Phonology **8** (1991) 171–180
Printed in Great Britain

On ich-Laut, ach-Laut and Structure Preservation

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Hall (1989) introduces a rule of Fricative Assimilation (FA) in German, which, he claims, poses a challenge to the principle of Structure Preservation in Lexical Phonology, as presented in Kiparsky (1985). This claim is based on the observation that FA is demonstrably lexical because it respects morpheme boundaries, but nonetheless introduces a non-distinctive feature, thus violating a marking condition. However, Hall has not appreciated the force of the analysis of Catalan in Kiparsky (1985), which suggests that assimilated sequences may show special behaviour with respect to marking conditions. In this paper we show first, based on arguments in Kiparsky (1985), Hayes (1986) and Itô (1988), that a general constraint on the interpretation of autosegmental formalism specifically rules out the application of the marking condition to the output of FA. Thus, contrary to Hall's claims, Fricative Assimilation is not a counter-example to Structure Preservation. We also consider the consequences of this constraint for a number of other analyses in Kiparsky (1985) in the light of the theory of feature geometry (Clements 1985; Sagey 1986). While some analyses still stand, the force of Structure Preservation for constraining assimilatory processes is found to be weakened.

First, let us summarise Hall's argument. In addition to the voiceless fricatives [f], [s], [ʃ] and [h], German has two other such sounds: ich-Laut [ç] and ach-Laut [x]. These segments differ from one another in that [ç] is palatal ([+high, −back]), and [x] is velar ([+high, +back]). The two sounds agree in all other relevant features.

Although the feature [back] is distinctive for vowels, it is non-distinctive for fricatives in German: there exist no minimal pairs differing only with respect to backness. Apparent examples of such minimal pairs, however, are often discussed:

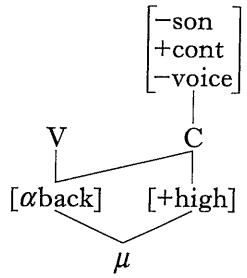
(1) a. Kuhchen [kuːçən] 'little cow'
b. Kuchen [kuːxən] 'cake'

In these examples, one member of the pair is a noun containing the final morpheme *-chen*, a diminutive suffix in German. The *-chen* ending of the other word, however, is not a morpheme: *Kuchen* is a monomorphemic noun. No true minimal pairs, distinguishable only by underlying [ç] *vs.* [x], exist in German, so that the two sounds are non-distinctive in the language.

It has generally been recognised that the distribution of [ç] and [x] is predictable: [x] occurs after back vowels, and [ç] occurs elsewhere (Bloomfield 1930; Meinhold & Stock 1980; Hall 1989; etc.). Earlier theories had treated one or the other of these phones as basic and had derived the other from it by rule. More recently however, based on work in underspecification theory, both phones have been derived from a segment /X/ which is underlyingly unspecified for backness. Rules must then be formulated in order to derive [ç] and [x] from /X/ in the appropriate distribution.

For this purpose, Hall introduces his rule of Fricative Assimilation. This rule spreads the feature backness from a vowel to an immediately following voiceless high fricative, /X/. The rule Hall proposes is (cf. pp. 3, 6):

(2)



Hall (p. 4) notes that the feature [−voice] is a necessary part of the structural description of FA because the rule never applies to voiced fricatives. German has a voiced high fricative, [j], which is [−back]. FA does not apply to this fricative to turn it into its [+back] counterpart ([ɣ]), which does not exist in German. Thus [j] remains [−back] following a [+back], vowel, as in *Koje* [koːjə] 'bunk'.

Furthermore, FA can apply only to voiceless fricatives immediately preceded by a vowel. For voiceless fricatives in word-initial position or following a consonant, and for voiced fricatives, Hall gives a default rule which assigns the feature [−back]:

(3) $\begin{bmatrix}-\text{son}\\+\text{cont}\\+\text{high}\end{bmatrix} \rightarrow [-\text{back}]$

