] and that although type P2 palatalisation does not rely on the promotion of features, but is expressed as autosegmental spreading, no explanation is given for the fact that type P2 is unusual for labials.

3. Discussion and a possible new approach

In the preceding section we discussed three feature-geometric approaches to palatalisation, which, as we tried to show, were not able to characterise palatalisation as spreading, c.q. to account for the two natural-classlike properties mentioned at the beginning of this paper. In this section, we discuss a possible way of describing palatalisation that is not thwarted by the drawbacks of the proposals discussed so far.

As a starting-point let us summarise the proposal by Jacobs (1989), who argues that an elegant description of palatalisation is possible if Sagey's model is slightly adapted, namely by specifying both the palatal glide and front vowels not only for a Dorsal, but also for a Coronal articulator node. In this perspective, the palatal glide and the front vowel are considered to be complex segments. There is phonetic evidence in favour of this view. Keating (1988) suggests, on the basis of cross-linguistic evidence from the UCLA X-ray database, that palatals are more complex than palato-alveolars in that palatals are simultaneously Coronal and [+high, -back], while palato-alveolars are also Coronal, but unspecified for tongue body features.

This strategy makes it possible to describe the different types of palatalisation straightforwardly as autosegmental spreading, as in Lahiri and Evers's model, so that no recourse to Tier Promotion is necessary. If /j/ is
specified for both a Dorsal and a Coronal articulator node, then the change from /k/ to palatalised [k̞] before /j/ can be described as the spreading of the Dorsal articulator node (dominating the features [+high, -back]) from the /j/ onto the preceding /k/, as in (6a), and the change from /k/ to [c] (palatal/palato-alveolar) before /j/ as the spreading of both the Dorsal and the Coronal articulator node (i.e. the entire Place node) from /j/ to a preceding /k/, as in (6b).

(6) a. \(k \rightarrow k\̞ / \_ j\) 
(6) b. \(k \rightarrow c / \_ j\)

Similarly, the different effects of palatalisation on apicals can be described as in (7).

(7) a. \(t \rightarrow t\̞ / \_ j\) 
(7) b. \(t \rightarrow c / \_ j\)

Once we accept the proposal that the palatal glide and front vowels are specified for both a Dorsal and a Coronal articulator node, we also explain why cross-linguistically velars and coronals are more susceptible to type P2 palatalisation than labials, because velars and coronals form a natural class with front vowels and the palatal semivowel.

Finally, we can also account for the second natural class-like aspect discussed at the beginning of this paper, namely that a following front vowel is the strongest environment that induces the fronting (and hence the palatalisation) of a velar consonant, whereas /j/ is a stronger environment than front vowels for the raising (and hence palatalisation) of apical consonants. To
ON THE FORMAL DESCRIPTION OF PALATALISATION

explain this, Jacobs (1989) assumes that in underlying representation the palatal glide is specified for only a Coronal articulator node, whereas a front vowel is specified for only a Dorsal articulator node, as in (8).

(8) Underlying representation of /j/ and front vowels (Jacobs 1989)

\[
\begin{array}{ccc}
\text{Place} & \text{Place} \\
\text{Coronal} & \text{Dorsal} \\
\text{[high]} & \text{[back]} \\
\text{[low]} & \\
\end{array}
\]

The insertion of a Dorsal articulator node on /j/ and of a Coronal articulator node on front vowels may then be thought of as an enhancement rule in the sense of Stevens, Keyser and Kawasaki (1986), who use the feature [+coronal] to enhance the feature [-back] for vowels and the feature [back] to enhance the feature [anterior].

There are, however, a number of problems with this proposal. First, it is not clear whether it is desirable to have a level of representation in the grammar at which the palatal glide and the front vowels are distinguished in the way indicated in (8). Second, although the rules in (7) account for the fact that velars and coronals are more susceptible to type P2 palatalisation than labials, it now seems to be predicted that type P1 should occur more easily before dorsal consonants than before any other type of consonant, given its description as spreading of the Dorsal node in (6). This is not correct, however, as indicated in section 1. This then seems to be an advantage of the description proposed by Lahiri and Evers (1989) in which type P1 is described as the spreading of [+high] and in which it is thus correctly predicted that P1 is a process to which any consonant, regardless of its primary articulation, is equally susceptible. However, as pointed out above, cases in which P1 is triggered by all, and not only [+high], front vowels are problematic for this approach.

Moreover, in Clements (1989b) evidence is adduced to separate vowel height features from vowel Place features (cf. (3) above, and Wetzels 1986 for the same idea). If we tried to carry over Lahiri and Evers's idea that P1 palatalisation is [+high] spreading, this would be accomplished in Clements's model by [+open] spreading. However, in Clements's model it is not possible to describe P1 in this way, given the fact that low front vowels should spread
the feature \([+ \text{open}]\), which in his model serves to distinguish velars from uvulars.

In view of the difficulties mentioned above, we would like to propose a different conception of palatalisation P1. The formalisation we propose is given in (9).

