# The analysis of German schwa

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0. Introduction. In German, schwa poses some intriguing problems. These concern the schwa-zero alternations in inflexion. Working within the framework of lexical phonology, Wiese (1986a,b) argues that these alternations are syllabically conditioned. According to him, there is no need for the distinction between schwa constans and schwa mobile, as drawn up by Issatschenko (1974). Instead, he postulates that there are no underlying schwas at all, and postulates a specific lexical epenthesis rule, inserting a schwa before an unsyllabified consonant. However, the domain in which this rule applies has to be specified in an adhoc way: it applies on level 1 to verbs with a stem final liquid, on level 2 to nouns, adjectives with a stem final nasal, as well as before an unsyllabified r, and on level 3 to verbs with a stem final nasal, adjectives in general, and again before r.

We will, as Wiese, account for the phenomena in question in the framework of lexical phonology. We will show however, that schwa insertion is a direct consequence of syllabification: empty nuclei created by syllabification are filled by the neutral vowel, schwa. Also, we will show that by assuming that schwa in German can be underlying as well as epenthetic, the observed difference between schwa constans and schwa mobile can be accounted for straightforwardly.

1. Verbs. The infinitive of verbs with liquid-final stems is formed by the addition of -n:

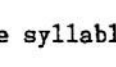
(1) a. zittern 'to tremble' b. betteln 'to beg'

Stems ending in other consonants get -ən:

(2) a. atmen 'to breath' b. regnen 'to rain' c. geben 'to give'
d. retten 'to save' e. sagen 'to say'

These data raise the question whether the underlying form of the infinitive morpheme is -ən or -n. We will show here that an integrated analysis of German schwa/zero alternations is possible if it is assumed that the infinitive ending is -n. As in other proposals (see, e.g., Kiparsky (1984) for Icelandic and Noske (1987) for Tonkawa), we assume that lexical syllabification takes place after the first morphological operation. We make one specific assumption, i.e. that lexically, liquids, but not nasals, can be syllabified as nuclei. Hence, on this point the lexical and postlexical syllables differ in German. While phonetically in German there is a free variation between schwa followed by a sonorant consonant, and a syllabic sonorant consonant, lexically only liquids can be syllabic in German. This, as we will see is the key to the understanding of the phenomena of the resistant ə/Ø alternations in German. Note that the idea that liquids can be syllabified as nuclei but not nasals is straightforward, since liquids are higher in the sonority scale.

How then does syllabification take place? The string of segments is scanned directionally for unsyllabified segments. Unsyllabified segments trigger syllabification. Syllabification consists of the superposition of a complete syllable structure:

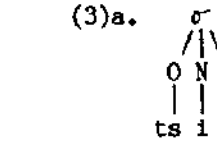


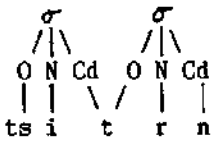

(σ=syllable, O=onset, N=nucleus, Cd=coda)

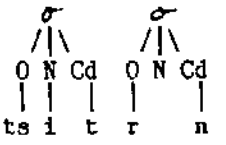
onto the segmental tier (or skeleton; the assumption of a skeleton is not crucial here). After the superposition of this structure, the unsyllabified segmental nodes are linked to the syllabic structure, in such a way that the structure is optimally satisfied, i.e. that a minimal number of empty syllabic nodes are left over. The directionality is in line with many other syllabification proposals (see Itô 1986:163fn.). For German, we will assume that syllabification takes place from left to right (LR). The principle of achievement of a minimal number empty subsyllabic nodes was used by Noske (1982,1985,1987) to account for syllable changing processes in French, Yawelmani and Tonkawa respectively.

Let us now look at the way syllabification takes place in the form of the

type displayed in (1). Scanning the string from left to right, the syllabification mechanism first finds an unsyllabified affricate consonant ts. Now a syllabic structure is projected and association takes place, cf. (3a):

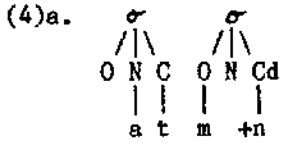
(3)a. 

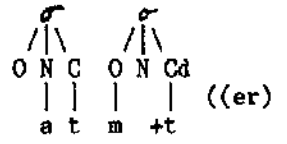

b. 


c.* 


Then the syllabification process continues and the next unsyllabified segment *the mechanism discovers is* r. *Again a syllabic structure is superposed,* cf. (3b). In (3b), the t is ambisyllabic. The ambisyllabicity of intervocalic consonants is a well-established fact in German and West Germanic languages in general. The association in (3b) is chosen by virtue of the principle of optimal syllabic structure satisfaction, because in (3c) we find an empty node, while in (3b) there is none. The r is linked to the nucleus node (recall that liquids may be syllabic). The phonetic realisation of the forms in (1) may be with or with out schwa ([tsitərn] or [tsitṛn]). A late phonetic variation rule takes care of the free variation between liquids and nasals and their counterparts consisting of schwa followed by a liquid or nasal respectively.