In the light of the literature on coarticulation (e.g. Öhman 1966; Sussman & Westbury 1981; Bell-Berti & Harris 1982; Keating 1988; Boyce *et al.* 1990) and on fundamental frequency (Pierrehumbert 1980; Pierrehumbert & Beckman 1988), one might question whether assimilation and default rules really are needed. The alternative would be that the phonology does not assign any value of the backness feature to the fricatives, and that the observed pronunciations are attributable to coarticulation with the neighbouring vowel. However, two types of evidence lead us to reject this alternative. As shown below, the specification of the feature [back] is sensitive to morpheme boundaries, which are

not available to phonetic rules. Similarly, the default rule has lexical exceptions in the form of two incompletely assimilated borrowings: *Chatschaturjan*, the name of a Russian composer, and *Chuzpe*, a Yiddish/Hebrew expression, surface with a word-initial ach-Laut. Second, our own preliminary investigations show that word-initial /X/ behaves differently from the stops /k/ and /g/. For the fricative /X/, [ç] (the [−back] variant) surfaces regardless of the value for backness of the following vowel, whereas /k/ and /g/ tend to assimilate to the backness of the following vowel. Coarticulation might be expected to affect stops and fricatives similarly.

Finally, Hall adds to the rule in (2) above the restriction that the vowel and the adjacent fricative be tautomorphemic (p. 6). This restriction becomes evident from the interaction of FA with other morphological and phonological processes, such as derivation, compounding and Umlauting. We will here consider an argument involving derivation, examining data of the sort presented in (1) above.

In German, the diminutive suffix *-chen* is a level 2 affix (Hall, p. 5). In order to distinguish *Kuhchen* 'little cow' (which contains the suffix *-chen*) from *Kuchen* 'cake' (where *chen* is part of the monomorphemic stem), FA must apply before the addition of the affix. Compare the derivation of the two forms:

(4)

	Kuchen 'cake' /kuːXən/	*Kuhchen* 'little cow' /kuː/
level 1:	—	—
Bracket Erasure:	—	—
level 2: *morphology*		
add *-chen*	—	kuː]Xən
phonology		
FA	kuːxən	—
Default Rule[1]	—	kuː]çən
Bracket Erasure:	[kuːxən]	[kuːçən]

As can be seen from the above table, if FA were to follow the addition of the morpheme *-chen* at a later level, the word-internal brackets would be erased, and the result of the derivation would be the ungrammatical *[kuːxən] for 'little cow'. The fact that the FA rule must have access to word-internal morpheme structure then establishes that it is a lexical rule. (Note that an alternative treatment in which *-chen* is a lexical exception to FA would also have the force of making the rule lexical.)

Thus far we have established, following Hall, that Fricative Assimilation is a lexical rule which introduces the feature of backness onto a segment for which it is not distinctive. This is where Hall challenges Kiparsky's Structure Preservation principle. We will now examine this point in detail.

In accordance with the principles of underspecification theory, Hall

presents the following marking condition (p. 13) to represent the fact that backness in [ç] and [x] is non-distinctive:

(5) $*\begin{bmatrix}+\text{high}\\ \alpha\text{back}\end{bmatrix}$
|
[−son]

High obstruents in German include the voiceless fricatives [ç] and [x], the voiced fricative [j] and the stops [k] and [g]. The feature backness is distinctive for none of these segments, and they receive the relevant marking for backness by default rules. Therefore the filter given above in (5) does not violate other regularities of the language.

Kiparsky's Structure Preservation principle states that marking conditions such as (5) above must apply not only to 'underived lexical representations but also to derived lexical representations' (Kiparsky 1985: 92). Any form created through application of the lexical FA rule therefore should respect the marking condition. However, FA assigns the feature backness to high obstruents, thus violating the condition. This is the data Hall presents as a challenge to the Structure Preservation principle. He states (p. 13) that 'the data ... provide evidence against Kiparsky's Structure Preservation principle, since FA clearly has a lexical domain. Hence, Fricative Assimilation in German is a lexical rule that creates non-distinctive segments'.

In order to rescue Structure Preservation, one would have to reconcile FA and the marking condition. Suggestions are provided in Kiparsky's (1985) discussion of Catalan Nasal Assimilation. The work of Itô (1988), building on Hayes (1986), provides an explicit basis for this reconciliation.