(9) Secondary palatalisation (P1)

\[
\begin{array}{c}
\text{SupLar} \\
\text{Place} \\
\text{Dorsal} \\
\;
\end{array}
\begin{array}{c}
\text{SupLar} \\
\text{Place} \\
\text{Coronal} \\
\;
\end{array}
\begin{array}{c}
\{+ \text{high}\} \\
\{- \text{back}\} \\
\{\text{-ant}\}
\end{array}
\]

In (9), palatalisation P1 is represented as the spreading of the entire Place node of a front vowel or \(/j/\) to a preceding consonant. The original Place node of the palatalised consonant is left intact. Clements's (1989b) No Branching Condition, which prohibits branching of a nonterminal node into two lower nodes on the same tier, will rule out a representation like (9). Representation (9) will then automatically be repaired by the Node Fission Convention (cf. Clements 1989b), which turns the result of (9) into a representation like (10).

(10)

\[
\begin{array}{c}
\times \\
o \\
| \\
o \\
| \\
o \\
| \\
| \\
\text{Dors} \\
\text{Cor} \\
\{+ \text{high}\} \\
\{\text{-ant}\} \\
\{- \text{back}\}
\end{array}
\begin{array}{c}
\text{Skeleton} \\
\text{Root} \\
\text{Supralaryngeal} \\
\text{Place}
\end{array}
\]

This way of accounting for type P1 palatalisation, viz. the formation of a two-root complex segment, seems an insightful way of bringing out the character of secondary palatalisation, namely as 'misting', or superimposition of a vowel articulation onto a consonant. It appears to make
no difference if the triggering root is a vocalic or semivocalic one. It is predicted that consonants are susceptible to this kind of palatalisation regardless of their primary place of articulation, and that the process is likely to affect the consonant system as a whole (cf. Bhat 1978:68). Note, finally, that in a theory which does not recognise intermediate nodes like 'Place' and 'Supralaryngeal' (cf. van de Weijer 1991), root node spreading is the only possible way of describing palatalisation P1, while the resultant two-root complex segment is derived without recourse to conventions.

Let us finally turn to another problem with respect to the representation of P1 and P2 as in (6) and (7). As pointed out above, Clements (1989b) argues that the vowel height features should be represented under a separate Aperture node, a sister node of the V-place node, both linked to the vocalic node. Whereas in Sagey's model a dorsal articulator for a vowel both dominated its height features and the value for [back], in Clements's model this feature now only dominates the feature [back]. Clements observes in this respect: “In Sagey's model, a dorsal sound is simply one involving the tongue body as an active articulator in any capacity (Sagey 1986:273). In accordance with this view, the tongue body features [back], [high], and [low] are placed under the dorsal node (...). It follows from these assumptions, however, that we are no longer able to provide a uniform articulatory-based definition of dorsal for both consonants and vowels” (Clements 1991:4). Given the fact that front vowels are specified for [coronal] and that the vowel height features are not represented under the Place node, the feature [back] is totally redundant. This means that, if in (6) and (7) the height features are discarded, the only reason to assume that front vowels have a dorsal node is that otherwise it would not be possible to express type P2 palatalisation as spreading within the feature geometry.

To salvage this proposal, we either have to give up the idea that the difference between the two type of palatalisation processes should be accounted for within the feature geometry, or we should allow the Dorsal articulator node in (6), although underlyingly redundant, to play a role in phonological processes. A possible way to achieve this would be to assume that the Dorsal node in (6) and (7) is considered an enhancement value for the front vowels and the palatal glide. However, this proposal is not easy to integrate into Clements's model. Not only would we be forced to reintroduce the feature [+dorsal] as a redundant value for [+coronal] for front vowels and /j/, but also, given the fact that back vowels are also [+dorsal], would we be forced to reintroduce the feature [back] in order to differentiate back and front vowels.

Eventually, we might give up the idea of expressing the differences between the two types of palatalisation processes within the feature geometry and express palatalisation along the lines of Calabrese (1992), who argues that palatalisation should be expressed not only by means of spreading rules,
but also by way of demarking conventions and filters. However, in that case it would not be clear why the natural class of, for instance, round vowels and labials should be reflected in the feature system and geometrical representation of segments, but not that of front vowels and /j/ with coronal and dorsal consonants.

4. Conclusion

In this article we have discussed two different types of palatalisation processes, informed by the cross-linguistic data from Bhat (1978), within the contexts of three different feature geometry frameworks, namely Sagey (1986), Clements (1991), and Lahiri and Evers (1991). All were seen to suffer from particular drawbacks.

An attempt was made to solve these problems in section 3, where an amalgamated model was put forward and discussed. Crucial is that front vowels, the palatal semivowel /j/, and palatal consonants are represented as complex segments, combining the nodes Coronal and Dorsal. In this model, we have proposed that the addition of a secondary articulation is achieved by the creation of a two-root complex segment.

References

Clements, G.N. (1989a) 'A Unified Set of Features for Consonants and Vowels', Ms, Cornell University and University of Paris VII.