Let us now look at what happens during the syllabification of the form of the type displayed in (2). Underlyingly, forms like atmen have the structure /atm+n/. The syllabification proceeds as follows, cf. (4a):

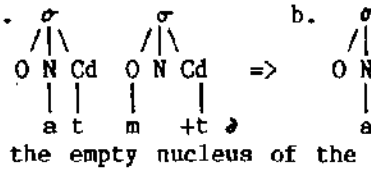
(4)a. 


b. 

((er) atmet 'he breathes')

The empty nucleus is now filled with the neutral vowel, thus the form atmen is created. (In addition, the empty onset is filled with the neutral consonant, i.e. the glottal stop). Here too, we assume that the late phonetic variation rule takes care of the variation [ʔatmən ∿ ʔatmṇ]. Consider now the form in (4b). Here too, we find with the LR directionality that the correct form is predicted. In other syllable based analyses, forms like (4b) are problematic. While the difference in schwa epenthesis sites between zittern and atmen could be explained by the fact that rn is a possible coda and mn is not, mt IS a possible coda and therefore *[er atəmt] is syllabically well-formed.

The analysis can also predict the correct epenthesis site for (er) atmete '(he) breathed'. LR syllabification will at a certain moment arrive at the situation displayed in (5).

(5) a. 

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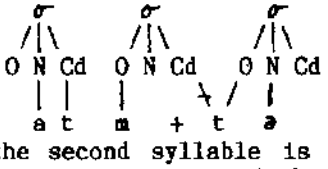
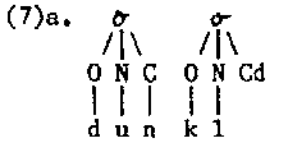
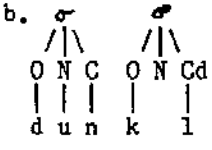
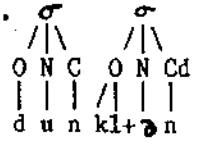
b. 


In (5b), the empty nucleus of the second syllable is ultimately filled by schwa. The superposition of the final syllable in (5b) has been triggered by the unsyllabified schwa.

2. Adjectives. Compare the following forms:
(6)a. dunkel "dark" (adj.) b. dunklen (adj. + case affix)
These forms can be explained right away if it is assumed that the case affix is -en. (6a) is then syllabified as follows (cf. 7 a,b):

(7)a. 

or:



c. 

During syllabification, either (7a) or (7b) can be formed, because both have the same number of empty subsyllabic nodes. Our postlexical phonetic variation rule can produce [dunkəl] or [dunkl] out of either form. Let us now look at (7c) here, the schwa has to be syllabified, and as a result, the k and the l are both dominated by the onset. Hence, the result is [dunklən]. We now turn to another criucial example, used in the discussions about schwa-zero alternations, the form in (8).

(8) trockeneren /trɔkən+ər+ən/ 'dry' (adj+comparitive+case)

Here, the forms can be accounted for straightforwardly by assuming that the shwas are underlying. If it is assumed, in contrast to Wiese's assumption, that schwa is underlying here, the forms come out straightforwardly.

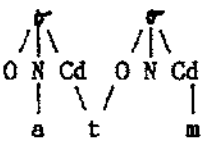
3. Nouns

A special case is the nominalised adjective, cf. (9)

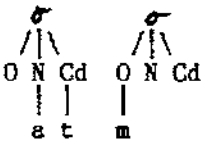
(9)a. dunkel b. dunkeln /dunkl+n/ (nominalized adj.+case/plur. ending)
'the dark'

This form can be accounted for if it is assumed that the nominal case/plural ending is -n. After the nominalization process, syllabification takes place, creating a form anologous to either (7a) or (7b). Then, a -n is affixed. Subsequent syllabification to incorporate the n into the coda of the last syllable. The syllabification of the noun Atem 'breath' works as follows: after the nominalization V —> N, syllabification can in principle make either (10a) or (10b):

(10)a.




b.*




Because of the principle of syllabic structure satisfaction, (10a) is selected.

4.Conclusion. We have posited a lexical syllabification mechanism projecting full syllabic structures (i.e. structures consisting of onset, nucleus, coda). The principle of syllabic structure satisfaction, together with the assumption that liquids can be syllabic in the lexical part of the phonology can account for the notorious ə/Ø alternations in German. We posited the following morphemes: -n (infinitive marker), -ən (adjectival case ending), -ər (comparative morpheme), -n (nominal case marker). By doing this, we have been able to account for the schwa-zero alternations in German in a principled way.

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