Consider first Kiparsky's mention of a marking condition in his discussion of Catalan Nasal Assimilation. He states that 'the velar nasal /ŋ/ only occurs before /k/ and /g/ lexically. This restriction is reflected by a marking condition that restricts velar nasals to linked matrices' (Kiparsky 1985: 99). The formalisation of this condition is given as (6):

(6) *[−back]
✳
[+high]
|
[+nasal]
|
C in an unlinked matrix

The important remark here is 'in an unlinked matrix'. This note calls to our attention the fact that the marking condition holds only if its structural description is matched exactly, that is, when the number of association lines in the structural description in question is equal to the number of association lines in the filter, namely one. When the structural description

of the feature filter is not exactly matched, the filter does not apply, and assimilation of the nasal to a following velar is possible.

What is treated as an idiosyncratic specification by Kiparsky is shown to be generic for structural descriptions in rules by Hayes (1986). His Linking Constraint (1986: 331) states:

(7) Association lines in structural descriptions are interpreted as exhaustive.

Hayes elaborates: 'This formulation is intended to cover structural descriptions in which an autosegment is multiply-linked: an autosegment bearing *n* linkages in a structural description must be matched to an autosegment bearing exactly *n* linkages in the actual form' (Hayes 1986: 331). He exemplifies the constraint in the context of rules (such as Persian /v/-weakening) which can apply only to certain structural descriptions (fake geminates, where each of two consonants is singly linked to a feature) and not to others (true geminates, where two consonants are linked jointly to one feature) (1986: 332).

The extension of this idea to marking conditions is defended in Itô (1988). Using data from Japanese involving a condition which 'disallows syllable-final nonnasal consonants' (1988: 26), Itô demonstrates that a marking condition with a single association line in its structural description does not apply to any form with more than one association line in its structural description. She suggests in general that marking conditions and rules should adopt the same interpretation of the formalism, attributing this idea to Prince. We strongly agree with this suggestion, because it is difficult to imagine a technically coherent scientific theory in which the representations are not uniformly interpreted.

The consequence for Fricative Assimilation in German is that the marking condition given in (5) above does not block the FA rule. The reasoning for this is as follows: in order for an underived or derived lexical representation to violate the marking condition, its structural description must match that of the condition exactly. This is not the case for the forms created by FA. The rule spreads the feature [back] so that both segments, vowel and consonant, now share that feature, with the result that [αback] is doubly linked. The marking condition, however, specifies that [αback] be only singly linked. Adopting the arguments presented by Hayes and Itô, we claim that the marking condition given in (5) above is not applicable to the output of the lexical FA rule. Thus, although lexical FA introduces a non-distinctive feature, it does not violate a marking condition and therefore, contrary to Hall's claims, it does not oppose the principle of Structure Preservation.

The above discussion of FA shows that structures can be exempt from marking conditions by virtue of being linked. This treatment eliminates the problem pointed out by Hall, as well as other possible counterexamples to Structure Preservation. However, at the same time it raises questions concerning the empirical predictions of Structure Preservation. Whether or not the output of a given rule respects or violates Structure Preservation

now hinges on whether the relevant marking condition specifically involves autosegmental links.

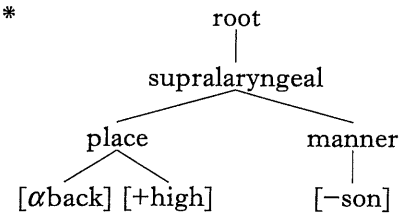
The marking conditions proposed by Itô (1988) *prima facie* must contain autosegmental links because, as she is dealing with syllable structure, the link between feature tiers and the structural tier is crucial. Marking conditions then must specify the autosegmental link involved and, by Hayes' Linking Constraint, a marking condition only applies to a structure with the exact same number of autosegmental links.

Consider, on the other hand, the single-feature marking condition discussed in Kiparsky (1985: 92). A language in which voicing is lexically non-distinctive would have the marking condition *[αvoice]. This marking condition involves absolutely no autosegmental links, and the predictions Kiparsky draws from Structure Preservation in this case carry through intact.

Cases in which the marking condition and the output of a rule refer only to a single timing slot are also straightforward. In such cases, the exhaustiveness condition is met because all autosegmental links are as specified by the theory of feature geometry, and therefore correspond. As a result, previous analyses can be maintained. Examples of this kind are Final Devoicing and W Strengthening in Kiparsky's discussion of Russian Voicing Assimilation (1985: 105). Structure Preservation also blocks the lexical deletion of a velar obstruent after a velar nasal in Catalan, as Kiparsky suggests (1985: 102). The result of the deletion would be a velar nasal which did not share its place features with any adjacent segment, and therefore it would violate the marking condition.

More complex cases are found when some features are multiply linked and others are not. In such cases, the force of Structure Preservation depends on the specific claims of the theory of feature geometry and the autosegmental treatment of assimilation. Hall tacitly invokes such claims about the nature of representations when he states his marking condition with a link between the feature [−sonorant] and the features [+high], [αback]. This representation is in line with Clements' organisation of features (Clements 1985: 229; Sagey 1986: 27), and it is actually a shorthand way of stating the following hierarchically ordered relationship:[2]

(8) *



Recall that the marking condition shown here is depicted as an 'end view', a two-dimensional view of a three-dimensional structure (Sagey

1986: 28). The lines in the above representation are autosegmental links, as evidenced by linking and delinking in assimilation and by other phonological and phonetic processes (Sagey 1986: 25–30). That is, if we assume that e.g. backness spreads by creating an autosegmental link to an additional place node, it is only reasonable to assume the relation of the feature to its original place node was also autosegmental. A rigorous application of the theory of feature geometry leads to the conclusion that any marking condition involving more than one terminal feature necessarily contains autosegmental association lines.

Consider, for example, the discussion of Russian Voicing Assimilation in Kiparsky (1985). He states that the Russian lexicon is subject to the following marking condition (1985: 108):

(9) $*\begin{bmatrix}\alpha\text{voiced}\\ +\text{son}\end{bmatrix}$

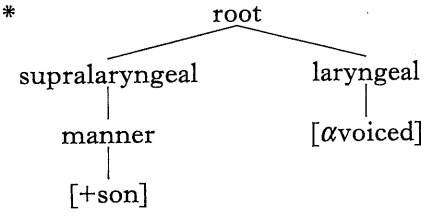
This condition specifies that, in Russian, voicing is not distinctive for sonorants. Now, Russian has a lexical rule of Voicing Assimilation (VA), by which all consonants in a cluster assimilate to the voicing of the cluster's rightmost constituent (Kiparsky 1985: 108). Kiparsky describes the interaction of VA with the marking condition as a consequence of Structure Preservation: 'Lexical applications of Devoicing and Voicing Assimilation affect obstruents only and are triggered by obstruents only. This follows from Structure Preservation, since voicing may not be specified on sonorants anywhere in the lexicon. Postlexically, both rules affect and are triggered by sonorants as well as obstruents.' This situation accounts for the Russian data, explaining the fact that sonorants are 'transparent' to VA (1985: 104):

(10) a. iz # mcensk + a → i[s mc]enska 'from Mcensk'
b. ot # mzd + y → o[d mzd]y 'from the bribe'
c. ot # nauki → o[t n]auki 'from science'

In all cases, the sonorant is transparent to VA: it does not devoice in a voiceless cluster (a); it does not stop the obstruent to its left from assimilating (a, b); and finally, it does not trigger voicing assimilation in a cluster in which it is the rightmost constituent (c).

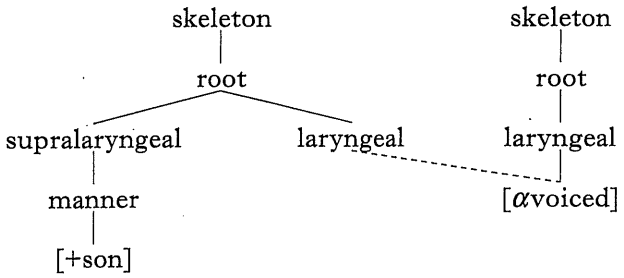
However, again assuming Clements' hierarchical organisation of features, the marking condition given in (9) above actually is shorthand for:

(11) *



The situation here is therefore analogous to that presented above regarding FA. Sonorants marked for voicing in the lexicon can be created by a lexical rule of assimilation, as shown in (12):

(12)



In this situation, we end up with sonorants lexically marked for the feature [voiced] without violating Structure Preservation. With regard to undergoing voicing assimilation, there is no longer a distinction between sonorants and obstruents, and lexical VA should apply equally to both kinds of segments. However, since the feature [voiced] is spread from right to left, a nasal in cluster-final position remains unspecified for voicing and can therefore not pass on such a feature to other consonants. Thus, although sonorants and obstruents are similar in that they both undergo VA, they differ in that only obstruents can trigger it.

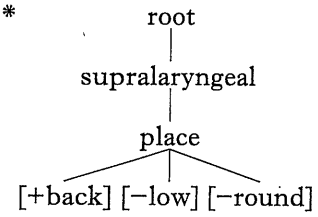
We are thus prevented from explaining the voicing of [m] in (11a) in the way that Kiparsky does. However, Hayes (1984) proposes a rule of Sonorant Revoicing which is postlexical, indeed being a phonetic implementation rule. Specifically he suggests that the laryngeal configuration which suppresses vocal fold oscillation for obstruents still permits it for sonorants, with the result that [−voiced] sonorants can still display some periodicity. Kiparsky also adopts this proposal in connection with examples not discussed here. If we take Sonorant Revoicing to be responsible for voiced [m] in (11a), the empirical differences from Kiparsky's original proposal are rather slight. In fact, exhaustive experiments of a sort which certainly have not been carried out would be needed to establish whether or not such sonorants are phonologically [−voiced] or not.

Kiparsky's analysis of Finnish Vowel Harmony (1985: 115) is more drastically affected. Finnish has three distinctively [+back] vowels *a*, *o*, *u*, three distinctively [−back] vowels *ä*, *ö*, *y* and two non-distinctively [−back] vowels *i*, *e*. The [+back] counterparts to these last two vowels do not exist in Finnish and therefore should not be created by lexical Vowel Harmony (VH). These neutral vowels are not only unaffected by Vowel Harmony, but the VH rule skips over them so that Finnish can have the back vowels *a*, *o*, *u* and the neutral vowels *i*, *e* in the same word: *asema* 'station', *kaupunki* 'city, town'. The marking condition which Kiparsky claims explains these facts would be:

(13) $*\begin{bmatrix}+\text{back}\\-\text{low}\\-\text{round}\end{bmatrix}$

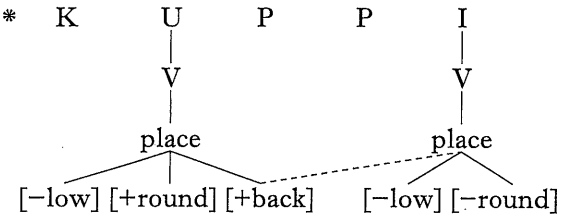
(13), of course, is an abbreviation of the following feature geometry representation:

(14) *



However, given this autosegmental representation, there is nothing to prevent a lexical VH rule from spreading the feature [+back] to a neutral vowel. Vowel Harmony spreads from left to right in Finnish. Thus in the word *kuppi* 'cup' (nom. sg.), it would spread the feature [+back] from the first vowel onto the second, as shown in the representation below (only the relevant aspects are shown):

(15) *



This spreading of the feature [+back] should change the second vowel from [i] to [ɨ]. Since the vowel does not surface in Finnish, such spreading obviously cannot occur. But if Vowel Harmony is a lexical rule that spreads backness from one segment to another, then a lexically created [+back] counterpart to *i* and *e* is not ruled out by (14) through Structure Preservation. It can of course be ruled out explicitly in the rule formulation or through a marking condition with multiple links. Such proposals, however, leave unexplained Kiparsky's observation that unpaired vowels are universally neutral in harmony systems.

In this paper we have shown that certain counterexamples to Structure Preservation are eliminated if one accepts a representation of rules and marking conditions containing autosegmental links, as suggested in the theory of feature geometry. This type of representation can account for German Fricative Assimilation and Catalan Nasal Assimilation without challenging Structure Preservation. At the same time, the force of

Structure Preservation for constraining some types of assimilation, such as Vowel Harmony rules, is lost. The cases discussed here show that the stated implications of Structure Preservation need to be reexamined using a consistent and rigorous approach to rules and representations.

NOTES

[1] Although we list the Default Rule as immediately following the FA rule, as does Hall (p. 7), this is merely for ease of presentation. At this point we want to make no claims as to whether the Default rule immediately follows the FA rule in the lexicon, or whether it is a postlexical rule.

[2] We have chosen Clements' manner of representation for ease of exposition: in his hierarchical ordering of features, he mentions the exact features which Hall uses in his marking condition and rules (especially the feature [sonorant]). Recasting the marking condition in term of Sagey's features would lead to an analogous representation.

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